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**A PROGRAM FOR RESEARCH ON**

## SOCIAL AND ECONOMIC DIMENSIONS OF AN AGING POPULATION

**Population Change and Economic Growth: The Long-Term Outlook**

**Frank T. Denton**
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**SEDAP Research Paper No. 102**

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# POPULATION CHANGE AND ECONOMIC GROWTH: THE LONG-TERM OUTLOOK

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# ABSTRACT

## POPULATION CHANGE AND ECONOMIC GROWTH: THE LONG-TERM OUTLOOK

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The rate of growth of GDP can be expressed as the sum of the rates of growth of the population, the proportion of the population from which the labour force is drawn, the overall labour force participation rate, the employment rate, and the aggregate labour productivity ratio. Making use of this simple accounting identity we examine the contributions of the various components to the growth of GDP and GDP per capita in the half-century 1951-2001, decade by decade, and the prospective contributions to future growth under alternative demographic, participation rate, and productivity assumptions.

# POPULATION CHANGE AND ECONOMIC GROWTH: THE LONG-TERM OUTLOOK[*]

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## 1. INTRODUCTION

Forecasting is an uncertain business and demographic forecasting is no exception. But the natural human progression from one age to the next and the high degree of serial correlation in fertility and mortality rates gives demographic forecasters an advantage that economic forecasters can only envy. Uncertainty about future levels of immigration clouds the crystal ball but there are virtual certainties too. Taking 20 as a rough marker for the attainment of working age, the number of born-in-Canada 20-year-olds in 2023 will be determined by the number of births this year. And (as we are constantly reminded) the population is aging as the baby boomers march relentlessly toward retirement: we can predict with a high degree of certainty that the median age of the population will continue to rise and the proportion 65 and over will increase markedly. Conditioning on any level of immigration it is possible to make a reliable prediction of the future population of working age. How many people will actually be in the labour force will depend also, of course, on rates of participation, and that adds a degree of uncertainty. But for the next two decades at least one can form a pretty clear idea about the range of possible labour force

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growth rates, and under reasonable assumptions about future fertility rates one can extend the forecast with some confidence beyond two decades. Again though, that is conditional on what one assumes about immigration. Immigration is the demographic wild card.

The move from population and labour force forecasting to the forecasting of economic growth introduces another wild card, the rate of growth of productivity. Productivity gains (by any measure) are highly variable and average rates of increase have differed greatly over the decades of the past half-century. We make use in this paper of a simple accounting identity to evaluate the contributions to past economic growth of changes in productivity and changes in the population and labour force, and to assess the possibilities for future growth.

## 2. A SIMPLE ACCOUNTING IDENTITY

The players in the identity are real $GDP$, total population ($POP$), the labour force source population ($SPOP$), the labour force itself ($LF$), and the number of persons employed ($EMP$). The identity is

$$(1)\quad GDP = POP * \left(\frac{SPOP}{POP}\right) * \left(\frac{LF}{SPOP}\right) * \left(\frac{EMP}{LF}\right) * \left(\frac{GDP}{EMP}\right)$$

$GDP$ is thus equal to the product of the population, the proportion of the population regarded as the source from which the labour force is drawn, the overall labour force participation rate, the employment rate (or 1 minus the unemployment rate), and aggregate productivity, represented by output per person employed. (Output per person employed reflects of a number of factors: the capital/labour ratio, returns to scale, the state of technical progress, the proportions of high and low productivity industries in aggregate output, average hours worked and the educational and

skill composition of the work force.) The instantaneous rate of growth of $GDP$ can then be expressed as the sum of the rates of growth of the variables on the right side of the equation:

$$(2)\ \Delta \ln GDP = \Delta \ln POP + \Delta \ln\left(\frac{SPOP}{POP}\right) + \Delta \ln\left(\frac{LF}{SPOP}\right) + \Delta \ln\left(\frac{EMP}{LF}\right) + \Delta \ln\left(\frac{GDP}{EMP}\right)$$

The rate of growth of $GDP$ per capita can be expressed similarly as the sum of its component growth rates:

$$(3)\ \Delta \ln\left(\frac{GDP}{POP}\right) = \Delta \ln\left(\frac{SPOP}{POP}\right) + \Delta \ln\left(\frac{LF}{SPOP}\right) + \Delta \ln\left(\frac{EMP}{LF}\right) + \Delta \ln\left(\frac{GDP}{EMP}\right)$$

Equations (2) and (3) hold (to a close approximation) if log differences are replaced by annual percentage rates of change.

In practical applications of the equations to historical data $GDP$ is taken from the Statistics Canada National Income and Expenditure Accounts; consistent revised series based on current price indexing formulas are available back to 1961 and we have extended the series by "old-onto-new" splicing to take it back to 1951. The population series is the Statcan published mid-year series back to 1971, based on successive censuses and intercensal or postcensal estimates, with adjustments to allow for enumeration undercounts (by age and sex); again the series is extended back to 1951 by splicing to allow for definitional changes. The $SPOP$ series is defined as in the Labour Force Survey as the noninstitutional population 15 years of age and older; the $LF$ and $EMP$ series are annual averages also defined as in the Labour Force Survey except that we have included the armed forces (based on data from the Department of National

Defence and historical census data) and estimates for the Territories ( *SPOP* has been adjusted to include the Territories as well), whereas the Survey excludes these components; also we have incorporated adjustments to allow for Statcan revisions of the population underlying the published Survey sample estimates. Based on the foregoing we are able to calculate a half-century of growth rates to which equations (2) and (3) can be applied for historical analysis and with which forecasts can be compared.

## 3. HISTORICAL REVIEW AND A STATUS QUO FORECAST

Table 1 displays annual average rates of change of $GDP$, population, labour force, and the $SPOP$ / $POP$, $LF$ / $SPOP$, $EMP$ / $LF$ and $GDP$ / $EMP$ ratios going back five decades and forward five, based in the latter case on calculations that we refer to as a "status quo" forecast. We begin with the past.

### Looking Back

Real $GDP$ increased at about 4.4 percent per year in the 1950s and even faster, 5.3 percent, in the 1960s. (The decades shown in the table are defined in terms of census years but it is convenient to refer to them as "1950s", "1960s", etc.) The growth rate declined somewhat in the 1970s, to 4.0 percent, declined further in the 1980s, to 2.3 percent, and then increased in the 1990s to 3.2 percent. Overall, labour force and productivity growth were the major contributors to this pattern. The baby boomers came of working age in large numbers in the 1970s, and that plus continuing increases in female labour force participation rates sustained the $GDP$ growth rate at a high level, in spite of much slower productivity gains and a noticeable decline in the participation rates of men over 55. By the 1980s though the labour market effects of the baby bust were beginning to be felt. Productivity gains continued to be modest (by the earlier postwar

standard), the rate of inflow of young people into the labour force fell sharply, the participation rates of older men continued to decline, and further increases in the rates for women were insufficient to provide significant offsets. The 1990s witnessed some degree of turnaround: the rate of productivity growth rose (though not to earlier postwar levels), there was an increase in the employment rate (decrease in the unemployment rate) and by the end of the decade there was some reversal of the downward trend in older male labour force participation rates (although for the decade as a whole the overall $LF / SPOP$ ratio still failed to increase). The 3.2 percent annual average increase in $GDP$ in this final decade of the half-century was a consequence of these developments.

Looking Forward: A Status Quo Forecast

We present a number of forecasts based on alternative scenarios for the future, going out as far as 2051. (The forecasts were calculated using the MEDS demographic software; see Denton, Feaver, and Spencer, 1994, 1997.) The first, the Scenario 1 forecast, we refer to as a "status quo" forecast. By that we mean the following: fertility rates remain the same as in 2000 at all ages (the total fertility rate was 1.49 in that year, well below the natural replacement rate of about 2.1); mortality rates continue to fall, as they have historically, but at a moderate pace, producing increases in life expectancies at birth of 4.6 and 2.2 years for males and females, respectively, by 2051, compared with 2001; immigration remains at 230,000 per year, roughly in the middle of the Canadian government's announced target range and consistent with recent actual levels; annual emigration is set at 70,000, approximately its level in recent years; labour force participation rates remain at their 2002 levels in all age-sex groups; the unemployment rate holds constant at 7.5 percent, its average in the period 1998-02; and the annual rate of increase in

labour productivity remains the same as in the decade 1991-2001, 1.61 percent. These assumptions allow us to predict what will happen if "nothing changes."

What will happen is that the population will grow at a steadily decreasing rate until it stops growing altogether by the middle of the century. The labour force growth rate will also fall. By 2011-21 it will be close to zero and in each of the succeeding decades it will be negative. In other words the Canadian labour force will actually decrease, starting in 2021-31, a reflection of declines in the overall participation rate, which in turn reflect the shift in age distribution of the adult population towards the retirement end of the age spectrum. Immigration will offset a large part of the decrease in domestic supply but not enough to keep the labour force growing. Under the assumption of constant productivity growth the $GDP$ will continue to increase nevertheless but at a slower rate in 2001-11, and at slower rates still in the subsequent decades. Output per capita ( $GDP / POP$ ) will also increase more slowly, falling from an annual rate of 2.2 percent in 1991-01 to 1.8 percent in 2001-11 and then to 1.1 percent in each of the next two decades. By the last two decades of the forecast period the rate of increase will rise, though, to 1.4 percent, in consequence of the cessation of population growth coupled with the assumed constant rate of increase in productivity. Comparing the status quo forecasts of growth rates of $GDP$ per capita with the historical rates in the top part of Table 1 we note that the forecast rates will be lower than the rate in the 1990s but greater than or equal to the rate in the 1980s. If $GDP$ per capita is viewed as a welfare indicator (albeit a crude one) the status quo scenario does not qualify as a disaster scenario. But of course much depends on the assumption about the continuation of productivity growth, one of the two wild cards in the forecasting game.

## 4. THE ROLE OF IMMIGRATION

The other wild card, immigration, deserves special attention, partly because of its historical quantitative importance and partly because it is the only significant, direct, and reliable policy instrument available to the Canadian government for affecting long-run population and labour force growth. The estimated contributions of immigration to population and labour force growth in the last half-century and to the status quo forecasts are shown in Table 2 and Figure 1, on a net basis (net of emigration), together with the corresponding domestic contributions. (The figures in the table are decade totals, in thousands, rather than annual rates.)

It is estimated that immigration accounted for more than two-fifths of the increase in the labour force in the 1950s. Its share was much lower in the 1960s and 1970s, but then rose in each of the next two decades. By the 1990s it accounted again for over two-fifths. Under our status quo assumptions it will account for half of the increase in the present decade and by the next one it will be the only source of labour force growth: the domestic supply will decrease and immigration will be responsible entirely for the small net gain during the decade. In the remaining decades of the forecast period even the assumed gross inflow of 230,000 immigrants per year will fall well short of enough to offset the declines in domestic supply.

Much the same can be said about immigration's contribution to population growth. Its share was in the range one quarter to two-fifths in the 1950s through to the 1980s, rising to half in the 1990s. The status quo forecast has the share increasing to two-thirds in the present decade and four fifths in the next one. With continuing low fertility rates domestic population growth will be negative thereafter; the inflow of 230,000 immigrants per year will keep the overall growth rate positive for two decades longer but will be insufficient to keep it from going negative

by 2041-51. In short, population and labour force increases, or the moderation of declines, will be increasingly dependent on high levels of immigration far into the future.

The point can be made in a different way by asking what would happen if there were no immigration. Leaving the other assumptions of the status quo forecast intact, no-immigration calculations are presented in Table 3 and Figure 2. The calculations are done in two ways: assuming that net immigration per year is zero (emigration as well as immigration eliminated in the forecasts) and that only gross immigration is zero (no change in emigration). Both calculations are of course unrealistic as forecasts of what will actually happen but they serve to underscore again how dependent Canada will be on foreign sources for population and labour force growth. If gross immigration is set to zero the population declines in every decade of the forecast period while the labour force is hardly changed in the present decade and then declines thereafter. If net immigration is set to zero the patterns are essentially as before; the decrease in population is postponed (but barely) for a decade and the subsequent rates of decline in both the population and labour force are moderated a little. But the inference is the same: heavy future dependence on foreign sources.

## 5. WHAT COULD HAPPEN TO CHANGE THE FUTURE?

Many things could happen to increase growth. Fertility rates could start to rise, with immediate implications for population growth and implications for labour force growth some two decades down the road. Mortality rates could decline more rapidly, thus increasing the number of elderly survivors, and hence the denominator of the $GDP / POP$ ratio, but decreasing to some extent the number of deaths of people of working age, and thus increasing the size of the labour force. Labour force participation rates could rise, with immediate effects on the size and age

composition of the working population. Immigration could move to a higher annual level, and with it the rate of inflow of foreign-born workers. Emigration could decline: fewer people of all ages, but especially working ages, could leave the country. The rate of growth of productivity could increase. We explore these possibilities in a series of scenarios alternative to Scenario 1, the status quo forecast scenario. We introduce possible changes of the kind just enumerated, in Scenarios 2 to 7, one at a time. Then, in Scenario 8, we pull out all the stops and provide a forecast in which all of the changes occur simultaneously. Results are presented in Tables 4 and 5. Table 4 shows the annual growth rates of *GDP*, population, labour force, and per capita *GDP* for each scenario. Table 5 shows the same growth rates as differences from the Scenario 1 rates so that the incremental effects of the changes in forecast assumptions can be seen more easily.

Scenario 2: Higher Fertility Rates

The total fertility rate increases by 50 percent in this scenario, from 1.49 children per woman in 2001 to 2.23 in 2011, with rates calculated by linear interpolation for the intervening years. Age-specific rates change in the same proportion as the total rate. The effect is to increase the annual rate of population growth from the Scenario 1 level by about a quarter of one percent in the present decade, a little over two fifths of one percent in the next two decades, and six tenths and then seven tenths in the last two decades of the forecast period (Table 5). The effects on labour force growth are not realized in any significant degree until the third decade, 2021-31, when the rate is higher than the Scenario 1 rate by more than half a percentage point. The rates are seven or eight tenths of a percentage point higher in 2031-41 and 2041-51. With the employment rate and *GDP* per person employed held constant the growth rate of total *GDP*

changes in the same manner as the labour force growth rate. The growth rate of $GDP$ per capita is affected differently though, in consequence of the addition to the number of mouths to feed without compensating increase in the number of workers: the $GDP / POP$ growth rate falls below its Scenario 1 level for two decades and then rises above it in each subsequent decade, but only a little.

Scenario 3: Faster Mortality Decline

The pattern of mortality declines by age and sex is altered here to allow death rates to fall more quickly so that 2.2 more years of life are added to male life expectancy at birth by the year 2051 and 2.7 to female life expectancy, compared with the expectancy gains in Scenario 1. The effects are negligible in all decades.

Scenario 4: Increased Labour Force Participation Rates

This is an important one. We assume here that male participation rates for ages 20 and over will return (by equal annual increments) to their 1971 levels by the year 2011, which means that the rates will rise from current levels in all 20-and-over age groups. (The 15-19 rate is already above its 1971 level.) We assume too that the female participation rates will converge to the male rates in every age group, reaching equality by 2011. The rates for both sexes remain constant thereafter. It goes without saying that these assumptions imply major changes in patterns of labour force behaviour and that such changes would actually occur seems unlikely (though not impossible – impossible is a risky word in the forecasting game). Indeed if they were to occur there might well be other changes that would ensue as a consequence – changes to fertility rates, for example. We ignore that. Our aim in this scenario is simply to squeeze out as much as we can in the way of labour force participation effects – to see just how much growth

could be added to the system if there were in fact large increases in participation rates.[1]

What would happen is that the rate of growth of the labour force would rise sharply in 2001-11 from its Scenario 1 level. Some 1.7 percent per year would be added to the rate in that decade, and there would be corresponding increases to the *GDP* and *GDP* per capita growth rates. However that would be the end of it. Continued large increases in participation could not be sustained and while the higher participation rates are assumed to hold in subsequent decades in this scenario no further increases can reasonably be permitted. The scenario's forecast growth effects after 2011 are thus very small to negligible, reflecting simply the interaction of changes in population age distribution with the higher (but constant) participation rates.

Scenario 5: Increased Immigration

Here we assume a 50 percent increase in annual immigration, starting in 2003-04. The number of immigrants thus becomes 345,000 in every year. The effects on the labour force and *GDP* growth rates are identical and commence immediately. The rates rise above the Scenario 1 level by about a third of a percentage point in 2001-11 and by a little more in the subsequent decades. The effect on the labour force growth rate in 2001-11 is much smaller in this scenario than the effect of increased participation rates in Scenario 4. In 2011-21 immigration has the largest impact but by 2021-31 it takes second place to the increased numbers of young people entering the labour force in Scenario 2 as the delayed effects of higher fertility rates in that scenario come to be felt.

Scenario 6: Decreased Emigration

The annual number of emigrants is reduced to 35,000, a decrease of 50 percent, and remains at 35,000 throughout the rest of the forecast period. The effects are very small, as one

would have expected. The effects on the growth rates of population, labour force, and $GDP$ never exceed about an eighth of a percentage point and the effects on $GDP$ per capita are virtually zero.

Scenario 7: Faster Productivity Growth

Labour productivity grew by about 1.6 percent per year in the decade 1991-01. We increase that by 50 percent in this forecast scenario, to 2.4 percent. Needless to say that has substantial (and equivalent) effects on the rates of growth of $GDP$ and $GDP$ per capita. It adds about four fifths of a percentage point to those rates in every decade, compared with Scenario 1. In the case of $GDP$ per capita its effect on the growth rate is greater than the effects of any of the factors allowed to change in the other scenarios, with the exception of the Scenario 4 increase in labour force participation rates in the decade 2001-11.

Scenario 8: Scenarios 2-7 Combined

We combine Scenarios 2 to 7 and allow all of the assumed changes to occur at the same time in this one. In 2001-11 $GDP$ grows at 5.4 percent per year (Table 4), a rate just above the 5.3 percent recorded for the decade 1961-71 and well above the rates for any of the other decades in the half-century 1951-2001 (Table 1). The assumed very large increases in labour force participation rates are by far the major source of such rapid growth, with faster productivity gains a distant second and higher immigration a considerably more distant third. The increase in participation is a one-time event though, and once its effects have been realized the situation changes abruptly. The $GDP$ growth rate falls to only 1.5 percent above the Scenario 1 level in 2011-21 and then moves into the range 1.8 to 2.0 above in the succeeding three decades as higher fertility rates finally fulfill their promise of more youthful labour force entrants and join faster

productivity growth and increased immigration as a major contributor.

The increase in the forecast rate of growth of $GDP$ per capita in 2001-11 in this scenario is phenomenal (or would be if it actually happened). The $GDP$ / $POP$ ratio grows at an annual rate of 4.0 percent in 2001-11, well above any decade rate in the last half of the 20th century. Again this is mainly the result of the assumed rise in participation rates, the effect of which is to increase $GDP$ without altering the population denominator in the ratio. The growth rate declines to 1.7 in 2011-21, rises to 2.0 in 2021-31, and then rises further, into the 2.3 to 2.4 range, in the subsequent two decades, rates that are similar or somewhat higher than the rate in the 1990s and appreciably higher than the rate in the 1980s. That the $GDP$ / $POP$ growth rate is so high in these forecast decades is the result mainly of the assumed rate of productivity increase. Putting the productivity rate of increase back to its 1990s level would result in much lower $GDP$ / $POP$ growth rates in 2011-21 and the subsequent decades. Productivity increases, like participation rate increases, leave the denominator of the ratio unchanged; all other sources of growth affect both the numerator and denominator.

Summary Assessment

A substantial rise in labour force participation rates could offset slower growth in the working age population in the present decade, 2001-11. It seems highly unlikely that the very large participation rate increases that we have assumed for analytical purposes would in fact occur but even smaller increases would provide some offset. Beyond that, higher levels of immigration could have an immediate and continuing effect on $GDP$ growth but (within our accounting framework) only a negligible effect on the growth of $GDP$ per capita. If fertility rates were to increase substantially, starting soon, there would be a significant effect on the

number of new labour force entrants, but not for some two decades; the effect on the rate of growth of *GDP* per capita would be negative during the interim period and positive but small thereafter. While much higher levels of immigration than what we have assumed in Scenarios 5 and 8 would increase labour force and *GDP* growth, more rapid gains in productivity would seem to be the only real possibility for raising substantially the rate of growth of *GDP* per capita, once any effects of participation rate increases had been realized.

## 6. IMMIGRATION AS A POLICY INSTRUMENT

Let us suppose that *GDP* growth is the policy focus rather than the growth of *GDP* per capita, or that for reasons outside of the framework of analysis in this paper it is believed that increases in *GDP* growth, whatever the source, would somehow raise output or income per capita, or achieve some other desirable goal. Let us suppose too that fertility rates remain at their current low level. The one policy lever available to the Canadian government that can increase labour force growth and hence *GDP* growth substantially, without doubt or delay, is then immigration. One may think that other policy levers might affect other sources of growth, in particular labour force participation rates, but the connections must surely be much weaker and the effectiveness of such levers (whatever they might be) more speculative. Immigration increases the population and labour force directly and immediately. With that in mind we calculate the level of gross immigration that would be required in each of the forecast decades to achieve specified target rates of labour force growth. The target rates chosen are 0, 1, 2, and 3 percent per year, plus the actual 1991-01 rate, which was 1.24 percent. The required annual immigration levels are displayed in Table 6.

Annual immigration in the first forecast decade, 2001-11, ranges from -22,000 to achieve

a rate of 0 percent (meaning that there would have to be an increase of 22,000 in emigration) through 250,000 to achieve a 1 percent rate of increase, 545,000 for a 2 percent rate, and 870,000 for a 3 percent rate. To achieve a rate equal to the actual 1991-01 rate of 1.24 percent would require annual immigration to be 317,000, substantially higher than the levels of recent years (though not as high as assumed in Scenario 5). Maintenance of the 1991-01 rate in 2011-21 and subsequent decades would require much higher levels still, ranging from almost 600,000 to well over 800,000 by the last decade of the forecast period, as shown in Figure 3 (as well as Table 6). To achieve a rate of 2 percent labour force growth by 2021-31 there would have to be more than a million immigrants a year, and by 2041-51 the number would be more than a million and a half. Even achieving a 1 percent growth rate would require well in excess of half a million, starting in the decade 2011-21. Of course, fertility rates might increase (although to date there has been no indication of that, indeed quite the contrary) but unless the increases are large and come soon the prospect of stabilizing labour force growth by the use of the immigration lever is a daunting one, to put it mildly.

## 7. PRODUCTIVITY GAINS AS AN OFFSET TO THE DEMOGRAPHIC SLOWDOWN

There is no policy instrument that can guarantee productivity growth in the way that immigration can guarantee labour force growth but one can calculate how fast productivity would have to increase to achieve specified rates of growth of $GDP$ and $GDP$ per capita. We do this and report the full set of results in Table 7. The specified $GDP$ growth rates are 0, 1, 2, 3 and 4 percent per year, plus the 1991-01 rate of 3.22 percent; the specified $GDP$ per capita rates are 0, 1, 2 and 3 percent, plus the 1991-01 rate, which was 2.15 percent.

Maintaining a rate of growth of $GDP$ equal to the 1991-01 rate of 3.22 percent would

require that labour productivity increase at 2.3 percent per year in the first forecast decade, 3.2 percent in the second decade, and then 3.3 or 3.4 percent thereafter, as shown in Figure 4 (upper panel), as well as Table 7. Maintaining a rate of growth of $GDP$ per capita equal to the 1991-01 rate would require a productivity increase of 2.0 percent in the first decade, 2.6 or 2.7 percent in the next two decades, and 2.3 percent in the final two (Figure 4, lower panel, and Table 7). Rates such as those that would maintain $GDP$ per capita growth at the 1991-01 level are conceivable if the productivity gains of the 1950s and 1960s are any guide (see Table 1), but they would certainly be much higher than what we have seen since that time. What good luck or policy magic might bring them about is by no means clear.

## 8. CONCLUDING THOUGHTS

We have presented forecasts going out half a century – conditional forecasts, of course, depending on whether the "status quo" is maintained, or on whether this or that happens. Half a century is a much longer period than what economists are usually concerned with, a far cry from the forecasting of next quarter's rate of inflation or next year's rate of growth of $GDP$. But population change has great inertia and the current age distribution and fertility rates have implications for decades to come. The "problems" of an aging population, or "challenges" if one prefers, are not going to go away in a few years, to be replaced by others. They will be with us for a very long time. Short-term "solutions" should be suspect. Think long.

In principle the economy could squeeze quite a bit more labour from the population if participation rates were to rise as we assumed in our Scenario 4, and thereby increase sharply the rates of growth of $GDP$ and $GDP$ per capita in the present decade. That is very unlikely to happen to the extent that we hypothesized, but smaller increases would move the growth rates in

the right direction, and slower increases would diminish the impact but spread it over a longer period. In any event participation rate increases cannot continue indefinitely; were they to occur they would simply put off the day of reckoning. In the longer-run – once the effects of participation rate increases have been exhausted, if indeed they happen at all – immigration would seem to be the only source of sustained population and labour force growth on the demographic horizon, and the rate of immigration would have to move to a much higher level if labour force growth were to be stabilized. Of course fertility rates could make a dramatic recovery, although from today's perspective that seems unlikely. Canada is not alone in having low rates. Indeed, all industrialized countries have total fertility rates below the natural replacement level of 2.1 children per woman. The average U.S. rate is below but close to the replacement level (although many of the fifty states are well below it) whereas Canada's rate is far lower – about 1.5 in the latest year for which a figure is available, and it has been inching downwards in recent years rather than showing any sign of increase. But conceivably things could turn around. Even if that were to happen though it would be at least two decades before any significant effects of a fertility increase were felt in the labour market. (Any significant direct effects that is; indirect effects might include some decrease in female participation rates, which would tend to slow the rate of growth of the labour force.) Then there is the possibility of higher rates of productivity growth, which would solve the "problem" very nicely. However productivity is not something for which a government has a well defined and effective instrument in its policy tool bag and there seem to be no particular grounds for optimism in that regard.

Let us end on a positive note, though. We are not ones to engage in what has been called "apocalyptic demography" (Gee and Gutman, 2000; Evans et al., 2001). Elsewhere we have

demonstrated (in spite of all the hype about population aging) that "dependency" ratios – ratios such as population to labour force or dependent population (elderly plus children) to working age population – are unlikely to rise in the next several decades above the levels seen in the 1950s and 1960s when there were such large numbers of baby boom children in the population. (That prediction holds whether or not one assigns different weights to old and young dependents to reflect different levels of required support; see Denton, Feaver, and Spencer, 1998, 1999; Denton and Spencer, 2000, 2002.) Of course, productivity growth rates were higher in those decades than subsequently, and that is an important consideration. In the present context, though, our status quo forecast suggests that if productivity grows at the same rate as in the 1990s, then $GDP$ per capita will continue to rise at a rate equal to or above the rate in the 1980s – and perhaps productivity will grow more quickly. Who knows? Challenges yes, but not a scenario for disaster. Economies are adaptive organisms. The Canadian one coped with the baby boom and the baby bust. One way or another we can expect it to cope with the elderly boom.

REFERENCES

Denton, Frank T., Christine H. Feaver, and Byron G. Spencer (1994). "Economic-Demographic Projection and Simulation: A Description of the MEDS System of Models," in K. Vaninadha Rao and Jerry W. Wicks, eds., *Studies in Applied Demography: Proceedings of the International Conference on Applied Demography*. Population and Society Research Center, Bowling Green State University.

Denton, Frank T., Christine H. Feaver, and Byron G. Spencer (1997). "PMEDS-D Users' Manual," McMaster University Research Institute for Quantitative Studies in Economics and Population QSEP Research Report Number 326.

Denton, Frank T., Christine H. Feaver, and Byron G. Spencer (1998). "The Future Population of Canada: Its Age Distribution and Dependency Relations," *Canadian Journal on Aging*, Vol. 17, No. 1.

Denton, Frank T., Christine H. Feaver, and Byron G. Spencer (1999). "Immigration and Population Aging," *Canadian Business Economics*, February.

Denton, Frank T. and Byron G. Spencer (2000). "Population Aging and Its Economic Costs: A Survey of the Issues and Evidence," *Canadian Journal on Aging*, Vol. 19, Supplement 1, Summer.

Denton, Frank T. and Byron G. Spencer (2002). "Some Demographic Consequences of Revising the Definition of 'Old' to Reflect Future Changes in Life Table Probabilities," *Canadian Journal on Aging*, Vol. 21, Number 3.

Evans, R.G., K.M. McGrail, S.G. Morgan, M.L. Barer, and C. Hertzman (2001). "Apocalypse No: Population and the Future of Health Care Systems," *Canadian Journal on Aging*, Vol. 20, Supplement 1.

England, Robert Stowe (2002). *The Macroeconomic Impact of Global Aging: A New Era of Economic Frailty?* The CSIS Press, Centre for Strategic and International Studies, Washington, DC.

Gee, Ellen M. and Gloria M. Gutman, eds. (2000). *The Overselling of Population Aging: Apocalyptic Demography, Intergenerational Challenges, and Social Policy*, Toronto: Oxford University Press.

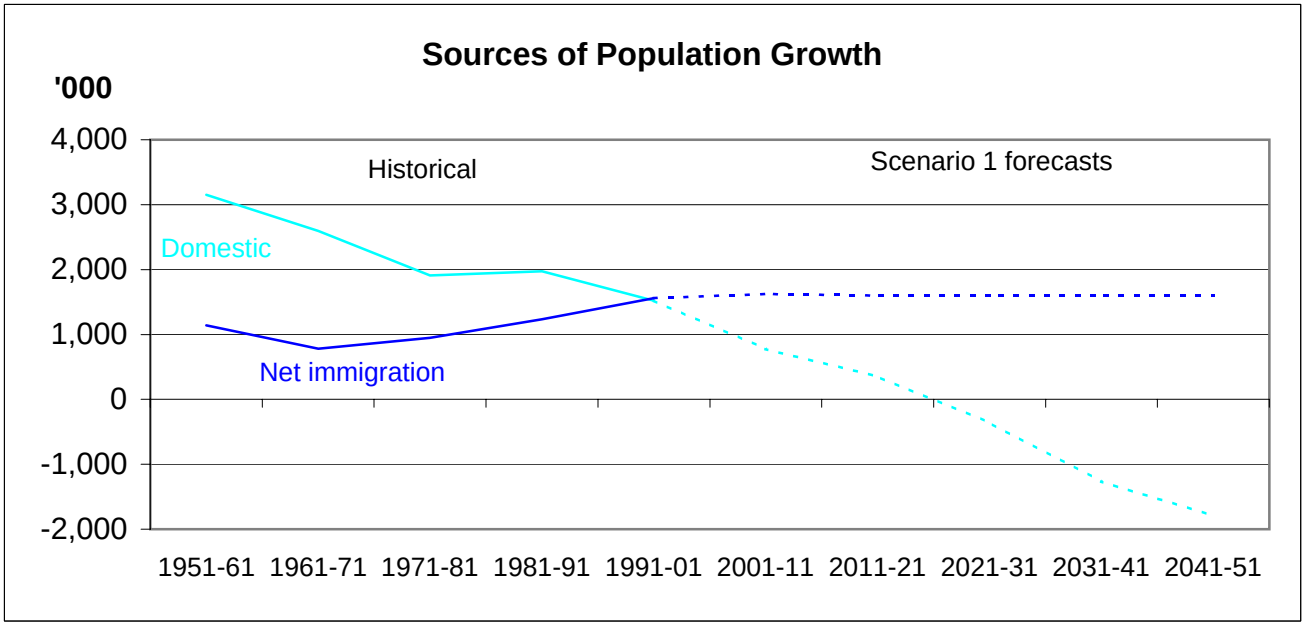
McMorrow, Kieran, and Werner Roeger (1999). "The Economic Consequences of Ageing Populations," Economic Papers of the Directorate-General for Economic and Financial Affairs, No. 138, Brussels: European Commission.

Turner, Dave, Claude Giornio, Alain De Serres, Ann Vouch'h, and Peter Richardson (1998). "The Macroeconomic Implications of Ageing in a Global Context," Economics Department Working Paper 193, Paris: OECD.

## ENDNOTE

1. Turner et al. (1998) explore the possibly large effects of regulatory and other reforms on participation rates in OECD countries. A European Commission study by McMorrow and Roeger (1999) simulates the effects of a 10 percentage point increase by 2020 in the overall participation rate in the European Union. Those two studies, among others, are discussed at length in England (2002).

**Figure 1**


Sources of Population Growth
'000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
Historical
Scenario 1 forecasts
Domestic
Net immigration
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

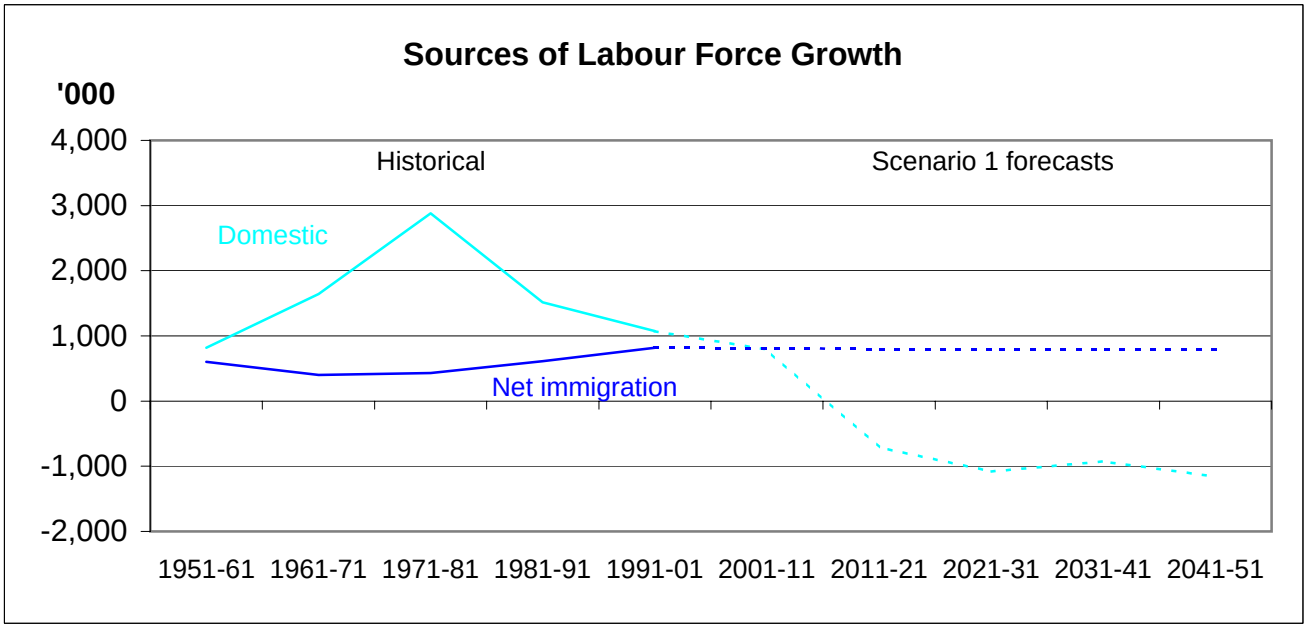
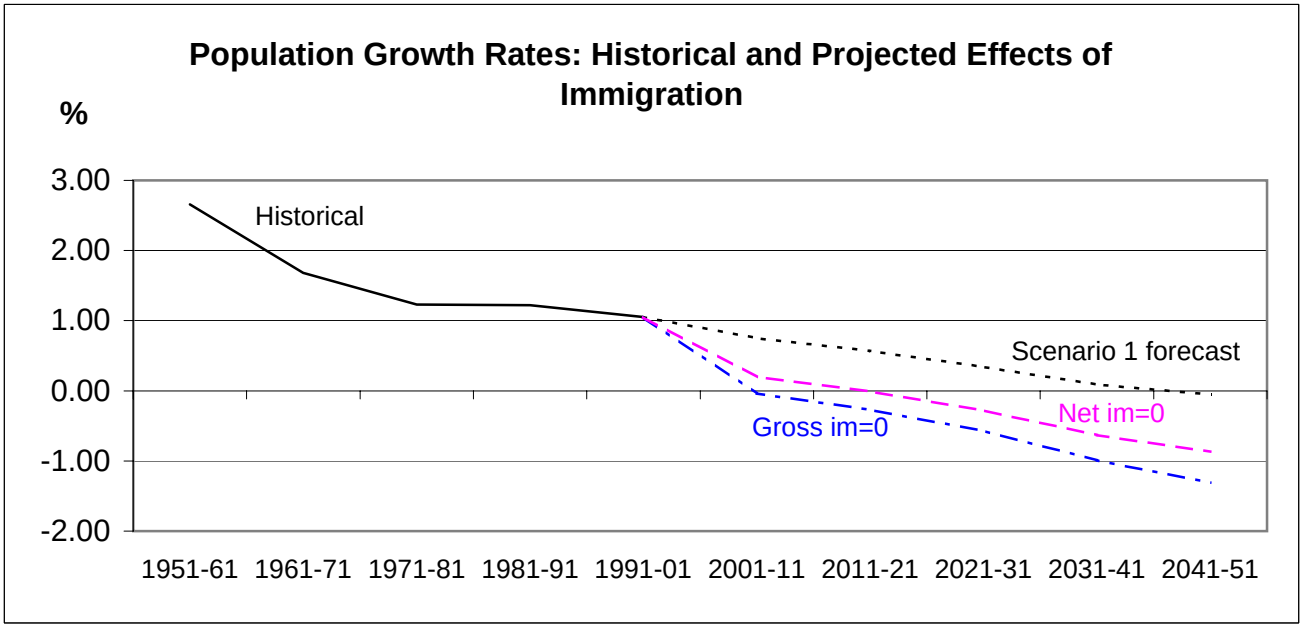

Sources of Labour Force Growth
'000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
Historical
Scenario 1 forecasts
Domestic
Net immigration
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

**Figure 2**


Population Growth Rates: Historical and Projected Effects of Immigration
%
3.00
2.00
1.00
0.00
-1.00
-2.00
Historical
Scenario 1 forecast
Net im=0
Gross im=0
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

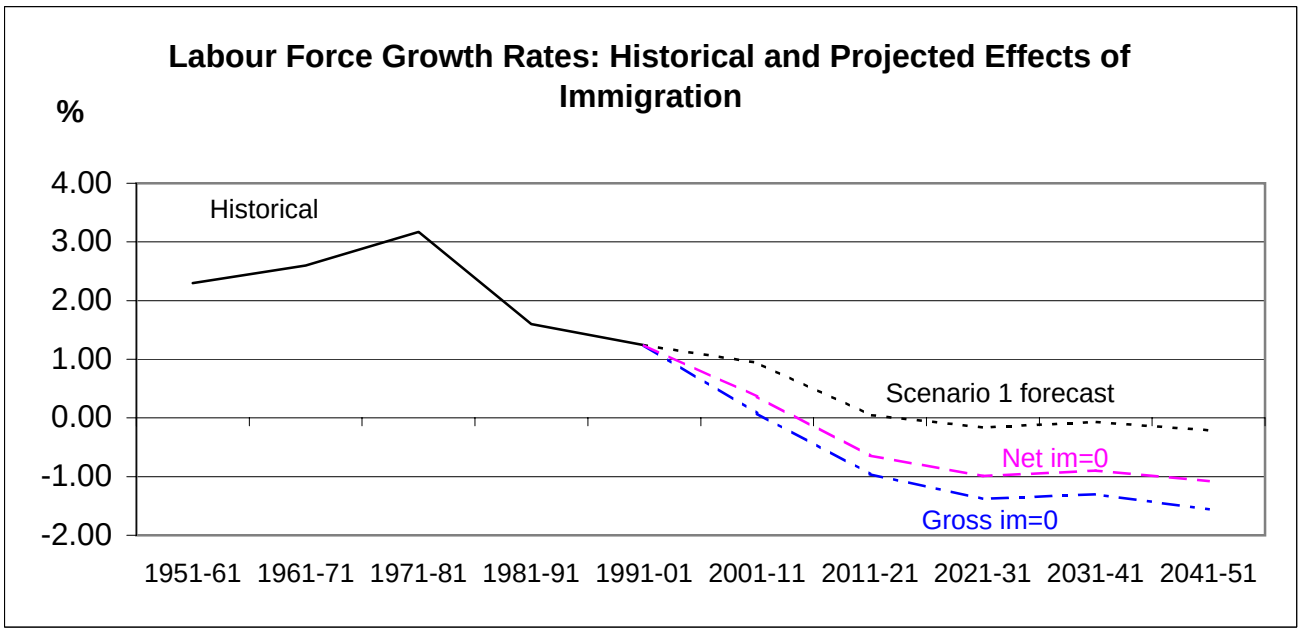

Labour Force Growth Rates: Historical and Projected Effects of Immigration
%
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Historical
Scenario 1 forecast
Net im=0
Gross im=0
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

**Figure 3: Annual Gross Immigration, Historical and Level Required to Maintain LF Growth Rate at 1.24 %**

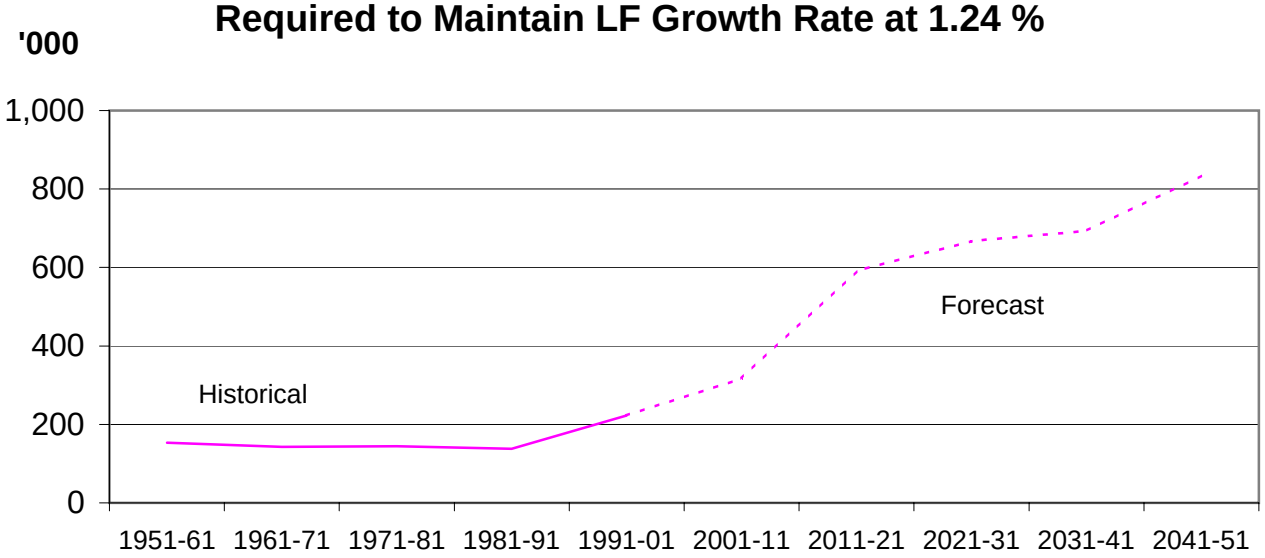
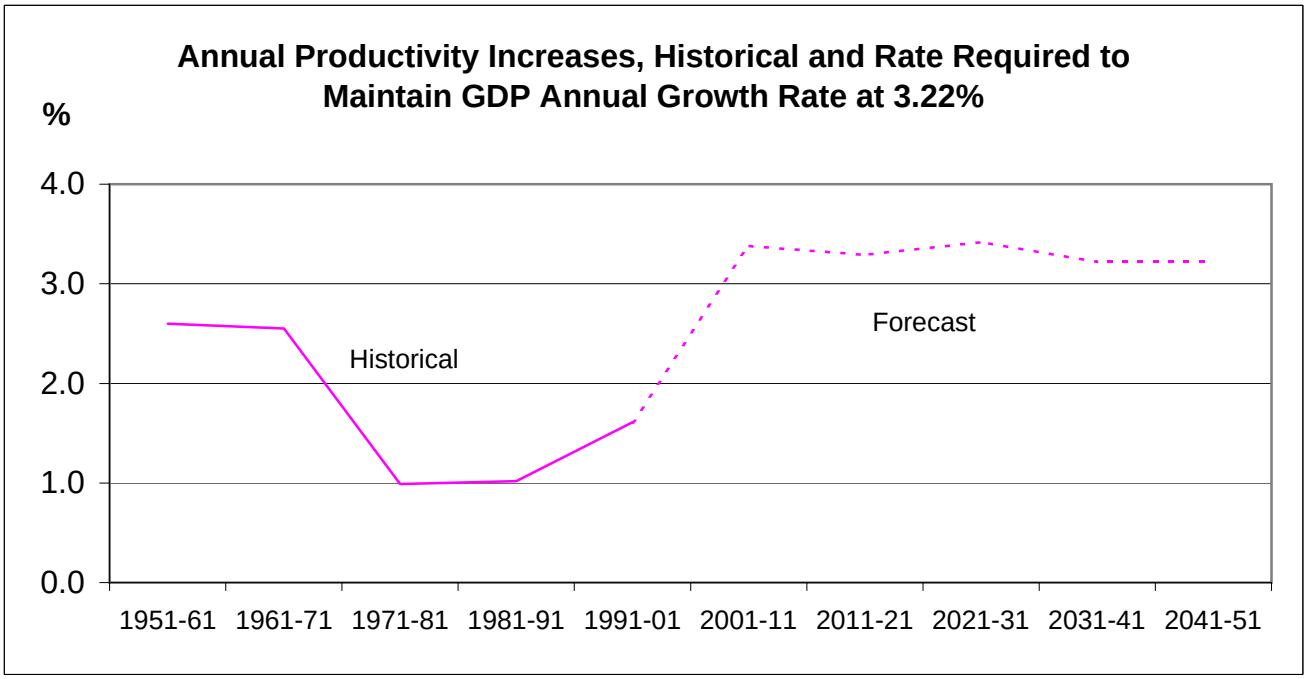


**Figure 4**


Annual Productivity Increases, Historical and Rate Required to Maintain GDP Annual Growth Rate at 3.22%
%
4.0
3.0
2.0
1.0
0.0
Historical
Forecast
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

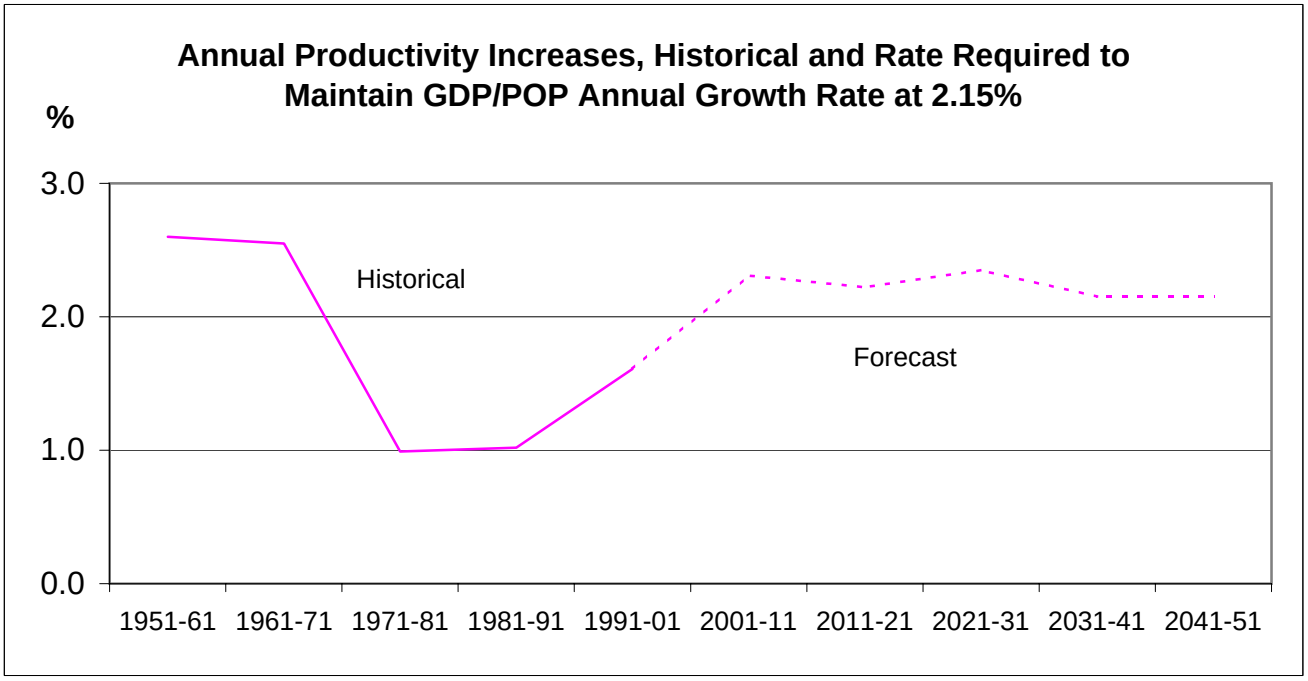

Annual Productivity Increases, Historical and Rate Required to Maintain GDP/POP Annual Growth Rate at 2.15%
%
3.0
2.0
1.0
0.0
Historical
Forecast
1951-61
1961-71
1971-81
1981-91
1991-01
2001-11
2011-21
2021-31
2031-41
2041-51

Table 1: Rates and Components of Growth: Historical and Scenario 1 Forecasts

| | Annual increase (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GDP | POP | LF | GDP/POP | SPOP/POP | LF/SPOP | EMP/LF | GDP/EMP |
| Historical | | | | | | | | |
| 1951-61 | 4.45 | 2.66 | 2.30 | 1.74 | -0.48 | 0.13 | -0.49 | 2.60 |
| 1961-71 | 5.32 | 1.68 | 2.60 | 3.58 | 0.73 | 0.18 | 0.10 | 2.55 |
| 1971-81 | 4.05 | 1.23 | 3.17 | 2.78 | 0.89 | 1.02 | -0.14 | 0.99 |
| 1981-91 | 2.33 | 1.22 | 1.60 | 1.09 | 0.14 | 0.23 | -0.30 | 1.02 |
| 1991-01 | 3.22 | 1.05 | 1.24 | 2.15 | 0.29 | -0.10 | 0.34 | 1.61 |
| Forecast | | | | | | | | |
| 2001-11 | 2.52 | 0.75 | 0.94 | 1.77 | 0.36 | -0.17 | -0.03 | 1.61 |
| 2011-21 | 1.66 | 0.57 | 0.05 | 1.09 | 0.05 | -0.57 | 0.00 | 1.61 |
| 2021-31 | 1.45 | 0.34 | -0.16 | 1.11 | 0.04 | -0.54 | 0.00 | 1.61 |
| 2031-41 | 1.54 | 0.09 | -0.07 | 1.45 | 0.08 | -0.24 | 0.00 | 1.61 |
| 2041-51 | 1.40 | -0.05 | -0.21 | 1.45 | 0.00 | -0.15 | 0.00 | 1.61 |

Table 2: Domestic and Net Immigration Contributions to Population and Labour Force Growth: Historical and Scenario 1 Forecasts

| | Population Growth ('000) | | | Labour Force Growth ('000) | | |
|---|---|---|---|---|---|---|
| | Total | Domestic | Immigration | Total | Domestic | Immigration |
| Historical | | | | | | |
| 1951-61 | 4293 | 3,153 | 1,140 | 1,420 | 816 | 604 |
| 1961-71 | 3378 | 2,597 | 781 | 2,047 | 1,645 | 402 |
| 1971-81 | 2858 | 1,908 | 950 | 3,311 | 2,881 | 430 |
| 1981-91 | 3210 | 1,974 | 1,236 | 2,125 | 1,515 | 610 |
| 1991-01 | 3080 | 1,520 | 1,559 | 1,894 | 1,076 | 818 |
| Forecast | | | | | | |
| 2001-11 | 2402 | 777 | 1,625 | 1,602 | 791 | 811 |
| 2011-21 | 1951 | 351 | 1,600 | 88 | -710 | 798 |
| 2021-31 | 1241 | -359 | 1,600 | -285 | -1,083 | 798 |
| 2031-41 | 334 | -1,266 | 1,600 | -125 | -923 | 798 |
| 2041-51 | -191 | -1,791 | 1,600 | -363 | -1,161 | 798 |

Table 3: Future Population and Labour Force Growth If There Were No Immigration

| | Annual Growth Rate of Population (%) | | Annual Growth Rate of Labour Force (%) | |
|---|---|---|---|---|
| | If gross immigration were zero | If net immigration were zero | If gross immigration were zero | If net immigration were zero |
| 2001-11 | -0.04 | 0.20 | 0.08 | 0.36 |
| 2011-21 | -0.27 | -0.01 | -0.96 | -0.64 |
| 2021-31 | -0.57 | -0.28 | -1.38 | -0.99 |
| 2031-41 | -0.99 | -0.63 | -1.30 | -0.90 |
| 2041-51 | -1.31 | -0.87 | -1.56 | -1.08 |

Table 4: Growth Rates Based on Alternative Forecast Scenarios

| Scenario | 2001-11 | 2011-21 | 2021-31 | 2031-41 | 2041-51 |
|---|---|---|---|---|---|
| | | --annual growth rate of GDP (%)-- | | | |
| 1. Status quo | 2.52 | 1.66 | 1.45 | 1.54 | 1.40 |
| 2. Higher fertility rates | 2.52 | 1.73 | 2.00 | 2.28 | 2.24 |
| 3. Faster mortality decline | 2.52 | 1.67 | 1.47 | 1.56 | 1.42 |
| 4. Increased LF participation | 4.24 | 1.85 | 1.51 | 1.59 | 1.46 |
| 5. Increased immigration | 2.83 | 2.08 | 1.89 | 1.93 | 1.75 |
| 6. Decreased emigration | 2.62 | 1.79 | 1.58 | 1.64 | 1.50 |
| 7. Faster productivity growth | 3.31 | 2.45 | 2.24 | 2.33 | 2.19 |
| 8. Scenarios 2-7 combined | 5.38 | 3.21 | 3.28 | 3.48 | 3.35 |
| | | --annual growth rate of POP (%)-- | | | |
| 1. Status quo | 0.75 | 0.57 | 0.34 | 0.09 | -0.05 |
| 2. Higher fertility rates | 0.99 | 1.02 | 0.77 | 0.68 | 0.68 |
| 3. Faster mortality decline | 0.76 | 0.60 | 0.40 | 0.17 | 0.03 |
| 4. Increased LF participation | 0.75 | 0.57 | 0.34 | 0.09 | -0.05 |
| 5. Increased immigration | 1.04 | 0.92 | 0.69 | 0.45 | 0.31 |
| 6. Decreased emigration | 0.83 | 0.67 | 0.45 | 0.19 | 0.05 |
| 7. Faster productivity growth | 0.75 | 0.57 | 0.34 | 0.09 | -0.05 |
| 8. Scenarios 2-7 combined | 1.34 | 1.49 | 1.23 | 1.12 | 1.08 |
| | | --annual growth rate of LF (%)-- | | | |
| 1. Status quo | 0.94 | 0.05 | -0.16 | -0.07 | -0.21 |
| 2. Higher fertility rates | 0.94 | 0.11 | 0.39 | 0.67 | 0.63 |
| 3. Faster mortality decline | 0.95 | 0.06 | -0.14 | -0.05 | -0.19 |
| 4. Increased LF participation | 2.66 | 0.24 | -0.11 | -0.03 | -0.15 |
| 5. Increased immigration | 1.26 | 0.46 | 0.28 | 0.31 | 0.14 |
| 6. Decreased emigration | 1.04 | 0.18 | -0.04 | 0.03 | -0.11 |
| 7. Faster productivity growth | 0.94 | 0.05 | -0.16 | -0.07 | -0.21 |
| 8. Scenarios 2-7 combined | 3.04 | 0.80 | 0.88 | 1.08 | 0.95 |
| | | --annual growth rate of GDP/POP (%)-- | | | |
| 1. Status quo | 1.77 | 1.09 | 1.11 | 1.45 | 1.45 |
| 2. Higher fertility rates | 1.53 | 0.71 | 1.23 | 1.60 | 1.56 |
| 3. Faster mortality decline | 1.77 | 1.08 | 1.07 | 1.39 | 1.39 |
| 4. Increased LF participation | 3.49 | 1.28 | 1.16 | 1.49 | 1.51 |
| 5. Increased immigration | 1.80 | 1.16 | 1.20 | 1.48 | 1.45 |
| 6. Decreased emigration | 1.78 | 1.12 | 1.13 | 1.45 | 1.45 |
| 7. Faster productivity growth | 2.56 | 1.88 | 1.90 | 2.24 | 2.24 |
| 8. Scenarios 2-7 combined | 4.04 | 1.72 | 2.05 | 2.36 | 2.27 |

Table 5: Difference from Status Quo Growth Rates Based on Alternative Forecast Scenarios

| Scenario | 2001-11 | 2011-21 | 2021-31 | 2031-41 | 2041-51 |
|---|---|---|---|---|---|
| | --difference from status quo annual growth rate of GDP (%)-- | | | | |
| 1. Status quo | -- | -- | -- | -- | -- |
| 2. Higher fertility rates | 0.00 | 0.06 | 0.55 | 0.74 | 0.84 |
| 3. Faster mortality decline | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 |
| 4. Increased LF participation | 1.72 | 0.19 | 0.05 | 0.05 | 0.06 |
| 5. Increased immigration | 0.32 | 0.42 | 0.44 | 0.39 | 0.35 |
| 6. Decreased emigration | 0.10 | 0.13 | 0.12 | 0.10 | 0.10 |
| 7. Faster productivity growth | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| 8. Scenarios 2-7 combined | 2.87 | 1.54 | 1.83 | 1.94 | 1.95 |
| | --difference from status quo annual growth rate of POP (%)-- | | | | |
| 1. Status quo | -- | -- | -- | -- | -- |
| 2. Higher fertility rates | 0.25 | 0.45 | 0.43 | 0.59 | 0.73 |
| 3. Faster mortality decline | 0.01 | 0.03 | 0.06 | 0.08 | 0.08 |
| 4. Increased LF participation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Increased immigration | 0.29 | 0.35 | 0.35 | 0.35 | 0.36 |
| 6. Decreased emigration | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 |
| 7. Faster productivity growth | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8. Scenarios 2-7 combined | 0.59 | 0.92 | 0.88 | 1.03 | 1.13 |
| | --difference from status quo annual growth rate of LF (%)-- | | | | |
| 1. Status quo | -- | -- | -- | -- | -- |
| 2. Higher fertility rates | 0.00 | 0.06 | 0.55 | 0.74 | 0.84 |
| 3. Faster mortality decline | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 |
| 4. Increased LF participation | 1.72 | 0.19 | 0.05 | 0.05 | 0.06 |
| 5. Increased immigration | 0.32 | 0.42 | 0.44 | 0.39 | 0.35 |
| 6. Decreased emigration | 0.10 | 0.13 | 0.12 | 0.10 | 0.10 |
| 7. Faster productivity growth | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8. Scenarios 2-7 combined | 2.10 | 0.75 | 1.04 | 1.15 | 1.16 |
| | --difference from status quo annual growth rate of GDP/POP (%)-- | | | | |
| 1. Status quo | -- | -- | -- | -- | -- |
| 2. Higher fertility rates | -0.25 | -0.38 | 0.12 | 0.15 | 0.11 |
| 3. Faster mortality decline | -0.01 | -0.02 | -0.04 | -0.06 | -0.06 |
| 4. Increased LF participation | 1.72 | 0.19 | 0.05 | 0.05 | 0.06 |
| 5. Increased immigration | 0.03 | 0.06 | 0.09 | 0.03 | -0.01 |
| 6. Decreased emigration | 0.01 | 0.02 | 0.02 | 0.00 | -0.01 |
| 7. Faster productivity growth | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| 8. Scenarios 2-7 combined | 2.27 | 0.62 | 0.95 | 0.91 | 0.82 |

Table 6: Annual Gross Immigration Required to Maintain Specified Labour Force Growth Rates

| | Required Immigration ('000) | | | | |
|---|---|---|---|---|---|
| | 2001-11 | 2011-21 | 2021-31 | 2031-41 | 2041-51 |
| Annual labour force growth rate | | | | | |
| 0% | -22 | 242 | 278 | 213 | 257 |
| 1% | 250 | 513 | 573 | 570 | 678 |
| 2% | 545 | 875 | 1,040 | 1,205 | 1,525 |
| 3% | 870 | 1,345 | 1,745 | 2,290 | 3,130 |
| 1991-01 rate (1.24%) | 317 | 591 | 667 | 693 | 834 |

Table 7: Annual Productivity Increases Required to Maintain Specified GDP and GDP/POP Growth Rates with Scenario 1

| | Required productivity increase (%) | | | | |
|---|---|---|---|---|---|
| | 2001-11 | 2011-21 | 2021-31 | 2031-41 | 2041-51 |
| Annual GDP growth rate | | | | | |
| 0% | -0.91 | -0.05 | 0.16 | 0.07 | 0.20 |
| 1% | 0.09 | 0.95 | 1.16 | 1.07 | 1.20 |
| 2% | 1.09 | 1.95 | 2.16 | 2.07 | 2.20 |
| 3% | 2.09 | 2.95 | 3.16 | 3.07 | 3.20 |
| 4% | 3.09 | 3.95 | 4.16 | 4.07 | 4.20 |
| 1991-01 rate (3.22%) | 2.31 | 3.17 | 3.38 | 3.29 | 3.42 |
| Annual GDP/POP growth rate | | | | | |
| 0% | -0.16 | 0.52 | 0.50 | 0.16 | 0.15 |
| 1% | 0.84 | 1.52 | 1.50 | 1.16 | 1.15 |
| 2% | 1.84 | 2.52 | 2.50 | 2.16 | 2.15 |
| 3% | 2.84 | 3.52 | 3.50 | 3.16 | 3.15 |
| 1991-01 rate (2.15%) | 1.99 | 2.67 | 2.65 | 2.31 | 2.30 |

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