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Long-Run Inequality and Annual Instability of Men's and Women's Earnings in Canada

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1. Introduction

Canada's labour market in the 1980s and 1990s was subject to transformations such as increasing integration with the US economy and shifting trade flows, the rapidly advancing state of information technology, shifting modes and organization of production such as 'out-sourcing' and non-standard work patterns, fluctuating prices for natural resources and marked changes in the Canadian exchange rates, highly uneven regional growth rates, increasing competition and workers vulnerability, and high inflows of immigrants. On the macroeconomic level, the economy recovered slowly from the severe recession of the early 1990s, as the unemployment rate was persistently high until the late 1990s. These developments might well be expected to have an impact on the distribution of labour market earnings across workers.

This paper examines the variability of workers' earnings in Canada over the period 1982-2000 in a graphical non-structural approach using a large representative longitudinal administrative database. Following a methodology from Gottschalk and Moffit (1994), we decompose the total variance of workers' earnings over this period into a "permanent" or long-run component between workers and a transitory or year-to-year earnings instability component over time for given workers. The novel methodological extension of this paper is that this decomposition is applied to a five-year moving window of earnings, so that we can examine (graphically and through regression techniques) how total earnings variation and its two components have changed over these two recent decades in a quite flexible non-structural fashion. We report results separately for men and women and for four separate age groups of workers. The flexible moving feature of the structure of our data set also permits an examination of how the earnings variance components vary with the macroeconomic indicators, the unemployment rate and the real GDP growth rate over this period.

Understanding the patterns of long-run earnings differences across workers and their year-to-year earnings instability is of economic and policy interest. Long-run earnings differentials across workers are related to lifetime earnings patterns and are affected by factors such as human capital attainment and skill levels, long-run labour force attachment and work patterns, evolving industry/occupational mix in the economy, and shifting returns to skills and cohort effects which speak to issues involving skill, job matching, access to training and efficient usage of human capital. Year-to-year changes reflecting earnings instability are a result of more transitional factors such as unemployment and workplace restructuring, contingent and non-standard employment relationships, volatile primary good prices and changing occupational demand patterns, and volatility in firm performance. They focus policy attention more on issues such as social insurance, improving the flow and quality of labour market information, and macroeconomic policy. Decomposing overall inequality changes into more permanent and short-run sources also allows one to better interpret and test alternative explanations for observed outcomes.

Strictly cross-sectional analyses have shown that earnings inequality increased significantly in Canada in the later 1980s and over the 1990s (eg., Beach and Slotsve, 1996; Burbidge, Magee and Robb, 1997; Frenette et. al., 2004; Heisz et. al., 2002; Johnson and Kuhn, 2004; Picot, 1997; Richardson, 1997; and Wolfson and Murphy, 1998). This development is reflected in Figure 1 which illustrates how total variance of workers' earnings – explained in more formal detail below[1] – did indeed increase over this period (the horizontal axis representing a moving five-year window from the 1982-1986 interval to the 1996-2000 interval). But looking at a moving time series shows that this overall increase was not at all monotonic, and there were indeed quite different patterns (outside the 1986-1990 to 1991-1995 period) occurring for

women and men. There is evidently a major cyclical aspect to the patterns as well. Furthermore, Figures 2 and 3 highlight that the transitory and long-run components – again described in more detail below – are contributing in quite different ways to the total variance increase. Long-run earnings differentials (Figure 3) have largely increased – especially for men – while earnings instability (Figure 2) has largely decreased – most markedly among women in the labour market. One interesting finding is that long-run earnings inequality for men decreased over the growth period of the 1980s, but then increased over the growth period of the 1990s. The primary objective of this paper is to examine and try to explain these (and more detailed age-specific) patterns of earnings variation changes for Canada.

In terms of both scope and methodology, the current paper builds on our previous work. Beach, Finnie, and Gray (2003) laid out the background for estimation of the variation in earnings and the decomposition process, and showed a structural shift in the variance measure between the 1980s and 1990s. Beach, Finnie and Gray (2005) incorporated a regional dimension along with a temporal shift (1982-1989 vs 1990-1997) and used multivariate analysis to identify business cycle effects on the measures of earnings variance between the two periods and across geographical regions. The present paper extends the latter analysis methodologically by incorporating a moving-average measure of permanent earnings within the Gottschalk-Moffitt decomposition approach. This allows one to calculate a time series of variance components and thus to analyse detailed year-to-year changes in these variance measures both graphically and by regression techniques. Macroeconomic effects can thus be estimated directly rather than inferred indirectly from regional differences in macroeconomic performance. The current analysis also extends up to 2000 and brings in the further richness of age and gender differences in the time series patterns.

The next section of this paper contains a brief survey of the relevant literature. Section 3 then sets out the analytical framework, and Section 4 outlines the data set employed and the main characteristics of the estimation samples. Section 5 presents sets of graphical results on time-series patterns of long-run earnings inequality and year-to-year earnings instability. A regression analysis of underlying trends and macroeconomic effects occurs in Section 6. The major findings are then reviewed and highlighted in the concluding section.

2. Review of the Literature

Based on the US Panel Study of Income Dynamics (PSID), Gottschalk and Moffitt (1994) found that both a growing instability of earnings and a widening dispersion of permanent earnings (of white male workers) contributed to the increasing degree of wage inequality which occurred between the late 1970s and the 1980s, although the latter element was about twice as large. Using a different methodology applied to the same data set, Haider (2001) found that the transitory component increased during the 1970s, while the variation in permanent earnings increased substantially during the early 1980s among US males. He determines that the persistent variation is only mildly counter-cyclical, while earnings instability is strongly counter-cyclical. In an updated study drawing from the PSID employing a different methodology, Moffitt and Gottschalk (2002) discern a secular rise in the permanent component until 1997, and a rather dramatic increase in the transitory component during the 1980s, followed by a decline after 1991.

The Canadian literature on earnings variability is fairly sparse, largely due to (until recently) a lack of longitudinal data that are required for analysis of earnings dynamics. Consequently, the only existing work is based on administrative data files.[2] Baker and Solon

(2003) and Morissette and Ostrovsky (2005) are the closest Canadian work involving the decomposition of earnings variation. Baker and Solon (2003) employ data merged from the Canada Customs and Revenue Agency's (CCRA's) T-1 tax forms (filed by individuals) and T-4 Supplementary Tax Files (submitted by employers) covering the period from 1976 to 1992, and include only male workers having positive earnings for at least nine consecutive years. Using a parametric time series econometric methodology, they estimate the covariance structure of the time series processes generating the earnings data. One of their empirical results is point estimates of total earnings variation as well as the permanent and transitory components. Morissette and Ostrovsky (2005) also use the LAD file to look at the instability of *family* earnings and total income over the separate periods 1986-1991 and 1996-2001. They also find that permanent earnings inequality among families widened considerably between these two periods.

Despite sharing a common theme of decomposition of the variation of earnings with Baker and Solon (2003), our objectives and methodology are different. The underlying statistical methodology that we employ for the decomposition process is relatively simple in its specification of inter-temporal earnings changes. Our analysis includes both genders and consists of break-downs into different age-groups, and our data set covers a later period, specifically 1982-2000. We also seek to estimate empirical relationships between the variance components and macroeconomic indicators.

3. Analytical Framework

This paper adopts the methodology employed by Gottschalk and Moffitt (1994, p. 254), which involves a variance decomposition procedure using longitudinal data. The common starting point is the variance of a worker's (log) earnings over time. Consider the following variables:

y_{it} = log earnings for person i in year t

T_i = number of years of earnings data observed for person i, i = 1, ..., N

and $K = \sum_{i=1}^{N} T_i = N \bullet \overline{T}$,

where an over-bar indicates a sample average. $\overline{T}$ is thus the average number of years of earnings data for the sample of N workers. It follows that $\overline{y}_i = \left(\frac{1}{T_i}\right)\sum_{t=1}^{T_i} y_{it}$ is average (log) earnings over the earnings-reported years of worker i, and $\overline{\overline{y}} = \left(\frac{1}{K}\right)\sum_{i=1}^{N}\sum_{t=1}^{T_i} y_{it}$ is the global, or overall, average level of (log) earnings across all workers in the data set. The measure of total earnings variation used is then the unbiased estimate for the global variance:

$$\text{Var}_{\text{Total}} = \left(\frac{1}{K-1}\right)\sum_{i=1}^{N}\sum_{t=1}^{Ti}\left(y_{it} - \overline{\overline{y}}\right)^2 \qquad (1)$$

This expression reflects both variation in earnings across time for individual workers and variation in earnings between workers. One can commence the decomposition process by defining a measure of transitory variance or temporary earnings instability as:

$$\text{Var}_{\text{Transitory}} = \textit{average over } i\left[\text{var}\,\textit{over } t\left(y_{it}\right)\right]$$

$$= \left(\frac{1}{N}\right)\sum_{i=1}^{N}\left[\left(\frac{1}{T_i - 1}\right)\sum_{t=1}^{T_i}\left(y_{it} - \overline{y}_i\right)^2\right] \qquad (2)$$

$$= \hat{\sigma}^2_{trans}$$

The above quantity represents the average across workers of the intertemporal variance of (log) earnings. The measure appearing in square brackets is an (unbiased) estimate of the year-to-year volatility or instability of the (log) earnings of a worker i. The next step is to define a measure of persistent or permanent earnings variance as:

$$\text{Var}_{\text{Permament}} = \left(\frac{1}{N-1}\right)\sum_{i=1}^{N}\left(\bar{y}_i - \bar{\bar{y}}\right)^2 - \left(\hat{\sigma}^2_{trans} \Big/ \bar{T}\right) \quad (3)$$

Although this entire expression (3) is less intuitive than (2), the term on the left essentially captures the variation in earnings (that have already been averaged over time for each worker) across all workers in the sample. It can then be shown that the total variance equals the sum of the transitory variance and the permanent variance, thus providing a convenient decomposition of total variance. Following the same notation as above, we have:

$$\text{Var}_{\text{Total}} = \text{Var}_{\text{Transitory}} + \text{Var}_{\text{Permanent}} \quad (4)$$

provided that $T_i = T$ for all i, meaning that there are the same number of time-series observations for all individuals in the sample. That condition applies throughout this analysis.

In the application of formulas (1), (2), and (3), y_{it} is replaced by the life-cycle-adjusted (log) earnings of $\ln Y_{i,t}$ which is generated as:

$$ya_{it} \equiv \ln Y_{it} - \text{estimated } (\ln Y_{it}), \quad (5)$$

where $\ln Y_{it}$ is the actual reported (log) earnings, and estimated ($\ln Y_{it}$) is predicted log-earnings from an OLS regression equation of log-earnings on a quartic in age; ya_{it} is thus generated as log earnings net of life-cycle effects attributable to age. The measure in square brackets in (2), therefore, picks up the life-cycle adjusted variance in (log) earnings, or the variation in (log) earnings about the worker's life-cycle earnings trajectory. The entire expression (2) captures the average across all workers of this earnings variability. Similarly, formula (3) essentially

captures differences in the levels of life-cycle log-earnings trajectories across workers. Since there is only one life-cycle (log) earnings regression estimated across all workers in each of our samples, high-skilled workers with high earnings trajectories will have a series of large positive ya_{it} values, and low-skilled workers with low earnings trajectories will have a series of large negative ya_{it} values. The transitory variance captures the volatility of earnings about individuals' life-cycle trajectories, while the permanent variance captures the more persistent and enduring variation in log-earnings between workers of different life-cycle profile levels (i.e., between workers of different skill levels).

Formulas (1) - (4) can also be interpreted as a random-effects or error components model of error structure in the life-cycle equation of log earnings regressed on age (see Johnston, 3rd edition, 1984, p. 400). The permanent component of the variation in log-earnings is the "between (workers) component" of variation, and the transitory component term is the "within component" of variation (i.e., within the life-cycle for a given worker).

4. The Data File and the Estimation Samples

The data file is Statistics Canada's Longitudinal Administrative Database (LAD). It is a 10 percent representative sample of all Canadian income tax filers drawn from CCRA's T-1 income tax files, containing over 1.5 million records per year. The measure of earnings used in the paper is total annual wage and salary income (henceforth "earnings"), as reported on individuals' tax forms.

The estimation samples used in this analysis include all paid workers aged 20 to 64 who were not full-time students during the tax year, who received at least $1,000 (in 1997 constant dollars) of wage and salary income, whose earnings exceeded any net (declared) self-

employment income, and who reported at least two years of above-minimum earnings (as just defined) on the LAD file. These omissions are aimed at approximating Statistics Canada's concept of "All Paid Workers" while excluding those with only limited attachment to the labour market.[3] Most of the exclusions stem from workers over age 64, the self-employed (most of whom had very low labour market earnings), and non-continuous participants in the labour market. Further details regarding the data file, including the coverage of the LAD, its degree of representativeness of the general population, the number of records in the full LAD file, and the effects of the specific sampling exclusion criteria are contained in the appendix of Beach, Finnie, and Gray (2001).

The period covered by the study is 1982-2000. In order to capture inter-temporal changes in the variance components occurring over this period on a continual basis, a trade-off between the length of the window over which the variance components are calculated (i.e., $\max(T_i)$ in the Section 3 presentation) and the frequency of the observations that we generate from those intervals emerges. The longer the window for the calculation, the more degrees of freedom there are in order to identify the deviations from the mean and the better the mean represents long-term earnings, but the lower the frequency of independent observations over the entire interval, and the fewer values one has in order to produce time series graphs and execute regression analysis. We choose a window length of 5 years as long enough to distinguish "permanent" or long-run earnings inequality from short-run or "transitory" earnings instability, but short enough to generate a sufficient number of time-series points to allow reasonable statistical analysis of the effects of macroeconomic variables. As we seek to generate point estimates at an annual frequency, overlapping as opposed to disjoint windows are employed.

The entire 19-year estimation interval is divided into 15 contiguous rolling sampling windows of equal 5-year length, each involving a fixed and balanced sample of workers whose earnings are positive for 5 consecutive years. The initial sample, for instance, is comprised of all individuals who reported positive earnings for each of the years 1982-1986. The second sample is comprised of all individuals who reported positive earnings for each of the years 1983-1987, and the fifteenth and final sample is comprised of all individuals who reported positive earnings for the years 1986-2000. For each such 5-year sample, the three variance measures (from equations (1) - (3) of the previous section) are calculated – hence the horizontal axis indicators (8286, 8387, ..., 9600) in Figures 1-3. By construction, any two adjacent samples will share 4 years of data, any two samples that commence two years apart from each other will share 3 years of data, and any two samples that commence five or more years apart from each other will share no observations.[4] The statistics that are generated from this data generating process of rolling samples – of which there are 15 annual observations – are analogous to a moving average process over 5 consecutive years. Despite the obviously high correlations that exist between statistics that are calculated from samples that are either one or two years apart from each other (only in the case of 5 or more years of time between the start dates will the calculated values be totally independent), it turns out that distinctive turning points can be discerned over the global interval from 1982 to 2000.

The estimation samples of this paper also involve breakdowns by age as well as gender. The four age groups are 'Entry' (age 20-24), 'Younger' (age 25-34), 'Prime' (age 35-54), and 'Older' (age 55-64) for each of women and men. This allows us to examine earnings variability patterns over different phases of workers' life-cycles. The full set of sample sizes of the 120 samples (four age groups for each gender over 15 cohorts) are provided in appendix Table A1.

The samples vary between 31.5 thousand and 489 thousand data points and reflect the demographic shifts and labour market participation trends that occurred over this period. In particular, over the course of the period, there is a diminishing number of younger workers and an increase in the number of women in the labour market. These patterns also reflect individuals' movements across age groups over the relevant sample period. For example, individuals exit the 'Entry' age groups and enter the 'Younger' groups as they age, and a similar dynamic operates across the entire age spectrum.

For the graphical as well as the regression analysis, we first estimate life-cycle adjusted earnings profiles based on log-earnings regressions. As mentioned above, the dependent variable is y_{it}, the log earnings for an individual in a given year, and the independent variables consist of a quartic in age for each of the male and the female estimation samples. For these (log) earnings equations, the four age groups are pooled together for a given gender. These regressions are estimated separately for each estimation window. This results in 30 such (log) earnings regressions (a male and a female regression for each of the 15 window samples). Results from these earning equations are presented in appendix Table A2, and they indicate a statistically significant and strong positive (negative) effect associated with age (age squared), which are consistent with the broad earnings literature.

5. Graphical Analysis

5.1 Patterns for Men and Women

Estimates of the three variance measures appear in Figures 1-3 with Figure 1 on total variance, Figure 2 on earnings instability, and Figure 3 on long-run inequality. The breakdown of total variance is approximately 73 percent for the long-run inequality components versus 27 percent

for the earnings instability component for both men and women on average over the interval. All three variance measures are also higher for women than for men. Second, the general pattern of change in total earnings variability has been driven primarily by changes in long-run earnings inequality. The increased degree of earnings instability in the mid-1980s to early 1990s for men, however, did play a secondary role in the run-up of men's total earnings variability, while for women the earnings instability effect was small or even worked to reduce total earnings variability. Third, since total earnings variance is the sum of its permanent and transitory components, we will view it as the outcome of its two structural components and focus discussion on the latter.

The 1982-2000 period of interest is characterized by almost two complete business cycles that are useful in interpreting cyclical patterns in the variance series. A steep recession occurred over the first two years of our data (1982-83), which was followed by a strong recovery phase up until 1989. There was another severe recession in 1990-91. The ensuing recovery was uneven and the labour market recovery quite slow, however, as economic growth stalled in 1995-96 due to significant government austerity (in order to reduce large deficits) and perhaps increased economic uncertainty (e.g., the Mexican peso crisis and 1995 Quebec referendum). Economic growth then was quite strong in the final several years of our sample.

These cyclical patterns show up quite strongly for men. Long-run earnings inequality (i.e., the permanent component) rose most markedly from 1986/90 to 1991/95 after declining very slightly from 1982/86 to 1986/90; its continuing rise since 1991/95 was again much more moderate. Since 1986/90, though, long-run earnings inequality has continuously risen. Men's earnings instability, however, has generally trended downward – as has the average unemployment rate as well (from 11.1 percent in 1982 and 11.9 percent in 1983 to 6.8 percent in

2000). Only during the interval from 1986/90 to 1989/93 did men's earnings instability go up. Since 1989/93, it has strongly trended down, again following the average unemployment rate (which peaked at 11.4 percent in 1993). The result has been a steady increase in total earnings variations since 1986/90.

For women in the labour market, the opposite patterns of long-run inequality and earnings instability components over the 1986/90 to 1991/95 period is really quite dramatic, as the former rose by 9.0 percent while the latter declined by 11.6 percent. Since then, both components fell by 3.7 percent and 2.0 percent, respectively. For women, long-run earnings differentials appear to be strongly pro-cyclical – as was the case for men as well – while short-run earnings instability has pretty steadily declined since 1986/90 pretty well independently of the business cycle. The result has been an inverted-U pattern in total earnings variation, with a broad rise from 1982/86 to 1991/95 followed by a strong decline from the 1991/95 peak.

Across all workers (men and women combined), total earnings variance troughed in 1986/90 and peaked in 1991/95 (reflecting the severe recession in the early 1990s) and has since largely declined. Over the former recessionary period, the strong pro-cyclical run up in long-run earnings differentials was clearly the driving factor. But over the latter expansionary period, both permanent and transitory components operated to reinforce each other in reducing overall earnings variance.

5.2 Patterns by Age

We have calculated estimates of long-run earnings inequality, total variance, and earnings instability over time by age group. Due to space constraints, these graphs are relegated to a corresponding working paper. They contain a lot of detail, so we focus only on several

highlights. Table 1 provides the actual numerical values of the three variance measures by age for the beginning and end sample windows of the 1982-2000 time frame.[5] As can be seen, the patterns across ages of the two variance components are almost opposite. Long-run earnings inequality generally rises with age, at least for younger workers and beyond, so that it is markedly highest among the older age group, much as one would expect from a standard OJT human capital model; while earnings instability generally declines with age, at least until workers reach prime age, so that instability is markedly highest among entry-age workers, which is very much consistent with a career job-matching perspective. The pattern for total earnings variance basically reflects that of long-run earnings inequality, the larger source component of total variation.

For the middle two age groups – to which the great majority of workers belong – all three variance measures are also higher for women than for men. When averaged across all age groups, the three variance measures are higher by 21-25 percent in 1982/86 and by 9-22 percent in 1996/00 (with the biggest reduction in the male-female gap occurring in the long-run earnings inequality component from a differential of 25 percent at the beginning of the period down to 9 percent by the end of the period).

With the variance components moving in opposite directions according to age, it should not be surprising that the relative size of the variance components also varies markedly with age. Table 2 shows the ratio of long-run inequality to earnings instability across age groups. For both women and men, the ratio markedly rises with age, at least up to the prime age group (for men) and beyond (for women). For entry workers, the ratio is less than one and a half, while for prime age workers it is approximately three or more. That is, instability of earnings markedly declines in importance compared to long-run earnings differences among workers for prime age and older

workers. The ratios of long-run inequality to earning instability for men and women as a whole have also risen quite markedly over the sample period covered, more so for men (from 2.32 to 3.16) than for women (from 2.41 to 2.87).

5.3 Changes in Patterns by Age

The figures in Tables 1 and 2 indicate that the variance component patterns have indeed changed over the sample period. The changes are highlighted in Figures 4 through 9, where age is measured along the horizontal axis. In each of these diagrams, there are four age profiles: for the two end-period windows 1982/86 and 1996/00, and for the two windows to facilitate a comparison of stages of the business cycle: the growth interval of 1986/90 and the recessionary window of 1991/95. The multiple age profiles can show whether the patterns of changes are steady (or monotonic) over the entire period or mixed (or cyclical) over the period.

All of the graphs show how long-run earnings inequality generally rises with age (cross-sectionally) for both men and women (figures 6 and 9). Furthermore, the age profile for long-run inequality has generally shifted upward (so that such long-run inequality has been rising); but the up-shift has been much more marked for men than for women, has been more dramatic for the older age groups, and has been more persistent or steady among men while more mixed for women workers.

Figures 5 and 8 illustrate the U-shaped pattern of earnings instability across ages for men and the ski-jump pattern across ages for women. Here, though, the shifts in the age profiles for earnings instability have a more mixed pattern than for long-run earnings inequality. Over the entire interval earnings instability has basically declined for prime age workers (age 25-54) and shifted up for older workers (though the up-shift has not been steady over time).

Thirdly, figures 4 and 7 also illustrate the J-shaped pattern of total earnings variance across ages for men and the general upward pattern across ages for women workers. The shifts over time in these age profiles for total variance essentially reflect the pattern of shifts in long-run earnings inequality. For men, there has been a big up-shift in total variance for prime age and older workers, resulting in markedly widening earnings differentials across ages. Interestingly, while the (cross-sectional) age-earnings profile of mean earnings for men has been characterized by widening differentials arising from declining real wages among younger workers and steady (real) wages among middle-age workers, the change in the age profile of total variance of earnings has been characterized by marked up-shifts among prime age and older workers. The distribution does not seem to have widened as much amongst the younger two age groups. For women, there has also been a big up-shift in the total variance of earnings among older workers, but there has been a decrease in the total variance of earnings among prime age workers.

6. Underlying Trends and Macroeconomic Effects

In order to assess the empirical relationship between the alternative variance measures on the one hand and underlying trends and major macroeconomic effects on the other, we estimate a series of multiple regressions of the time series of observations on the variance measures. As in the graphical presentation of Figures 4-9 above, the data points reflect both the underlying trends and aggregate labour market changes in Canada between 1982 and 2000. There are a total of 15 time-series observations for each of the variance measures, starting with the 1982/86 sample window and ending with the 1996/00 sample window. Following Haider's (2001) parsimonious specifications, the macroeconomic effects are represented by the aggregate unemployment rate and the real GDP growth rate. For each of the five-year windows, the unemployment rate

regressor assumes the average annual value over the five-year window (expressed as a percentage). The real GDP growth variable is calculated by first taking the fourth quarter GDP value in year t divided by that in year t-1 subtracting one, then computing the mean of the five such annual growth rates over the five years within a window (expressed as a decimal). The three variance measures are treated as separate dependent variables in the regression analysis for men and women as a whole and for each of the eight age-sex groups under analysis. The general form of the regression equations estimated is:

$$Y_t = \beta_0 + \beta_1 T + \beta_2 GR_t + \beta_3 UR_t + \varepsilon_t$$

where Y_t is one of the three variance measures, T is a linear time trend, GR_t is the average annual GDP growth rate, UR_t is the average annual unemployment rate, and ε_t is a regression error term. The net trend effect is picked up by the β_1 coefficient. The inclusion of the time trend also has the effect of detrending either of the remaining independent variables.

Because of the way that the variables are calculated in terms of rolling overlapping windows, the error terms in the regressions are likely to be highly correlated. To address this issue, we specify an error structure that follows a fourth-order moving average process. Although for many of the regression equations some of the four MA estimated coefficients turn out to be insignificant, we include them in all specifications. The equations were estimated by maximum likelihood techniques (the AUTO command in the SHAZAM regression program).

6.1 Net Trend Effects

Estimates of the β_1 trend coefficient from the above equation appear in Table 3, first for women and men as a whole (Panel A) and then broken down by age group (Panel B).[6] Figures in parentheses are the trend effects expressed in percentage terms (relative to the sample means of

the dependent variables). Basically, the net trend effects for women and men as a whole replicate the graphical shifts in the initial Figures 1 - 3: long-run earnings inequality has risen over the 1982-2000 period; earnings instability has declined; and since the former trend dominates in magnitude the latter, total earnings variance — our closest measure to observed cross-sectional earnings inequality — has also risen (though at a slower rate than the rise in long-run earnings inequality). This pattern holds for both men and women. But the rise in long-run inequality is about twice as strong for men than for women, and the decrease in earnings instability is about four to five times stronger for women than men. As a result, the increase in total earnings variance was highly significant and much more marked for men, and only marginally significant and much weaker for women workers.

Across the four age groups, the increasing trend in long-run earnings inequality rises markedly with age for both men and women, though much more strongly for male workers. Trends in earnings instability, however, are mixed across age groups. For men, the strong increasing trend in long-run inequality again dominates the relatively weak and mixed trends in earnings instability, so that the net trend in total earnings variance is also strongly positive and increasing with age. For women, the trends in earnings instability are often stronger (in percentage terms) than those in long-run inequality, so that the mixed trend pattern in total earnings variance generally reflects that for earnings instability. The net trend effects pretty well reflect the general shifts in the age profile of the variance measures illustrated in Figures 4-9.

Finally, Panel C provides a complementary set of net trend effects for men and women as a whole based on a pooled regression. In this case, the four age groups (of 15 observations each) were pooled into one regression (of 60 observations) with the set of regressors specified above plus three age-group dummy variable controls so that more degrees of freedom are gained. The

common trend coefficients are listed in Panel C. Since the pooled regressions are estimated by OLS, the coefficient estimates are generally unbiased, but their standard errors are incorrect, so indicators of statistical significance are not included. As can be seen, the pooled trend coefficients for long-run inequality and for total variance are quite similar to the aggregate trend coefficients in Panel A. The earnings instability trend coefficients, however, have flipped sign to become positive, though are still quite small. Evidently, any underlying trends in earnings instability are not robustly or reliably estimated, while those for long-run inequality and for total earnings variance are.

6.2 Macroeconomic Effects

Macroeconomic effects are captured by two variables: the (aggregate) unemployment rate and real GDP growth rate. The regression results for the former appear in Table 4 and for the latter in Table 5. Each cell in these tables contains three figures. The first is the actual regression coefficient ($\hat{\beta}_3$ or $\hat{\beta}_2$). The figure in parentheses is the percentage change of the relevant effect ($\hat{\beta}_3$ *or* $\hat{\beta}_2$ divided by the mean of the dependent variable). For example, in the top-left cell of the first table, the number 2.71 indicates that the estimated effect of a one percentage point increase in the unemployment rate is to raise the degree of long-run earnings inequality for men in the labour market over the 1982-2000 period by 2.71 percent. The figure in square brackets is the (partial) elasticity corresponding to the estimated regression coefficient (i.e. $\hat{\beta}_3$ *or* $\hat{\beta}_2$ multiplied by the ratio of the mean of the relevant regressor to the mean of the corresponding dependent variable). Thus, again in the top-left cell of Table 4, the estimated

effect of a one percent rise in the aggregate unemployment rate is a 0.26 percent increase in long-run earnings inequality for men in the labour market.

The unemployment rate is an indicator of labour market tightness. Reduced unemployment rates and thus tighter labour markets, according to conventional economic theory, would be expected to disproportionately benefit the earnings of low-skilled lower-wage workers, so that earnings inequality should attenuate and earnings instability be reduced; higher unemployment rates should have the opposite effect. We would therefore expect positive unemployment rate effects on all three variance measures. Since male workers are traditionally more concentrated in primary and manufacturing/construction/transportation sectors which have greater cyclicality than service sector employment where women are more concentrated, one would also expect stronger counter-cyclicality in the unemployment rate effects for men than for women.

The results presented in Table 4 turn out to be very much consistent with this expectation. There are positive unemployment rate effects for all samples — for both men and women as a whole (panel A) and for all ages (panel B) — for long-run earnings inequality and for total earnings variance. These results, at least for men and women as a whole, appear to be robustly estimated. These effects are indeed also stronger for men than for women. Since the two variance components sum to the total variance, the sum of the unemployment rate effects (as measured by the regression coefficients) is the same as that estimated for total variance across each row of the table. The coefficient effects on long-run earnings inequality are about twice as strong as on earnings instability, so that for men the former effect accounts for about two-thirds of the effect on total earnings variance. Higher unemployment is thus also found to increase earnings instability for men, as one would expect from conventional theory. For women workers,

however, the unemployment rate effect on earnings instability shows a weaker and more mixed pattern. Indeed, for women as a whole, the estimated effect turns out to be negative (although for the pooled estimates in panel C it is quite small). Finally, the unemployment rate effect is U-shaped across age groups for both long-run inequality and total earnings variance for men. It is smallest among younger and prime age workers, who typically have the strongest labour market attachment among all age/sex groups, and largest for entry and older workers, who often include workers with more intermittent labour market attachment and who typically experience the highest rates of unemployment. Again the pattern across ages for women is more uneven or mixed.

The GDP growth rate variable is an indicator of growing earnings prosperity and increased employment experience in the labour market; hence it picks up a different facet of the business cycle. Greater (real) GDP growth rates and hence faster growing economies, according to conventional economic theory, would be expected to have a negative effect on earnings variance measures through three related but conceptually distinct routes or channels, given that we are controlling for aggregate unemployment rates. The first channel operates through the labour force participation rate and hence the employment rate: higher economic growth and real wage rates generally increase participation rates through an upward-sloping labour supply, likely moreso for women than for men and more strongly among lower-skilled workers less permanently attached to the labour market. The second channel operates through hours worked: again an upward-sloping labour supply effect induces longer hours worked (conditional on being employed), and again likely more strongly for women than men and among lower-skilled workers with less than regular normal-hours work. The third channel is the so-called trickle-down effect on hourly wages: higher growth and tighter labour markets are likely to bid up

disproportionately the wages of relatively low-skilled workers, particularly in more cyclically sensitive sectors, such as primary and manufacturing/construction/transportation where men are more concentrated.[7]

These conventional expectations for the impact of real GDP growth rate effects are only partially validated by the regression results presented in Table 5. The findings for women in the labour market across all three earnings variance measures are in line with these expectations, but for men our priors are supported only with respect to earnings instability (i.e., improved economic growth, not surprisingly, reduces the degree of earnings instability in the labour market). Again, the coefficients on long-run earnings inequality are generally larger (in absolute terms) than those on earnings instability — in the case of women by a factor of eight. The implied elasticities and percentage changes are also, right across the board, much weaker or smaller than found in the previous table for unemployment rate effects. Interestingly, women are found to have stronger GDP growth rate effects on long-run inequality and total earnings variance than men, while men have stronger growth rate effects (and in the direction expected) on earnings instability than women. Looking at patterns across ages, one notes that, for both men and women, the growth rate effect (algebraically) increases with age for long-run earnings inequality and for total earnings variance — except for the case of older women. For earnings instability, the growth rate effect generally manifests a U-shaped pattern across age groups for men and a declining pattern across ages for women. Interestingly, unemployment rate effects come through quite consistently with conventional theory and operate most strongly through long-run earnings inequality (and hence total earnings variance), whereas GDP growth rate effects operate more consistently through the earnings instability component.

A summary of cyclical regression effects from Tables 4 and 5 is presented in Table 6. The entry "C" designates counter-cyclical findings (i.e., poor economic times result in higher earnings variances), while entry "P" indicates pro-cyclical effects (i.e., good economic times result in higher variances). As found by Haider (2001), counter-cyclical effects clearly dominate, with greater economic growth and lower unemployment generally reducing earnings variances. The exception of a pro-cyclical effect of economic growth on long-run earnings inequality for men, however, stands out.

The inconsistency of the growth rate effects with conventional economic explanations for male long-run earnings inequality (and hence total variance) poses a puzzle. This finding is consistent across the alternative estimation methods and was also found in Beach et. al. (2005) using a somewhat different methodology including a regional dimension to pick up macroeconomic effects. It would appear that alternative phenomena are occurring not picked up by conventional explanations. An alternative paradigm or explanation offered in Beach *et al.* (2005) is based on economic restructuring and changing demographics. According to this proposition, high growth areas of the country have attracted substantial in-migration of young workers (whose earnings levels tend to be relatively low and have indeed fallen significantly compared to the previous generation of youth) and of immigrants (whose earnings have also fallen significantly relative to non-immigrants over the last twenty years). Indeed, overall levels of Canadian immigration shifted up in the mid-to-later 1980s and continued at a much higher level in the 1990s than in the 1960s and 1970s. The 1990s also saw a marked decrease in the rate of growth — indeed a downsizing — of the public sector, a decline in the overall unionization rate in the private sector, and steps toward deregulation in selective and formerly protected industries such as airlines and telecommunications.

More generally, two phenomena — growing globalization, out-sourcing, and international trade; and the advent of skill-biased technological change based on chip-based recent information technology — have been argued to have huge effects on economic restructuring and reorganization of the workplace (eg., Katz and Autor, 1999; Verma and Taras, 2005). The Canada-US Free Trade Agreement took effect in 1989 and the North American Free Trade Agreement took effect in January 1994. The results, as Courchene and Telmer (1998) and others have argued, have been a massive reorganization of Canadian trade patterns away from an east-west axis to a north-south axis and a corresponding increase in the competitiveness of output markets and hence increased cost awareness, restructuring of workplace arrangements, and greater use of out-sourcing and non-standard work arrangements (Bartel et. al., 2005). If these "new economy" changes have generally been implemented in the more high-growth and more manufacturing-oriented sectors of the economy, this could explain the widening degree of earnings inequality, particularly for male workers, contrary to the conventional view of the impact of growth. More research is obviously needed to evaluate and test between the conventional and new-economy explanations of how economic growth is affecting earnings inequality in the current labour market.

7. Review and Conclusions

This study has examined the variability of workers' earnings in Canada over the period 1982-2000 using a largely non-structural approach using the Longitudinal Administrative Database (LAD file). The total longitudinal variance in earnings across workers and over time for sample workers is decomposed, using a methodology employed by Gottschalk and Moffitt (1994), into a permanent or long-run inequality component between workers and a year-to-year

earnings instability component over time. A methodological innovation of the paper is that this decomposition is applied to a five-year moving window of earnings, so that the analysis can examine how total earnings variance and its two components have changed over the 1980s and 1990s in a quite flexible non-structural fashion at an annual frequency. This approach also allows for linkage to macroeconomic indicators. The study reports results separately for men and women and for four separate age groups of workers. The empirical analysis relies on both graphical and regression techniques.

Several major results have been found. First, the general rise in total earnings variance between the 1980s and 1990s was not at all inter-temporally monotonic and reflects quite different patterns of changes between its two components. Long-run earnings inequality has generally increased over the period, while year-to-year earnings instability has pretty steadily — except during the early 1990s recession — decreased. Changes in total earnings variability have been driven primarily by changes in long-run earnings inequality. In contrast to Moffitt and Gottschalk's (2002) finding of a secular rise in permanent earnings inequality in the US, we find (for both men and women) — as in Figure 3 — a significant run up in the permanent component around 1986 to 1995 following a slight decrease in the early-mid 1980s. Our results are more reflective of strong cyclical effects than of a dominating upward trend. Also, unlike Moffitt and Gottschalk (2002), we do not find dramatic increases in earnings instability in the 1980s, — as in Figure 2 — but only around 1988 to 1991 and thereafter largely decreases. Again our results are suggestive of stronger cyclical effects on earnings instability in Canada than in the United States. Thus, like Haider (2001), we find counter-cyclical patterns in *both* long-run inequality and earnings instability components, but our findings suggest rather stronger cyclical effects than for

the US, and that these cyclical effects operate more strongly through permanent inequality earnings differences in Canada than in the US.

Second, outside the early 1990s recession period (when almost all variance measures rose), the patterns of change in the two variance components were quite different between men and women. Since the early 1990s, long-run earnings inequality continued to rise for men, but markedly decreased for women. Since the later 1980s, short-run earnings instability fell quite steadily for women, but showed a more cyclical pattern for men. As a result, underlying trends in earnings instability reinforced the rising trends in long-run earnings inequality for men, but weakened or countered the latter effect for women. Unemployment rate effects in both variance components show up quite strongly for men and less so for women. For example, higher unemployment increases earnings instability for men, but shows much weaker and mixed effects on earnings instability for women. GDP growth rate effects on long-run earnings inequality, however, show up more strongly for women than for men.

Third, the patterns across ages of the two variance components are almost opposite. Long-run earnings inequality generally rises with age, at least for younger workers and beyond, so that it is markedly highest among the older age workers; while earnings instability generally declines with age, at least until workers reach prime age, so that earnings instability is markedly highest among entry age workers. The pattern for total earnings variance basically reflects that of long-run earnings inequality. The shifts over time in these age profiles have essentially accentuated these major patterns and are stronger for long-run earnings inequality and particularly so for men.

Fourth, both unemployment rates and GDP growth rates, as macroeconomic indicators, have statistically significant net regression effects on all the earnings variance measures.

Unemployment rate effects are positive on almost all variance measures, which are consistent with conventional expectations that tighter labour markets reduce earnings variances, while higher unemployment is associated with widened long-run earnings differentials and greater short-run earnings instability. The effect is stronger for men than for women and operates more strongly through long-run inequality than through short-run instability of earnings for Canada. The GDP growth rate effect would be expected, according to conventional economic arguments, to be negative on the different variance measures, as greater economic growth reduces earnings inequality and instability. Such estimated effects indeed hold for women and for earnings instability among men. Growth rate effects on men's long-run earnings inequality (and total earnings variance), however, are found to be positive — more consistent with an alternative "new economy" set of explanations based on economic restructuring and changing demographics. Overall economic prosperity has evidently not been narrowing men's earnings inequality in the Canadian economy over the last decade, and further inquiry is needed as to why.

Endnotes

[1] All variance measures are calculated from life-cycle adjusted log earnings (in thousands of 1997 dollars).

[2] The Survey of Labour and Income Dynamics or SLID is another relatively recently available longitudinal database, but it has not been used as yet to address the issues covered in this paper. Its first cohorts date to 1993, and individuals are rotated out of the sample after no more than 6 years.

[3] When compiling the LAD file, special procedures are employed in order to deal with individuals who have changed their SINs (social insurance numbers which serve as our identifier), who have multiple SINs, and other non-standard cases (see Finnie, 2000), which comprise on the order of 4 percent of the file in any given year. Full-time students are identified from tuition and education tax credit responses on T-1 forms.

[4] Note that no two samples will be composed of the exact same individuals. As one moves from one sample to another with the passage of time, some new individuals will enter the sample as they meet our overall sampling criteria, and some individuals will leave the sample as they no longer meet these criteria.

[5] Using individual end years is always risky, but in this case the end windows are each five-year moving averages.

[6] Note that an artifact of the construction of the dependent variables is that there is likely to be a significant time trend.

[7] Unfortunately, since the analysis uses administrative data, we cannot observe amount of working time, so we cannot separate out these distinct channels in our regression estimates.

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Table 1

Earnings Variance Measures by Sex and Age, 1982/86 and 1996/00

A) Men

1) Long-Run Earnings Inequality

	Entry	Younger	Prime Age	Older
8286 –	.2918	.2647	.2994	.4016
9600 –	.2742	.3088	.3660	.5402

2) Earnings Instability

	Entry	Younger	Prime Age	Older
8286 –	.1963	.1201	.1019	.1652
9600 –	.1864	.1093	.0966	.1777

3) Total Variance of Earnings

	Entry	Younger	Prime Age	Older
8286 –	.4881	.3847	.4012	.5668
9600 –	.4605	.4182	.4626	.7179

B) Women

1) Long-Run Earnings Inequality

	Entry	Younger	Prime Age	Older
8286 –	.2702	.3537	.4175	.4196
9600 –	.2469	.3438	.4143	.4816

2) Earnings Instability

	Entry	Younger	Prime Age	Older
8286 –	.2070	.1704	.1217	.1108
9600 –	.2310	.1664	.1100	.1459

3) Total Variance of Earnings

	Entry	Younger	Prime Age	Older
8286 –	.4773	.5241	.5392	.5304
9600 –	.4779	.5102	.5244	.6276

Table 2

Ratio of Long-Run Inequality to Earnings Instability Measures by Sex and Age, 1982/86 and 1996/00

A) Men

Ages	Entry	Younger	Prime Age	Older	All
8286 –	1.49	2.20	2.94	2.43	2.32
9600 –	1.47	2.83	3.79	3.04	3.16

B) Women

Ages	Entry	Younger	Prime Age	Older	All
8286 –	1.31	2.08	3.43	3.79	2.41
9600 –	1.07	2.07	3.77	3.30	2.87

Table 3

Regression Estimates of Net Trend Effects on Earnings Variance Measures for Men and Women, 1982-2000

A) Men and Women

	LR Inequality	Earnings Instability	Total Variance
Men	.00586** (1.84)	-.00047** (-0.40)	.00538** (1.23)
Women	.00264** (0.69)	-.00219** (-1.51)	.00043* (0.08)

B) Men and Women by Age

	LR Inequality	Earnings Instability	Total Variance
Men:			
Entry	.00135** (0.47)	.00033** (0.17)	.00169* (0.36)
Younger	.00419** (1.45)	-.00006 (-0.05)	.00414** (1.03)
Prime	.00629** (1.93)	.00024** (0.24)	.00653** (1.53)
Older	.01340** (2.99)	.00205** (1.22)	.01546** (2.50)
Women:			
Entry	-.00028 (-0.10)	.00193** (0.89)	.00165** (0.34)
Younger	.00027 (0.08)	-.00108** (-0.64)	-.00081** (-0.15)
Prime	.00128** (0.31)	-.00041 (-0.34)	-.00062** (-0.12)
Older	.00539** (1.18)	.00144** (1.08)	.00688** (1.16)

C) Men and Women, Pooled Estimates

	LR Inequality	Earnings Instability	Total Variance
Men	.00636 (1.89)	.00068 (0.47)	.00704 (1.46)
Women	.00155 (0.41)	.00035 (0.22)	.00161 (0.30)

Note: ** indicates statistical significance at the 1 percent level and * at the 5 percent level. Figures in parenthesis are percentage changes relative to the sample mean of the relevant dependent variable.

Table 4

Regression Estimates of Unemployment Rate Effects on Earnings Variance Measures for Men and Women, 1982-2000

A) Men and Women

	LR Inequality	Earnings Instability	Total Variance
Men	.008641** (2.71) [.258]	.004259** (3.62) [.345]	.012663** (2.90) [.276]
Women	.008082** (2.10) [.201]	-.003807** (-2.63) [-.250]	.004208** (0.80) [.076]

B) Men and Women by Age

	LR Inequality	Earnings Instability	Total Variance
Men:			
Entry	.016553** (5.79) [.552]	.005916** (3.13) [.298]	.022287** (4.69) [.447]
Younger	.006928** (2.40) [.229]	.004901** (4.28) [.408]	.011620** (2.88) [.275]
Prime	.008221** (2.52) [.240]	.004156** (4.19) [.400]	.012237** (2.87) [.274]
Older	.014369** (3.20) [.305]	.004765** (2.83) [.270]	.019158** (3.10) [.296]
Women:			
Entry	.009176** (3.37) [.321]	.000065 (0.03) [.003]	.009217** (1.89) [.180]
Younger	.006147** (1.73) [.165]	-.003168** (-1.88) [-.179]	.003019* (0.58) [.055]
Prime	.009170** (2.19) [.209]	.001172 (0.96) [.092]	.004507** (0.84) [.080]
Older	.007282** (1.59) [.151]	-.005148** (-3.88) [-.370]	.002167 (0.37) [.035]

C) Men and Women, Pooled Estimates

	LR Inequality	Earnings Instability	Total Variance
Men	.011186 (3.31) [.316]	.004689 (3.28) [.313]	.015878 (3.31) [.315]
Women	.007836 (2.08) [.199]	-.001333 (-0.83) [-.080]	.004648 (0.87) [.083]

Note: ** (*) indicates statistical significance at the 1(5) percent level in the top two panels. Figures in parentheses are percentage changes relative to the sample mean of the dependent variable.

Figures in square brackets are elasticities.

Table 5

Regression Estimates of GDP Growth Rate Effects on Earnings Variance Measures for Men and Women, 1982-2000

A) Men and Women

	LR Inequality	Earnings Instability	Total Variance
Men	.049254** (0.51) [.0184]	-.027850* (-0.24) [-.0282]	.022735 (0.05) [.0062]
Women	-.081731** (-0.21) [-.0254]	-.010251 (-0.07) [-.0084]	-.090407** (-0.17) [-.0204]

B) Men and Women by Age

		LR Inequality	Earnings Instability	Total Variance
Men:				
	Entry	-.048209* (-0.17) [-.0201]	-.031280* (-0.17) [-.0197]	-.077138** (-0.16) [-.0194]
	Younger	.000939 (0.00) [.0004]	-.052463** (-0.46) [-.0550]	-.048203** (-0.12) [-.0143]
	Prime	.056813** (0.17) [.0207]	-.033406** (-0.34) [-.0402]	.023029 (0.05) [.0065]
	Older	.11639 (0.26) [.0309]	-.002831 (-0.02) [-.0020]	.11306 (0.18) [.0218]
Women:				
	Entry	-.15673** (-0.58) [-.0686]	.055562** (0.26) [.0307]	-.10230** (-0.21) [-.0250]
	Younger	-.096908** (-0.27) [-.0325]	-.013436 (-0.08) [-.0095]	-.11060** (-0.21) [-.0251]
	Prime	-.045395** (-0.11) [-.0130]	-.025575 (-0.21) [-.0250]	-.055402** (-0.10) [-.0123]
	Older	-.10683** (-0.23) [-.0278]	-.040213** (-0.30) [-.0361]	-.14568** (-0.25) [-.0294]

Men and Women, Pooled Estimates

	LR Inequality	Earnings Instability	Total Variance
Men	.028658 (0.08) [.0101]	-.033529 (-0.23) [-.0280]	-.004958 (-0.01) [-.0012]

Women	-.089991 (-0.24) [-.0285]	-.003312 (-0.02) [-.0025]	-.091658 (-0.17) [-.0204]

Note: ** (*) indicates statistical significance at the 1(5) percent level in the top two panels. Figures in parentheses are percentage changes relative to the sample mean of the dependent variable.

Figures in square brackets are elasticities.

Table 6

Summary of Cyclical Regression Effects on Earnings Variance Measures

	LR Inequality	Earnings Instability	Total Variance
Unemployment Rate:			
Men	C**	C**	C**
Women	C**	P**	C**
Growth Rate:			
Men	P**	C*	C
Women	C**	C	C**

C = Counter-cyclical P = Pro-cyclical

Note: P or C designations based on panel C of Tables 4 and 5.
** (*) indicates statistical significance at the 1 (5) percent level based on panel A of Tables 4 and 5.

Table A1
Sample Sizes for the 15 Estimation Windows

window years	Men				Women			
	entry	younger	prime	Older	entry	younger	prime	older
1982-86	109,865	257,415	324,150	59,430	97,910	180,830	222,915	31,550
83-87	102,135	254,205	327,795	58,285	91,125	183,150	230,915	31,630
84-88	100,210	257,810	339,035	57,115	89,380	190,275	244,930	31,520
85-89	96,495	261,255	352,280	57,255	86,480	197,355	261,230	32,185
86-90	91,000	263,330	363,260	56,065	82,385	203,575	277,395	32,350
87-91	84,250	260,635	371,620	55,130	76,335	206,440	291,575	32,665
88-92	77,310	261,230	388,740	53,340	70,680	211,805	311,665	32,830
89-93	70,325	259,455	397,655	51,290	64,740	214,810	327,585	33,105
90-94	65,930	259,090	410,050	49,780	59,945	217,180	344,265	33,235
91-95	62,535	254,855	420,870	48,645	56,210	215,810	358,655	33,290
92-96	59,675	249,940	434,910	47,760	52,720	212,780	374,235	33,260
93-97	58,025	244,290	446,910	47,590	49,845	208,170	386,675	33,195
94-98	56,650	237,020	458,605	48,090	47,410	203,140	397,700	33,355
95-99	54,775	230,370	473,465	49,995	45,570	199,440	413,755	35,195
96-2000	54,325	224,640	489,000	52,455	45,015	197,375	431,320	37,580

Table A2
Regression Results from the Earnings Equations
(log earnings regressed on a quartic in age)

window yrs.	constant	Age	age^2	age^3	age^4
82-86 men	0.213	0.899	-0.029	4.29 E-4	-2.38 E-6
82-86 women	1.891	0.765	-0.026	3.98 E-4	-2.22 E-6
83-87 men	-0.457	0.955	-0.031	4.52 E-4	-2.5 E-6
83-87 women	1.430	0.797	-0.027	4.06 E-4	-2.25 E-6
84-88 men	-0.312	0.939	-0.030	4.44 E-4	-2.46 E-6
84-88 women	1.570	0.772	-0.026	3.87 E-4	-2.14 E-6
85-89 men	0.079**	0.899	-0.029	4.23 E-4	-2.35 E-6
85-89 women	2.037	0.722	-0.024	3.58 E-4	-1.99 E-6
86-90 men	0.793	0.829	-0.026	3.88 E-4	-2.17 E-6
86-90 women	2.700	0.653	-0.022	3.19 E-4	-1.78 E-6
87-91 men	1.931	0.722	-0.023	3.37 E-4	-1.92 E-6
87-91 women	3.535	0.572	-0.019	2.79 E-4	-1.58 E-6
88-92men	2.726	0.647	-0.021	3.04 E-4	-1.76 E-6
88-92 women	4.248	0.502	-0.016	2.44 E-4	-1.40 E-6
89-93 men	2.535	0.666	-0.021	3.18 E-4	-1.85 E-6
89-93 women	4.395	0.489	-0.016	2.42 E-4	-1.14 E-6
90-94 men	1.688	0.745	-0.024	3.61 E-4	-2.09 E-6
90-94 women	3.800	0.546	-0.018	2.76 E-4	-1.61 E-6
91-95 men	0.348	0.872	-0.029	4.30 E-4	-2.48 E-6
91-95 women	2.377	0.686	-0.023	3.57 E-4	-2.09 E-6
92-96 men	-0.608	0.968	-0.032	4.86 E-4	-2.81 E-6
92-96 women	1.201	0.803	-0.027	4.25 E-4	-2.5 E-6
93-97 men	-1.151	1.024	-0.034	5.20 E-4	-3.01 E-6
93-97 women	0.054	0.912	-0.031	4.86 E-4	-2.84 E-6
94-98 men	-1.261	1.037	-0.034	5.28 E-4	-3.06 E-6
94-98 women	-0.244*	0.937	-0.032	4.96 E-4	-2.89 E-6
95-99 men	-1.371	1.053	-0.035	5.41 E-4	-3.13 E-6
95-99 women	-0.543	0.967	-0.033	5.13 E-4	-3.00 E-6

96-00 men	-1.360	1.055	-0.036	5.42 E-4	-3.14 E-6
96-00 women	-0.953	1.011	-0.034	5.41 E-4	-3.16 E-6

Notes: ** denotes statistical insignificance at the 10 % level; * denotes statistical insignificance at the 3 % level; all other point estimates have prob values below 0.001

figure 1 - Total variance by gender

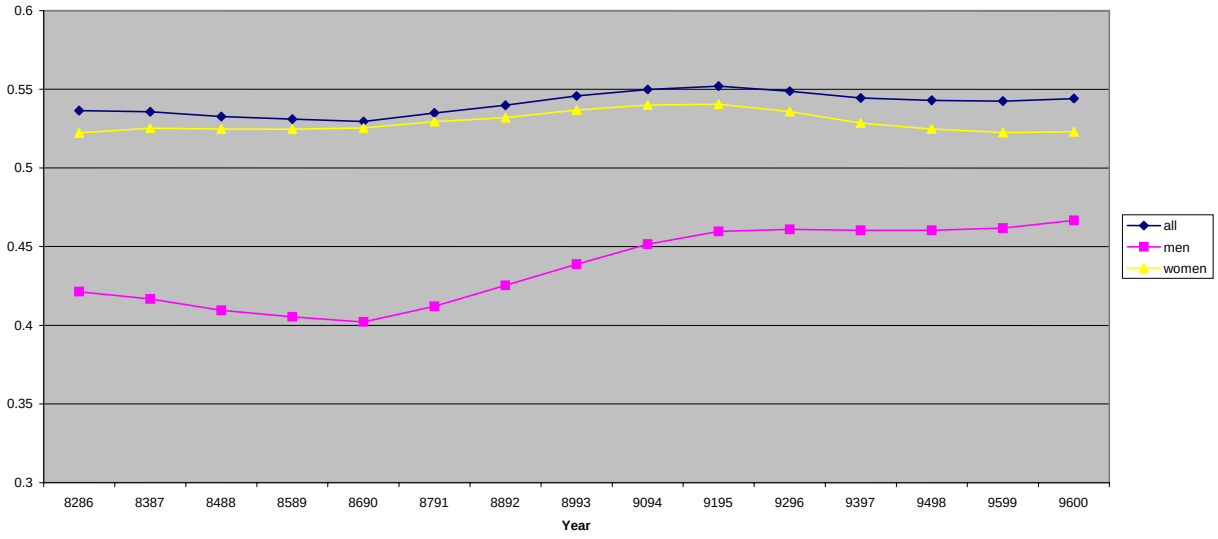

figure 2 - Transitory Variance by gender

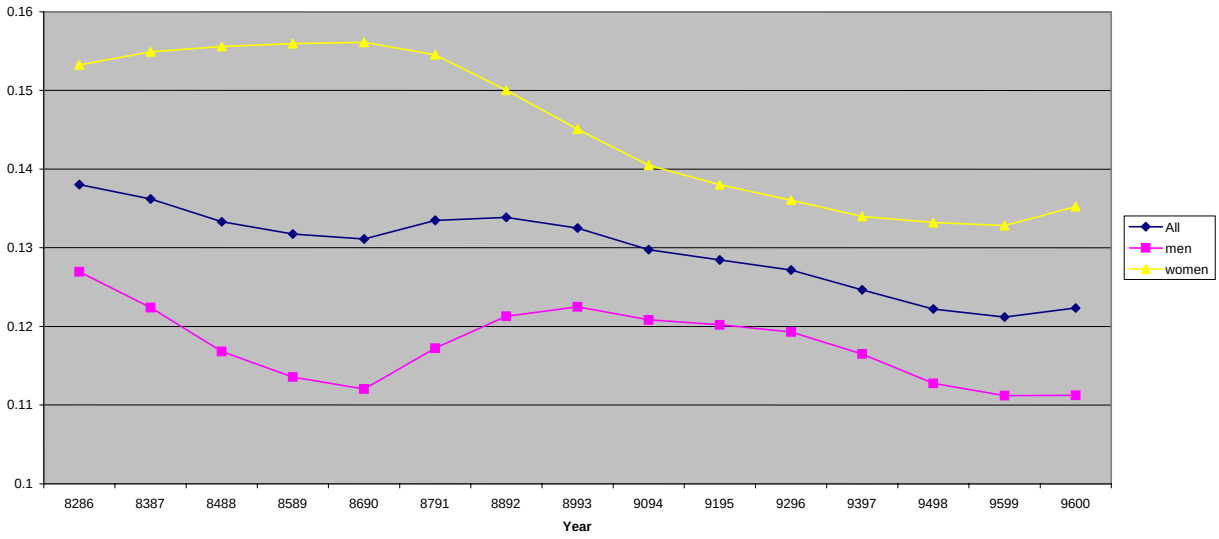

Figure 3 - Permanent Variance by Gender

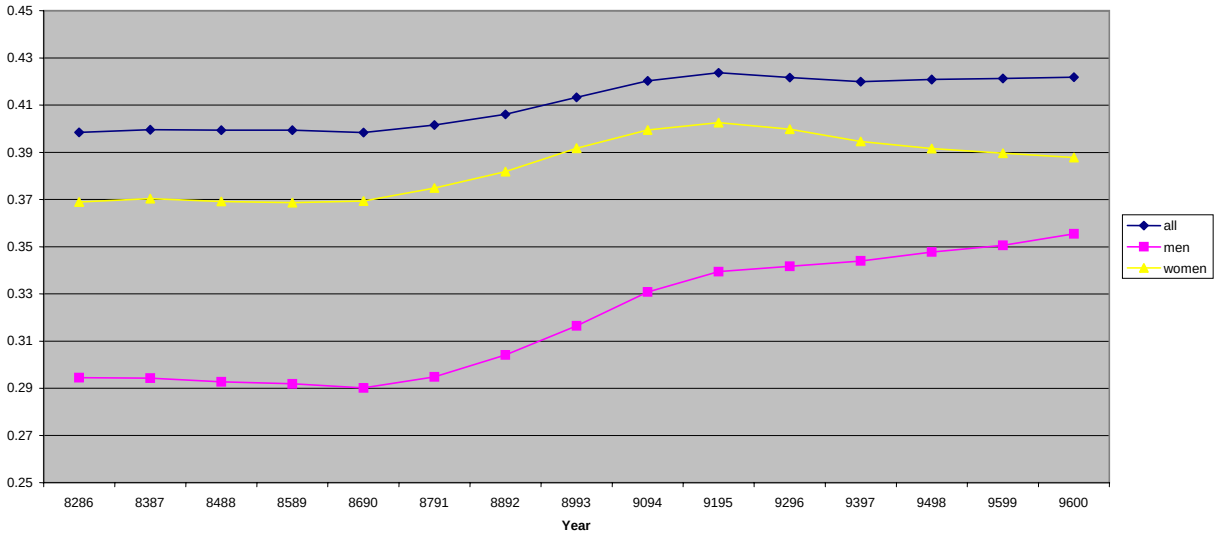

Figure 4 - Men - Total Variance

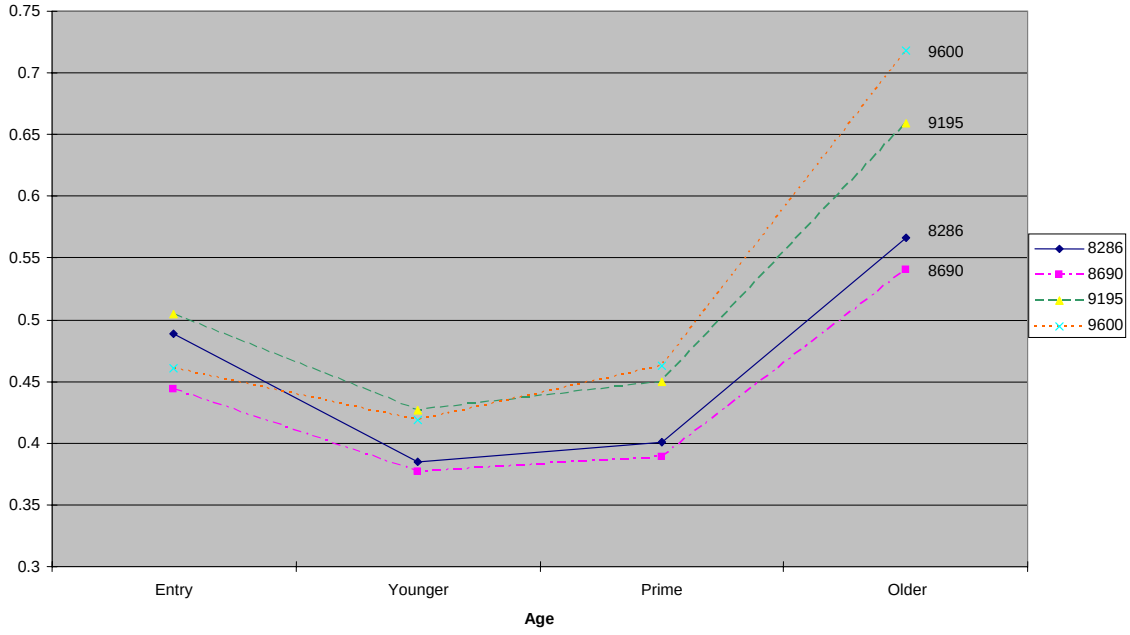

Figure 5 - Men - Transitory Variance

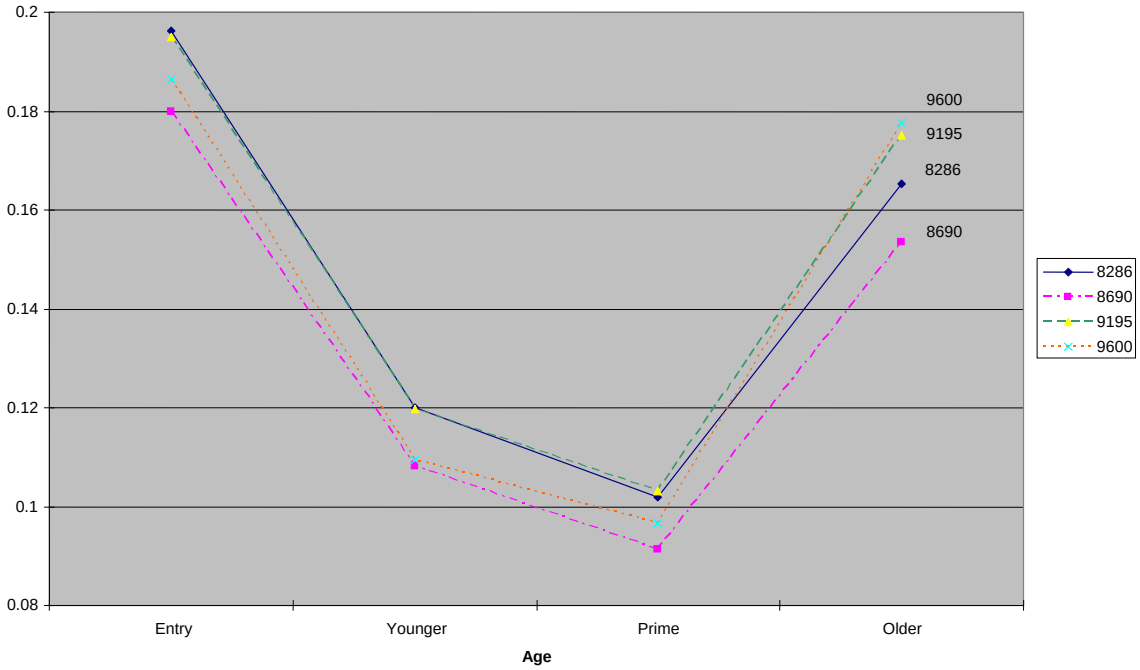

Figure 6 - Men - Permanent Variance

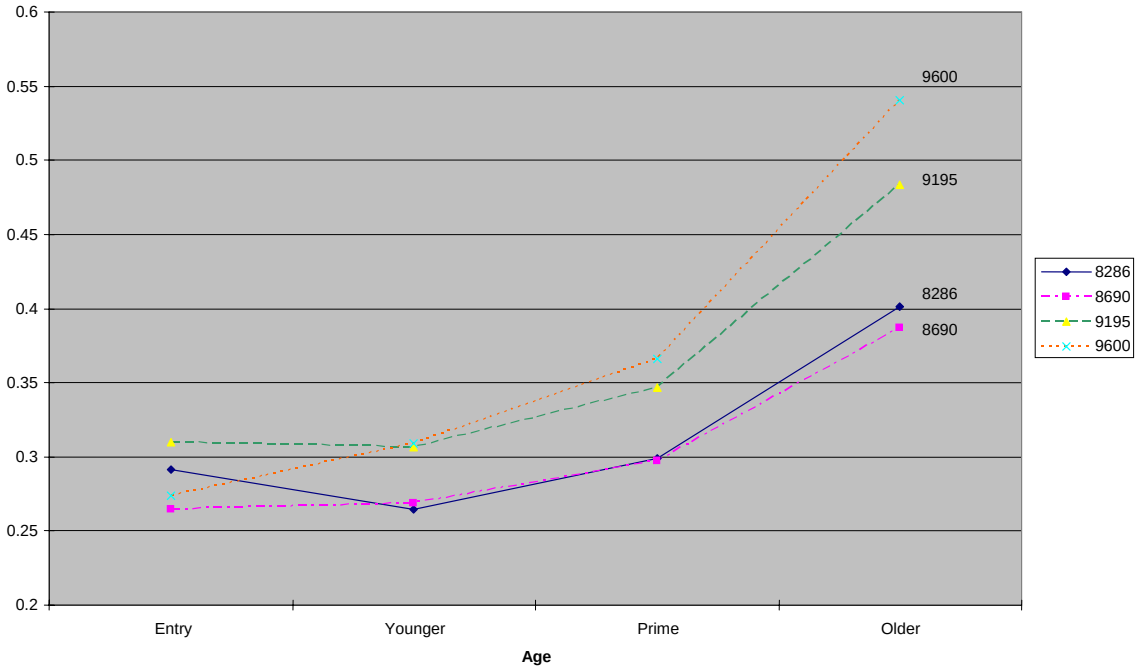

Figure 7 - Women - Total Variance

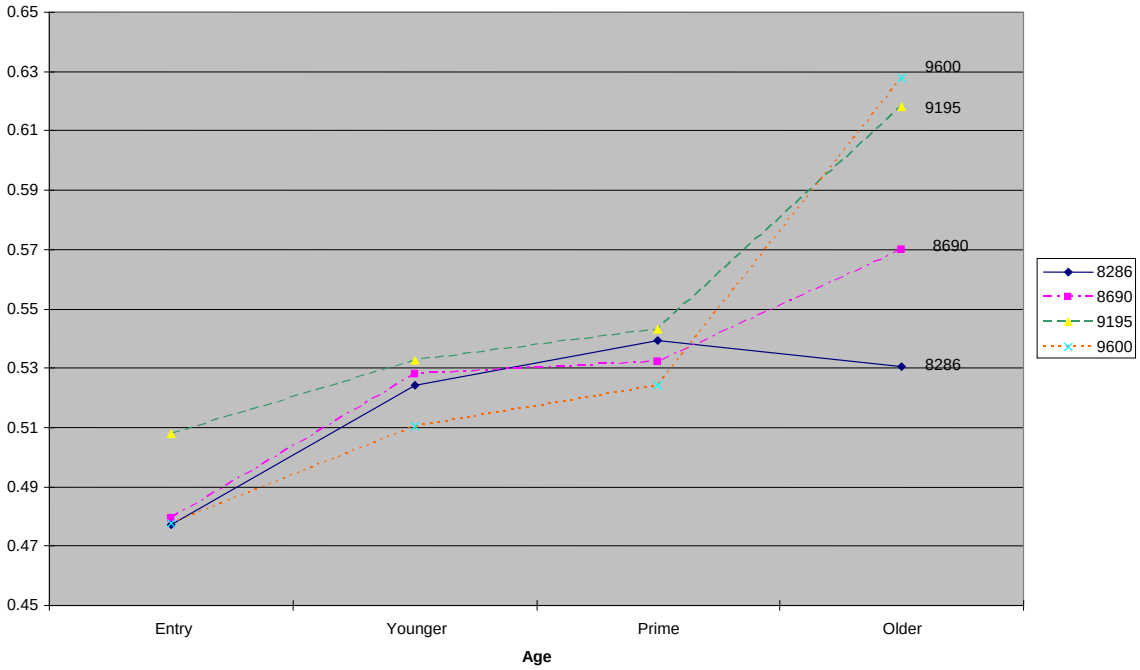

Figure 8 - Women - Transitory Variance

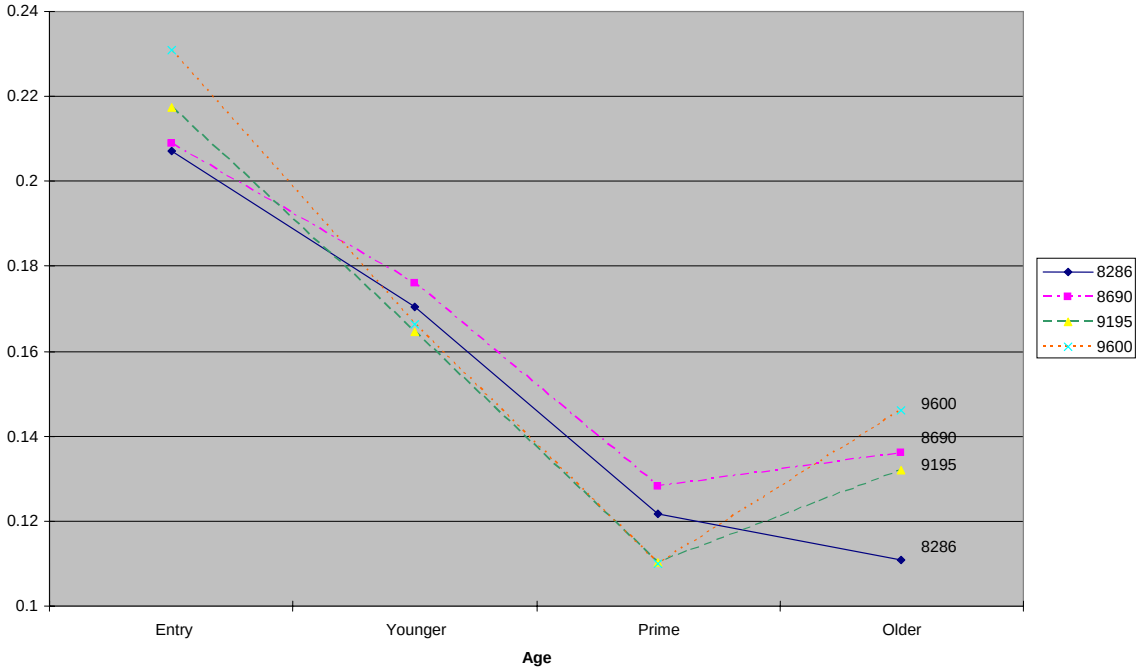

Figure 9 - Women - Permanent Variance