Trend Labour Supply in Canada: Implications of Demographic Shifts and the Increasing Labour Force Attachment of Women

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- *Over the past 25 years, labour input growth has been driven by growth of the working-age population and a steady rise in the aggregate employment rate stemming from an increase in the labour market attachment of women.*
- *Looking ahead, growth of the working-age population is projected to slow substantially over the coming decades, owing to the cumulative impact of past declines in the national fertility rate.*
- *Our analysis suggests that the increased proportion of older individuals in the working-age population, whose average employment rates are lower than those of prime-age workers, is beginning to exert downward pressure on the aggregate trend employment rate.*
- *The aging of the baby boomers is projected to put downward pressure on labour input growth. Without an offsetting increase in labour productivity, this will imply lower potential output growth over the coming decades.*

Canada, like many industrialized countries, is approaching a demographic transition that will affect many aspects of the Canadian economic landscape, including the labour market. Over the next two years, the leading edge of the baby boomers (those born between 1946 and 1964) will reach 62 years of age, the average age of retirement in Canada. The baby boom generation has had a substantial impact on the demographic composition of the Canadian population over the past 60 years, and according to population projections this will continue to be the case over the next 40 years. Baby boomers' entry into the labour market in the 1960s and 1970s led to a significant increase in the percentage of those 15 to 64 years of age relative to the total population in Canada, as well as in the United States (Chart 1). The share of this age group subsequently stabilized in both countries but, according to United Nations projections, is expected to begin reversing itself in the next few years. This reversal is expected to be relatively larger in Canada than in the United States and suggests that in the future there will be fewer workers to meet the demand for goods and services from the total population. This development will put downward pressure on labour input growth[1] and, without an offsetting increase in labour productivity, will imply lower potential output growth over the coming decades.

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1. Labour input growth refers to the growth of total hours worked in the economy. This can be further decomposed into the growth of the working-age population, the change in the labour force employment rate, and the change in the average length of the workweek.

Since 1980, the growth in labour input has accounted for just over half of the growth of real gross domestic product (GDP) in Canada.[2] Most of this rise in labour input can be attributed to increases in the size of the working-age population and to an upward trend in the aggregate employment rate stemming from the strong increase in the labour force attachment of women. These two factors have been partly offset by a declining trend in average weekly hours worked. Both the employment rate and average weekly hours worked exhibit considerable variation over the business cycle. Therefore, to project future trends in labour input, it is essential to identify its underlying trend and the key variables that have determined its evolution over time.

Since 1980, trend labour input growth has been driven by the growth of the working-age population and a steady rise in the trend employment rate stemming from an increase in women's labour market attachment.

The Bank of Canada's main interest in identifying trend labour input is as an input into the calculation of potential output. Defined as the level of economic activity that the economy can produce on a sustained basis without adding to inflationary pressures, potential output has traditionally been constructed by combining an assumed path for trend labour input with an assumption for trend labour productivity. In turn, this measure is used to judge the current and projected amount of excess demand or supply in the economy, which is an input into monetary policy decisions.

The purpose of this article is to explain the methodology used by Bank staff to create its measure of trend labour input and to examine the likely impact on its profile over the next two decades, when Canada will be experiencing a dramatic demographic transition. The methodology used to construct our estimates over history is described first, followed by a presentation of a model-based projection. Possible risks surrounding

the base-case projection are then discussed. Finally, conclusions will be drawn.

Modelling and Constructing Trend Labour Input

Labour input, which is defined as total hours worked, is a function of three components: the size of the working-age population, the aggregate labour force employment rate, and the average number of weekly hours worked per employee. A trend estimate for each of these three components is required to construct a measure of trend labour input.
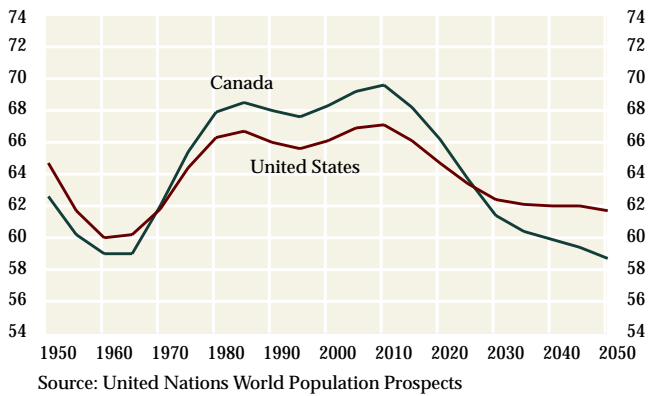
Working-age population

Since movements in the size of the working-age population occur slowly over time and do not appear to exhibit cyclical movements, it is assumed that trend population is simply equal to the actual size of the working-age population at each point in time. Growth of the working-age population has declined substantially since the early 1960s (Chart 2). After averaging growth of 2.4 per cent from 1961 to 1979, the 20-year period in which the full cohort of baby boomers first entered the labour market, growth of the working-age population subsequently fell and has only averaged 1.4 per cent since 1980, a full percentage point lower than the earlier period.

The other two components, the employment rate and average weekly hours worked, are modelled individually, using statistical models that attempt to separate the cyclical and trend factors affecting their respective movements over time. The employment rate and average weekly hours worked both exhibit procyclical behaviour, and it is important to control for these cyclical movements when attempting to identify their respective trends. In the remainder of this section, the methodologies used to estimate the trend employment rate and trend average weekly hours worked will be reviewed, the reasons for choosing the methodology will be explained, the estimation results reviewed, and the implications for our estimate of trend labour input discussed.
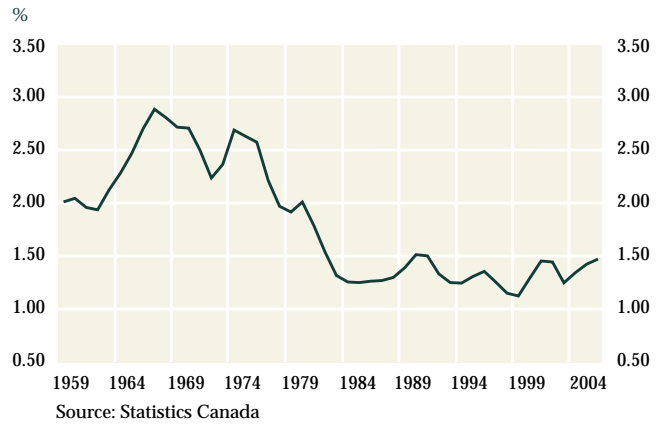
Labour force employment rate

The labour force employment rate has fluctuated substantially over the past three decades, rising during economic expansions and falling during downturns (Chart 3). Movements in the employment rate over the past 30 years have exhibited not only cyclical fluctuations, but an upward trend as well. The employment
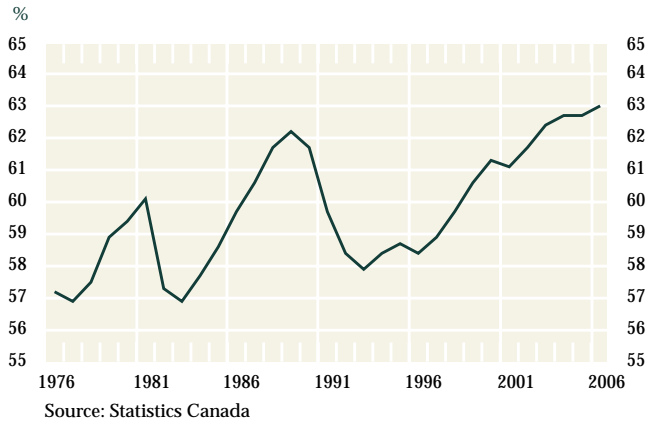
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2. In an accounting sense, real output growth can be divided between labour productivity growth and labour input growth.

Chart 1

Percentage of Total Population 15 to 64 years of age

Source: United Nations World Population Prospects

Chart 2

Working-Age Population Growth

Source: Statistics Canada

Chart 3

Aggregate Labour Force Employment Rate

Source: Statistics Canada

Chart 4

Labour Force Employment Rates for Men and Women

Source: Statistics Canada
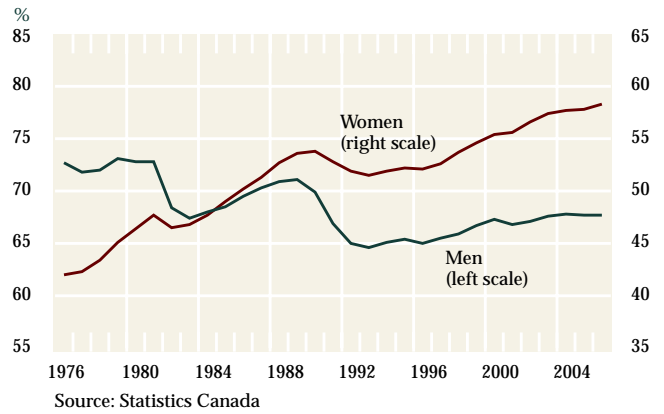
Chart 5

Age-Specific Employment Rates, 2006

Source: Statistics Canada
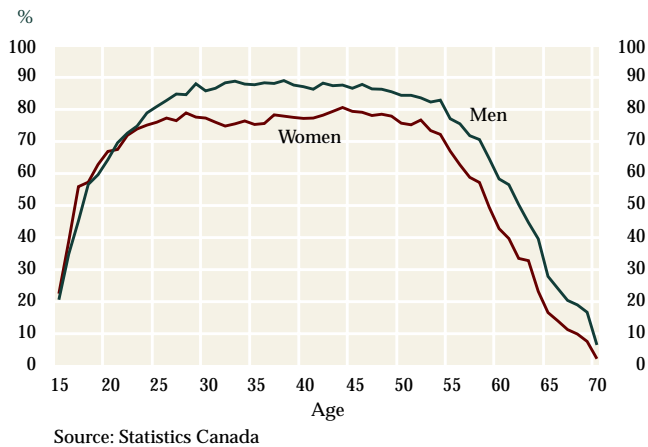
Chart 6

Birth-Cohort-Specific Employment Rates for Women, by Age, 1976–2006

Source: Statistics Canada
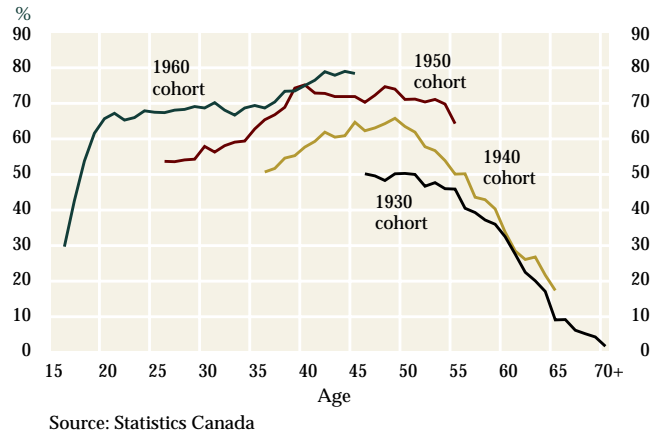
rate has risen by 5.8 percentage points since 1976, reaching a 31-year high of 63.0 per cent in 2006. This upward trend in the aggregate employment rate is mostly explained by the upward trend in the employment rates of women. Over the 1976–2006 period, the employment rate of men showed a mild downward trend, whereas that of women showed a strong upward trend (Chart 4).

Three factors are centrally important to modelling and projecting the trend aggregate employment rate: the shifts in the composition of the working-age population, the inverted-U-shaped lifetime employment rate profile, and the increasing labour force attachment of women over time. The first two factors interact with one another. If the composition of the population was constant over time, or if employment rates were the same at different ages, these two factors would be irrelevant. However, Canada has seen the demographic composition of its population change significantly over the past 30 years as the baby boomers have entered the labour force and moved through their working lives, and as life expectancies at birth have continued to improve. At the same time, labour force employment rates are not constant across age, as illustrated by the distinct inverted-U-shaped pattern across age (Chart 5). This pattern reflects the tendency of employment rates to be low, on average, in the early working years (15–24), when a sizable group of these individuals are still enrolled in educational institutions; to increase and stabilize in the prime working age (25–54); and, finally, to decline as people make the transition out of the labour market and into retirement. The pattern also suggests that the shifting distribution of the population has had, and will continue to have, a direct impact on the aggregate employment rate.

We observe several distinct upward shifts in the entire lifetime employment rate profiles of successive birth cohorts of women.

The third important factor is the significant increase in the labour force employment rate of women over the past half-century, which has led to a marked increase in the aggregate employment rate. While the profiles of the lifetime employment rates of men and women tend to have the same inverted-U shape across time, there have been several distinct upward shifts in the entire lifetime profiles of successive birth cohorts of women.[3] As illustrated in Chart 6, for a given age, the lifetime employment rate profile for women born in 1960 and 1950 lies above those of women born in 1940 and 1930. This upward shift in the lifetime employment rate profiles of successive birth cohorts likely reflects each generation of women's stronger labour force attachment than that of their mothers (Ip 1998). When attempting to explain the historical movements in the employment rate, it is therefore important to ensure that the model chosen is able to account, either explicitly or implicitly, for this phenomenon.

The labour force employment rate model

With these considerations in mind, we chose to model the employment rate using a cohort-based analysis, as described in Barnett et al. (2004). We chose a cohort model because it allows cyclical and structural factors to be taken into account while also measuring differences in the employment rate behaviour of individuals that relate directly to the year in which they were born, referred to as a cohort effect (Paquet, Sargent, and James 2000). The cohort effect will allow us to account for the upward shifts previously described. Our data set consists of single-year age (15–70 and over) and sex-specific annual employment rates from Statistics Canada's Labour Force Survey (LFS) over the 1976–2006 period. From this data set we are able to construct a total of 86 birth cohorts for men and women born in the years 1906 (the oldest cohort observed, i.e., 70 years old in 1976) through to 1991 (the youngest cohort observed, i.e., 15 years old in 2006).[4]

3. "Cohort" refers to people born in the *same year*. Individuals switch in and out of age groups from one year to the next, but they always remain members of the same birth cohort. This definition is identical to that used in Paquet, Sargent, and James (2000) and Barnett et al. (2004) and is similar to that of Beaudry and Lemieux (1999), who define their cohorts by an individual's year of entry into the labour force.

4. This methodology is quite similar to the work recently produced by the Board of Governors of the U.S. Federal Reserve (see Aaronson et al. 2006). The main difference between the two methodologies is that their analysis used five-year age groups to proxy individual birth cohorts when estimating their cohort model for the United States, whereas our data set consists of single-year birth cohorts.

The labour force employment rate (*LFER*) is modelled as a function of a cyclical labour demand variable, measured as the job-offer rate (*jor*),[5] and several structural factors, including: 11 age-related dummy variable (*age$_{k,j,t}$*),[6] the ratio of net wealth (adjusted for market prices) to nominal GDP (*wealth*), the real after-tax interest rate (*r*), a measure of employment insurance (*E.I.*) disincentives[7] (*eiindex*), and a birth-year cohort effect for women (α_j, where *j* denotes a cohort's birth year).[8] The model is estimated as a system of equations in the following log-linear form:

$$\overline{LFER}_{j,t} = \alpha_j + \Psi \times LFER_{j,t-1} + \beta_k \times age_{k,j,t} + \vartheta_l \times$$

$$wealth_t \times age_{l,j,t} + \zeta_l \times jor_t \times age_{l,j,t} + \gamma_l \times r_t \times$$

$$age_{l,j,t} + \delta_l \times eiindex_t \times age_{l,j,t},$$

where: *j* = 1911, 1912,…, 1986; *k* = 1, 2,…, 11; *l* = 1, 2,…, 12; *t* = 1977, 1978,…, 2006; $\overline{LFER}_{j,t} = -\log\left(\dfrac{100}{LFER_{j,t}} - 1\right)$.

The model is estimated over the 1977–2006 period for all cohorts with at least five observations. The model also includes a lagged dependent variable to account for the direct impact that an individual's previous labour market experience will likely have on their decision to engage in labour market activities today. With the exception of the birth-cohort effect and the lagged dependent variable, all the explanatory variables interact with 12 age-related dummy variable (*age$_{l,j,t}$*)[9] to

allow for their varied impacts over an individual's life cycle. The employment rates are estimated for each birth cohort and then aggregated using their respective shares of the working-age population, which will ensure that we capture any impact on the aggregate employment rate caused by shifts in the composition of the workforce.
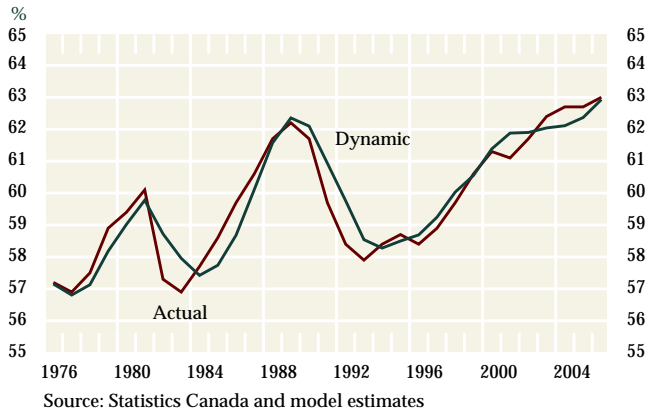
Results

Before attempting to isolate the trend employment rate, we perform a dynamic simulation with the model, including both the demand and supply components, to examine the model's empirical performance. The results show that the model is able to do a reasonably good job of tracking the general upward trend, as well as the business cycle movements, in the labour force employment rate (Chart 7).[10] In general, movements in labour demand as measured by the job-offer rate appear to drive the majority of the large swings in the employment rate. The upward trend, on the other hand, is mainly explained by an upward trend in the female cohort effect discussed earlier.

Between 1990 and 1996, the aggregate employment rate declined by 3.2 percentage points, with the employment rates of men and women falling by 4.9 and 1.7 percentage points, respectively. Our model attributes most of this drop to a steep decline in labour demand, which had a particularly strong impact on men. The model also estimates that increases in net wealth were putting downward pressure on the employment rate over this period, but that this pressure was entirely offset by a decline in the E.I. index, which was pushing up the employment rates of both men and women. As well, the shifting demographic composition of the labour force had a small negative impact on the aggregate employment rate over this period. Finally, the negative impact coming from the decline in labour demand was partially offset by the cohort effect of women which, all else being equal, would have raised the aggregate employment rate by 1.3 percentage points over this period.
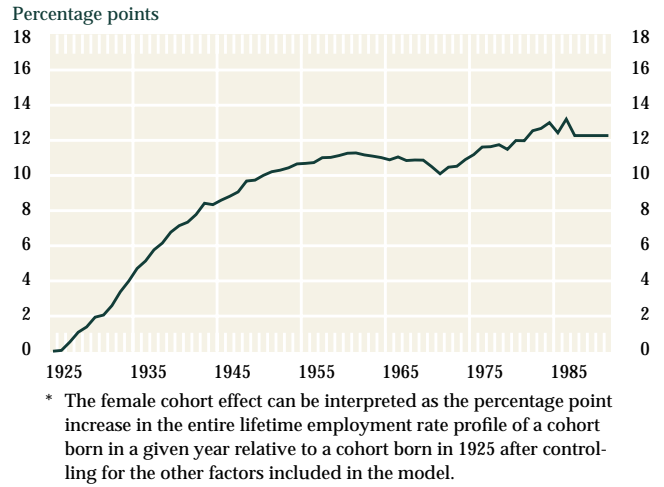
From 1996 to 2001, the aggregate employment rate rebounded from its 1996 trough, increasing by 2.7 percentage points, and therefore offsetting most of the decline observed over the previous six years. The model attributes the increase in the employment rate over this period to three main factors. First, the female

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5. From 1976 to 2002, the job-offer rate is defined as the ratio of the help-wanted index to the size of the working-age population. From 2003 to 2006, the job-offer rate was extended, using the percentage of firms who reported having a shortage of skilled or unskilled labour in the Business Conditions Survey published by Statistics Canada. The job-offer rate was used as the measure of cyclical labour demand for a couple of reasons. First, it would be inappropriate to include as a measure of labour demand a variable, such as GDP growth, that is endogenously driven by employment. Second, as noted in Fortin and Fortin (1999), Archambault and Fortin (1997) find that the help-wanted index is a good instrument of labour demand, since it is highly correlated with the probability of finding a job but appears to be insensitive to labour-supply shocks.

6. Where *k* denotes in which of the following age groups a cohort *j* is at time *t*: 15–17, 18–19, 20–24, 25–29, 45–54, 55–59, 60–62, 63–64, 65–66, 67–69, and 70 and over. The age dummies are measured relative to workers 30 to 44 years of age.

7. For a more detailed description, see Sargent (1995).

8. For men, differences in effect across cohorts were not statistically significant and were therefore excluded.

9. Where *l* denotes in which of the following age groups a cohort *j* is at time *t*: 15–17, 18–19, 20–24, 25–29, 30–44, 45–54, 55–59, 60–62, 63–64, 65–66, 67–69, and 70 and over.

10. The term "dynamic" is used to highlight that the results shown in Chart 7 are obtained with a simulation starting in 1977, using the estimated employment rate of cohort *j* in period *t*–1 to produce the employment rate in period *t*.
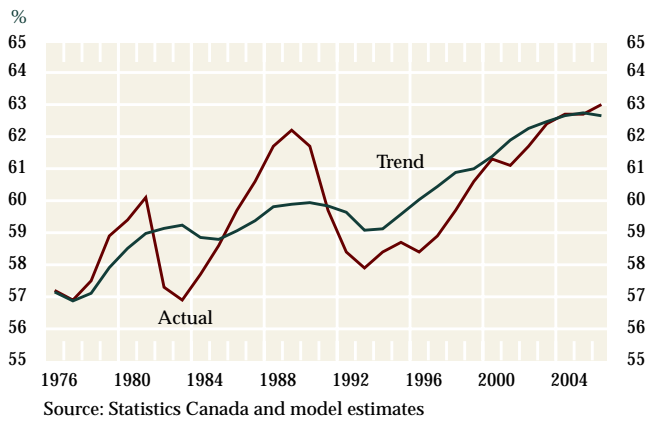
Chart 7

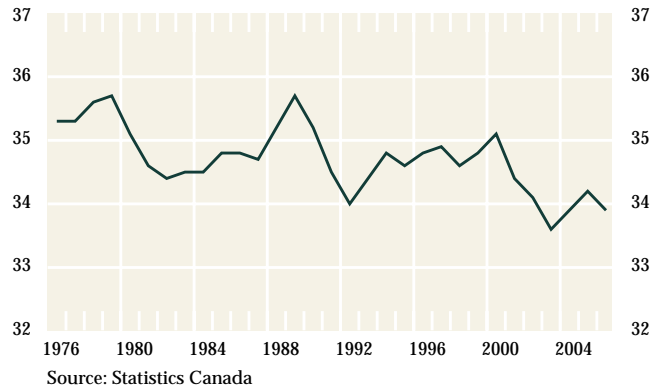**The Employment Rate: Dynamic Simulation Results**

%

Dynamic

Actual

Source: Statistics Canada and model estimates

Chart 8

Estimated Cohort Effects for Women (relative to a 1925 cohort)*

Percentage points

* The female cohort effect can be interpreted as the percentage point increase in the entire lifetime employment rate profile of a cohort born in a given year relative to a cohort born in 1925 after controlling for the other factors included in the model.

Chart 9

Actual and Trend Employment Rate

%

Trend

Actual

Source: Statistics Canada and model estimates

Chart 10

Average Weekly Hours Worked

Source: Statistics Canada

Chart 11

Average Weekly Hours Worked: Dynamic Simulation Results

Dynamic

Actual

Source: Statistics Canada and model estimates
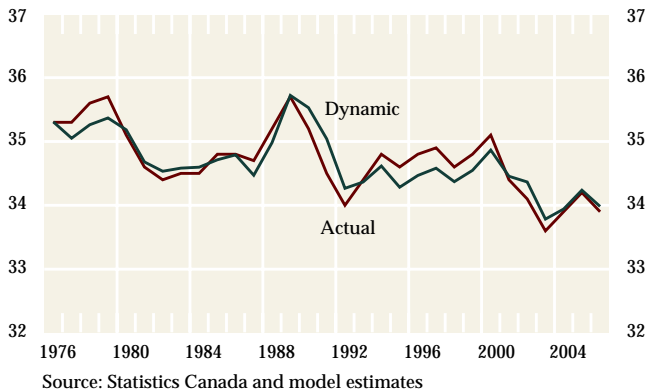
Chart 12

Actual and Trend Average Weekly Hours Worked

Actual

Trend

Source: Statistics Canada and model estimates
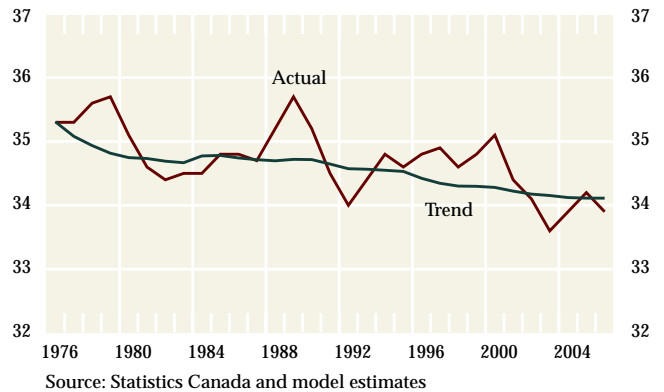
cohort effect continued to push up the aggregate employment rate, adding approximately 0.2 and 0.4 percentage points per year to the aggregate and female employment rates, respectively. Second, labour demand increased each year over this period, with the exception of 2001. Third, reforms to the E.I. system in the mid-1990s, which reduced the system's generosity, were also pushing up the employment rate. These positive pressures were only partially offset by the downward pressure from the continued increases in net wealth.

Finally, since 2001, the aggregate employment rate has risen a further 1.8 percentage points, to reach its highest annual level in 31 years. The female cohort pushed up the employment rate of older workers (55+) as well as contributing to the rise in the aggregate employment rate. Further strengthening in labour demand also contributed to the increase in the employment rate, particularly in 2005 and 2006. Income effects continued to push the employment rate down, although by a much smaller amount than in the previous two periods, owing to the bursting of the stock market bubble in 2000–01 and declines in real after-tax interest rates. Lastly, the changing composition of the working-age population has also put mild downward pressure on the aggregate employment rate.

The observed levelling off in the cohort effect means that most of the positive boost to the aggregate employment rate coming from the female cohort effect will be exhausted within the next 15 years.

Of particular interest is the shape and size of the cohort effect for women. Our estimates suggest that it trended upwards for cohorts born over the 1920s to the 1950s and began to level off for cohorts born after 1955 (Chart 8). The shape of the female cohort effect likely reflects several factors, including: changing views of women's role in society, reductions in workplace discrimination, higher levels of educational attainment, and greater availability of contraception and child-care services. The observed levelling off in the cohort effect means that most of the positive boost to the aggregate employment rate coming from the female cohort effect will be exhausted within the next 15 years.

Calculating the trend employment rate

Our trend estimate of the aggregate employment rate is constructed over history by performing a dynamic simulation of the model, with the cyclical labour demand variable set equal to its assumed trend value and the remaining explanatory variables set at their actual values. Our trend estimate of the employment rate has been increasing for most of the past three decades (Chart 9), largely because of the female cohort effect. According to our estimates, the employment rate was just above its trend in 2006.

Labour force average weekly hours worked

We now turn our attention to the last component of trend labour input, the amount of time that individuals spend at work, on average, during a typical week. Aggregate labour force average weekly hours worked has been on a downward trend over the past 30 years (Chart 10). Unlike the employment rate, the raw data do not suggest that there have been any discernible cohort effects for either men or women with respect to average hours worked. Examining the data by disaggregated age groups, on the other hand, shows that youth, defined as those 15 to 24 year of age, are the only age group to show a significant downward trend in the number of average hours worked. For the remaining age groups, the average hours worked have remained relatively stable over the past 30 years.

Modelling average weekly hours worked

We chose to model average weekly hours worked by age and sex using a fixed-effects[11] model, based on Hazel (2006). This framework makes it possible to control for differences in average hours worked relating exclusively to age. Examining the disaggregated age groups, for example, we notice that older workers (55 and over) worked approximately two fewer hours, on average, than prime-age workers (25–54). This disparity could reflect several factors, such as: older workers assigning greater value to leisure time, a greater number of missed work days for health reasons, or simply that older workers typically have more seniority and additional vacation days. Regardless of why older workers have lower average hours worked, the advantage of our framework is that it allows us to control for these differences, after accounting for other cyclical and structural factors. The data set used to

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11. Fixed effects refers to a panel-data estimation procedure that assumes that differences across the dependent variables can be captured by differences in the constant terms, once we have controlled for all the other observable variables.

estimate the average weekly hours worked consists of single-year age- (15–70 and over) and sex-specific annual average hours worked at all jobs from the LFS over the 1976–2006 period. Average weekly hours worked (*HAW*) are modelled as a function of lagged hours, the job-offer rate (*jor*), the real after-tax interest rate (*r*), the annual LFS seasonal adjustment factor on hours worked (*seasonal*), and the sex-specific full-time school enrolment rates (*school*).[12]

$$\overline{HAW}_{j,t} = \alpha_j + \psi_l \times HAW_{j,t-1} \times age_{l,j,t} + \xi_l$$

$$\times jor_t \times age_{l,j,t} + \vartheta_l \times seasonal_t \times age_{l,j,t}$$

$$+ \gamma_l \times r_t \times age_{l,j,t} + \delta \times school_t \times age_{15-24,j,t},$$

where: $j = 15, 16, \ldots, 70$ and over; $l = 1, 2, \ldots, 5$; $t = 1977, 1978, \ldots, 2006$.

All the explanatory variables interact with five age dummies ($age_{l,j,t}$)[13], with the exception of the school enrolment rate, which is only included for the 15 to 24-year-old age group. Average hours worked are estimated for each age (denoted by j) and sex, and then aggregated using their respective shares of the employed population.

Results

The dynamic simulation results indicate that the model is able to track the majority of the movements in aggregate average hours worked (Chart 11). Two key factors appear to explain the decline in average hours worked in the early part of the sample. First, average weekly hours worked by youth (males and females) shows a downward trend until the mid-1990s. The model attributes this mainly to an upward trend in the school enrolment rates which, from 1980 to 1997, increased by 16.9 and 21.2 percentage points for men and women, respectively. The negative effect from this trend has eased somewhat in recent years, since school enrolment rates of females have remained fairly stable since 1997, while those of males have given back some of their earlier increase. Second, women's share of employment rose substantially

between 1976 and 1992, increasing from 37.1 to 45.3 per cent of total employment. Because women work fewer paid hours on average than their male counterparts, this shift in the composition of employment put downward pressure on aggregate average weekly hours worked. Since 1992, this composition effect has continued to put downward pressure on average hours worked, but to a much smaller degree than in the past. Between 1992 and 2006, the employment share of women continued to rise, increasing by 0.1 per cent per year, on average, compared with 0.5 per cent in the earlier period. As noted previously, average weekly hours worked for most of the other age groups have remained relatively stable over the past 30 years.

Calculating trend average weekly hours worked

Our trend estimate of the average weekly hours worked by age and sex is constructed over history by performing a dynamic simulation of the model, after setting the cyclical variable and the seasonal factors at their assumed trend levels, and the remaining explanatory variables at their actual values. The aggregate series is then calculated by multiplying the age- and sex-specific trend average hours worked series by their respective shares of trend labour force employment.[14] Our trend estimate of average hours worked has been declining since 1976, which, as noted before, can be attributed to the increasing employment share of women and a fall in the average hours of youth, owing to an increasing trend towards school enrolment (Chart 12).

Constructing trend labour input

The estimated trends for the employment rate and average hours worked are now combined with the actual labour force source population to construct our measure of trend labour input. Since 1980, trend labour input is estimated to have grown, on average, by 1.6 per cent (Chart 13). Of this growth, 1.4 percentage points are attributable to growth in the working-age population. The upward trend in the labour force employment rate contributed, on average, 0.3 percentage points over the same period, while the downward trend in average hours worked subtracted about 0.1 percentage points.
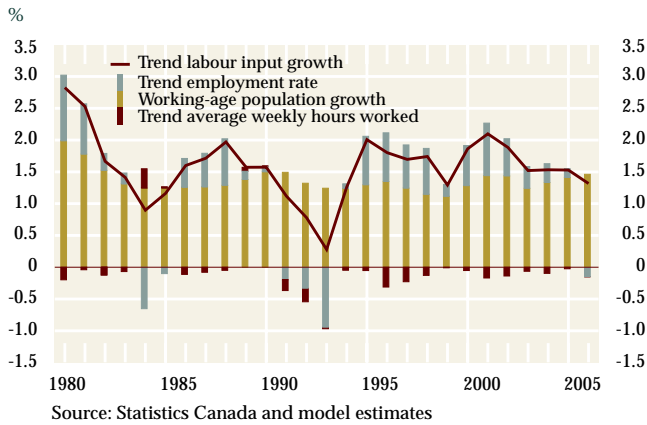
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12. The annual LFS seasonal factor for total hours worked (main job) is included to account for movements in the reference week that lead to excessive volatility in the unadjusted hours series.

13. Where *l* denotes the following age groups: 15–24, 25–54, 55–59, 60–64, and 65 and over.
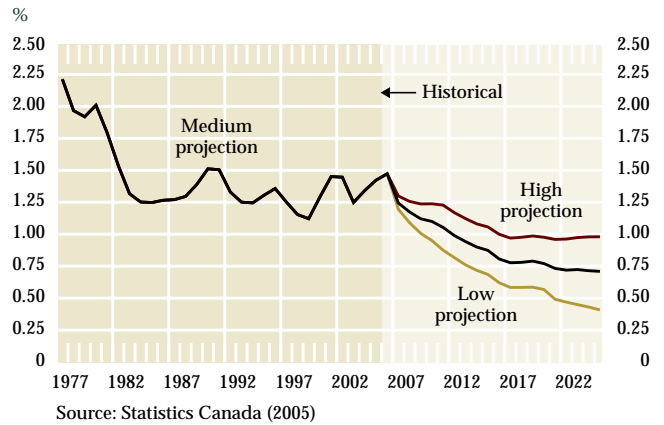
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14. Trend labour force employment is calculated using the age and sex-specific trend employment rates estimated in the previous section and the age- and sex-specific population.
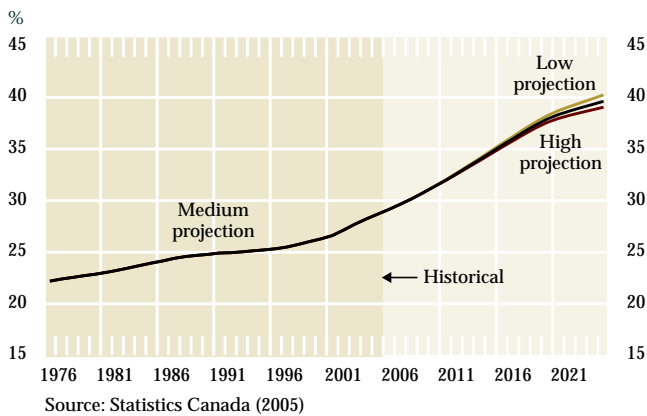
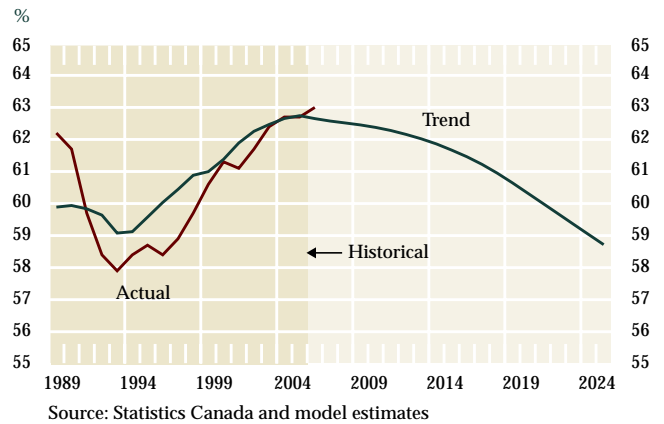**Chart 13**

Decomposing the Growth in Trend Labour Input

%

Legend:
— Trend labour input growth
Trend employment rate
Working-age population growth
Trend average weekly hours worked

Source: Statistics Canada and model estimates

Chart 14

Growth of the Working-Age Population

%

Historical

Medium projection

High projection

Low projection

Source: Statistics Canada (2005)

Chart 15

Older Workers' Share of the Working-Age Population

%

Low projection

High projection

Medium projection

← Historical

Source: Statistics Canada (2005)

Chart 16

Trend Employment Rate

%

Trend

← Historical

Actual

Source: Statistics Canada and model estimates

Chart 17

Trend Employment Rate of Women 55 and Over

%

Trend

← Historical

Actual

Source: Statistics Canada and model estimates
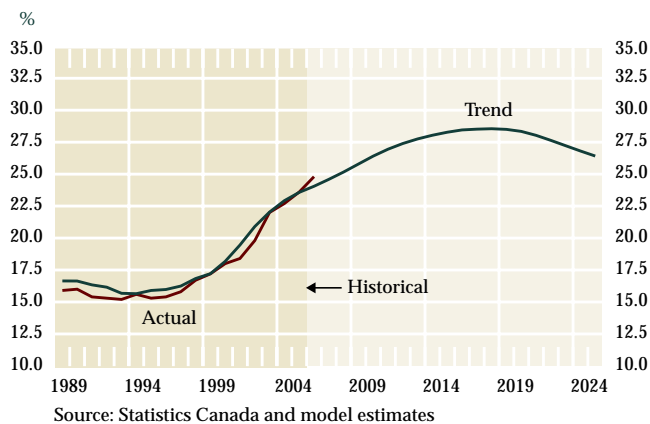
Prospects for Trend Labour Input

The working-age population

Statistics Canada's medium population projection scenario (discussed below) is used to project the size and composition of the working-age population. The population projection is driven by three key assumptions on the national fertility rate, life expectancy at birth, and the net migration rate. The fertility rate in Canada, like that for most industrialized countries, has been declining since the 1960s. The total fertility rate in Canada was close to 4 children per woman in 1960, but has declined in almost every year since, reaching 1.5 children per woman in 2002 (Statistics Canada 2005). Statistics Canada's medium scenario assumes that the fertility rate will remain near its current level of 1.5 births per woman, well below the replacement rate of 2.1 births per woman. As for the second assumption, life expectancies at birth have significantly improved over the past three decades, rising from 69.3 and 76.3 years in 1970 to 77.2 and 82.2 years in 2002, for men and women, respectively. Statistics Canada's medium scenario assumes that this trend will continue over the next three decades, with male and female life expectancies at birth reaching 81.9 and 86.0 years in 2031, respectively. Finally, the most difficult component to project is net migration, since it is strongly influenced by a country's national immigration policies. In the medium scenario, Statistics Canada projects the number of immigrants to Canada by assuming a fixed immigration rate of 7.0 per 1,000, which allows the level of immigration to grow in line with total population growth. Emigration is also projected, using a fixed emigration rate of 1.5 per 1,000, based on average emigration rates by age, sex, and province observed over the past five years (Statistics Canada 2005). These assumptions are combined to construct a population projection which suggests that growth in the working-age population will slow significantly in the next few decades.

Estimates of the size and composition of the population should be fairly reliable, at least in the near term, since they are essentially embedded in the current structure of the population. That does not mean, however, that the projections are flawless, since they still depend on the assumptions described above. For this reason, Statistics Canada constructs a range of scenarios that consider two alternative assumptions, one high and one low, for each of the key factors (specifically the fertility rate, life expectancy at birth, and the immigra-

Table 1

Assumptions for Statistics Canada's Population Projections

	Assumptions		
	Low	Medium	High
Fertility	1.3 children per woman	1.5 children per woman	1.7 children per woman
Life expectancy			
Men (in 2031)	81.1 years	81.9 years	82.6 years
Women (in 2031)	85.3 years	86.0 years	86.6 years
Immigration rate	5.5 per 1,000	7.0 per 1,000	8.5 per 1,000
Emigration rate	1.5 per 1,000	1.5 per 1,000	1.5 per 1,000

tion rate). A total of 27 scenarios can be constructed using different combinations of these alternative assumptions. Three scenarios are presented in Table 1, labelled as low, medium, and high scenarios. The medium scenario is our base-case profile, whereas the high (low) scenario combines all the highest (lowest) assumptions.[15] All three scenarios project the size of the working-age population and the age distribution.[16]

In all three scenarios, growth of the working-age population is expected to slow considerably over the next decade, falling from 1.5 per cent in 2006 to 1.0, 0.7, and 0.4 per cent by 2025 in the high, medium, and low scenarios, respectively (Chart 14). Since the growth in trend labour input is mainly driven by population growth, this decline will have an important effect on our projection.

Labour force employment rate

The second component of trend labour input, the trend aggregate labour force employment rate, is also expected to change substantially over the next three decades. The trend employment rate is constructed using the cohort model discussed above, after setting some long-run assumptions for the structural variables. Specifically, the cohort effect of females is estimated to have stabilized for cohorts born after 1955; the ratio of net wealth to nominal GDP is expected to stabilize

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15. If the alternative assumptions selected are believed to adequately capture the uncertainty surrounding these factors, then the high and low scenarios can be viewed as the high and low confidence bands surrounding the base-case scenario.

16. For more details, see Statistics Canada (2005).

at its average value observed over the 1997–2006 period; and the real after-tax interest rate is expected to return to a stable long-run value.

Outside the model, an equally important development embedded in all three population scenarios is the projected shift in the composition of the working-age population. The average age of this population is projected to increase significantly over the next 20 years as the share of older workers (55 and over) is projected to rise in all three scenarios (Chart 15). While there has been an upward trend in the share of older workers for some time, the pace of the increase is expected to pick up considerably over the next decade. While the share of older workers increased by seven percentage points over the past three decades, rising from roughly 22 per cent in 1976 to around 29 per cent in 2006, the aging of the baby boomers is projected in all three scenarios to lead to a seven percentage point increase in only 11 or 12 years. This development is expected to have a significant impact on the aggregate trend employment rate over the next 20 years.

The aggregate employment rate is projected to reverse the trend observed over the past 30 years and is expected to decline over the next two decades as older workers become an increasingly larger share of the working-age population.

At the aggregate level, the employment rate is projected to reverse the trend observed over the past 30 years and is expected to decline over the next two decades as older workers, whose employment rates are on average lower than those of prime-age workers, become an increasingly larger share of the working-age population (Chart 16). This downward trend occurs despite the projection that the employment rates of women 55 and over will continue to rise over the next 10 years as cohorts with stronger attachment to the labour force than their predecessors enter this age group (Chart 17).

Labour force average weekly hours worked

Third, the projection for trend labour force average weekly hours worked is constructed in much the same way as the employment rate, but with the fixed-effects hours model discussed above. The profiles for the explanatory variables included in both models are identical to the assumptions used for the trend employment rate. The other variable, the school enrolment rate, is projected to remain at its current level. Like the employment rate, aggregate average weekly hours worked is also affected by the age distribution of the population. The impact from the aging of the population on average weekly hours worked is quite small, however, and is expected to cause a mild downward trend over the projection horizon as older workers, who work fewer hours on average, become a greater share of the employed (Chart 18).
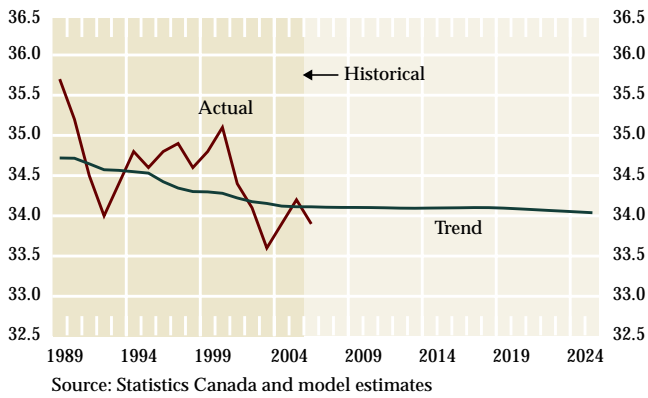
Growth of trend labour input

Using the above models, trend labour input growth is projected to contribute considerably less to potential output growth over the next two decades than it has in the past, regardless of which population projection is used (Chart 19). In the medium scenario, labour input growth is projected to fall from 1.3 per cent in 2006 to 1.0 and 0.6 per cent in 2010 and 2015, respectively. This is considerably weaker than the 1.5 per cent growth observed, on average, over the 1980–2006 period. The slowdown in trend labour input becomes especially evident from 2011 to 2020, as population growth continues to slow and the decline in the employment rate accelerates (Chart 20). Over this period, the contributions to trend labour input growth from population growth and the employment rate are expected to fall by 0.3 and 0.4 percentage points, respectively. Growth of the working-age population is projected to fal1 from 1.1 per cent in 2010 to 0.8 per cent in 2020, while the employment rate is expected to fall by 0.2 percentage points per year, on average, over the same period.
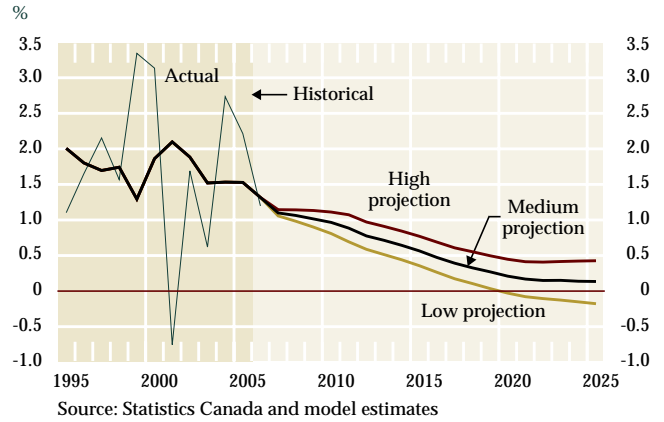
Risks Surrounding the Base-Case Scenario

The projection presented in the previous section is a model-based projection and could be subject to a number of risks. In particular, the projection relies on a presumed path for a number of explanatory variables, the evolution of which could turn out to be different than we have assumed in our base-case scenario. This poses both upside and downside risks to our projection.
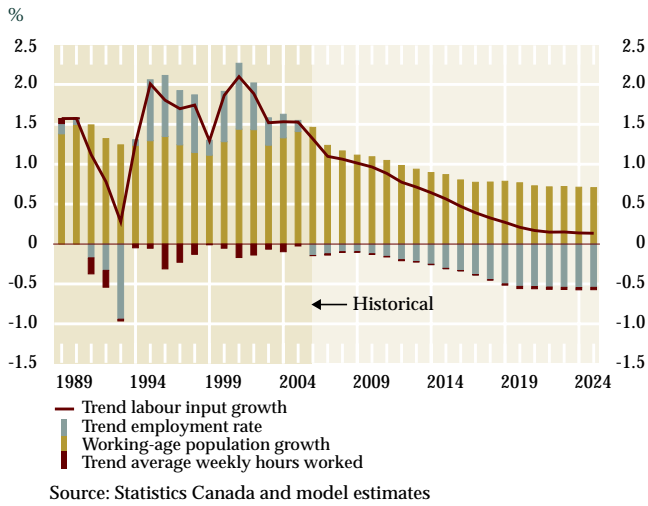
Chart 18

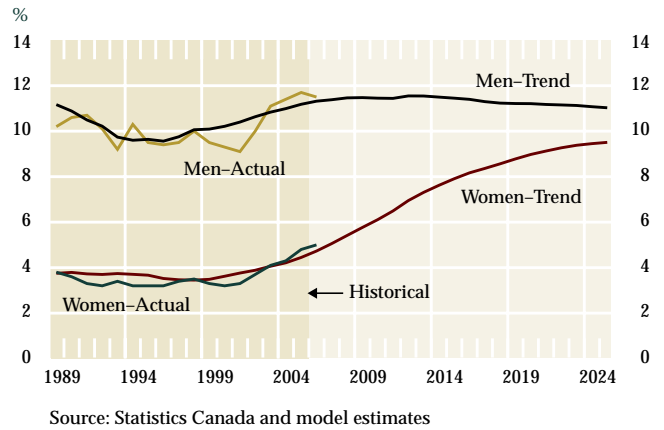**Trend Average Weekly Hours Worked**

Source: Statistics Canada and model estimates

Chart 19

Trend Labour Input Growth Using Alternative Population Projections

%

Source: Statistics Canada and model estimates

Chart 20

Decomposing the Growth in Trend Labour Input

%

— Trend labour input growth
Trend employment rate
Working-age population growth
Trend average weekly hours worked

Source: Statistics Canada and model estimates

Chart 21

Trend Employment Rates of Men and Women 65 and Over

%

Source: Statistics Canada and model estimates

Chart 22

Men: Employment Rates by Educational Attainment

%

Source: Statistics Canada
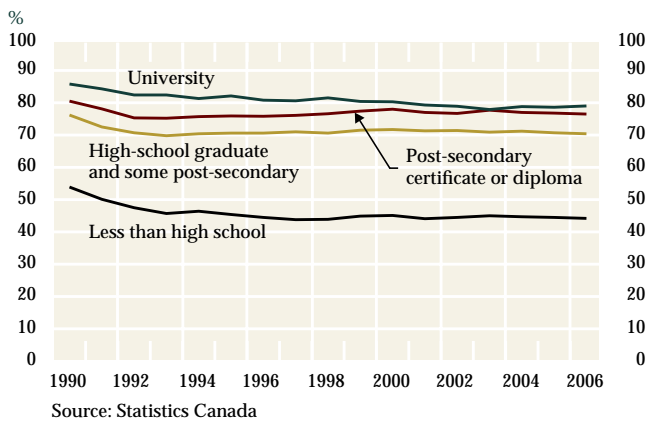
Chart 23

Women: Employment Rates by Educational Attainment

%

Source: Statistics Canada
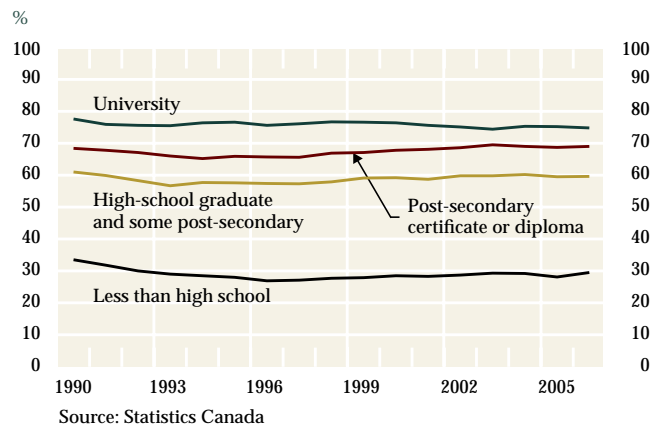
For example, our base-case scenario assumes that the ratio of net wealth to nominal GDP will stabilize over the projection horizon. However, should net wealth continue to increase as it has over the past number of years, our model suggests that individuals would consume more leisure by reducing the amount they work, which would lower the aggregate employment rate.

Apart from the future path of the explanatory variables, there are several other factors that could help to delay or partially offset some of the projected decline in the employment rate. These factors are not accounted for in this analysis, given their speculative nature and the difficulty in quantifying their respective magnitudes. First, continued improvements in health status and life expectancies could raise the employment rates of older workers. Second, as the pool of labour shrinks, employers and governments may remove barriers to continued labour force participation. From the employers' side, this could mean increased workplace flexibility or changes to the structure of existing pension plans that create large disincentives to remain with an organization past a particular age. Governments have already begun to address some of the barriers to continued labour market participation. Ontario, for example, followed the lead of several other provinces and passed legislation in 2006 that essentially made mandatory retirement illegal. The government might also examine the work disincentives currently built into Canada's income-security system, which have a significant effect on the retirement decisions of both men and women (Baker, Gruber, and Milligan 2003).

*Several other factors could help
to delay or partially offset some
of the projected decline in
the employment rate.*

Third, our cohort model treats the employment rates of men and women separately. There is evidence, however, that retirement decisions are in fact made jointly. For example, Schirle (2007) finds that wives' participation has a significant and positive impact on the participation rate of older husbands, suggesting a leisure complementarity that our model does not

explicitly capture. This poses an upside risk to our base-case scenario, since we project that the employment rates of older men will remain relatively stable, while those of older women will continue to rise over the next couple of decades as cohorts with stronger labour force attachment than their predecessors reach the conventional retirement age (Chart 21). However, even if we used the extreme assumption that the projected increase in the employment rates of older women would affect their male counterparts one-for-one, this would still not be sufficient to keep the aggregate employment rate from falling in the future, although it would alleviate the downward pressure over the next five to seven years.

Fourth, the average educational attainment of the population, or perhaps, more importantly, the nature of work, has changed significantly over the past 30 years. Continued improvements in educational attainment might raise the aggregate employment rate in the future, since employment rates are greater for higher levels of educational attainment (Charts 22 and 23). At the same time, the economy has become increasingly service based, where jobs are less physically demanding than in the past. This shift towards a knowledge-based economy has likely enabled workers to remain in the labour market longer. If this poses a risk to our projection, it is probably less important for women than for men, since these factors are likely at least partially captured by the female cohort effect.

Finally, the analysis presented above was not conducted in a full general-equilibrium framework. In such a framework, the reduction in labour supply would likely push up the real wage and create an incentive for a greater number of younger workers to enter the labour force and for older workers to delay their retirement.

Conclusions

Trend labour input growth has accounted for about half of real output growth over the past 25 years. Since 1980, trend labour input growth has been driven by the growth of the working-age population and a steady rise in the trend employment rate stemming from an increase in women's labour market attachment. Population growth is expected to slow significantly over the next 20 years, and the trend employment rate is projected to decline as older workers become an increasingly greater share of the working-age population. Together, these two factors suggest that trend labour input growth will fall markedly over the next two

decades, which, without an offsetting increase in labour productivity, will imply a lower growth rate of potential output.

> *As the pool of labour shrinks, firms will have a greater incentive to find ways of improving labour productivity.*

The model-based projection presented in this article implicitly assumes that employer and government policies will remain unchanged in the future. Yet the good news is that the aging of the baby boomers is a well-documented and understood phenomenon that will occur slowly over the next few decades. In turn, employers and governments will likely look for ways to address barriers to continued labour force participation, which might help to alleviate some of the labour market pressure generated by this impending demographic transition. As well, as the pool of labour shrinks, firms will have a greater incentive to find ways of improving labour productivity, whether through greater capital deepening or modifying their business practices. Together, these possible initiatives on the part of employers and governments will likely dampen the impact on future potential output growth.

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