Evidence from the Self-Employed on Changing Wages for Less-Educated Men in the 1980's*

Harry Krashinsky
University of Toronto

June 25, 2004

Abstract

Less-educated workers exhibited negative real wage growth from the late nineteen-seventies to the early nineties. A well-received argument to explain this decline is that skill-biased technological change is the primary cause for this change, but others argue that changes in labor market institutions are primarily responsible. A comparison of the earnings dynamics of the self-employed with their wage and salary counterparts demonstrates that the decline of labor market institutions, not skill-biased technological change, is the likely explanation for these wage dynamics. I also demonstrate that skill-biased technical change is not the cause of the decline in these labor market institutions.

*Contact information: Centre for Industrial Relations, University of Toronto, 121 St. George Street, Toronto, Ontario, Canada. Email: harry.krashinsky@utoronto.ca. I am indebted to David Card, Henry Farber, Jeffrey Kling, Orley Ashenfelter, Marianne Bertrand and Morley Gunderson for their helpful comments. I gratefully acknowledge support provided by a Connaught grant and the Social Science and Humanities Research Council of Canada.

1 Introduction

One of best-documented features of the labor market during the 1980's is the decline in fortunes of the less-educated. Workers with low levels of education exhibited negative real wage growth during this decade, and two main hypotheses have been advanced to account for this fact. The first hypothesis proposes that the weakening of labor market institutions such as labor unions and the real value of the minimum wage is largely responsible for this decrease.[1] The wages received by less-educated workers are disproportionately dependent upon such institutions, and their decline would naturally have a more pronounced effect on the wages of the less-educated. An alternative, and well-received hypothesis explaining this deterioration relies upon changes in demand for high- and low-skilled workers, and a theory proposed to explain these changes is skill-biased technical change.[2] This hypothesis suggests that innovations such as computers have put less-skilled workers at a relative disadvantage in the labor market. Because of the resulting drop in demand for less-educated workers, their wages have fallen.

This paper will compare new evidence on the changes in the wage distributions of less-skilled self-employed and wage and salary workers to evaluate these competing hypotheses. Since self-employed workers are not subject to labor-market institutions such as the minimum wage or labor unions (but are potentially affected by skill-biased technical change), changes in their wages will be contrasted with those of wage and salary workers, who are subject to both labor market institutions and skill-biased technical change. The results will demonstrate that, remarkably, wages received by less-educated self-employed workers did not decrease very much (unlike those of wage and salary workers, which declined a great deal), and that this relative stability can be attributed to the fact that the self-employed were not adversely affected by the decline in labor market institutions. More importantly, skill-biased technical change does not provide a convincing explanation for the

[1] Some of the first papers to espouse this view is DiNardo, Fortin and Lemieux (1996) and Lee (1999).

[2] See Acemoglu (1999). Also, Katz and Autor (1999) provide a comprehensive review of articles associated with this hypothesis. It has also been argued that trade plays some role in explaining increased wage inequality, but that this effect is rather small (see Topel (1997)).

changes in wages for self-employed less-educated workers, or for the decline of labor market institutions.

2 Literature Review

The literature on self-employment in the United States has been small until recent years, but it has been growing rapidly. Early studies of self-employment examined the characteristics of those workers who tended to become self-employed, and the effects of tax policies on the decision to become self-employed. The seminal work by Evans and Leighton (1989) found that the propensity to become self-employed was independent of age, a result which runs counter to the job-shopping hypothesis, which suggests that younger workers would be more likely to become self-employed.[3] Other papers that consider the propensity to become self-employed have focussed on liquidity constraints (Evans and Jovanovic (1989), Holtz-Eakin, Joulfaian and Rosen (1994a, 1994b)) and tax rates (Bruce (2000), Robson and Wren (1999)), both of which have generally been found to be important determinants of entry into and exit from self-employment. Blau's (1987) time-series analysis of self-employment considers the effect of marginal and average tax rates on self-employment rates. Blau views the relative ease of under-reporting self-employment income as a potential cause of becoming self-employed, and finds that higher marginal tax rates cause the self-employment rate to rise for high-income workers, which suggests that the potential to under-report income may be a factor for self-employment determination.

Few papers have analyzed wage trends among the self-employed in the United States.[4] Hamilton (2000) compares different measures of self-employment earnings to the earnings of wage and salary workers, and finds that all of his measures of self-employment income suggest that the self-employed earn less than wage and salary workers. But he con-

[3] "Job-shopping" theories espoused by Johnson (1978) and Miller (1984) suggest that younger workers would be more willing to take riskier jobs than older workers. Since bankrupcy is more likely in self-employed work than wage and salary work, these theories suggest that younger workers would be more likely to become self-employed than older workers.

[4] The only paper I know of that considers this issue for is Green, Hamilton and Paarsch (1995).

ducts this analysis for only one year and does not consider the trends in self-employment earnings. However, such work has been done with data from the United Kingdom. Parker (1997) considers the increasing wage inequality among self-employed British workers between 1976 and 1991, and determines this increase was due to the increased heterogeneity of these workers.

By comparison, there is a vast literature on increasing wage inequality from the late 1970's to the early 1990's for wage and salary workers in the United States.[5] The explanations forwarded to explain this increase can basically be categorized into two main groups: "supply-" or "demand-based" explanations which emphasize changes in the composition of the labor force, or shifts in demand such as those caused by skill-biased technological change or import competition; and "institutional-based" explanations, such as the decline in the minimum wage and unionization rates in the labor market.[6] The crux of the skill-biased technical change theory is that the introduction of technologies such as computers in the workplace disproportionately boosts the productivity of "skilled" workers relative to their unskilled counterparts. This increased demand for skilled workers (and decreased demand for less-skilled workers) raises overall wage inequality. Conversely, the institutional explanation posits that the drop in unionization rates and in the real value of the minimum wage have had a much more pronounced effect on low-skilled workers than high-skill workers. The decrease in real wages resulting from these institutional changes will lower the relative wages of unskilled workers and increase overall wage inequality.

To differentiate between these two hypotheses, I compare the changes in earnings for wage and salary workers and self-employed workers. The self-employed are a group that is plausibly unaffected by changes in labor market institutions (the minimum wage and union coverage do not apply to the self-employed), but is affected by skill-biased technical change. As a result, the self-employed wage distribution can provide insights into the effects of labor market institutions and skill-biased technical change. As such, some basic wage trends for the self-employed are discussed in the next section.

[5] See Levy and Murnane (1992) and Katz and Autor (1999) for surveys of this literature.

[6] Surveys of these explanations can be found in Johnson (1997) and Fortin and Lemieux (1997).

3 Data

The data used for this analysis are derived from the outgoing rotation groups of the CPS and the March supplement of the CPS.[7] Table 1 presents data on the characteristics of prime-aged, white male workers[8] who are either wage and salary or non-agricultural, unincorporated[9] self-employed workers during the period from 1979 to 1991. The period of 1979 to 1991 was chosen because this analysis is concerned with changing inequality, and inequality greatly increased for wage and salary workers during this time. Using this sample, Table 1 demonstrates that the self-employed are, in general, older than their wage and salary counterparts, less likely to be in manufacturing, and more likely to be in managerial occupations. As it will be demonstrated in the next section, these differences remain stable over time.

After taking appropriate steps to account for preliminary data concerns about self-employment income,[10] there are remarkable, and apparently undocumented, trends in the

[7] The March supplement files collect information on the number of jobs held by a worker, wage and salary earnings and self-employment income in the previous year, and are the source of information for relative wages in the two sectors. The outgoing rotation group files are comprised of data from one quarter of all observations in each of the twelve monthly CPS surveys in each year. A household in its fourth or eighth month in the sample is considered to be part of the "outgoing rotation group".

[8] Only men were selected for this analysis because the decision to become self-employed is complicit with the decision to supply labor, which is less complicated to model for men than for women. Furthermore, only men between the ages of 25 and 60 were considered to avoid including men who were entering into self-employment to effectively retire. The analysis was limited to whites because of sample size restrictions – self-employment rates among blacks is one-third that of whites, suggesting that a separate model is necessary to consider the self-employment decision among non-whites. Due to sample size limitations, it is difficult to meaningfully analyze earnings changes among non-whites.

[9] Incorporated self-employed wage data is encumbered by the fact that incorporated self-employed workers pay themselves a "salary" from the company's earnings, but this salary may be dependent upon the number of owners of the business (which can not be known from the data). As such, only the unincorporated, non-agricultural self-employed will be used in this study.

[10] Due to survey inaccuracies identified by Devine (1995), only non-imputed wages are used in this study. In addition, to avoid complications about workers who hold both a self-employed and a wage-and-salary job, the sample is limited to workers with one job in the prior year, but this does not have a significant impact on the paper's final results.

Devine and others have also noted that some self-employment income is derived in returns to capital, which are not measured by CPS data. Although this may complicate interpretations of cross-sectional

level and dispersion of self-employed earnings relative to those of wage and salary workers. Figure 1 compares the median relative earnings of white males who are self-employed with the earnings of wage and salary workers. The upper-left panel shows that the median earnings of self-employed high school dropouts were approximately 30% lower than those of wage and salary workers in 1979. But by 1991, median earnings were basically equivalent for both groups of workers. A general convergence in earnings is also seen with high-school graduates in the upper-right panel of this Figure. Also, the earnings of college graduates in the wage and salary sector grew faster than earnings for this group in the self-employment sector, which lead to a decrease in the relative earnings of the self-employed who were college graduates.

The kernel densities of hourly wages for these groups reveal a similar pattern. Figure 2 compares the log hourly wage densities of 1979 and 1991 for high-school dropouts and college graduates working in the wage and salary and self-employed sectors.[11] The upper-right panel of Figure 2 shows that there is a large shift of the wage density for high school dropouts who are wage and salary workers, but the upper-left panel demonstrates that there is no corresponding shift in the kernel density of hourly wages for the self-employed. In each graph, a vertical line is imposed at the real value of the 1979 minimum wage, and the movement below this line of a large portion of the density for less-educated wage and salary workers makes it apparent that the decline of the minimum wage is an important factor for explaining the decreased earnings of wage and salary workers. But an equivalent decrease is not evident with the less-educated self-employed. There is relatively little movement of the self-employed wage densities between 1979 and 1991, especially around the minimum wage, suggesting that the decline of this institution probably had

differences in earnings between the self-employed and wage and salary workers, it does not affect observations about trends in this difference over time, assuming that capital-labor ratioes are remaining relatively constant for the self-employed.

[11] Only high-school dropouts and college graduates are included in this figure for brevity's sake. Changes in the wage densities for high school graduates in the self-employed or wage and salary sector are basically the same as those seen for their counterparts who are high school dropouts. Similarly, those with some college education who are self-employed or in the wage and salary sector exhibit changes to their wage densities that are similar to their counterparts who are college graduates.

little effect on self-employed wages (these wage dynamics are also evident for high school graduates).[12] However, the changes in the real hourly wage kernel densities for highly-educated workers (both self-employed and wage and salary) are generally similar, with slightly more wage growth in the wage and salary sector. The results in Figures 1 and 2 suggest two things: first, that more educated workers had positive wage growth in both the self-employed and wage and salary sectors, which suggests that increases in demand for more-skilled workers (due to factors such as skill-biased technological change) may have been responsible for this wage increase. But the difference in the wage dynamics of less-educated self-employed workers with their wage and salary counterparts may shed some light on the causes of the increase in wage inequality for these workers during this time period. As such, the majority of the analysis will be devoted to examining the wage dynamics of less-educated workers in both sectors.

To account for these changes in wages for the less-educated in both sectors, there are essentially two alternative theoretical explanations. A basic, competitive C.E.S. model of the labor market would imply that the law of one price prevails across all sectors, and hence wages for a given educational group in both sectors should only depend upon the relative supply of that educational group to the entire economy.[13] Alternatively, a model that incorporates institutional factors into the analysis would imply that labor market institutions such as the minimum wage or labor unions only directly affect the wage and salary sector. As a result, to differentiate the effects of these two models on the wage and salary sector and the self-employment sector, it is necessary to focus on two relevant aspects of the labor market: changes in institutions operating in the wage and salary sector, and the possibility of compositional shifts in employment in the wage and salary or self-employment

[12] These findings are the result of a general trend in the data, and not simply two years that yielded uncharacteristic results. Appendix tables are available upon request from the author which illustrate that across the thirteen year period from 1979 to 1991, there are few changes in the wage percentiles of less-educated self-employed, but large decreases for their wage and salary counterparts.

[13] Of course, it is possible for a wage difference to persist between the wage and salary sector and the self-employment sector if there is a non-wage benefit to being self-employed (arising from greater flexibility in one's work schedule, for instance). But this difference should be unchanging under the assumptions of the competitive model.

sectors that would cause observed relative wages to diverge even while skill prices were set identically between the two sectors (for instance, if the self-employed became more skilled over time). To consider these compositional effects, the next section will analyze the supply trends in both sectors, and which kinds of workers are selecting into (or out of) self-employment over time.

4 Supply Trends in Self Employment

To consider why self-employment earnings have changed relative to those of wage and salary workers, it is natural to first determine whether or not there have been changes in the number of workers who are becoming self-employed or leaving self-employment. This is done in Table 2 using data from the matched outgoing rotation groups of the Current Population Survey and also the 5% samples of the U.S. Census from 1980 and 1990, and regressing self-employment indicator variables on a trend term interacted with a dummy variable for each of the four major educational categories (to show how self-employment rates are changing for each educational group). A benefit to using the Census is that it contains information on a respondent's nativity, so it is possible to determine whether or not changing immigration rates by educational group have any impact on the number of self-employed workers. This was accomplished by including an indicator variable equal to one if the respondent was an immigrant to the United States, and interacting it with the trend terms in the regression. Columns 1 through 4 use a self-employment indicator as the dependent variable in the analysis; columns 5 and 6 use an indicator for the dependent variable that is equal to one if the individual enters self-employment from the wage and salary sector, and zero if he does not; columns 7 and 8 use an indicator equal to one if the individual leaves self-employment, and zero if he does not. The first four rows of Table 2 display the coefficients for the interacted trend terms, and none of them are individually significant in any of the eight columns[14], suggesting that there were no changes in self-

[14] In addition, the interacted trend terms are also jointly insignificant in all but one of the eight columns. The p-values for the joint F-tests of the trend terms in columns one through four are 0.12, 0.13, 0.02, and 0.09; for columns five and six, these p-values are 0.13 and 0.40; and lastly, for columns seven and eight,

employment rates over this period, and both entry and exit rates were similarly stable. In addition, the results from columns 3 and 4 demonstrate that the self-employment decisions of immigrants are not influencing these results, and that self-employment rates are quite stable with or without controls for nativity.

In addition, it is useful to consider whether or not immigrant earnings patterns are influencing the wage dynamics illustrated in Figure 1. There have been changes in the percent of the labor market that is composed of immigrants to the United States[15], and it is possible that changing immigrant composition in the labor market gave rise to the wage dynamics in Figures 1 and 2. To consider this possibility, wage regressions were estimated in Table 2A using data from 1980 and 1990 March supplements of the CPS and the 5% samples of the 1980 and 1990 U.S. Census. Since the March supplements of the CPS do not contain information on nativity, trends in self-employment earnings were estimated using regressions which included an indicator for 1989, self-employment status, the interaction of these two variables, and other control variates. The Census regressions included all of these variables, but also an indicator for nativity status that was fully interacted with the model in order to control for any effects of nativity on wage dynamics. The results demonstrate that nativity was not the cause of the wage dynamics in Figures 1 and 2. In all three samples, the regression results indicate that overall change in relative wages for the self-employed (captured by the interaction of the self-employment indicator with the 1989 year indicator) is basically unchanged if controls for nativity are included in the regression. As such, the evidence in Tables 2 and 2A demonstrate that the relative wage changes exhibited in Figures 1 and 2 were not driven by supply changes in the two sectors.

Of course, these wage dynamics could be affected by more than just changes in the

these p-values are 0.35 and 0.40.

In general, the regression results arise from the fact that self-employment rates simply did not change very much over this period. The percentage of self-employment workers in 1979 and 1991 were: 10.6 and 10.3, respectively, for those with less than a high school diploma; 9.4 and 9.7, respectively for high school graduates; 8.9 and 9.1, respectively, for those with some college; and 11.8 and 12.1, respectively, for college graduates.

[15] For instance, by the middle of the 1990's, 45% of all workers who did not graduate from high-school were foreign-born.

number of people in each sector – it is also important to consider the kinds of workers selecting into self-employment during this period. The results in Tables 3 and 4 address these selection issues by examining trends in other relevant characteristics of the self-employed over this time period. Table 3 uses regressions that are similar in structure to those in Table 2, but uses the worker's age as a dependent variable. None of the coefficients in the first four rows of Table 3 are individually or jointly significant, which show that the trend in age differences between self-employed and wage and salary workers has remained constant over time for all educational groups, and this is also evident for entrants into self-employment (relative to non-entrants), and for individuals who leave self-employment (relative to those who remain self-employed).

It is also the case that there have been no real changes in the relative wages of entrants into self-employment, in comparison with those workers who remain in the wage and salary sector. Table 4 displays results from a wage regression for all wage and salary workers which includes an indicator variable equal to one if the worker will enter self-employment next period. By interacting this variable with a trend term, it is possible to determine whether or not there is a significant change in the pre-entry wages of workers electing to become self-employed. As illustrated in columns 1, 3, 5, and 7 of Table 4, the trend in mean log wages of entrants into self-employment (relative to non-entrants, in the period before this transition is made) is very stable, and not changing significantly over this period.[16] This implies that there are no changing observable differences in the productivity of workers who do or do not enter self-employment. To consider whether or not there are changing unobserved differences in productivity between the workers who do and do not enter self-employment, the other four columns in Table 4 examine trends in wage residuals for these workers. To do so, I estimate a standard wage regression using a sample of all wage and salary workers, including those who will become self-employed. The residual

[16] It is also the case that individuals exiting from self-employment into the wage and salary sector are not changing over this time period. A similar regression for those exiting self-employment reveals that there is no significant trend in the wage these people tend to earn in the period after they leave self-employment. That is, relative to those who are in the wage and salary sector, people who exit self-employment are not changing over this time period.

from this wage regression is regressed on the interacted trend term for each of the four educational groups to analyze changing trends in unobserved characteristics of entrants into self-employment. The results in columns 2, 4, 6 and 8 of Table 4 demonstrate that these interaction terms are not significant, which means that there is no significant trend in the effect of these residuals for any education level over the 1979-1991 period.

In addition, it is also the case that there has not been any significant change in the hours worked by the self-employed in comparison with their wage and salary counterparts during this period. Regressions using a specification similar to Tables 2 through 4 demonstrate that there has not been a significant change in the relative hours worked by the self-employed,[17] which suggests that firms have not been substituting self-employed workers with wage and salary workers over time. This is an especially relevant concern for less-educated workers, since there was a large decline in the earnings of wage and salary workers during this time period; if the self-employed are complements or substitutes for their wage and salary counterparts, then this change in the "price" of less-skilled labor would certainly affect the hours worked and earnings of the self-employed.

These facts collectively suggest that the observable (and certain residual) differences between self-employed and wage and salary workers have not been changing over time.[18] As such, we can conclude that the observed wage dynamics for the less-educated

[17] I ran regressions for all four educational groups to determine whether or not the relative number of hours worked by the self employed was changing over time, and all regressions included industry, occupation, marital and age controls. None of the trend terms were significant at the 10% level for any of the four educational groups. The p-values for these coefficients were: 0.247 for individuals with less than a high school education, 0.138 for high school graduates, 0.326 for those with some college, and 0.188 for college gradutes.

[18] The wage dynamics of the self-employed and the stable entry and exit rates for the self-employment sector are consistent with a queuing model, such as that proposed by Mincer (1976), where workers use self-employment to queue for wage and salary jobs. Krashinsky (2004) finds that self-employment is generally used as a way for most individuals to search for new wage and salary employment after job loss. In fact, the propensity of less-educated men to become self-employed is enormously high after job loss, and most men in this educational group who enter self-employment do so after a job loss. Given the importance of job loss in this context, it is important to consider two different options for workers unable to find re-employment in the wage and salary sector: unemployment and self-employment. Krashinsky(2004) finds that the relative payoff to being self-employed, compared to being unemployed and receiving unemployment insurance, is

self-employed or wage and salary workers are not driven by supply changes in the two sectors, or selection effects that are drawing better (or worse) workers into self-employment. The fact that changing economic events in the wage and salary sector do not affect the selection of workers into or out of self-employment, or the relative number of hours the self-employed work, is important because this kind of constancy for the two sectors makes the self-employed a legitimate comparison group to wage and salary workers. Most importantly, the examination of the self-employed can provide new evidence on the impacts of labor market institutions and skill-biased technical change on the wages of less-educated workers.

5 Skill-Biased Technological Change

Since there was virtually no change in the relative supply of self-employed workers between the late 1970's and early 1990's, changes in the relative technological efficiency of the self-employed may be an important causal determinant in this framework. Many authors have contended that skill-biased technological change (SBTC) has been a pervasive force in the economy, changing wages because of technical innovations that favor skilled workers. Changes in demand for more-skilled workers have been identified by different authors (Bound and Johnson (1991), Katz and Murphy (1992)), and the rationale for this shift in demand has been attributed by many to SBTC. Convincing theoretical models have been devised by different authors, and those of Acemoglu (1998 and 1999) are of particular interest. Much evidence for SBTC has been derived from the correlation between skill upgrading and various other changes in the economy, such as changes in computer

constant over this time period. In addition, the relative wages of men who find new wage and salary jobs after self-employment is generally unchanging, compared to men who re-enter the wage and salary sector from a state of unemployment.

As such, this explains why workers continue to enter into self-employment at a constant rate over this decade: after controlling for business cycle effects, the job loss rate is reasonably constant over the 1980's, and the relative advantages of the self-employment and unemployment sectors are relatively constant over this period. A more fullsome discussion of this point is available in a theoretical appendix from the author upon request.

usage (Autor, Katz and Krueger (1998)), changes in research and development expenditures (Machin and Van Reenen (1998)), or changes in total factor productivity (Kahn and Lim (1998)). Others have considered international evidence of skill-upgrading to find support for SBTC (Berman et. al. (1998)), while Heckman et. al. (1998) find both theoretical and empirical support for SBTC from a dynamic general equilibrium model which incorporates technology shocks.

To determine whether or not wage changes for less-educated self-employed and wage and salary workers provide evidence for or against SBTC, it should be recognized that earnings in the self-employed sector are not distorted like those in the wage and salary sector. Different labor market institutions such as labor unions or minimum wage laws can mitigate the effects of technological shocks, so it would be expected that SBTC would cause greater increases in wage inequality in the self-employed sector, *ceteris paribus.* However, Figure 2 demonstrated that there was a much greater increase in wage dispersion in the wage and salary sector for the less-educated. To account for the fact that the self-employed are not concentrated in similar industries as their wage and salary counterparts (as demonstrated in Table 1), this same analysis is conducted for both types of workers in the same industry. Once again, similar trends are evident, as the relative wage gap for less-educated workers in both sectors closes over time,[19] and increases in within-industry wage inequality are much more pronounced for the wage and salary sector than the self-employed.[20] This is general evidence against the impact of skill-biased technological change on the less-educated, since SBTC would predict that the lack of mitigating labor market institutions in the self-employment sector would allow changes in both in median wages and in wage dispersion to be greater for the self-employed than their wage and salary counterparts.

[19] In 1979, self-employed workers who were high-school dropouts had median real hourly earnings that were over 20% less than their wage-and-salary counterparts. But by 1991, both groups had virtually the same median real hourly earnings.

[20] The standard deviation for the log wage distribution of the self-employed in the service industry decreased by nearly 0.1 log points, while the similar measure for wage and salary workers increased by 0.06 points over this time period.

The evidence against SBTC becomes more persuasive when more specific tests are used to determine how technological change affected both sectors. Krueger (1993) showed that workers who use a computer receive higher wages, and although the causal link between these two variables has been disputed by some, such as DiNardo and Pischke (1997), it is generally accepted that individuals who use a computer at work are more skilled and also more likely to benefit from the skill-biased changes in the labor market. So, one method of testing the SBTC hypothesis would compare the rates of computer usage for the self-employed and their wage and salary counterparts. Conceivably, the wage dynamics of less-educated workers in Figures 1 and 2 could be the result of greater computer usage by the self-employed, which has helped maintain their wages relative to the decline of those in the wage and salary sector.[21] If it were the case that the self-employed are more likely to be positively affected by skill-biased technical change, then they should be more likely to use a computer at work. But Tables 1 and 5 demonstrate that this is not the case. Table 1 shows that for all levels of education, computer use is less prevalent among the self-employed than among wage and salary workers. To confirm this in a regression context, I regress a computer usage indicator variable on a self-employment indicator for each of the four major educational groups, using three CPS supplements that ask about computer use during the period of analysis.[22] The first three rows of Table 5 corroborate the findings in Table 1, and show that computer usage is lower for self-employed workers. Although this evidence is consistent with the wage dynamics seen for more-educated workers (where the wages of the wage and salary workers grow faster than the wages of the self-employed), this runs counter to the predictions of SBTC for less-educated workers. If less-educated

[21] In addition to Krueger's work, both Katz and Murphy (1992) and Juhn, Murphy and Pierce (1993) were among the first to identify and analyze the increase in demand for "skilled" workers. The use of computers could be considered as an indication of skill, which could differentially effect either the self-employed or the wage and salary sector. Using information amassed from the October supplements of the Current Population Survey, the rates of computer use for the self-employed and wage and salary workers can be determined.

[22] Questions about computer usage are asked in the October supplement to the CPS in 1984, 1988, 1993 and 1998. Since my analysis of self-employment wages involves the years from 1979 to 1991, I use the 1984, 1988 and 1993 supplements to obtain information about overall computer use and trends in computer use.

self-employed workers were being aided by SBTC, then it would be expected that they should be more likely to use a computer at work.

Within this context, it is also important to consider the change in computer usage rates for both groups of workers, since many authors have documented the effects of skill upgrading on wages.[23] Using a difference-in-difference of computer usage between 1984 and 1993, the fourth row of Table 5 shows that there is favorable evidence for SBTC when more-educated workers are considered, since earnings in the wage and salary sector increased relative to the self-employed sector for the more-educated, and it is the case that computer usage grew faster in the wage and salary sector. But, computer usage for self-employed high school dropouts and high school graduates has decreased relative to usage in the wage and salary sector. This evidence suggests that the relative increase in self-employed earnings for the less-educated is not due to higher overall rates of computer use or relatively increasing computer usage for this group of workers, which is directly contrary to the predictions of SBTC for the less-educated.

However, there is an alternative explanation for the results from the less-educated sample that is still consistent with SBTC and the results in Table 5: the self-employed could be protected from skill-biased technical change by the different kinds of jobs they perform (compared to their wage and salary counterparts). Autor, Katz and Krueger (1998) found a positive correlation between computer usage within an industry and demand increases for workers employed in that industry, so if the self-employed were employed in jobs that don't generally require a lot of computer usage, then they might be exempt from the downward demand pressure exerted by skill-biased technical change on the earnings of less-skilled workers. But this explanation is not supported by the data. Analyzing relative employment by industry and occupation cells, a shift-share analysis demonstrates that self-employed high school dropouts are more likely to be employed in jobs with higher rates of computer usage, and that these jobs have had higher rates of growth in computer usage between 1984 and 1993.[24] In 1993, overall computer use in the types of jobs held

[23] For example, see Autor, Katz and Krueger (1998).

[24] To derive these changes in computer usage for group j between years t and τ, ΔC_{jt}, the following

by self-employed high-school dropouts is 27.7%, compared with only 24.0% usage rates for the types of jobs held by wage and salary workers with the same level of education. Also, for high-school dropouts, the rate of increase in computer use between 1984 and 1993 for the types of jobs held by the self-employed is 14.1%, compared with only 12.7% for the privately employed. Workers who are high-school graduates tend to show equivalent rates of computer use, regardless of self-employment status.[25] Together, with the results from Table 5, the data show that the less-educated self-employed were less likely to use a computer, but more likely to work in a job in which overall computer usage is high. Theoretically, this group should be adversely affected by SBTC, but their wages remained relatively constant over this period.

It is also the case that computer usage has not affected entry patterns into self-employment. Table 6 analyzes entry rates into self-employment based upon rates of computer usage in the pre-entry year. In particular, it presents estimates of a linear-probability model for entry rates into self-employment using regressors based on whether or not the individual falls into one of four categories before he enters self-employment: uses a computer in a job where computer-usage rates are "high"[26], doesn't use a computer at a job with high

shift-share formula was used:

$$\Delta C_{jt} = \sum_k (\Delta E_{jkt} \gamma_{jk}) + \sum_k (\Delta \gamma_{jkt} E_{jk})$$

where k indexes industry and occupation combinations, E_{jkt} is the employment of group j in industry and occupation group k in year t as the share of total employment, E_{jk} is the average employment in industry-occupation combination k between years t and τ, γ_{jkt} is the average computer use of group j in industry-occupation combination k for year t, γ_{jk} is the average computer use for group j in industry-occupation category k between years t and τ.

Tables containing rates of computer use by industry and occupation categories are available from the author upon request.

[25] Self-employed high school graduates are in jobs with similar computer use rates as their wage-and-salary counterparts (34.1% for both types of workers) and slightly more likely to be in a job with larger increases in the rate of computer usage (16.4% to 16.3%).

[26] "High" computer usage rates are defined as those above the average for the year in which the respondent was interviewed. These results were estimated by using white males from the matched October 1989 and October 1990 supplements of the CPS, and the October 1993 and 1994 supplements. For 1989, this average computer usage was 37.5%, and for 1993, this average rate was 49.6%.

usage rates, uses a computer at a job with low usage rates, and doesn't use a computer at a job where computer usage is low. If it was the case that the less-educated self-employed were composed of workers seeking to avoid skill-biased technological change, then we would expect to see high entry rates into self-employment for individuals who didn't use a computer, but worked in a field where overall computer usage was quite prevalent. But the results in Table 6 demonstrate that this is not the case – entry rates do not differ at all between these four categories, and this is true if the entire sample is used, or if the analysis is restricted to less-educated workers. Overall, this implies that there is no strategic behavior on the part of entrants into self-employment who may be trying to avoid the effects of SBTC, and that the selection of workers into self-employment is not dependent upon an aversion to (or aptitude for) technology.

This evidence collectively presents an argument against the overall effect of skill-biased technological change on the wage distributions of less-educated workers, but in favor of the effects of SBTC on the wage distributions of more-educated workers. More-educated workers in the wage and salary sector are more likely to use computers and have increased their computer usage more than their self-employed counterparts, and earnings of the more-educated have grown faster in the wage and salary sector than in the self-employment sector. However, the relative stability of wages earned by less-educated self-employed workers could have been accounted for by SBTC in different ways, but there was no evidence in favor of these possibilities. First, the self-employed could have used computers more (or exhibited a larger increase in usage) than their wage and salary counterparts. However, the data show the opposite to be true. Alternatively, SBTC could explain these wage dynamics if the self-employed were concentrated in jobs where computers usage was low, so that the downward pressure that SBTC exerted on wages was mitigated by these low usage rates. Again, the data show that this is not so. Furthermore, if the self-employed were trying to avoid the downward-wage pressure of SBTC, this theory would predict that the most likely entrants into self-employment would be those who would be most affected by skill-biased technological change: individuals who are technically limited (don't use computers)

in technologically demanding jobs (where computer usage rates are high). But the data do not support this possibility.

In sum, skill-biased technological change seems unable to account for the findings about the less-educated, and does not appear to be a convincing hypothesis to explain the changing wages of less-educated workers in the United States from the late seventies to early nineties. As such, these results suggest that a different hypothesis should be considered to explain the convergence of wages for less-educated self-employed and wage and salary workers, such as changing labor market institutions. Specifically, since the self-employed do not receive the benefits of union coverage or the minimum wage, then changing labor market institutions should only affect wage and salary workers.[27] The efficacy of this explanation will be considered in the next section.

6 Institutional Effects

Since there is little evidence supporting the effects of relative supply and SBTC on the relative wages of the less-educated self-employed between 1979 and 1991, it is important to consider an alternative potential cause of changing relative wages – changes in labor market institutions. Two such institutions are the minimum wage and labour unions. The decline in the real value of the minimum wage over the 1980's has been well documented. In 1979, the real value of the federal minimum wage was $5.71/hour, but only $4.25/hour in 1991.[28] Unionization rates also declined over this period,[29] and these two factors have affected many workers. To determine the impact of changing labor market institutions on the wage

[27] One important consideration to account for is whether or not these deteriorating labor market institutions would affect the self-employed by causing more workers to opt for self-employment in the face of worsening job prospects in the wage and salary market. But, as was illustrated by Table 2, there were no changes in the stocks or flows of self-employed workers. Furthermore, the relative pre-transition wages of workers who become self-employed stayed constant over this period, suggesting that the changing labor market institutions had no effect on the selection of workers entering or leaving self-employment.

[28] The real value of the minimum wage was calculated in 1991 dollars using the consumer price index.

[29] For white males between the ages of 25 and 60, the unionization rate fell from 48% in 1979 to 23% in 1991 for high school dropouts, 45% in 1979 to 30% in 1991 for high school graduates, 34% in 1979 to 25% in 1991 for those with some college and 22% in 1979 to 16% in 1991 for college graduates.

distributions of wage and salary workers, this analysis will rely upon the reweighted kernel density estimation technique developed by DiNardo, Fortin and Lemieux (1996). This approach estimates the effect of declining real value of the minimum wage and labor unions on the distribution of wages if individual attributes had remained at their 1979 levels, and workers were paid according to the wage structure observed in 1991. Specifically, the 1991 wage distribution will be reweighted to incorporate the level of unionization and the real value of the minimum wage that prevailed in 1979. This technique essentially makes two changes to the 1991 wage distribution: the first is that the portion of the distribution that lies below the real value of the minimum wage in 1979 is replaced by the corresponding portion of the 1979 distribution.[30] The second is that the unionized and non-unionized workers who comprise the overall distribution in 1991 are reweighted to reflect unionization rates in 1979.[31] This reweighting function, $\widehat{\psi}_z(z)$, depends upon observable characteristics, z, and can be used to estimate the reweighted 1991 wage density, $\widehat{f}(w)$, with a weighted kernel approach:

$$\widehat{f}(w) = \sum_i \left(\frac{\theta_i}{h}\right) \widehat{\psi}_z(z) K\left(\frac{w - W_i}{h}\right)$$

where θ_i are the weights associated with each observation (and $\sum_i \theta_i = 1$), h is the bandwidth of the kernel, and W_i is the observed log wage for individual i.[32]

This paper differs from DiNardo, Fortin and Lemieux's by using the wage distribution of the self-employed as a counter-factual for that of wage and salary workers in order to measure the impact of changes in demand on the wage distribution of the wage and salary

[30] Since there was negative real wage growth for the low end of the wage distribution, this causes a decrease in the estimated densities below the 1979 real value of the minimum wage. Intuitively, this assumes that the proportion of individuals paid at a level below the minimum wage is the same in both time periods. Furthermore, the procedure takes the difference in the proportion of workers below the 1979 minimum wage in 1991 and 1979 and "heaps" them at the 1979 real value of the minimum wage.

[31] Please refer to DiNardo, Fortin and Lemieux for a more detailed discussion of the derivation of this reweighting function.

[32] To incorporate the change in the minimum wage, it is necessary to make three assumptions: the minimum wage has no spillover effects on the wage distribution above the minimum wage, the minimum wage has no effect on employment probabilities, and the shape of the conditional density at or below the minimum wage depends only on the minimum wage. Using these assumptions, I employ a similar method as DiNardo, Fortin and Lemieux to compute the effect of a changing minimum wage.

workers. It has been argued that both the self-employed and wage and salary workers are subject to changes in demand, but only wage and salary workers are affected by changes in labor market institutions. By using changes in average real log wages for both types of workers, the percentage decrease in wages caused by declining labor market institutions can be identified using the re-weighted wage distribution:

$$\frac{\Delta\widetilde{w}_{WS} - \Delta\overline{w}_{SE}}{\Delta\overline{w}_{WS} - \Delta\overline{w}_{SE}} = \frac{(\widetilde{w}^{a}_{WS,1991} - \overline{w}_{WS,1979}) - (\overline{w}_{SE,1991} - \overline{w}_{SE,1979})}{(\overline{w}_{WS,1991} - \overline{w}_{WS,1979}) - (\overline{w}_{SE,1991} - \overline{w}_{SE,1979})}$$

where $\overline{w}_{SE,C}$ is the average log real wage for the self-employed in the year C, $\overline{w}_{WS,C}$ is the average log real wage for wage and salary workers in the year C, and $\widetilde{w}_{WS,1991}$ is the sample moment in 1991 that would result for wage and salary workers if individual attributes had remained at their 1979 levels, and workers were paid according to the wage schedule observed in 1991.

These changes in different moments for real log hourly wages are displayed in Table 7. The first row displays the change in statistical moments for wage and salary workers, and the second row displays the same change for the self-employed. The results are typical: there are large decreases in wages for less-educated wage and salary workers and increases for the most highly educated. But the second row shows that there are very small changes in the sample moments of the wage distribution for less-educated self-employed workers. Both high-school dropouts and graduates who are self-employed have very small changes in their average earnings between 1979 and 1991. This implies that the effects of demand changes on earnings were modest; this is identified by the fact that the self-employed were only affected by changes in demand and were immune to institutional changes in the labor market.

The third row of these tables calculates the change in the wage densities of wage and salary workers, net of the change in self-employed wages. This difference is the portion of the wage change that is not due to demand or supply changes, and using the approach taken by DiNardo, Fortin and Lemieux (1996), it is clear that institutional changes have a strong effect on these "net changes" in wages for less-educated workers. For high-school dropouts, the minimum wage can account for 11% of the decrease in the relative average

wage received by wage and salary workers compared to self-employed workers, and the decrease in unionization rates between 1979 and 1991 accounts for another 33% of this decline. These two factors can jointly explain over 40% of the decrease in average wages (not due to demand factors) for high school dropouts who work in the wage and salary sector, and over 60% of this change for high school graduates. Naturally, one concern in this analysis relates to how the nature of work differs for wage and salary workers and the self-employed. But the last row of this table demonstrates that observable characteristics such as industry or occupation are important, but aren't as large as the joint effect of the labor market institutions for these two groups. These findings are generally consistent with the results of DiNardo, Fortin and Lemieux, who find that both the minimum wage and labor unions are important factors for explaining increasing wage inequality, and are generally as significant as changing individual attributes and changes in supply and demand.[33]

The third and fourth columns of Table 7 perform a similar analysis for workers with some college education and those who are college graduates. The results illustrate that very little of the change in wages accruing to wage and salary workers with some college education is due to changes in institutional factors. For workers with some college education, there are only small changes in wages, net of their self-employed counterparts. But, this is not surprising. Earlier evidence suggested that SBTC is a decent candidate to explain the wage dynamics of this group. As well, the decline in unionization rates is much less pronounced for both this group and college graduates, and the effect of the minimum wage on both groups should not be large (since only a small proportion of highly-educated workers would be affected by the minimum wage). Furthermore, although changes in labor market institutions have less explanatory power for high-education groups, it is also the

[33]DiNardo, Fortin and Lemieux do not consider changes in the average wages of specific educational groups, so it is difficult to directly compare the results in this paper to their findings. However, DiNardo, Fortin and Lemieux do find that the minimum wage is highly significant for explaining decreases in the low end of the wage distribution (the 10th or 5th percentiles) and the decrease in unionization rates is significant for higher percentiles, such as the 25th or 50th. This is generally consistent with my findings, which show that these institutions are important for the less-educated (who are in the middle and low end of the overall wage distribution) but not as much for the highly educated.

case that these groups did not have as large changes in average log wages over this time period. However, changes in labor market institutions are clearly important for analyzing the wage changes for groups like the less-educated.

6.1 SBTC and Institutional Change

A potential criticism of this approach for measuring the impacts of institutional change on wages is that SBTC may have actually caused the decline in the labor market institutions that are assumed to be exogenous. For instance, Acemoglu, Aghion and Violante (2001) argue that it is possible for technological innovations to weaken the coalitions between high- and low-skill workers that maintain labor unions. In the authors' model, all workers can opt for either a union job or a non-union job, depending on which job offers the highest wage. Workers are paid their marginal products at a non-union job, which are A_H and A_L for the high- and low-skilled worker, respectively. Unions compress the difference in earnings between the high- and low-skilled, so that the relationship between high-skilled wages (w_H) and low-skilled wages (w_L) paid by the union is determined as follows:

$$\frac{w_H}{w_L} \leq \Psi \frac{A_H}{A_L}$$

where $\Psi < 1$. In addition, unions pay all workers a benefit η,[34] which will entice some high-skilled workers to become unionized. The key point to this argument is that if a technological innovation occurs that is skill-biased, it increases $\frac{A_H}{A_L}$, and w_H will decrease relative to A_H. This makes it increasingly unlikely that high-skilled workers will remain in the union, and this out-migration of high-skilled workers into the non-union sector can lead to a destabilization of existing unions, and deunionization overall in the labor market. Acemoglu, Aghion and Violante present some empirical evidence that is loosely consistent with this theory, but Acemoglu (2002) believes that the effect of SBTC on deunionization is still an open question.

To provide some evidence for or against the relationship between SBTC and the

[34] Acemoglu (1999) argues that unions provide η because it increases worker productivity or it encourages training. Alternatively, η could also be part of the rents captured from the firm by the union.

decline in unionization in the U.S. labor market, it is possible to consider how unionization rates have been changing in comparison with computer usage. Since computer usage represents skill-biased technical change, then it is plausible that sectors exhibiting larger growth in computer usage should also have larger decreases in unionization rates, since these are the sectors that should have the greatest changes in $\frac{A_H}{A_L}$ due to SBTC. Using data from the October 1984, 1989 and 1993 supplements of the CPS, it is possible to determine both the changes in average unionization and computer usage rates within different industry and occupation cells[35] by estimating the following regression:

$$\Delta Union_i = \alpha(\Delta Computer\ Usage)_i + \beta\Delta X_i + \epsilon_i$$

where $\Delta Union_i$ represents the change in unionization rates in cell i, $(\Delta Computer\ Usage)_i$ is cell i's change in computer usage rates, and ΔX_i is the change in other average attributes (such as education, and age) in cell i. If SBTC causes the deunionization of the labor market through a decline in w_H relative to A_H, then greater increases in technological change in each industry and occupation cell should lead to greater decreases in unionization rates for this cell, causing α to be negative. The model was tested with two specifications: the linear specification in columns one, three and five use variables calculated from the difference in the cell average from one year to the other. The log specification in columns two, four and six uses variables calculated from the difference in the logarithm of the cell average. All six columns of Table 8 show that there is no evidence for a significant effect of skill-biased technical change on changes in unionization rates in the labor market. Both the linear and log specifications of the model have exclusively insignificant estimates of α, suggesting that increasing computer usage was not a causal factor in the decline of this particular labor market institution. Although there may be some general equilibrium effects that temper the conclusions drawn from Table 8, these results demonstrate that there is no first-order

[35] To construct the industry and occupation cells, I used five major occupation classes and seven major industry classes, resulting in thirty-five different cell averages being computed for the 1984, 1989 and 1993 data sets. Ideally, I would have liked to have created more cells, but to maintain an adequate number of observations in each cell, it was not possible to increase the number of industry or occupational classifications used.

evidence to suggest any endogeneity for the decrease in unionization with regard to this analysis of wage dynamics in the 1980's.

7 Conclusion

The increase in wage inequality over the 1980's has been well-documented by many studies. Explanations for this increase in inequality have been based on two different hypotheses: skill-biased technical change and demand changes, and changes in labor market institutions. To test these hypotheses against each other, this paper presents new evidence on changes in self-employed earnings. The self-employed are a natural comparison group for wage and salary workers, since the self-employed are not affected by changes in labor market institutions, but are subject to the same changes in demand and skill-biased technical change as wage and salary workers. It was demonstrated that self-employed earnings for less-educated workers showed a remarkable convergence to the earnings of wage and salary workers; this stemmed from the fact that there was a large decrease in real wages for low-educated wage and salary workers between 1979 and 1991, but not for the self-employed. As well, the earnings of more-educated wage and salary workers grew relative to their self-employed counterparts. Evidence in this paper demonstrated that there were no significant changes in the relative supply of self-employed workers, or any significant changes in the types of workers who elect to become self-employed. Furthermore, it was also shown that self-employed workers are less likely to use a computer, but just as (or perhaps even more) exposed to skill-biased technical change as wage and salary workers, because they are employed in industry and occupation cells that have been subject to as great (or greater) computer usage, and the increase in computer use for these jobs has been just as large as that for jobs held by wage and salary workers. Although these findings provided support for the effect of SBTC on the wages of more-educated workers, the evidence also suggested that skill-biased technical change was not a likely cause of the different wage dynamics between less-educated self-employed and wage and salary workers. However, a large proportion of the change in real log earnings of less-educated workers was

found to be due to changes in unionization rates and the real value of the minimum wage. These two institutional changes accounted for significant amounts of the total decline in the average real hourly wages for both high-school dropouts and graduates who were wage and salary workers. These estimates are consistent with those of DiNardo, Fortin and Lemieux (1996), and demonstrate the importance of institutional changes on the less-skilled labor market over the 1980's. One potential criticism of this technique, however, is that the decline in labor market institutions during the 1980's was endogenous, since skill-biased technical change could be a significant factor in the deunionization of the labor force. This concern was addressed by comparing changes in computer usage rates with changes in unionization rates by industry and occupation cells, and it was demonstrated that there is no significant causal link between these two events. As such, it does not appear that skill-biased technical change had any direct impact on the change in labor market institutions such as unions during the 1980's.

References

[1] Abowd, John M. and Farber, Henry S. "Job Queues and the Union Status of Workers." *Industrial and Labor Relations Review*, April 1982, 35(3), pp.354-367.

[2] Acemoglu, Daron. "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence." *American Economic Review*, December 1999, 89(3), pp. 1259-1278.

[3] Acemoglu, Daron. "Technical Change, Inequality and the Labor Market." *Journal of Economic Literature*, March 2002, 40(2), pp. 7-72.

[4] Acemoglu, Daron. "Why Do new Technologies Complement Skills? Directed Technical Change and Wage Inequality." *Quarterly Journal of Economics*, November 1998, 113(4), pp. 1055-1089.

[5] Acemoglu, Daron, Phillipe Aghion and Giovanni L. Violante. "Deunionization, Technical Change and Inequality." *Carnegie-Rochester Conference Series of Public Policy.*

[6] Autor, David H., Frank Levy and Richard J. Murnane. "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics*, November 2003, 118(4), pp. 1279-1334.

[7] Autor, David H., Lawrence F. Katz and Alan B. Krueger. "Computing Inequality: Have Computers Changed the Labor Market?" *Quarterly Journal of Economics*, November 1998, 113(4), pp. 1169-1213.

[8] Berman, Eli, John Bound and Stephen Machin. "Implications of Skill-Biased Technological Change: International Evidence." *Quarterly Journal of Economics*, November 1998, 113(4), pp.1245-1279.

[9] Bernhardt, Irwin. "Comparative Advantage in Self-Employment and Paid Work." *Canadian Journal of Economics,* May 1994, 27(2), pp. 273-289.

[10] Blau, David M. "A Time Series Analysis of Self Employment in the United States." *Journal of Political Economy*, June 1987, 95(3), pp. 445-46.

[11] Borjas, George J. and Bronars, Stephen G. "Consumer Discrimination and Self-Employment." *Journal of Political Economy,* June 1989, 97(3), pp. 581-605.

[12] Bound, John and Johnson, George. "Changes in the Structures of Wages in the 1980's: An Evaluation of Alternative Explanations." *American Economic Review*, June 1992, 82(3), pp. 371-392.

[13] Card, David and Krueger, Alan B. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania." *American Economic Review*, September 1994, 84(4), pp. 772-793.

[14] Card, David and DiNardo, John E. "Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles." *Journal of Labor Economics,* October 2002, 20(4), pp. 733-783.

[15] Carrington, William J., Kristin McCue and Brooks Pierce. "The Role of Employer/Employee Interactions in Labor Market Cycles: Evidence from the Self-Employed." *Journal of Labor Economics,* October 1996, 14(4), pp. 571-602.

[16] Devine, Theresa J. "CPS Earnings Data for the Self-Employed: Words of Caution for Use and Interpretation." *Journal of Economic and Social Measurement, 1995,* 21(3), pp. 213-251.

[17] DiNardo, John, Nicole M. Fortin and Thomas Lemieux. "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica*, September 1996, 64(5), pp.1001-1044.

[18] DiNardo, John E. and Jorn-Steffen Pischke. "The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure, too?" *Quarterly Journal of Economics,* February 1997, 113(1), pp. 291-303.

[19] Evans, David S. and Jovanovic, Boyan. "As Estimated Model of Entrepreneurial Choice under Liquidity Constraints." *Journal of Political Economy,* August 1989, 97(4), pp. 808-827.

[20] Evans, David S. and Leighton, Linda S. "Some Empirical Aspects of Entrepreneurship." *American Economic Review,* June 1989, 79(3), pp. 519-535.

[21] Farber, Henry S. "The Determination of the Union Status of Workers." *Econometrica,* September 1983, 51(5), pp. 1417-1437.

[22] Fortin, Nicole M. and Lemieux, Thomas. "Institutional Changes and Rising Wage Inequality: Is There a Linkage?" *Journal of Economic Perspectives,* Spring 1997, 11(2), pp. 75-96.

[23] Green, David A., Barton H. Hamilton, and Harry J. Paarsch. "Trends in Earnings Inequality among the Self-Employed, 1979-1989." Mimeo. Montreal, Canada: Department of Economics, McGill University, 1995.

[24] Hamilton, Barton H. "Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment." *Journal of Political Economy,* June 2000, 108(3), pp. 604-631.

[25] Johnson, George E. "Changes in Earnings Inequality: The Role of Demand Shifts." *Journal of Economic Perspectives,* Spring 1997, 11(2), pp. 41-54.

[26] Juhn, Chinhui, Kevin M. Murphy and Brooks Pierce. "Wage Inequality and the Rise in Returns to Skill." *Journal of Political Economy*, June 1993, 101(3), pp. 410-442.

[27] Kahn, James A. and Lim, Jong-Soo. "Skilled Labor-Augmenting Technical Progress in U.S. Manufacturing." *Quarterly Journal of Economics*, November 1998, 113(4), pp. 1281-1308.

[28] Katz, Lawrence F. and Autor, David H. "Changes in the Wage Structure and Earnings Inequality." Chapter 26 in Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics*, Vol 3A (Amsterdam: Elsevier, 1999), pp.1463-1555.

[29] Katz, Lawrence F. and Murphy, Kevin M. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics*, February 1992, 107(1), pp.35-78.

[30] Krashinsky, Harry. "Self-Employment for Less-Educated Men." Mimeo, 2004.

[31] Levy, Frank and Murnane, Richard J. "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations." *Journal of Economic Literature,* September 1992, 30(3), pp. 1333-1381.

[32] Machin, Stephen and Van Reenen, John. "Technology and Changes in Skill Structure: Evidence from Seven OECD Countries." *Quarterly Journal of Economics*, November 1998, 113(4), pp. 1215-1244.

[33] Mincer, Jacob. "Unemployment Effects of Minimum Wages." *Journal of Political Economy*, August 1976, 84(4), pp. S87-S104.

[34] Parker, Simon C. "The Distribution of Self-Employment Income in the United Kingdom, 1976-1991." *Economic Journal*, March 1997, 107, pp. 455-466.

[35] Robson, Martin T. and Wren, Colin. "Marginal and Average Tax Rates and the Incentive for Self-Employment." *Southern Economic Journal,* April 1999, 65(4), pp. 757-773.

Table 1: Sample Means for White Males, Self-Employed and Wage and Salary Workers, 1979-1991

	High School Dropout		High School Graduate		Some College		College Graduate	
	Self-Employed	Wage and Salary	Self-Employed	Wage and Salary	Self-Employed	Wage and Salary	Self-Employed	Wage and Salary
Age	48.15 (11.39)	43.92 (14.21)	43.72 (11.67)	39.07 (12.90)	42.50 (11.21)	37.06 (12.15)	45.04 (10.31)	41.21 (10.70)
Construction Industry	0.369 (0.483)	0.175 (0.380)	0.328 (0.469)	0.134 (0.340)	0.260 (0.439)	0.095 (0.293)	0.090 (0.286)	0.034 (0.181)
Manufacturing Industry	0.063 (0.243)	0.378 (0.485)	0.065 (0.246)	0.354 (0.478)	0.059 (0.236)	0.278 (0.448)	0.040 (0.197)	0.239 (0.427)
Service Industry	0.232 (0.422)	0.139 (0.346)	0.249 (0.432)	0.131 (0.338)	0.291 (0.454)	0.197 (0.398)	0.580 (0.494)	0.424 (0.494)
Manager	0.222 (0.416)	0.044 (0.204)	0.274 (0.446)	0.105 (0.307)	0.354 (0.478)	0.228 (0.420)	0.670 (0.470)	0.693 (0.461)
Operators & Laborers	0.187 (0.390)	0.461 (0.498)	0.134 (0.341)	0.317 (0.465)	0.084 (0.277)	0.178 (0.382)	0.025 (0.155)	0.031 (0.174)
Computer Use	0.028 (0.166)	0.069 (0.253)	0.083 (0.276)	0.218 (0.413)	0.226 (0.418)	0.432 (0.495)	0.391 (0.488)	0.630 (0.483)

Standard deviations are listed in parentheses. Data for this table was collected from the outgoing rotation groups of the CPS from 1979 to 1991, and the sample was limited to White men, between the ages of 25 and 60, who earned at least $2 per hour (in 1991 dollars) and no more than $50 per hour.

Table 2: Trends in Self-Employment Levels, Entry Rates and Exit Rates, 1979-1991

	Self-Employment Rates (CPS)		Self-Employment Rates (Census)		Self-Employment Entry Rates (CPS)		Self-Employment Exit Rates (CPS)	
Year*H.S. Dropout	0.0007 (0.0004)	-0.0013 (0.0009)	0.0017 (0.0025)	-0.0035 (0.0028)	0.0003 (0.0002)	0.0002 (0.0002)	0.0055 (0.0032)	0.0051 (0.0031)
Year*H.S. Graduate	-0.0003 (0.0003)	-0.0010 (0.0006)	-0.0064 (0.0029)	0.0061 (0.0032)	-0.0002 (0.0001)	-0.00018 (0.00011)	0.0011 (0.0022)	0.0004 (0.0022)
Year* Some College	-0.0018 (0.0014)	-0.0026 (0.0016)	-0.0045 (0.0031)	-0.0035 (0.0030)	-0.0002 (0.0002)	-0.0001 (0.0002)	0.0028 (0.0030)	0.0034 (0.0030)
Year*College Graduate	-0.0002 (0.0003)	0.0001 (0.0007)	-0.0055 (0.0028)	-0.0029 (0.0028)	-0.0002 (0.0002)	-0.00003 (0.0001)	-0.0015 (0.0025)	-0.0010 (0.0025)
H.S. Dropout	-0.0183 (0.0106)	-0.0093 (0.0105)	-0.0068 (0.0030)	-0.0105 (0.0029)	-0.0061 (0.0018)	-0.0041 (0.0018)	-0.0406 (0.0132)	-0.0079 (0.0131)
H.S. Graduate	-0.0135 (0.0104)	-0.0015 (0.0102)	0.0104 (0.0033)	0.0080 (0.0032)	-0.0053 (0.0016)	-0.0037 (0.0016)	-0.0180 (0.0118)	-0.0024 (0.0117)
College Graduate	0.0041 (0.0105)	-0.0139 (0.0102)	0.0059 (0.0034)	-0.0069 (0.0033)	-0.0016 (0.0017)	-0.0033 (0.0017)	-0.0111 (0.0125)	-0.0023 (0.0126)
Other Covariates	No	Yes	No	Yes	No	Yes	No	Yes

Standard errors were calculated using White's standard error formula. The linear probability models use data from the matched outgoing rotation groups of the CPS from 1979 to 1991, and the 5% samples from the United States Census in 1980 and 1990. The first four columns list results from a regression which uses a self-employment dummy as the dependent variable – the first two use data from the CPS, and the last two use data from the census. The fifth and sixth columns display results from a regression using as its dependent variable a dummy variable equal to one if the individual enters self-employment. The seventh and eighth columns show results from a regression which uses as its dependent variable a dummy equal to one if the individual exits from self-employment. The regressions used 3 dummy variables for educational attainment (leaving "Some College" as the reference group), but interacted all four educational groups with the year trend. The "other covariates" include age, marital and industry controls, as well as dummy variables for recession years to capture business cycle effects (for the CPS data), and tax rates for the entry equations (since other studies have demonstrated their importance when modeling the entry decision). In addition, a dummy variable was added for the years after 1985, to capture any erroneous effects due to a recoding in the CPS data after this point. The Census regressions also include controls for whether or not the respondent is an immigrant to the United States.

Table 2A: Relative Wages for the Self-Employed in the CPS and Census in 1979 and 1989

	Less than High School Graduate			High School Graduate			Some College and College Graduate		
	CPS	Census		CPS	Census		CPS	Census	
Self-Employed	-0.147 (0.035)	-0.218 (0.008)	-0.233 (0.008)	-0.233 (0.067)	-0.313 (0.011)	-0.205 (0.020)	-0.060 (0.039)	-0.035 (0.005)	-0.034 (0.005)
Year Dummy for 1989	-0.109 (0.013)	-0.159 (0.002)	-0.160 (0.002)	-0.063 (0.008)	-0.153 (0.001)	-0.136 (0.005)	0.071 (0.010)	0.003 (0.001)	0.003 (0.001)
Self-Employed* Year Dummy for 1989	0.173 (0.052)	0.146 (0.014)	0.144 (0.014)	0.079 (0.072)	0.082 (0.012)	0.107 (0.026)	0.046 (0.048)	0.016 (0.007)	0.021 (0.007)
Controls for Immigrant Status?	No	No	Yes	No	No	Yes	No	No	Yes

Standard errors were calculated using White's standard error formula. The regression models use data from the matched outgoing rotation groups of the CPS in 1980 to 1990, and the 5% samples from the United States Census in 1980 and 1990, and the sample was limited to White men, between the ages of 25 and 60, who earned at least $2 per hour (in 1991 dollars) and no more than $50 per hour. The dependent variable is the log of hourly wages, and all the regressions in this table use a full set of control variates, such as age and age squared, industry controls, and an indicator variable for marital status. The third, sixth and ninth columns also contain controls for whether or not the respondent is an immigrant to the United States. The first, fourth and seventh columns, entitled "CPS" use data from the Current Population Survey, and the remaining columns use data from the Census. The wage regressions were estimated for three groups: those with education attainment of less than a high-school graduate (the results for this group are displayed in the first three columns), high school graduates (in the next three columns), and those whose educational attainment was greater than a high-school graduate's (in the final three columns).

Table 3: Relative Ages by Self-Employment Levels, Entry Rates and Exit Rates, 1979-1991

	Age Difference Between Self-Employed and Wage and Salary		Age Difference Between Self-Employed Entrants and Non-Entrants		Age Difference Between Self-Employed Exits and Non-Exits	
Year*H.S. Dropout	0.205 (0.107)	0.159 (0.107)	0.025 (0.087)	0.026 (0.086)	-0.042 (0.093)	-0.018 (0.092)
Year*H.S. Graduate	-0.002 (0.023)	-0.007 (0.023)	0.309 (0.190)	0.228 (0.186)	0.036 (0.066)	0.067 (0.063)
Year* Some College	-0.023 (0.031)	-0.021 (0.030)	0.037 (0.019)	0.021 (0.019)	0.110 (0.087)	0.145 (0.081)
Year*College Graduate	-0.001 (0.024)	-0.003 (0.024)	0.003 (0.061)	-0.018 (0.058)	-0.055 (0.069)	-0.059 (0.068)
H.S. Dropout	0.893 (0.282)	1.231 (0.285)	-2.579 (0.600)	-2.015 (0.599)	-4.223 (0.671)	-3.897 (0.670)
H.S. Graduate	2.505 (0.170)	2.889 (0.168)	-3.244 (0.520)	-2.598 (0.509)	-4.172 (0.494)	-4.030 (0.477)
Some College	2.591 (0.239)	2.862 (0.233)	-0.446 (0.179)	-0.227 (0.173)	-0.980 (0.315)	-1.121 (0.296)
College Graduate	2.948 (0.186)	3.087 (0.182)	-0.185 (0.224)	-0.065 (0.214)	-0.369 (0.246)	-0.311 (0.240)
Other Covariates	No	Yes	No	Yes	No	Yes

Standard errors were calculated using White's standard error formula. All regressions use data from the matched outgoing rotation groups of the CPS from 1979 to 1991. The "other covariates" include age, marital and industry controls, as well as dummy variables for recession years to capture business cycle effects. In addition, a dummy variable was added for the years after 1985, to capture any erroneous effects due to a recoding in the CPS data after this point. The p-values for the F-tests of the joint significance of the year variables interacted with the educational grouping in columns 1-6 are: 0.3796, 0.5979, 0.1778, 0.5726, 0.5974, and 0.2714, respectively.

Table 4: The Relative Wages of Entrants and Non-Entrants into Self-Employment for 1979-1991

	High School Dropouts		High School Graduates		Some College		College Graduates	
	Wages (1)	Residual (2)	Wages (3)	Residual (4)	Wages (5)	Residual (6)	Wages (7)	Residual (8)
Will Become Self-Employed	-0.016 (0.026)	-0.014 (0.045)	-0.050 (0.018)	-0.049 (0.027)	-0.060 (0.025)	-0.095 (0.038)	-0.035 (0.024)	-0.021 (0.033)
Trend	-0.014 (0.001)	0.0002 (0.0006)	-0.013 (0.001)	0.0002 (0.0003)	-0.011 (0.001)	0.0001 (0.0006)	0.001 (0.001)	0.0001 (0.0005)
(Will Become Self-Employed)*Trend	0.005 (0.004)	-0.002 (0.006)	-0.001 (0.002)	-0.001 (0.003)	-0.001 (0.003)	0.007 (0.005)	-0.005 (0.003)	-0.005 (0.004)
R^2	0.273	0.0002	0.316	0.0003	0.388	0.0002	0.195	0.0004
P-Value For (Will Become Self-Employed)*Trend	0.174	0.760	0.768	0.769	0.971	0.141	0.147	0.200

This table was compiled using matched CPS data from 1979 to 1991. The matched data yields two observations on a single individual, and the regressions listed here rely upon the information in both periods. Specifically, the regressions involve only those who are in the wage-and-salary sector in the first year of the panel, and the variable "Will Become Self-Employed" is equal to one if the individual becomes self-employed in the second year of the panel, and zero otherwise. For each educational group, there are two types of regressions reported: a wage regression with the three variables reported on the table, and a regression of wage residuals on the same variables. The coefficients are calculated using ordinary least squares, and the White standard errors are listed below the coefficients in parentheses. The "other covariates" used in the model include: age, age squared, marital status, tax rates, and six industry dummy variables.

Table 5: Relative Computer Usage for Self-Employed White Males, Linear Probability Model and Probit Results, 1984-1993

	High School Dropout		High School Graduate		Some College		College Graduate	
	LPM	Probit*	LPM	Probit*	LPM	Probit*	LPM	Probit*
1984	-0.030	-0.025	-0.071	-0.077	-0.114	-0.123	-0.143	-0.153
	(0.012)	(0.006)	(0.013)	(0.010)	(0.022)	(0.020)	(0.020)	(0.020)
1989	-0.030	-0.030	-0.081	-0.096	-0.142	-0.145	-0.163	-0.173
	(0.016)	(0.011)	(0.015)	(0.013)	(0.024)	(0.025)	(0.019)	(0.020)
1993	-0.022	-0.039	-0.105	-0.117	-0.129	-0.143	-0.192	-0.193
	(0.020)	(0.014)	(0.018)	(0.016)	(0.022)	(0.023)	(0.017)	(0.020)
1993-1984	-0.005		-0.051		-0.020		-0.025	
	(0.020)		(0.021)		(0.030)		(0.026)	

Standard errors are listed in parentheses (for the linear probability model results, these are White (heteroskedasticity-robust) standard errors). Other covariates in the regression include age, age squared, marital status, and six industry dummies. The row entitled "1993-1984" is a difference-in-difference linear probability model including data from 1984 and 1993. The regression itself includes all of the covariates already mentioned, along with dummy variables equal to one if the respondent is self-employed, if the respondent is in the 1993 sample, and if the respondent is self-employed and in the 1993 sample. The reported coefficient for this row is for the interacted variable, which indicates the difference in the change of computer usage for the self-employed. Data for this analysis was collected from the 1984, 1989 and 1993 October supplements of the CPS. The sample is limited to men between the ages of 25 and 60, earning between $2 per hour and $50 per hour.

* The coefficients for the probit model report the marginal effects for the variables, which are similar in significance to the ordinary probit coefficients estimated for the same models.

Table 6: The Effect of Computer Usage in High-Technology and Low-Technology Jobs on Entry Rates into Self-Employment

	Entire Sample		High-School Graduates and Dropouts	
Use Computers in High-Use Job	0.002 (0.007)	-0.001 (0.008)	0.008 (0.014)	0.010 (0.014)
Don't Use Computers in High-Use Job	-0.008 (0.006)	-0.009 (0.007)	-0.009 (0.006)	-0.011 (0.007)
Don't Use Computers in Low-Use Job	0.004 (0.006)	0.005 (0.006)	0.005 (0.008)	0.005 (0.008)
Other Covariates*	No	Yes	No	Yes

White Standard Errors are listed in parentheses. The data was compiled from matched October supplements of the CPS for 1989 and 1990, and 1993 and 1994 (matches from 1984 to 1985 were not possible because of recoding in the data). The excluded group from the regression is respondents who "Use Computers in a Low-Use Job". The matched data yields two observations on a single individual, and the regressions listed here rely upon the information in both periods. Specifically, the regressions involve only those who are in the wage-and-salary sector in the first year of the panel, and the dependent variable in all four columns is an indicator variable equal to one if the respondent entered the self-employment sector in the second year of the panel, and zero if he remained in the wage and salary sector during the second year of the panel.

*"Other covariates" differ between the two samples. For the "Entire Sample", they include three dummy variables for educational attainment, age and its square, and weekly income during the potential pre-entry year. For the "high-school graduates and dropouts", the other covariates include one dummy variable for being a high-school graduate, age and its square, and weekly earnings during the potential pre-entry year.

Table 7: The Effect of the Minimum Wage and Changing Unionization Rates on Wages of White Males who are Wage and Salary Workers

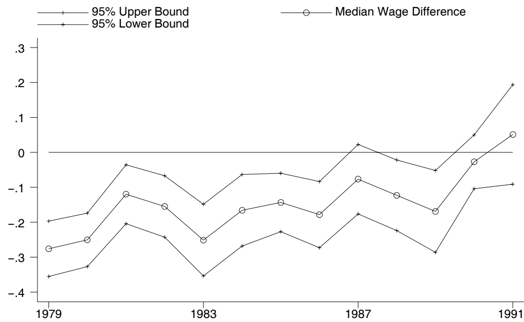
	Educational Category			
	High School Dropouts	High School Graduates	Some College	College Graduate
Change in the Wage and Salary Average Wage	-0.210	-0.145	-0.058	+0.090
Change in Self-Employed Average Wage	-0.010	-0.044	-0.079	+0.052
Net Change	-0.200	-0.101	+0.021	+0.038
Effect of Minimum Wage	-0.021 [0.105]	-0.012 [0.119]	-0.006 [0.286]	-0.003 [0.079]
Effect of Unionization	-0.062 [0.325]	-0.049 [0.485]	-0.030 [1.429]	+0.018 [0.474]
Effect of Observed Charactersitics	-0.028 [0.140]	+0.012 [0.119]	+0.026 [1.238]	+0.049 [1.289]

The first two rows of the table show the change in the log average wage for the wage-and-salary sample and the self-employed sample. The third row represents the difference between the first and second rows, and the remaining rows calculate how much of this “net change” can be accounted for by the changing minimum wage, changing unionization rates and changing observable characteristics (such as age, industry and occupational characteristics). In rows four through six, the actual amount of the net change that can be attributed to the variable in question is listed in the cell above the percentage of the net change that it can explain, which is displayed in square brackets.

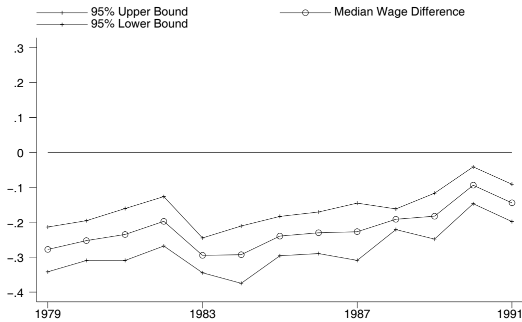
Table 8: The Impact of SBTC on Unionization Rates

	1984-1989		1989-1993		1984-1989-1993	
	Linear	Log	Linear	Log	Linear	Log
ΔComputer Usage	0.192 (0.128)	-0.097 (0.168)	0.105 (0.283)	0.668 (0.537)	0.169 (0.152)	-0.117 (0.150)
ΔEducation	-0.037 (0.038)	-2.492 (3.261)	-0.051 (0.047)	-5.963 (3.575)	0.005 (0.034)	0.707 (2.397)
ΔAge	-0.013 (0.014)	-0.407 (2.692)	-0.054 (0.019)	-4.220 (4.543)	-0.012 (0.012)	1.168 (3.290)
N	32	32	32	32	64	64

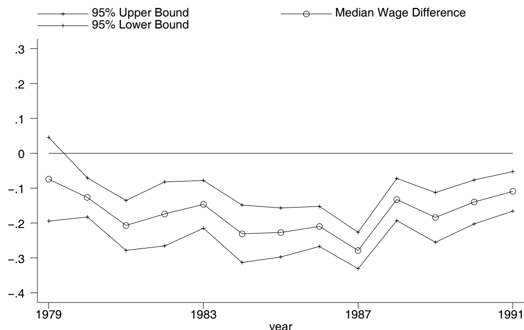
White standard errors are listed in parentheses. The regressions in this table were computed by determining the change in average unionization, computer usage, educational attainment and age by industry and occupation cell from the October 1984, 1989 and 1993 supplements to the CPS. The dependent variable in all six regressions listed in this table is the change in average cell unionization. To ensure that each cell had an acceptably large number of observations, the cell averages were calculated for seven different major industry classifications and five different major occupation classifications, resulting in the calculation of thirty-five different cell averages for each year. However, there were three cells that had fewer than thirty observations in 1984 and 1989, so they were dropped from the sample. The variables in the regression were calculated by determining the difference in these cell average between: 1984 and 1989 for the first columns, 1989 and 1993 for the third columns, and then combining these two samples for the fifth columns. The second, fourth and sixth columns display results from regressions which use variables computed with the difference of the log averages.



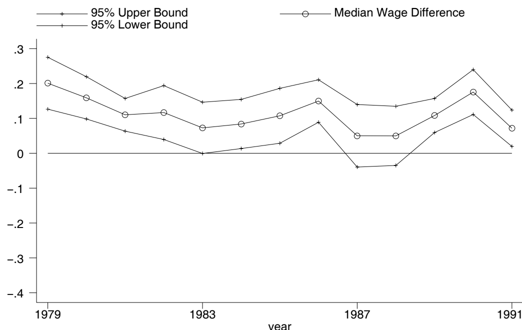
(A) High School Dropouts



(B) High School Graduates

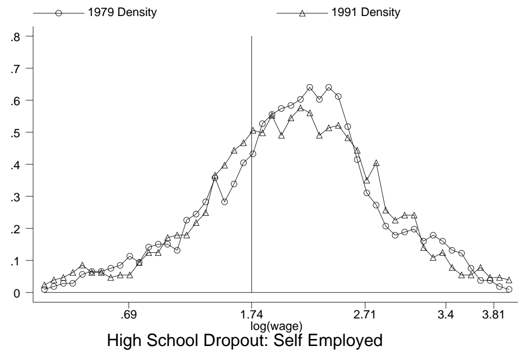


(C) Some College

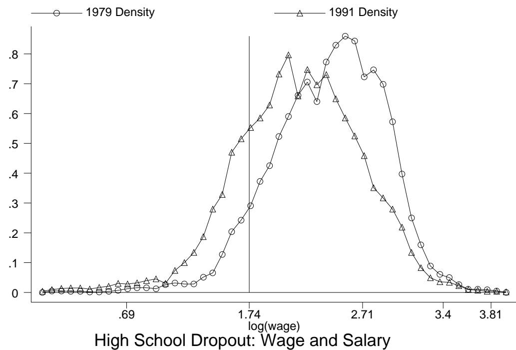


(D) College Graduates

Figure 1: Relative Median Log Wages for the Self−Employed

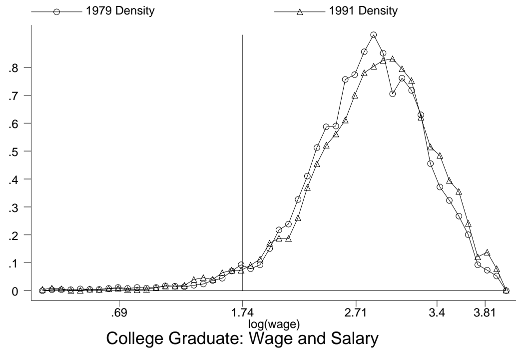


High School Dropout: Self Employed



High School Dropout: Wage and Salary

College Graduate: Self Employed



College Graduate: Wage and Salary

Figure 2: Changes in Wage Densities