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## ABSTRACT

### **The Evolution of the Returns to Human Capital in Canada, 1980-2005\***

We examine the evolution of the returns to human capital in Canada over the period 1980-2005. Our main finding is that returns to education increased substantially for Canadian men, contrary to conclusions reached previously. Most of this rise took place in the early 1980s and since 1995. Returns to education also rose, albeit more modestly, for Canadian women. Another important development is that after years of expansion, the wage gap between younger and older workers stabilized after 1995. Controlling for work experience and using Canadian Census data appear to account for the main differences between our results and earlier findings.

JEL Classification: J24, J31

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## **Introduction**

The purpose of this paper is to provide a comprehensive and up-to-date examination of the evolution of the returns to education and experience in Canada over the past 25 years. Particular emphasis is given to the returns to education.

Good and reliable estimates of the returns to human capital, in general, and the returns to education, in particular, are essential for assessing the benefits of the large investments in human capital made by local, provincial and federal governments in Canada. Furthermore, in order for the market for education to function well, it is essential for individuals contemplating investments in education to know the kinds of returns they should expect on these investments. This is particularly important in an era of rising tuition fees. We cannot expect as many young people to continue attending colleges and universities in the face of rising costs, unless they are aware of large pecuniary benefits associated with these costly investments.

Unfortunately, the existing Canadian literature on the returns to education presents a somewhat confusing picture. On the basis of studies such as Freeman and Needels (1993), Murphy, Riddell and Romer (1998) and Burbidge, Magee and Robb (2002) it is widely believed that, for the labour force as a whole, the wage gap between more- and less-educated workers remained stable during the 1980s and 1990s. Indeed, Burbidge et. al. (2002) conclude that the education wage premium – the gap in earnings between university-educated workers and those with less than a university degree – was approximately constant for males over the period 1981-2000 and declined for females. In contrast, Boudarbat, Lemieux and Riddell (2006) conclude that education wage differentials (adjusted for experience) increased substantially over the period 1980-2000.

They find that the education wage premium rose for both men and women, although the gains for women were more modest.

Differences across studies are even more evident when one examines specific demographic groups. Burbidge, Magee and Robb (2002) find that the return to schooling remained stable for young men during the decades of the 1980s and 1990s. This appears to contradict studies by Bar-Or et al. (1995), Beaudry and Green (1998), Card and Lemieux (2001) and Boudarbat, Lemieux and Riddell (2006) that all find that the return to schooling grew substantially for young men during the 1980s and early 1990s.

The main objective of this paper is to reconcile these divergent conclusions about the behaviour of the returns to education in Canada. We focus in particular on accounting for the different findings of the two most recent studies – those of Burbidge, Magee and Robb (2002) and Boudarbat, Lemieux and Riddell (2006). Another important contribution of the paper is to update earlier work using the recently released 2006 Census. We also examine the evolution of the returns to experience and estimate the returns to education for a broader set of outcomes such as annual earnings, annual weeks of work, and the probability of being employed any time over an entire year.

### **Measuring returns to human capital**

Human capital refers to the skills, knowledge and competencies of individuals. Although a person's human capital is the outcome of many influences, we focus on two key influences – formal education and work experience (or age). Acquisition of skills and knowledge has many consequences for individuals and society. Private benefits to the individual include higher lifetime earnings, reduced unemployment, greater employment opportunities, improved health and longevity, and inter-generational benefits that accrue

to one's children in the form of higher education and improved health. For many people there is also some "consumption value" associated with learning new skills and acquiring additional competencies. Social benefits include increased civic participation, reduced criminal activity, government tax revenue from higher earnings, and contributions to higher average living standards that arise from increased innovation and technological change as well as spillover effects from higher education that raise the productivity and earnings of others.<sup>1</sup> In this paper we will restrict our attention to the private benefits to the individual in the form of higher earnings and employment. Thus we will not attempt to estimate the social returns to education and experience, nor will we provide estimates of the total private returns. Nonetheless, the impacts of education and experience on lifetime earnings are among the most important consequences of human capital investments, and are thus a suitable focus for investigation.

Even when we restrict our attention to the employment and earnings impacts, there are several dimensions to the "return" to human capital investments and therefore several ways of estimating these returns. It is helpful to discuss these in the context of a specific example – the return to attending university compared to entering the work force at the completion of high school. One important distinction is that between the average return and the marginal return to a university education. The average return – which is what we estimate in this paper -- is based on a comparison of the average lifetime earnings streams of all university graduates to the average lifetime earnings experienced by all those who enter the workforce after completing high school. This measure corresponds to what is called the "average treatment effect on the treated" in the evaluation literature. It is based on a comparison of the average outcome experienced by

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<sup>1</sup> See Riddell (2007) for a survey of evidence on private and social benefits of education.

those who received the treatment -- in this case a university education -- to the average outcome experienced by those who did not receive the treatment – in this case those who ended their formal education upon completing high school. In contrast, the marginal return is based on the earnings gain that would be observed if an additional high school graduate were to attend university. The average return is the relevant measure if one is interested in knowing the return on existing investments in higher education. However, for some purposes the marginal return is the more relevant measure. For example, if government is considering expanding the university system to allow additional students to enroll, it is the return at the margin that matters for this decision rather than the average return experienced by those who are already attending (or have attended) university.

Another noteworthy feature of the consequences of additional education and experience is that there are “price” and “quantity” dimensions. In our example, the price dimension is the difference in the market wage rate of university graduates compared to that received by high school graduates. This “skill premium” or wage differential reflects the higher value placed by the labour market on those with additional education. The quantity dimension involves differences in the amount of work activity undertaken by those with different levels of education – such as hours of work per week, weeks worked per year, or years worked over the lifetime. Although both the price and quantity dimensions contribute to the total returns to human capital investments, in this paper (as is the case in most of the empirical literature) we devote most of our attention to providing estimates of the price dimension – the earnings differentials between groups of individuals with different levels of education and experience. The reason for focusing on the “skill premium” is that this is a clean measure of the impact of higher education on

individuals' lifetime opportunities. That is, on average a university graduate faces a higher market wage rate over the lifetime than does a high school graduate, and this market wage differential is the product of market forces influencing the demand and supply of university and high school graduates. It is a measure of the greater earnings opportunities available per unit of time to university graduates relative to high school graduates. In contrast, the quantity dimension may partly reflect differences in opportunities by educational attainment but also reflects the choices that individuals make about how much time to devote to market work. In economists' terminology, the quantity dimension is at least in part "endogenous" while the market wage differential is exogenously determined by market forces.

A further observation is that, when comparing the earnings of groups with different levels of education it is usually important to also control for other factors that may influence earnings. Otherwise the differences in earnings between two educational categories may understate or overstate the true returns to education. For example, because of rising educational attainment over time, older (and thus more experienced) workers are generally less well educated than younger, and less experienced, workers. Comparing the earnings of the well educated to the less well educated will tend to understate the true impact of education if one does not control for differences in labour market experience.<sup>2</sup>

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<sup>2</sup> Note that an individual wanting to assess the costs and benefits of additional education should use the adjusted returns, but should also take into account the opportunity cost of acquiring additional education. For example, a high school graduate considering entering university should use the adjusted earnings differential between university and high school graduates as an estimate of the earnings premium associated with higher education, but should also take into account the fact that entry into the workforce and the accumulation of work experience will be delayed by four years.

Furthermore, a well known fact due to Mincer (1974) is that returns to education tend to grow as a function of age because earnings-experience profiles are concave.<sup>3</sup> An important implication of this fact is that in an aging population, returns to education that are not adjusted for experience will appear to grow even if actual returns faced by a given individual with a given level of experience remain unchanged. Given the rapid aging of the Canadian population, failure to control for labour market experience can result in spurious changes in the returns to education. To illustrate the importance of these points, we present both raw (unadjusted) and adjusted measures of the return to education. More importantly, we show that whether or not one controls for experience goes a long way towards explaining the different trends in the returns to education that have been documented in earlier studies.

Although we control for observed differences among educational groups, there may also be unobserved differences such as motivation, ability and perseverance that we cannot take into account with available data. If such unobserved factors influence both educational attainment and earnings, standard OLS estimates that do not control for such factors will be biased estimates of the true causal impact of education on earnings. It should also be noted that educational attainment is measured with error in most surveys, and that measurement error biases the OLS estimates downward, thus at least partially offsetting any upward bias due to unobserved ability and motivation. Although there is some debate about the magnitudes of these biases, recent surveys suggest that the net

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<sup>3</sup> Since earnings grow faster earlier than later in one's career (concavity of the experience-earnings profile), young workers having just completed a university degree do not tend to earn much more than high school graduates of the same age. The reason is that high school graduates have experienced strong earnings growth in their first few years in the labour market while their university-educated peers were still in school. The gap grows rapidly, however, as the earnings of university graduates increase quickly in their first few years after entering the labour market.

effect of these offsetting forces is that there is a modest (e.g. 10-15%) upward bias in the OLS estimates (Card, 1999, 2001).

### **Data source: 1981-2006 Census**

One reason for the divergent conclusions reached by previous studies may be differences in the data sources employed. We believe that the Census is the best data source for documenting trends in the wage structure in Canada. One reason for this belief is that from 1981 to 2006 the Census has been collecting fairly consistent information on educational attainment, as well as earnings and work experience during the previous year and other socio-economic characteristics of individuals. In contrast, the Survey of Consumer Finances (SCF) – the data source used in much previous Canadian research, including the study by Burbidge, Magee and Robb (2002) – suffers from the disadvantage that the educational attainment questions changed several times over the years, in some cases very dramatically. In addition, the SCF was, unfortunately, discontinued in 1997 and cannot be used to study recent developments.

Another advantage of the Census is that the information on educational attainment is unusually rich. The Census provides detailed information on years of schooling (except in 2006) as well as all degrees and diplomas received. The information on years of schooling allows the researcher to construct a precise measure of (potential) experience. In contrast, the SCF does not contain information on years of schooling so work experience is generally imperfectly proxied by age.

The Census also provides large sample sizes, and is much less affected by non-reporting of earnings and other information at the bottom of the income distribution, a problem that has been identified in the SCF (Frenette, Green and Picot, 2006).

Because of these advantages, the analysis in this paper employs Census data. A major contribution of the paper is to use the recently released data from the 2006 Census to provide updated information on the returns to human capital until 2006.<sup>4</sup>

Unfortunately, two important changes introduced in the 2006 Census create some comparability problems with the 1981-2001 data. First, respondents who are required to complete the “long form” (Form 2b) of the Census are now given the opportunity of allowing Statistics Canada access to their income tax records instead of self-reporting the income items as was the case with earlier Censuses. Over 80 percent of respondents in the 2006 Census did permit access to their tax records (Statistics Canada, 2008). As a result, the information on income and earnings is not strictly comparable to previous Census data.<sup>5</sup>

Second, the information on educational attainment was simplified in 2006 relative to the 1981-2001 Censuses. While it was possible to precisely identify the number of years of schooling in the earlier Censuses, the only information available in the 2006 Census is the highest diploma or degree obtained. As a result, it is no longer possible to precisely compute years of potential experience. This also limits the number of educational categories that can be used in our empirical analysis. For example, all workers without any certificate or diploma are pooled in the same educational category, irrespective of whether they have one or eleven years of schooling. We are nonetheless

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<sup>4</sup> We use the master files (20 percent sample) of the 2006 Census since the public use files had not been released at the time this paper was written.

<sup>5</sup> According to Statistics Canada (2008), comparability problems are significant for workers more marginally attached to the labour market. Since we focus on workers with a strong attachment to the labour market (full time workers and, in some cases, full-time/full-year workers), the comparability problems should not have much impact on our results.

able to construct five education categories (see below) that are consistent over time, and construct some proxies for labour market experience.<sup>6</sup>

### **Measurement of earnings differences: mean versus median**

There are several other differences in the methods used in earlier studies that may also contribute to different findings. Another potentially important difference is that Burbidge, Magee and Robb (2002) use median earnings of high and low education groups to measure the education wage premium, while Boudarbat, Lemieux and Riddell (2006) follow the more common approach of using mean earnings. We investigate the importance of this feature by comparing measures of the returns to education based on both median and mean earnings.

A more fundamental question is which of the two measures of central tendency is preferred. A potential problem with the use of the median is that it is relatively unaffected by increases in the returns to education that take place in the top part of the wage distribution. Since highly educated workers are mainly located in the top half of the earnings distribution, this is a potentially important limitation of median-based measures. Furthermore, there is evidence that much of the growth in wage inequality during these two decades occurred in the very top of the earnings distribution (Saez and Veall, 2005). Such changes may have little effect on the median earnings of high and low educated workers.

Burbidge, Magee and Robb (2002) use median earnings to avoid dealing with top-coding problems in U.S. data in arbitrary ways and to reduce the influence of measurement error in the top decile of the SCF data noted by Kuhn and Robb (1998).

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<sup>6</sup> We compute average years of schooling for each detailed age-education category in the 2001 Census, and use this measure to impute years of schooling in each corresponding category in the 2006 Census. Years of potential experience are then computed using the usual Mincer formula ( $\text{age} - \text{years of education} - 6$ ).

However, the measurement error issue (division bias) that was raised in the context of a labour supply model by Kuhn and Robb (1998) should not affect measures of the mean earnings gap. Furthermore, there are other ways of dealing with top-coding problems that have been shown to be robust in U.S. data. Thus, in the presence of such problems, one does not have to employ median-based measures.

### **The role of work experience**

Another potentially important difference between the Burbidge, Magee and Robb (2002) and Boudarbat, Lemieux and Riddell (2006) studies is that the former study does not control for experience, and controls only crudely for age, whereas the latter study regression-controls (separately) for both age and experience. An important advantage of the Census data is that it allows the researcher to construct a measure of potential experience. In our previous study we found that controlling for age or experience – especially the latter – makes an important difference to measures of the return to education based on mean earnings. We also explore this issue in this paper with median-based measures by using median regressions.

In addition to providing a comprehensive and up-to-date examination of the evolution of the returns to education, we also examine the evolution of the returns to experience. The behaviour of the returns to experience has not been examined in Canada since the study by Beaudry and Green (2000) based on SCF data up to the mid-1990s. We believe that it is important to assess the recent behaviour of the returns to experience, not only to have current information but also because the latter half of the 1990s saw a major change in the earnings of younger workers relative to those of older workers. In

addition, as mentioned previously, the Census data provide a measure of experience whereas with SCF data one has to rely on age as a proxy for experience.

### **Empirical analysis of Census data**

The analysis employs public use data from the 1981, 1986, 1991, 1996 and 2001 Censuses and master file data from the 2006 Census. Following the existing literature, we focus our analysis on “adults” age 16 to 65 at the time of the Census (June).<sup>7</sup> The Census provides detailed information on all degrees, diplomas and certificates obtained. Using this information we classify workers into five education groups: less than a high school diploma, high school diploma, post-secondary degree or diploma below a university bachelor’s degree (including trade certificates), university bachelor’s degree, and post-graduate degree (Masters, PhD, and professional degrees).<sup>8</sup>

The information in the Census on annual hours of work is limited. As a consequence, we cannot measure average hourly wages by dividing annual earnings by annual hours of work. We therefore follow Card and Lemieux (2001), Boudarbat, Lemieux and Riddell (2006) and many U.S. studies such as Katz and Murphy (1992) that use weekly earnings of full-time workers as the principal measure of wages.

Following most of the literature, we use only wage and salary earnings for computing weekly earnings of full-time workers. Another frequent practice that we do not adopt is to restrict the sample to “full-year” workers – those who worked at least 49

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<sup>7</sup> The information on weeks worked and annual wage and salary earnings refer to the previous year. Thus the individuals in our samples were age 15 to 64 during the period to which our wage measures apply.

<sup>8</sup> The classification into five education categories is not as detailed as Boudarbat, Lemieux, and Riddell (2006) who divide workers into seven education groups using 1981-2001 Census data: 0-8 years of elementary schooling, some high school, high school diploma, some post-secondary education, post-secondary degree or diploma below a university bachelor’s degree (including trade certificates), university bachelor’s degree, and post-graduate degree (Masters, PhD, and professional degrees). Fortunately, the trends in the university-high school gap are very similar for the period 1981 to 2001 using the 5- or the 7-categories classification.

or 50 weeks during the previous year. The reasons for using this sample restriction are historical and no longer apply.<sup>9</sup> However, for completeness and comparability with other studies, we report some results using all earnings (wage and salary and positive self-employment earnings), as well as results when the sample is restricted to full-year workers.

In the Census public use data, earnings are top-coded for a small proportion (less than one percent) of respondents with very high earnings. Over time Statistics Canada alters the top-code value so that it remains approximately constant in real terms. Since there is no top coding in the master file of the 2006 Census used in this paper, we topcode these data ourselves to keep the sample comparable over time.<sup>10</sup> We also trim all wage observations with weekly earnings below \$75 (in 2000\$) because these imply implausible values for hourly wages.<sup>11</sup>

As noted previously, we report both raw (unadjusted) and regression-adjusted measures of the returns to education. These measures are obtained separately for males and females because both the magnitudes and trends differ by gender. For ease of interpretation the estimated returns are shown graphically. The unadjusted returns to education are simply the difference between the average log earnings of a specific education group and the average log earnings of high school graduates, referred to as the

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<sup>9</sup> Prior to 1981, it was not possible to compute average weekly earnings since the Census only reported annual weeks of work in a few intervals. The U.S. Census and Annual Demographic Supplement of the March Current Population Survey also used to follow that practice. Given these data limitations, focusing on “full-time/full-year” workers used to be the most sensible way of obtaining a reasonable proxy for hourly wages of workers.

<sup>10</sup> After some experimentation, we decided to apply a uniform topcode corresponding (in real terms) to the topcode of \$200,000 used in the 1996 census.

<sup>11</sup> Since full-time workers work at least 30 hours a week, a full-time worker earning \$75 a week makes at most \$2.50 an hour. This represents less than half of the minimum wage in any province in 2000.

percentage wage difference between the two groups.<sup>12</sup> The adjusted returns are obtained by regressing log wages on four educational attainment dummies (high school graduates is the omitted reference category) and a quartic in potential experience (age minus years of completed schooling minus 6).<sup>13</sup> Separate regressions are estimated for men and women in each year. The detailed information on years of schooling provided in the 1980 to 2000 Censuses is used to construct the measure of potential experience.

### **Returns to education**

The unadjusted wage differentials are shown in Figure 1a. For simplicity we refer to those with a university bachelor's degree and no additional post-secondary education as "BA graduates" even though this group includes those with other degrees such as B.Sc. or B. Ed. Similarly, we call those with a non-university post-secondary diploma or certificate "PS graduates". This heterogeneous group includes graduates of CEGEPs and community colleges as well as those who completed a trade school program.

Perhaps the most striking result in Figure 1a is the sharp increase in the return to a university BA over the past 25 years, from a wage differential of 32% in 1980 to 40% in 2005. Almost all of this increase took place during the period 1995 to 2005, although a smaller rise also occurred between 1980 and 1985. The modest change in the unadjusted BA-high school gap between 1980 and 1995 is consistent with Burbidge et al. (2002) who find little change in this gap using SCF data for a similar period.

The earnings gap between high school graduates and those with postgraduate and professional degrees is much larger – over 50 percentage points – but was more stable

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<sup>12</sup> The difference in log wages provides a close approximation to the percentage difference in wages.

<sup>13</sup> As in Boudarbat, Lemieux, and Riddell (2006), we collapse the data into age-education cells and run regressions on cell means using the number of observations in the cell as weight. This is equivalent to running the same regressions on the raw micro data.

over this 25-year period, increasing modestly from 51% to 54%. There is also an upward trend in the return to a post-secondary diploma, albeit less dramatic than that associated with university BA programs. At the bottom of the educational distribution, men with less than a high school education earn a bit less than their counterparts who completed high school. The earnings difference between high school dropouts and graduates was small over the period 1980 to 1995 but widened recently to almost 10%. Taken at face value, Figure 1a suggests that for men the returns to completing high school were very small during the 1980s and 1990s.

Figure 1b shows the corresponding (experience) adjusted earnings differentials. For most educational categories controlling for differences in potential experience has important consequences for the pattern of education differentials. The principal exception is that of university BA graduates, for whom adjusting for experience has little impact on the return to university education. As was the case for the raw wage gap, the return to a university BA increases from 32% to 40% over the sample period. Controlling for experience has a large impact on the estimated returns to other educational programs. The adjusted earnings gap between workers with university post graduate and high school education is smaller than the unadjusted differential – in the 40% to 50% range rather than 50% to 60%. An even more dramatic decline is evident for the PS – HS earnings differential – the estimated return to a postsecondary diploma falls by close to one-half once we control for work experience. Finally, the earnings differential between high school graduates and high school dropouts becomes much larger when we adjust for differences in work experience between these two groups. The adjusted differentials

make clear that there was a substantial economic return to completing high school throughout the 25-year period.

The differences between the adjusted and unadjusted returns to schooling are attributable to the fact that the labour force has become increasingly educated over time. For example, most of the workers with less than high school education are older and more experienced. Thus the earnings of this group relative to high school graduates decline substantially when experience is held constant. More generally, because younger cohorts are more highly educated, secular growth in educational attainment generates a negative correlation between schooling and experience. As a consequence, returns to education are biased when controls for experience are not incorporated in the analysis.

Accounting for work experience results not only in substantial changes in the average levels of the returns to schooling, but importantly it also results in significant changes in the time patterns of returns. A noteworthy feature of Figure 1b is clear evidence of upward trends in the wage differentials between education groups with more than secondary schooling and high school graduates. The BA – HS adjusted gap rises by 8 percentage points, an increase of 25% on the 1980 level (32 percentage points). The PS – HS differential also grows by 8 percentage points from 6.5% to 14.4%, an increase that is even more substantial in percentage terms than that for university BA graduates. Finally, unlike the university post-graduate – HS unadjusted differential, which was relatively stable over time, the adjusted returns to a post-graduate or professional degree increase by about 6 percentage points over the period 1980 to 2005.

Figures 1a and 1b show that the returns to education for Canadian men – as measured by the wage premium relative to high school graduates -- have been steadily

growing between 1980 and 2005. But while the growth in unadjusted differentials among education groups is most evident for non-university post-secondary and university bachelor's graduates between 1995 and 2005, the growth in adjusted wage gaps takes place more evenly throughout the 25-year period. Furthermore this upward trend in the returns to education is evident among all groups with educational attainment beyond high school, whereas the rise in the unadjusted gap is most evident for only the BA – HS differential. After controlling for experience, only the earnings gap between those with elementary or incomplete secondary schooling and those with a high school diploma does not widen over this time period.

Figures 1c and 1d contain the unadjusted and adjusted results for women. These differ in two key ways from those for men. First, returns to education are systematically larger for women, a finding that has also been reported in other Canadian studies such as Ferrer and Riddell (2002). For example, the adjusted wage premium associated with a university BA was 45% for women in 1980 versus 32% for men. In 2005 the comparable BA – HS adjusted differentials were 51% and 40%. Second, compared to those for men, adjusted education wage differentials among women were more stable over the period 1980 to 2000, though they did widen considerably between 2000 and 2005. Another noteworthy feature of Figure 1c is that un-adjusted education wage differentials were relatively stable over the period considered by Burbidge et al. (2002), as was the case for men.

The largest increase is that for the BA – HS wage differential, which grows by 6 percentage points from 45% to 51%. The earnings premium associated with a post-secondary diploma rises by 3 percentage points (from 12% to 15%), as does the premium

associated with a post-graduate or professional educational program. At the bottom of the education distribution, the adjusted gap between high school dropouts and graduates is stable at around 20% over the period 1980 to 2000, before widening to 25% in 2005.

Because the increases in female education wage differentials have been more modest than those for males, some convergence between the returns to education of men and women has taken place between 1980 and 2005. Nonetheless, at the end of our sample period the returns to education remain significantly larger for women than men.

Comparing Figures 1c and 1d reveals that adjusting for experience has a substantial impact on some of the educational wage differences, albeit a smaller impact than was found for men. Among women, controlling for work experience has the largest effect at the bottom of the education distribution and the smallest at the top. The adjusted wage differentials also reveal more of an upward trend over the 25-year period than do their unadjusted counterparts, a feature that was also evident (indeed, more evident) for men.

The differences between unadjusted and adjusted returns to schooling highlight the importance of controlling for other influences (in particular, experience) when comparing average earnings among education groups. Accounting for differences in work experience alters both the magnitudes of earnings differentials and their movements over time.

Note that, thanks to the large Census samples, most of the changes in educational wage gaps between 1980 and 2005 are statistically significant. Table 1 reports these estimated changes along with significance levels. In the case of the experience-adjusted

gaps, all the changes between 1980 and 2005 are statistically significant at the 5 percent level, and most are significant at the 1% level.

### **Returns to age/experience**

Education and experience are the two main sources of human capital that influence productivity and earnings. Experience is highly correlated with age. Although experience is more relevant to understanding earnings, we focus in this section on age-wage differentials for comparability with earlier studies. Figures 2a and 2b report the unadjusted and adjusted wage differentials between men age 46-55 and men of other age groups.<sup>14</sup> The adjusted wage gaps are calculated by regressing log wages on a set of age dummies. The regression also controls for education using dummies for the five education categories. Men age 46-55 are chosen as the reference group since they usually have higher earnings than other age groups. Both figures show a substantial expansion in the wage gap between younger workers (especially those aged 16-25 and 26-35) and older workers between 1980 and 1995. This finding accords with other studies such as Morissette (2002), Beaudry and Green (2000), and Picot (1998) who also found that returns to age/experience grew significantly over the period 1980-1995.

However, as Figures 2a and 2b show, relative wages of younger workers stabilized after 1995. Between 1995 and 2000 there was a marked reversal in earlier trends, indicating that young workers did relatively well in terms of earnings during the economic expansion of the late 1990s. Most of this improvement in relative earnings was given up during the next five years; nonetheless, overall, some recovery in the earnings of younger workers took place during the past decade.

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<sup>14</sup> We employ age categories such as 46-55 years of age as of the survey date so that the age of the respondents during the time period when wages are measured correspond to the standard age groupings used by Statistics Canada (in this case ages 45-54).

The growth in earnings inequality between younger and older workers is dramatic and has received much attention. However, it is worth noting that there is substantially less growth in age-wage gaps when adjusted wage differentials are used instead of unadjusted differentials. The principal reason for this pattern is the slowdown in growth in educational attainment among Canadian men born after 1950. To illustrate this point consider the wage gap between workers age 26-35 and 46-55. In 1995, both the adjusted and unadjusted wage gaps were about 28 percent. The finding that controlling for education has no impact on the wage gap implies that workers age 26-35 and 46-55 have similar levels of education. In contrast, in 1980 the unadjusted gap (12 percent) was substantially smaller than the adjusted gap (19 percent), indicating that in 1980 younger workers were more educated than older workers. This pattern of results reflects a more general phenomenon. Card and Lemieux (2001) show that, in both Canada and the United States, educational attainment of men born after 1950 (age 30 in 1980) has stagnated. This slowdown explains why the unadjusted wage gap grew almost twice as fast as the adjusted gap between 1980 and 1995.<sup>15</sup>

The patterns exhibited by female age-wage differentials, shown in Figures 2c and 2d, have some features common to those of men but also display important differences. The most salient similarity is the substantial growth in wage inequality by age over this period. Indeed, both unadjusted and adjusted age-wage differentials increase substantially more for women than men over the period 1980-95. Furthermore, in contrast to the case for men, these differentials widen further between 1995 and 2005. Although the earnings gap between younger and older workers increases more for women, the magnitudes of these gaps are larger for men -- in contrast to what was observed in the case of

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<sup>15</sup> This conclusion was also reached by Morissette, Picot, and Kapsalis (1999).

educational wage differentials. The smaller age-wage differentials for women likely reflect the well-known fact that returns to age, or potential experience, are lower for women, who typically accumulate less actual experience than do men over the life-cycle (Mincer and Polachek, 1974).<sup>16</sup> The fact that younger cohorts of women are increasingly attached to the labour market may thus account for much of the growth in age-wage differentials for women. The patterns of female wage differentials by age group are becoming increasingly similar to those of men.

### **Comparing means and medians**

As mentioned earlier, an important difference between our study and Burbidge, Magee and Robb (2002) is that they look at median wages, whereas we focus on more standard wage differentials based on comparisons of mean wages. While means and medians often yield similar results, some recent evidence by Chung (2006) shows that using medians tends to understate the growth in returns to education in Canada. Using the same Census data as we use here for 1980 and 2000, Chung (2006) finds that mean weekly earnings of full-time men age 35-54 grew by 16.3 percentage points more for men with a university degree than for men with only a high school diploma. In contrast, the median weekly earnings for the same group of university-educated men grew by only 5.0 percent more than for men with only a high school diploma. The results are similar for women. Using means indicates a 1.7 percentage point decline in the university-high school gap for full-time women age 35-54, compared to a 9.3 percentage point decline when using medians. These numbers suggest that using medians as opposed to means makes a large difference, and may explain the difference between our findings and those of Burbidge, Magee and Robb (2002).

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<sup>16</sup> Another possibility is that women are concentrated in occupations with less potential for wage growth.

It is important to note, however, that Chung (2006) works directly with earnings without taking the log transformation. This is of little consequence for medians, since the log of median earnings is equal to the median of log earnings. For means, however, the log of the mean is not equal to the mean of the logs. Furthermore, there are good reasons to expect that the log of mean earnings has been growing much faster than the mean of log earnings because of the dramatic increase in earnings at the very top end of the distribution (Saez and Veall, 2005). The reason is that taking the log transformation before averaging tends to reduce the influence of very high values of earnings.

With these considerations in mind, we now look directly at the gap in median log wages by education group. Figure 3a reproduces the raw education wage differentials for men, except that the median is now used instead of the mean. As in the case of means, we also present estimates of wage gaps in medians adjusted for experience. We do so by running median regressions where the explanatory variables used are education dummies and a quartic in experience, as in the models for conditional means.<sup>17</sup> The adjusted median gaps for men are reported in Figure 3b. The difference between means and medians is shown more explicitly in Table 1 that compares changes in the wage differentials for the two measures.

Over the period 1980 to 2005 there is evidence of substantial widening of male educational wage differentials based on medians as well as means. Indeed, use of medians produces larger increases in male wage inequality by education, especially in the case of measures that do not control for experience. When the (preferred) adjusted

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<sup>17</sup> As in the case of the other regressions, we run the median regressions using the median in each age-education cell as dependent variable, and using cells counts as weights. Unlike the case of means, however, running these cell models this does not exactly yield the same result as what would be obtained by running standard median regressions using the micro data. Angrist et al. (2006) show, however, that there exists a set of weights such that the two regression procedures yield the exact same results.

measures are employed the evolution of male wage gaps over this 25-year period is broadly similar whether one uses means or medians. For example, the adjusted wage gap between male university BA graduates and high school graduates increases by 8.7 percentage points whether the estimates are constructed using means or medians. For the non-university post-secondary and university post-graduate categories the growth in the adjusted wage differential is noticeably greater using medians. Similar results for women are reported in Figures 3c (unadjusted median gaps) and 3d (experience-adjusted median gaps). The most noteworthy result – also evident in Table 1 -- is that adjusted wage differentials increase for all education groups, albeit more modestly than is the case for men. Differences in the adjusted gaps between means and medians are generally modest, and in most cases the median measure produces somewhat larger increases in adjusted differentials. As was the case for men, the choice between medians and means matters much more for unadjusted earnings differences.

In summary, use of medians rather than means does not alter the conclusion that educational wage differentials have widened for both men and women over the past 25 years. Indeed, with the exception of the BA-HS wage gap, adjusted median wage gaps increase more than adjusted mean wage gaps for individuals with education above high school. Even so, the differences between adjusted measures based on means and those based on medians are not substantial. Generally these differences are 1 to 1.5 percentage points over the period 1980-2005.

### **Alternative earnings measures**

In this section we investigate the sensitivity of our results to the choice of earnings measures. As discussed previously, we focus principally on the weekly wage

and salary earnings of full time workers because this provides the cleanest measure of the “skill premium” associated with higher levels of education and experience. However, education and experience also influence employment opportunities and the likelihood of experiencing unemployment. The broader measures of earnings that we examine in this section include both quantity dimensions of the return to human capital as well as the price dimension captured in the skill premium. Thus the purpose of this section is to check the robustness of our previous findings to alternative measures, and to see whether use of broader earnings measures results in under-statement or over-statement of the returns to education and experience. To keep the volume of results manageable we focus on the adjusted earnings differential between university BA and high school graduates.

Figures 4 and 5 show the evolution of the high school – BA earnings gap using four different earnings measures available in the Census data, together with the benchmark earnings differential used in the previous analysis (based on the weekly wage and salary earnings of full time workers). In Figure 4 we show total earnings (wages, salaries and positive self-employment earnings) instead of wage and salary earnings alone. Also shown are results for full-year full-time workers (FYFT) in addition to those for full-time workers.<sup>18</sup> For women the four measures are very similar in magnitude and move closely together over the sample period. For men the inclusion of self-employment income makes little difference to the earnings gap and to its evolution over time. However, the restriction to FYFT workers does result in somewhat larger earnings differentials at each point in time and greater growth in the earnings differential over the period 1980-2005.

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<sup>18</sup> We use the conventional definition of full-year of working at least 49 weeks during the year.

In Figure 5 we broaden the earnings measures further by including earnings of all workers, rather than restricting the sample to full-time workers. These measures – both wage and salary earnings and total earnings -- thus include those who work part-time as well as those who work part-year. Thus here we are including the effect of education on weekly hours of work as well as the “skill price” of labour. The inclusion of all workers results in much higher returns to education for both men and women, and for greater growth in the earnings differentials over the period 1980-2000, especially for women.<sup>19</sup> As before, inclusion of self-employment earnings makes very little difference for females and a small difference for males. However, inclusion of part-time workers makes a big difference to both the magnitude of the earnings differential and to its growth over time. Those with higher education work more hours per week in addition to earning more conditional on working full-time.

In Figure 6 we broaden the analysis further by examining four annual measures: wage and salary earnings, total earnings (wages, salaries and self-employment earnings), weeks worked, and an indicator variable for whether or not the individual worked during the previous year (i.e. had positive weeks of work). For both men and women the use of annual earnings rather than weekly earnings results in larger differentials between the two education groups. For example, in 1980 the weekly wage and salary earnings differential is 34 percent for full-time male workers and 38 percent for all male workers, as shown in Figure 5a). The gap based on annual earnings is much larger – a premium of 47 percent. There is also substantial growth in the annual earnings differential over the 1980-2000 period for both genders, despite a decline in the gap between 1995 and 2000. For women

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<sup>19</sup> Statistics Canada advises against comparing the 2006 and earlier Census for workers not strongly attached to the labour market (Statistics Canada, 2008). Accordingly, the results for all workers in Figures 5 and 6 are shown for the period 1980 to 2000.

the adjusted annual earnings differential increases from about 62 percent to about 70 percent, while for men the gap rises from 47 percent to approximately 53 percent. Thus the return to higher education consists not only of a weekly earnings premium, but also increased amount of work during the year.

The measures of the return to education based on annual earnings are also more sensitive to the business cycle. In periods during which the economy is weak, such as 1985 (when the Canadian economy was recovering from the 1981-82 recession) and 1995 (when the economy was recovering from the 1990-92 recession) the earnings differential widens, reflecting the fact that weak economic conditions exert a greater adverse effect on those with less education. Similarly, when economic conditions are buoyant – such as in 1980 and, especially, in 2000 when the Canadian economy reached a cyclical peak -- the earnings differential narrows, reflecting the fact that lower skilled workers benefit relatively more from strong economic conditions.

The gaps in weeks worked and in whether or not one worked during the year are positive for both men and women and much larger for women than for men. These differentials also display sensitivity to cyclical conditions.

In summary, the use of broader measures of the return to education does not alter the principal results from our benchmark analysis based on weekly wage and salary earnings of full-time workers. However, the use of broader measures of the impact of education does increase the magnitudes of the estimated returns, in some cases quite substantially. These increases in the magnitudes of the returns arise because higher education is associated with increased employment – in the form of hours of work and weeks of work over the year – as well as a “skill premium” in the form of higher weekly

earnings. The use of broader measures also tends to result in greater growth in the return to education over the periods 1980-2000 and 1980-2005.

### **Reconciling conflicting findings**

As discussed previously, previous studies of the returns to post-secondary education in Canada paint a confusing picture. The two most recent studies, those of Burbidge, Magee and Robb (2002) and Boudarbat, Lemieux and Riddell (2006) reach strikingly different conclusions. Our findings extend, and generally support, those of our earlier study. In this section we discuss the most likely sources of these divergent results.

Four potential sources of different findings are the data sources employed, the time period covered by the study, the use of measures based on medians rather than means and whether or not experience is controlled for. As we explained earlier in the paper, the Census has important advantages over the SCF, the data used in most previous research. Not only does the Census provide much larger sample sizes, it also uses consistent measures of educational attainment, employment and earnings over the 1980 to 2000 period. We therefore focus on the role of the time period covered by the study and the choice between medians and means.

Table 1 reports results for the period 1980-2000 in order to show the consequences of using medians rather than means during the period covered by the Burbidge, Magee and Robb (2002) study. For men the general pattern is similar to that observed for the full sample period. The growth in unadjusted educational wage differentials based on medians is either the same as or greater than that obtained using means. For all three higher education groups (PS, BA, PG) there is less widening of wage gaps over the 1980-2000 period than over the 25-year period 1980-2005. Nonetheless,

even during the decades of the 1980s and 1990s there is clear evidence of rising returns to post-secondary education based on the raw data, whether one uses measures based on means or medians. Controlling for experience results in increases in estimated returns to education that are at least as large as, and in several cases considerably larger than, estimated based on the raw unadjusted data. This is the case whether one uses medians or means. The differences between our results and those of Burbidge et. al. during the same sample period can thus be attributed to the use of Census data (evident in the fact that we find increasing returns to education for men even with the unadjusted data) and controlling for experience (evident from the fact that education wage differentials increase much more when we control for experience).

In the case of females, the unadjusted differentials suggest that the returns to post-secondary education declined during the decades of the 1980s and 1990s, as was found by Burbidge et. al. The decline in the BA-HS wage gap is larger when estimated returns are based on medians, while the declines in the PS-HS and PG-HS gap are similar whether one uses medians or means. However, controlling for experience changes the results for women from suggesting declining returns to indicating increasing returns to education over the 1980s and 1990s. This is the case whether means or medians are used to estimate these returns.

The results for both males and females thus suggest two key sources of divergent results in the previous literature. One is adjusting for work experience, an adjustment that is facilitated by the fact that the Census provides detailed information on years of completed schooling during the period 1980-2000. The results reported in Table 1 indicate that adjusting for experience makes a bigger difference than using means or

medians. Doing so is particularly important when looking at changes over time for women, but is also important for men.

Our use of the Census is the second source of divergent findings. With Census data there is clearly an increase between 1980 and 2005 in the returns to post-secondary education for Canadian men, with or without controlling for work experience. Note however, that the increase is quite modest between 1980 and 1995 when experience is not adjusted for. For men, the returns increase only from 0.317 to 0.341, which is not very different from Burbidge et al. (2002) who find no change using SCF data for 1981 to 1997. For women, the unadjusted return in the Census decreases from 0.425 to 0.400 which is, once again, not very different from the results based on the SCF.

Burbidge et al. (2002) also extend their analysis beyond 1997 using data from the SLID and the LFS and still find no change in the return to education. This is inconsistent with our findings based on the Census since we find a steep increase in the return to education after 1995 even when experience is not controlled for. So while data sources may explain some of the differences between our results and those of Burbidge et al. (2002), it is important to stress that the results from the Census and the SCF between 1980 and the mid-1990s are not qualitatively very different.

This suggests that controlling for experience appears to be the most important source of differences between our results and those of Burbidge, Magee and Robb (2002). In contrast, using means or medians plays a very modest role when looking at log wages, as is standard practice in the human capital literature that we follow here.

## **Conclusions**

This paper examines the evolution of the returns to human capital in Canada over the period 1980-2005. While particular emphasis is given to the returns to education, we also examine the evolution of the returns to experience (or age). Our analysis is based on the Census because it allows a long time perspective, and provides consistent information on educational attainment, as well as labour market outcomes over the sample period. In addition, we focus on “adults” age 16 to 65 and use weekly wage and salary earnings of full-time workers as our main measure of wages. However, we also examine the impact on results of using broader earnings measures.

Our investigation with Census data yields several noteworthy findings. For men, the economic returns to education – as measured by the skill premium relative to high school graduates -- have been increasing between 1980 and 2005. For example, we find that the raw BA-high school differential rose from 32 percentage points in 1980 to 40 percentage points in 2005. Most of this rise took place in the early 1980s and since 1995. When we control for differences in years of potential experience, the male BA-high school differential also increases by 8 percentage points and, unlike the unadjusted wage gap, it shows an overall positive trend over the period. In addition, throughout the period there is steady growth in (adjusted) returns to schooling among all education groups above high school graduates. The adjusted differential rises by 8 percentage points for non-university post-secondary graduates and 6 percentage points for those with a university post-graduate or professional degree.

This finding contrasts with conclusions of studies based on SCF data that show little change in returns to education for men during the 1980s and 1990s. However, the

rise in the return to education among Canadian men, while significant, is much less dramatic than that experienced in the U.S.

The results for women are quite different from those for men. First, returns to education are systematically larger than for men. Second, among women the growth in the returns to education beyond high school has been less dramatic. The adjusted wage differentials increase over the period 1980-2005, but the increases are more modest than those for men – growth of 3 percentage points for the non-university post-secondary and university post-graduate categories and 6 percentage points for university bachelor's degree graduates. Given the smaller changes in education wage differentials for females, there has been some convergence between the returns to education of men and women. However, returns to education remain larger for women than men.

Regarding returns to work experience, our results show that the wage gap between younger (age 16-25 or 26-35) and older (age 46-55) men expanded between 1980 and 1995. During the subsequent period 1995-2005 the earnings of young workers kept pace with those of older workers, and the gap stabilized. Results for women are similar —substantial increases in wage inequality by age between 1980 and 1995, followed by relative stability (albeit some further widening) in age-wage differentials. In contrast to the case of education, returns to experience are lower for women than for men.

Adjusting for experience and using the consistent and larger samples from the Census appear to account for the bulk of the difference between our results and those of Burbidge, Magee and Robb (2002). In contrast, using means or medians plays a very small role.

The use of broader earnings measures – such as including self-employment earnings, using weekly earnings of all workers, or using annual earnings of full-time workers -- does not alter the principal findings from our benchmark analysis based on weekly wage and salary earnings of full-time workers. However, the use of broader measures of the impact of education does increase the magnitudes of the estimated returns, in some cases quite substantially. These increases in the magnitudes of the returns arise because higher education is associated with the quantity of work – as well as a “skill premium.” The use of broader measures also tends to result in greater growth in the return to education over the period 1980-2005.

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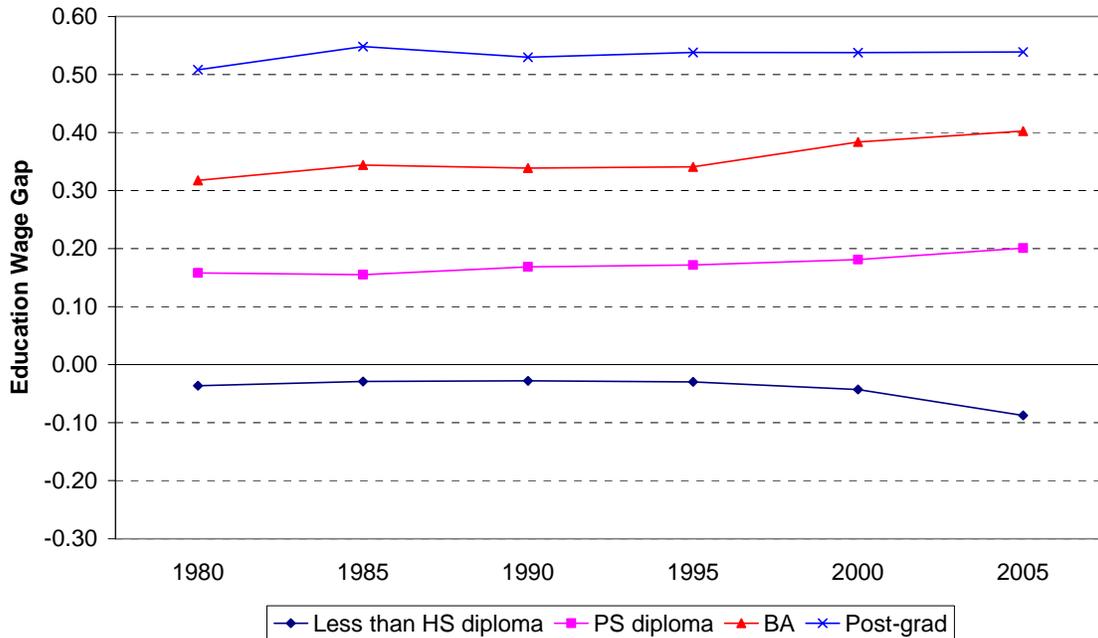
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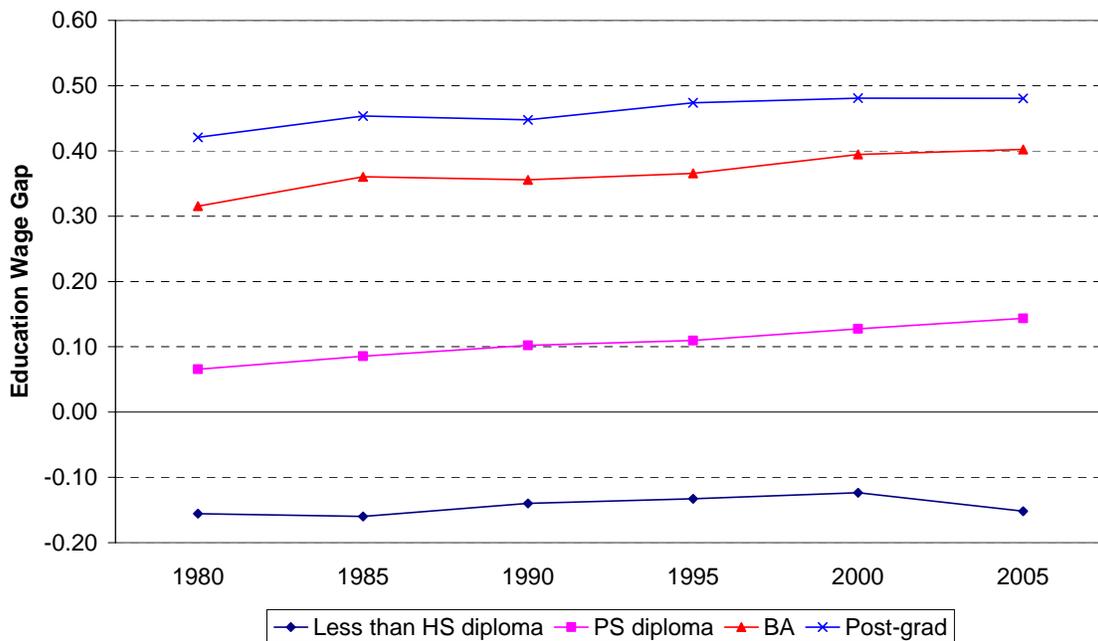
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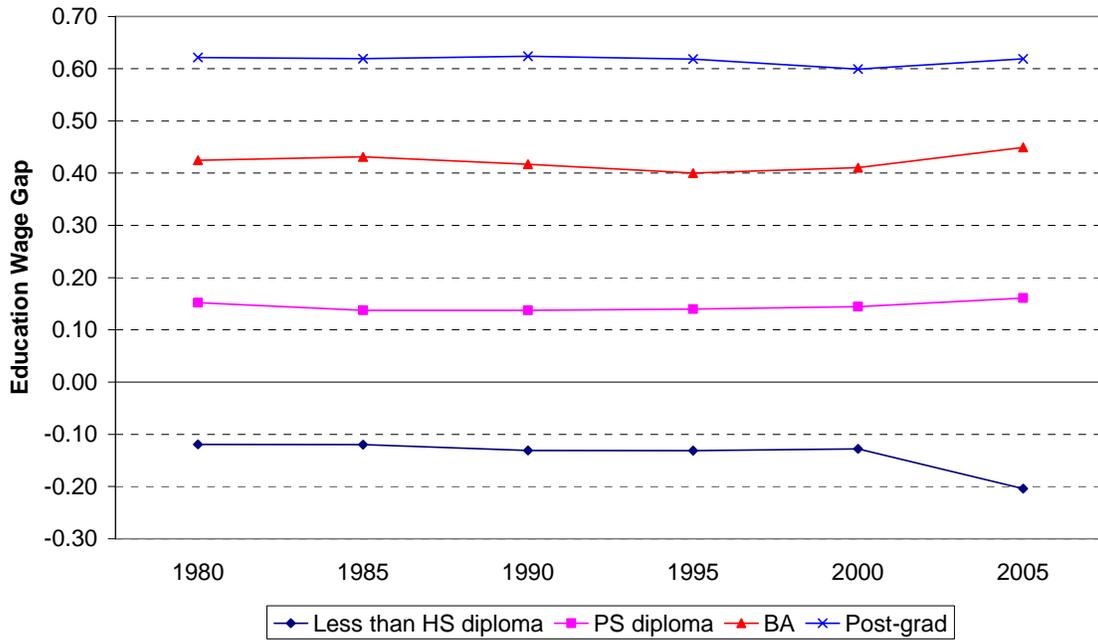
**Figure 1a: Unadjusted Wage Gap in Log Weekly Earnings of Full-time Men (Relative to High School Graduates)**



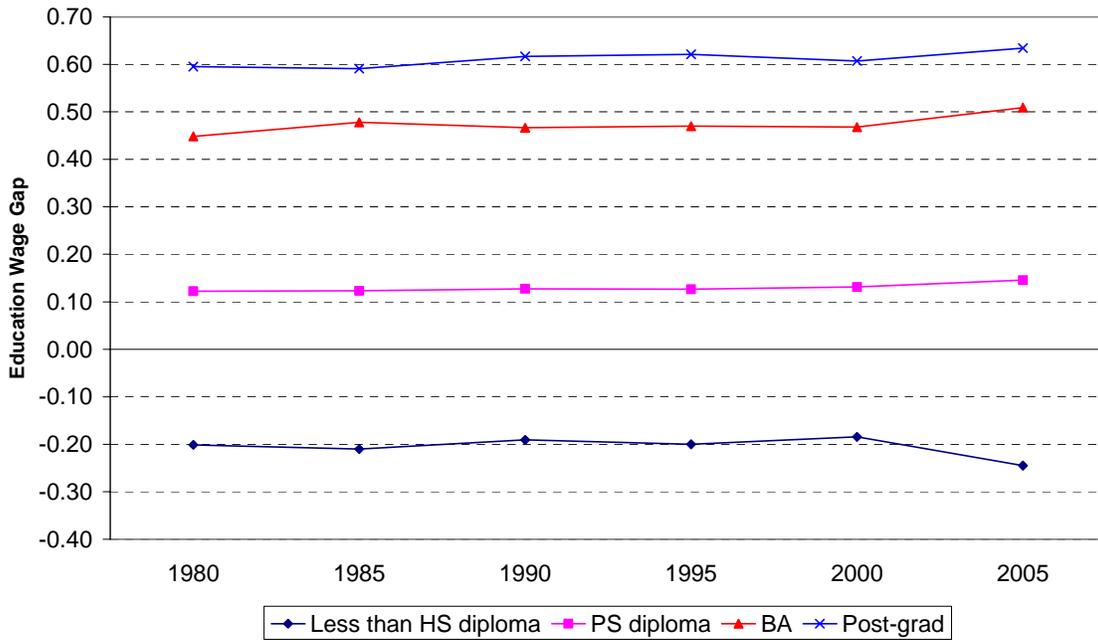
**Figure 1b: Regression-Adjusted Wage Gap in Log Weekly Earnings of Full-time Men (Relative to High School Graduates)**



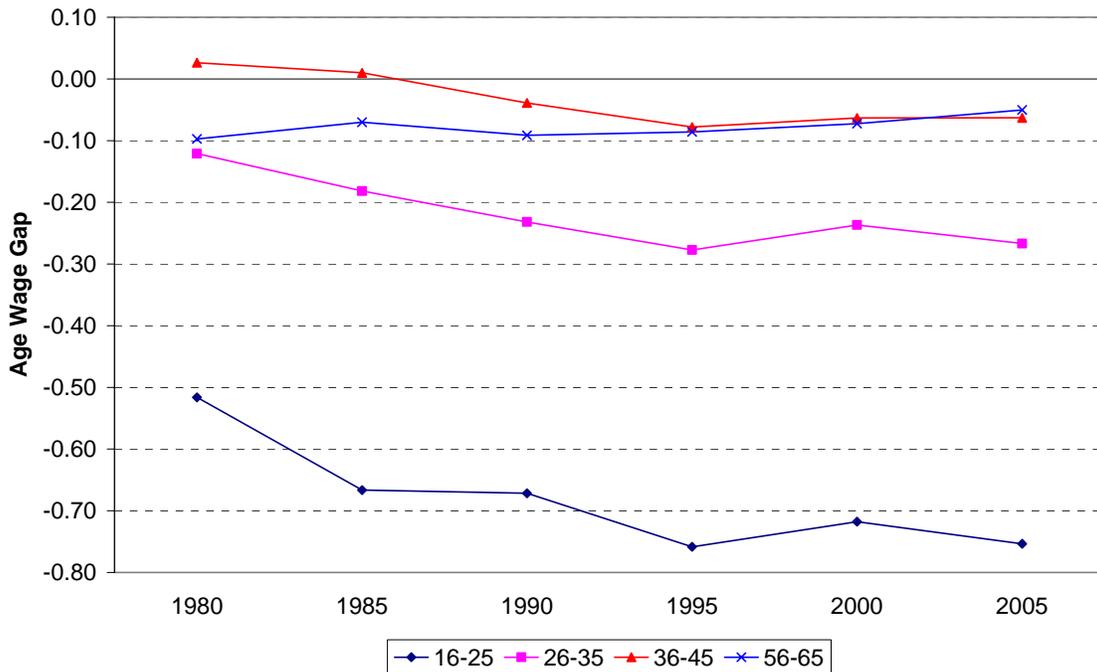
**Figure 1c: Unadjusted Wage Gap in Log Weekly Earnings of Full-time Women (Relative to High School Graduates)**



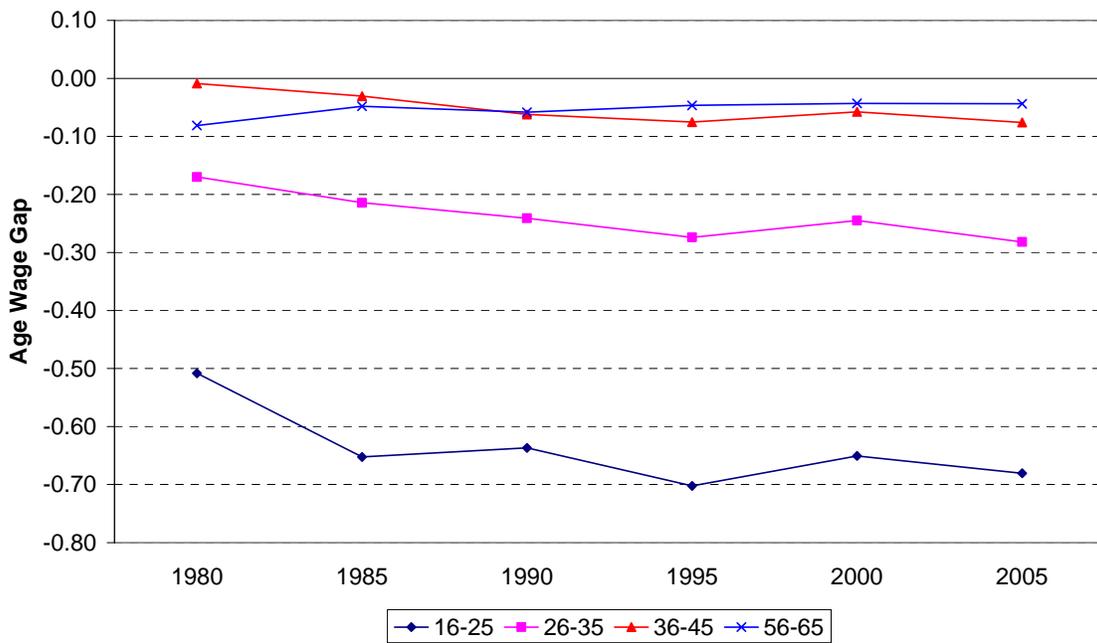
**Figure 1d: Regression-adjusted Wage Gap in Log Weekly Earnings of Full-time Women (Relative to High School Graduates)**



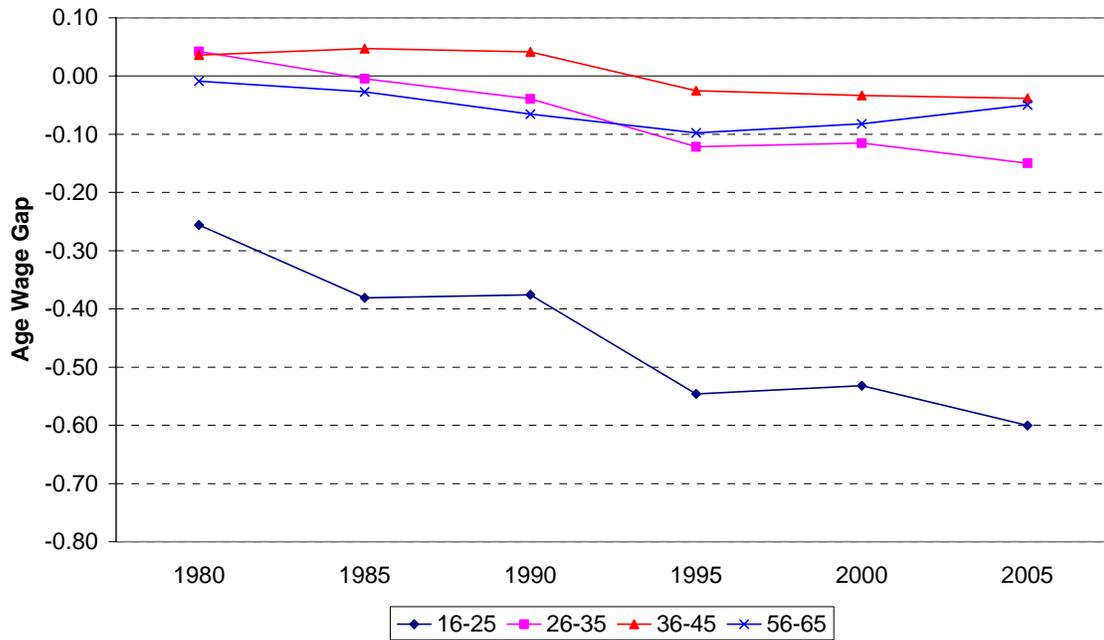
**Figure 2a: Unadjusted Age Wage Gaps Relative to Age 46-55, Men**



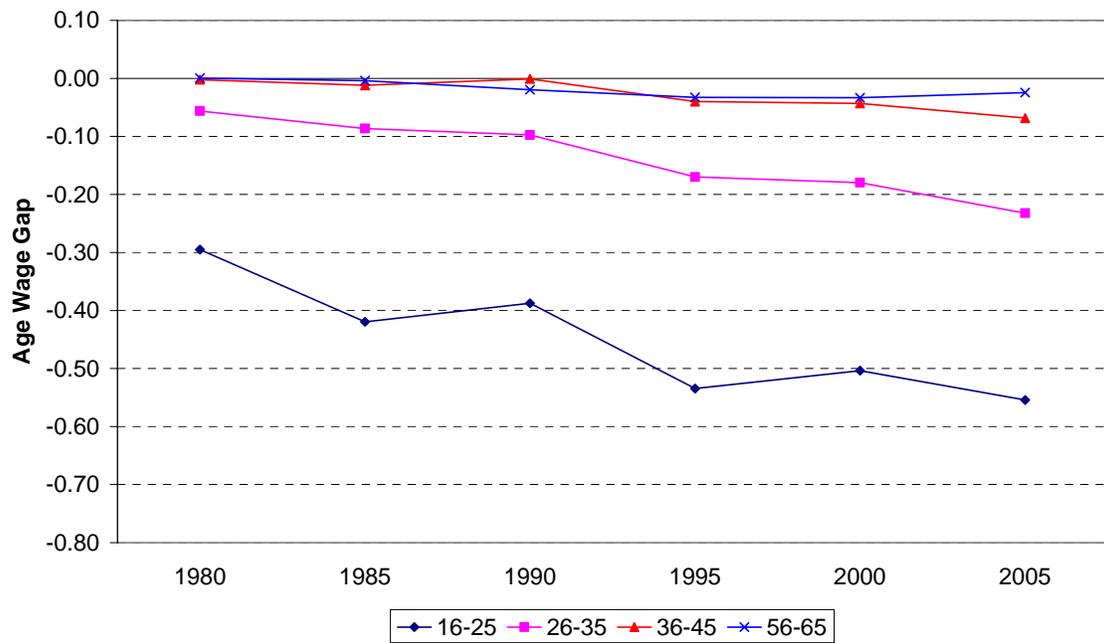
**Figure 2b: Regression-adjusted Age Wage Gaps Relative to Age 46-55, Men**



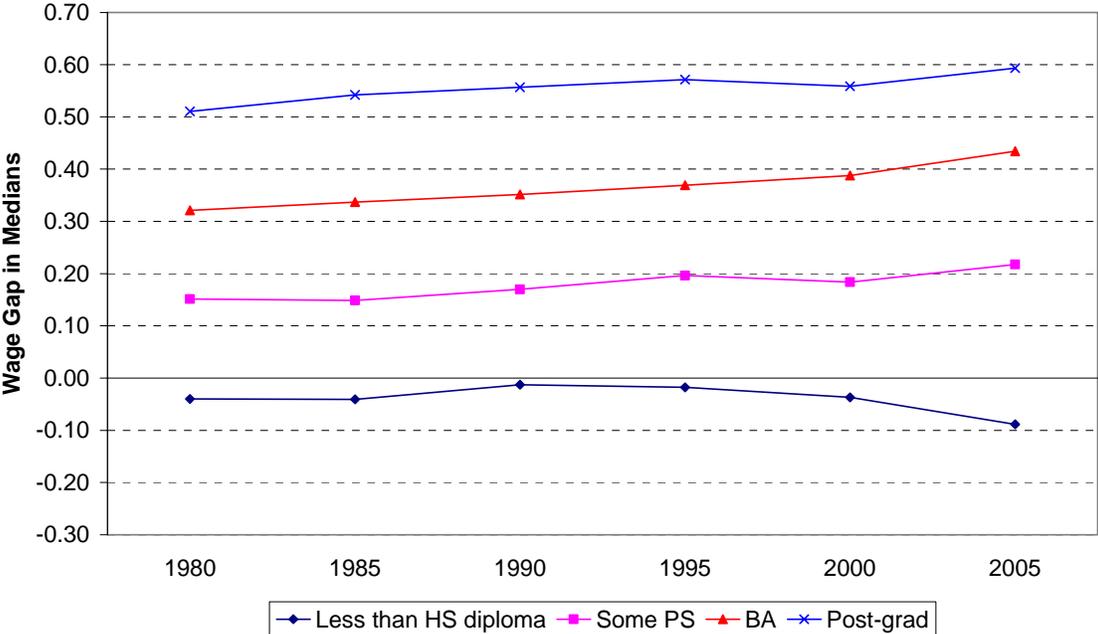
**Figure 2c: Unadjusted Age Wage Gaps Relative to Age 46-55, Women**



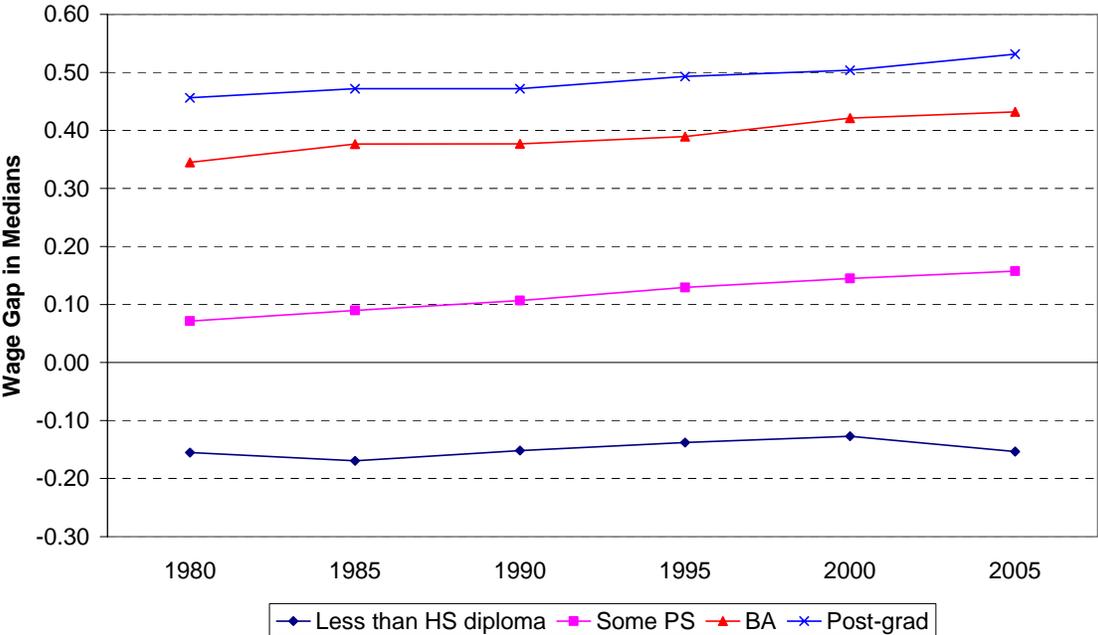
**Figure 2d: Regression-adjusted Age Wage Gaps Relative to Age 46-55, Women**



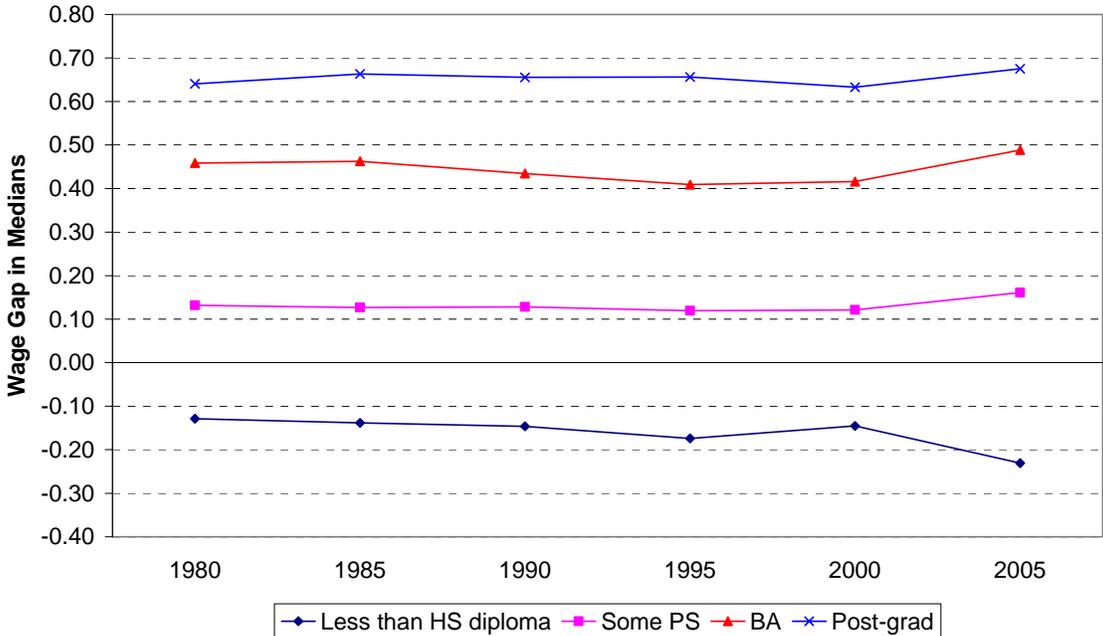
**Figure 3a: Unadjusted Median Wage Gap in Log Weekly Earnings of Full-time Men (Relative to High School Graduates)**



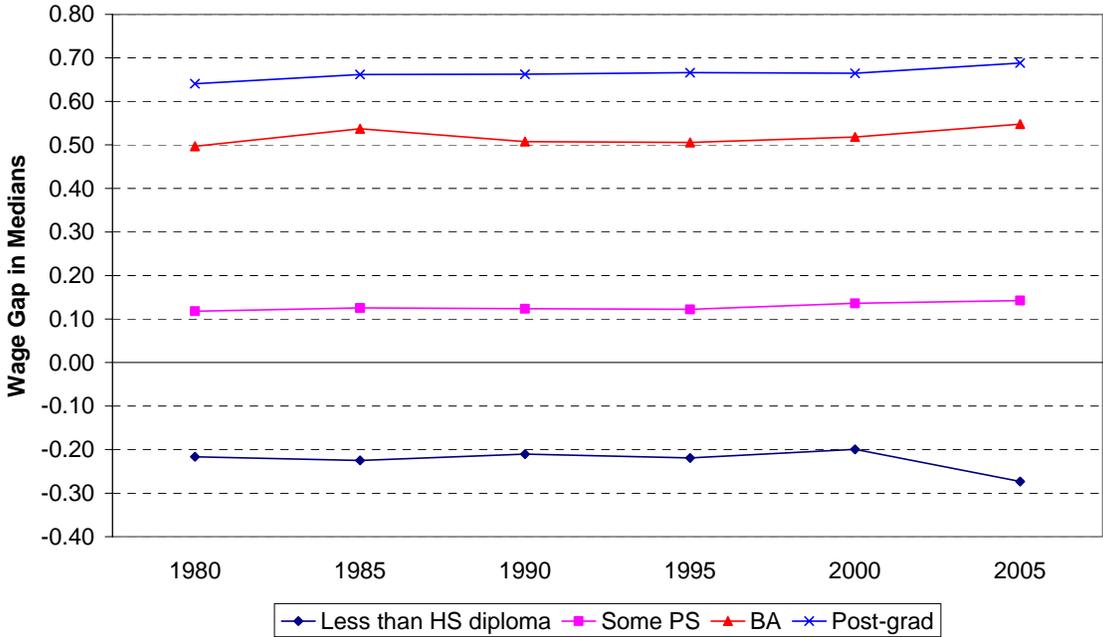
**Figure 3b: Regression-Adjusted Median Wage Gap in Log Weekly Earnings of Full-time Men (Relative to High School Graduates)**



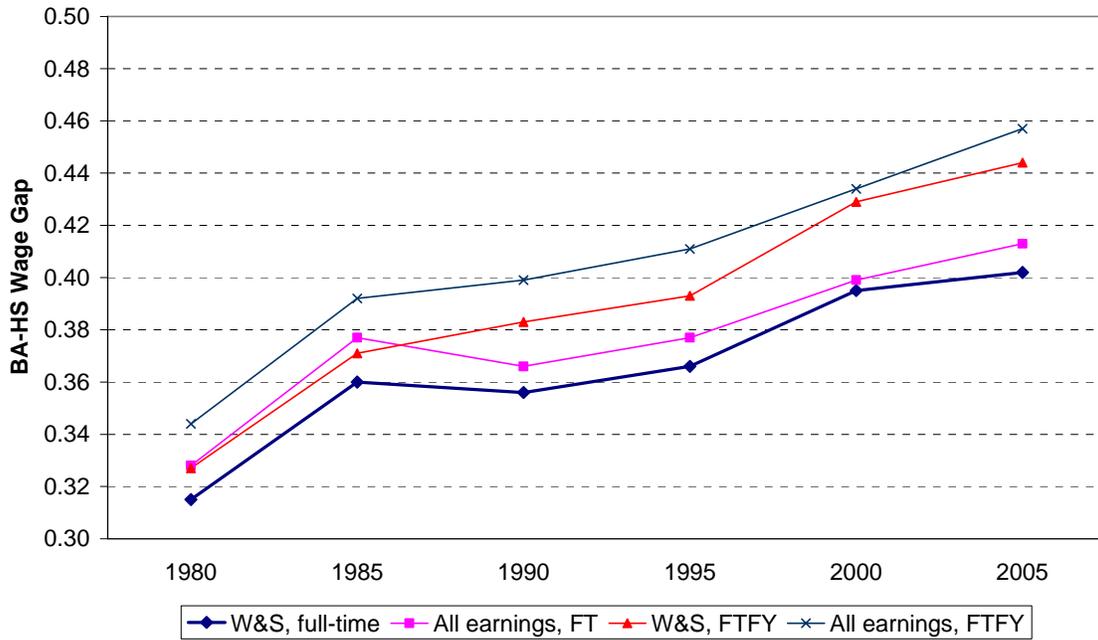
**Figure 3c: Unadjusted Median Wage Gap in Log Weekly Earnings of Full-time Women (Relative to High School Graduates)**



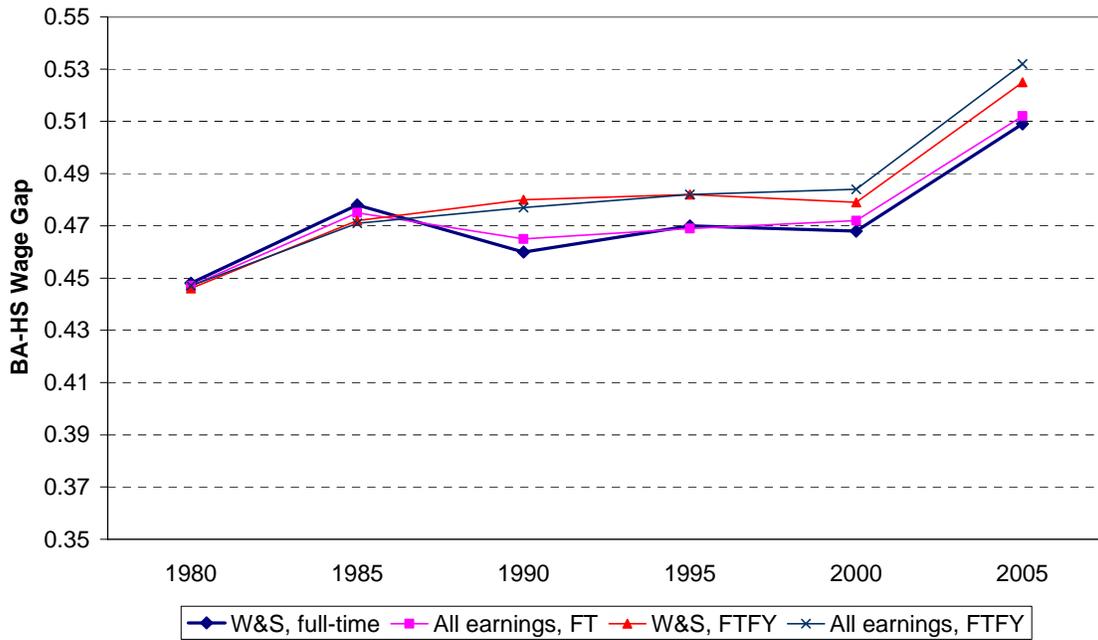
**Figure 3d: Regression-adjusted Median Wage Gap in Log Weekly Earnings of Full-time Women (Relative to High School Graduates)**



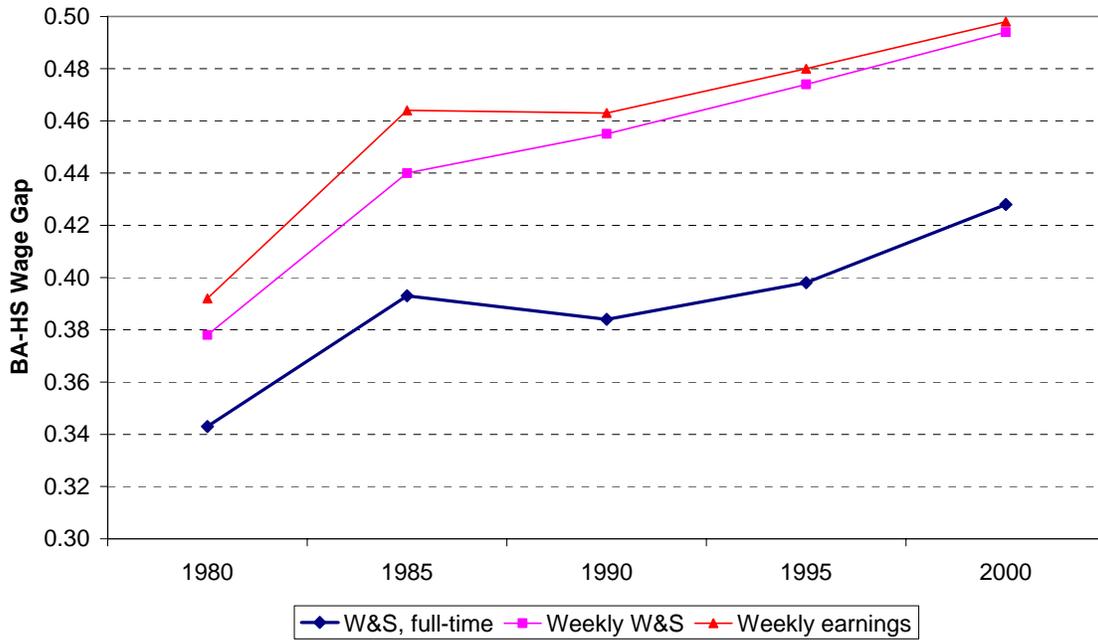
**Figure 4a: Alternative Measures of the Adjusted BA-HS Wage Gap from the Census, Men**



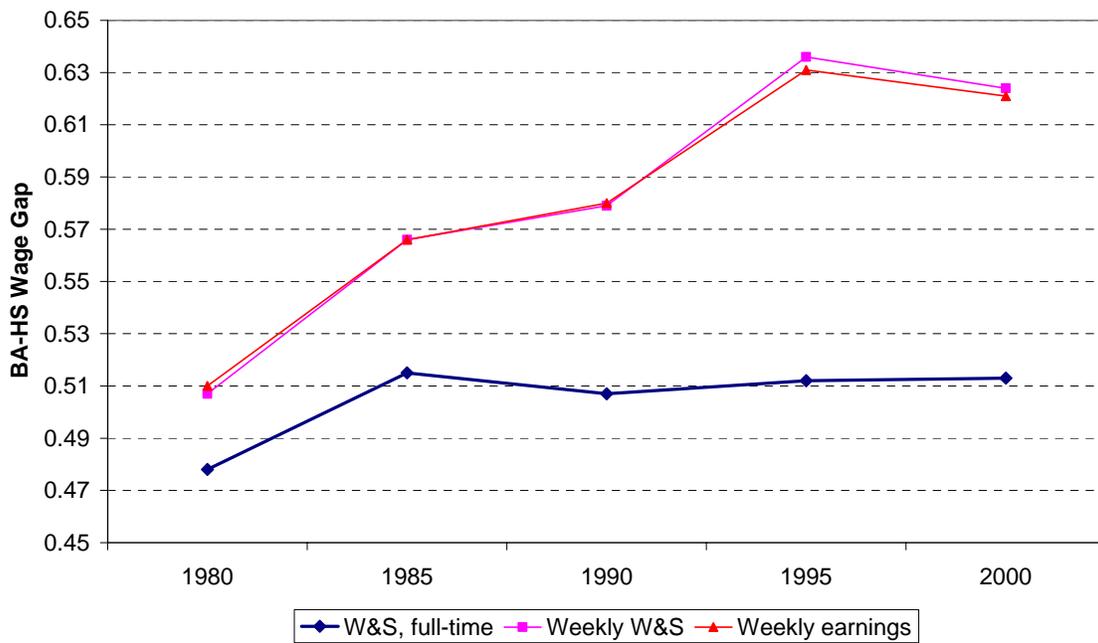
**Figure 4b: Alternative Measures of the Adjusted BA-HS Wage Gap from the Census, Women**



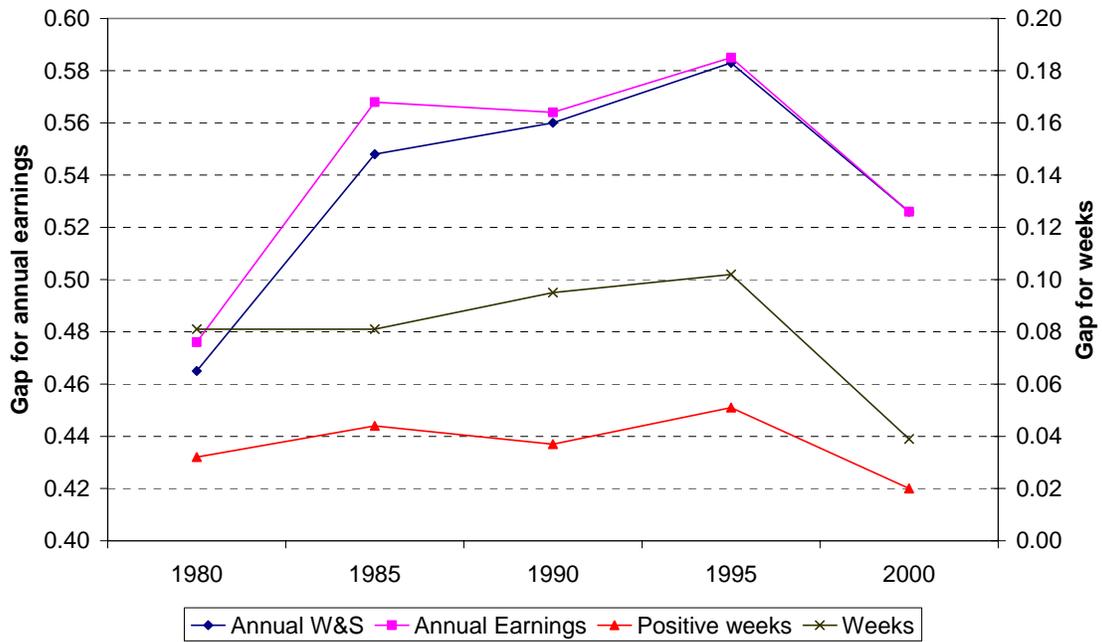
**Figure 5a: Adjusted BA-HS Wage Gap from the Census using Weekly Earnings for all Workers, Men**



**Figure 5b: Adjusted BA-HS Wage Gap from the Census using Weekly Earnings for all Workers, Women**



**Figure 6a: Adjusted BA-HS Gap from the Census using Annual Earnings and Employment, Men**



**Figure 6b: Adjusted BA-HS Gap from the Census using Annual Earnings and Employment, Women**

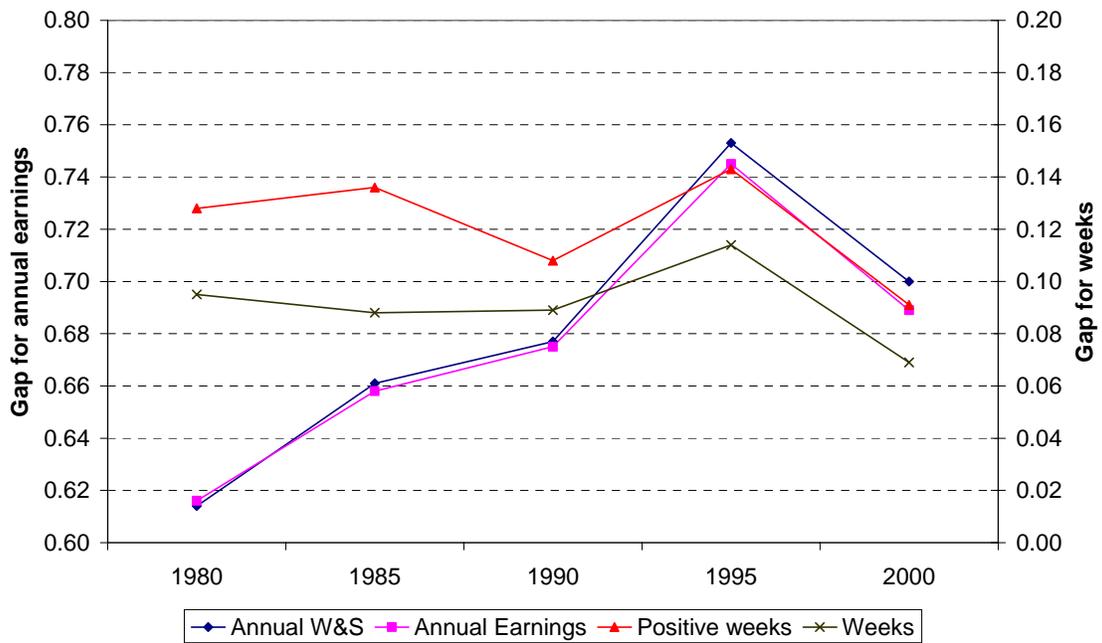


Table 1: Comparison of results for means and medians

**A. Unadjusted, Men**

	1980-2000		1980-2005			
	Mean	Median	Mean	Median		
	-		-			
Less than HS diploma	0.007	0.003	0.051	***	-0.048	***
Some PS	0.023 **	0.032 ***	0.043 ***		0.066	***
BA	0.066 ***	0.066 ***	0.085 ***		0.113	***
Post-grad	0.030 *	0.048 ***	0.031 **		0.083	***

**B. Regression adjusted, Men**

	1980-2000		1980-2005			
	Mean	Median	Mean	Median		
Less than HS diploma	0.032 ***	0.028 ***	0.004		0.002	
Some PS	0.062 ***	0.073 ***	0.078 ***		0.086	***
BA	0.079 ***	0.076 ***	0.087 ***		0.087	***
Post-grad	0.060 ***	0.047 ***	0.060 ***		0.075	***

**C. Unadjusted, Women**

	1980-2000		1980-2005			
	Mean	Median	Mean	Median		
	-		-			
Less than HS diploma	0.008	-0.017	0.085 ***		-0.102	***
Some PS	0.008	-0.011	0.009		0.029	***
BA	0.014	-0.042 ***	0.025 **		0.030	**
Post-grad	0.022	-0.008	0.003		0.035	*

**D. Regression adjusted, Women**

	1980-2000		1980-2005			
	Mean	Median	Mean	Median		
			-			
Less than HS diploma	0.017 *	0.017 *	0.044 ***		-0.057	***
Some PS	0.009	0.018 *	0.023 ***		0.025	***
BA	0.020 *	0.022 *	0.061 ***		0.051	***
Post-grad	0.012	0.024	0.039 **		0.048	**

Note: "\*", "\*\*", and "\*\*\*" indicate statistical significance at the 10, 5, and 1 percent level, respectively.