Equal Pay for Equal Work?
Wage and Productivity Differentials During Slovenia's Transition

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Abstract

How has the transition to a market economy affected the relationship between wages and productivity across different types of workers? Using a rich longitudinal dataset spanning the 1992-2001 period, this study explores this relationship across workers based on age, education and gender for Slovenia during its transition to a market economy. The results indicate that the transition to a market economy dramatically altered the relationship between the relative wages and productivity of different types of workers, yet yielded remarkably little convergence towards the equilibrium wage relativities one would expect to observe in a competitive spot labor market. The estimates indicate that relative wage and differentials tended to decrease for older workers, increase for educated workers, and remain relatively constant for women.

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1. Introduction

Since the collapse of socialism, transition economies have faced the daunting task of introducing market forces into wage determination. Under socialism, ideological principles – rather than market forces – guided the wage setting process, resulting in elaborate but arbitrary wage grids, compressed wage structures, and wages that largely failed to reflect differences in productivity across workers and firms. Clearly, transition reforms needed to correct these labor market distortions to contribute to an efficient allocation of resources, and wages would need to become more aligned with marginal products in the process.

To what extent have market forces shaped wage determination in transition economies? A large body of the literature has focused on the earnings premium associated with schooling and other personal characteristics, and their results point to sharply higher returns to education during the transition period, to falling returns to work experience, and to moderate increases in the relative wages of women.[1] Do these results imply commensurate changes in the productivity of these groups of workers? Without independent measures of worker productivity, it is difficult to determine whether the changing wage differentials reflect differences in productivity or if they are attributable to other factors, such as changes in institutions, shifts in relative labor supply, skill-biased technical change affecting labor demand (Andren, Earle and Sapatoru, 2005), or outright discrimination (Hellerstein *et al,* 1999). Given the considerable changes that were

[1] The increase in wage differentials associated with education has been the most widely studied and documented (see Fleisher, Sabirianova and Wang, 2005, for a recent survey). Evidence of the effect of transition on experience and gender wage differentials is not as clear-cut. In their survey of the gender wage inequality literature, Paci and Reilly (2004) find evidence of a decrease in the average gender wage gap in most transition economies; as Hunt (2002) and Liu (2007) point out, declining employment amongst lower-wage females may play an important explanatory role. Flanagan (1993), Rutkowski (1997) and Kollo and Kertesi (1999) provide evidence that the experience-earnings profile has flattened during transition for the Czech Republic, Poland and Hungary, respectively.

occurring during transition, drawing conclusions about productivity changes based solely on wage equations may require making rather untenable assumptions.

This study adds to the literature by directly exploring the relationship between wages and productivity for Slovenia. It employs a rich, longitudinal matched employer-employee database to calculate firm-level estimates of wage equations and production functions that yield relative wage and productivity differentials that are directly comparable across demographic groups and over time. The results shed light on important questions of whether changes in wages reflect changes in underlying productivity: Do wage increases for educated workers during transition reflect an increase in the marginal product of education, or are they a temporary, transitional adjustment to equilibrium wage relativities? Were older, more experienced workers able to apply their skills and knowledge in the radically different economic conditions – and if not, did commensurate adjustments of wages take place? Did wage liberalization increase discrimination against women, or did competitive pressures remove arbitrary wage setting mechanisms that may have previously discriminated against them? Furthermore, given the dramatic worker flows during transition (separation and accessions), did the changing composition of the labor force lead to a selection bias that favored more productive workers?

This paper finds that the transition to a market economy dramatically altered the relative wages and productivity of different types of workers, yet yielded remarkably little convergence towards the equilibrium wage relativities one would expect to observe in a competitive labor market. The wages of more educated workers increased in line with increases in their productivity, but the initial disparity between the two remains;

returns to work experience fell, but failed to keep pace with decreases in the productivity of older workers; and the relative productivity and wages of women remained largely unchanged. Underlying the changing relationships were structural changes affecting the productivity of labor and capital inputs and the exit of less productive workers from the labor market.

The structure of the paper is as follows. Section 2 discusses the impact of transition reforms on the labor market, and examines why the theoretical predictions regarding the changes in relative wages and productivity are ambiguous. Section 3 describes the process of constructing the longitudinal, matched employer-employee database from the multiple data sources, and Section 4 outlines the model used to estimate the relative wage and productivity differentials. Section 5 summarizes the results of previous studies that employ a similar methodology, [2] and Section 6 presents of the Slovenian data. The final section discusses policy implications and directions for future research.

2. Transition reforms and changes in productivity and wages

What theoretical predictions can we make regarding changes in productivity during transition, and how did these compare with relative wages? In order to provide a context with which to interpret the empirical results, the section below discusses transition reforms that arguably affected worker productivity - and, under certain assumptions, also wages – and derives theoretical predictions. Because the observed

[2] These six studies, all of which are for non-transition economies, are Hellerstein, Neumark and Troske (1999) for the USA, Hellerstein and Neumark (1999) for Israel, Haegeland and Klette (1999) for Norway, Jones (2001) for Ghana, Crepon, Deniau, and Perez-Duarte (2002) for France, and Illmakunnas, Maliranta and Vainiomaki (2004) for Finland. Their results are presented in greater detail in Section 5.3.

wages during transition presumably reflect both underlying worker productivity and the wage-setting mechanisms, the wage-determination process is also discussed.

2.1 The effects of labor market outcomes on productivity

Transition reforms affected worker productivity through several key labor market effects: they changed the structure of employment by age and education, altered labor force participation rates, and increased worker flows. In Slovenia, young and old workers suffered disproportionate losses in employment as a result of transition reforms - the share of workers under 30 years old steadily decreased during the 1990 to 2001 period, from 32.1 to 24.9 percent, and the share of workers over 50 fell from 12.2 to 7.2 percent from 1990 to 1993, before rising again to 9.7 percent in 2001 (Vodopivec, 2004). Both push and pull factors were at work: facing difficult access to jobs because of a tight labor market, many young people opted to enroll in tertiary education while many older workers opted to retire, the former further encouraged by the increasing wage premium associated with education[3] and the latter encouraged by early retirement schemes.[4] The structure of employment exhibited a marked increase in the share of educated workers: the employment share of those with high school or higher education increased in every year from 1991 to 2001, from 35.2 percent to 47.6 percent; conversely, the share of those with no more than elementary school education decreased in every year during that

[3] While Slovenia already exhibited a relatively high rate return to schooling under socialism, the increase from the pre-reform period to the late reform period – about 3.5 percentage points per year of schooling – is comparable to that seen in other transition economies (Fleisher, Sabirianova, Wang, 2005). Furthermore, full-time Slovenian students continue to enjoy a variety of fringe benefits in addition to their tuition-free education, such as tax-free part time employment, subsidized meals and housing, and free health insurance.
[4] The early retirement schemes offered fairly generous conditions: pensions were set at 85 percent of the pension base, which was determined by the average of the ten highest annual inflation-adjusted incomes in the pensioner's career (Orazem and Vodopivec, 1995). In contrast to wages, pensions were fully indexed to inflation.

period, from 34.8 to 21.5 percent. The structural reforms also increased job flows as firm entry was encouraged and bankruptcies were allowed to occur – paralleling the increase in other transition economies, the job reallocation rate (the sum of the job creation and destruction rates) peaked at 35 percent at the onset of transition in Slovenia, considerably higher than the 25 percent typically found in developed market economies (Scarpetta and Vodopivec, 2006).

Based on the above labor market developments, what theoretical predictions can we make regarding the productivity differentials associated with age? The relative productivity of older workers could have increased, on the one hand, if the early retirement programs of the mid-1990's either led less productive older workers to exit the labor force disproportionally or, by making older workers artificially scarce, placed a premium on their skills and experience. On the other hand, there are several factors that might decrease the productivity of older workers. First, the sharply increased worker flows, which for some workers would result in separations from firms where they had worked for their entire career, would imply significant losses of firm-specific capital, a problem particularly acute for older workers. Second, the increase in job flows, a natural by-product of restructuring as successful firms and industries expand employment while others contract, implies that workers were increasingly led into different occupations and industries and also suffered a decrease in the value of their general human capital. And third, even for old workers that remained at their jobs and companies, the changing market conditions – the need for firms to restructure, innovate, and compete – could imply a decrease in the value of both firm-specific and general human capital. This is because older workers were accustomed to working in an economy that was perpetually

in a steady-state (with stable supply and demand), and with constitutionally guaranteed job security. Younger workers, through a more critical perception of the disequilibria present in the newly liberalized markets, may have been better positioned to exploit the opportunities afforded to them in the less regulated economic environment.

A similar set of contrasting hypotheses emerge regarding the impact of transition on the productivity of different educational groups. On the one hand, there are several reasons why the relative productivity of educated workers may have decreased. First, the surge in college and university enrollment significantly increased the relative supply of educated workers. [5] Second, the quality of education could have decreased, in line with the large drop in per student expenditure, pulling down the relative value of education obtained during the transition. Third, the over-supply of certain vocations and over-subscription in certain fields of study implies a decrease of the value of education of individuals engaged in those professions and fields. Socialist educational systems tended to be geared towards satisfying the industrialization priorities of socialist planners, emphasizing the natural sciences (e.g., engineering) over the social sciences, with apprenticeship training that was both more extensively provided and more narrowly focused than what is typically observed in market economies (Flanagan, 1998). Finally, the tight labor market could have forced educated workers to accept jobs for which they were over-qualified, leading to inferior job matches.

On the other hand, there are other factors that may have led to an increase in the productivity of educated workers. First, economy-wide restructuring (e.g., investments in

[5] In 1990, Slovenia had 33.5 thousand students; by 2001, the number of students at higher educational institutions tripled, and by 2005, there were 115 thousand students, comprising 8 percent of the 1.4 million working age population (Statistical Office of Slovenia). Expenditure on education, however, failed to match the surge in tertiary enrollment and from 1995 to 2003 expenditure on higher education increased by only a third.

new technological processes, development of previously neglected sectors such as financial services) could have resulted in labor demand shifts that favored skilled labor. Second, the entry of private universities could have filled the curriculum gap of state schools (e.g. by offering business courses) and otherwise helped improve the quality of education through increased competition (Kraft and Vodopivec, 2003). Third, the transition to a market economy from the steady state observed in socialism may lead to an increase in the value of the ability to deal with disequilibria. As Schultz (1975) argues, education hones this ability by "enhancing the ability… to perceive new classes of problems, to clarify such problems, and to learn ways of solving them" (p. 835). Finally, to the extent that education may be endogenous to an individual's general cognitive ability, we may expect its observed value to increase with the onset of transition.

The effects of transition reforms on the relative productivity of women are not clear. According to several aggregate labor market indicators, women fared similarly to men in Slovenia: the ratio of their average wages relative to men remained constant at around 0.88, the slight decline in their labor force participation rates paralleled the decline among men, their share of employment in labor force stayed within a percentage point of 46% during the entire 1990 to 2001 period (Vodopivec, 2004). They exhibited a slightly lower decrease in unemployment rates, by 2 percentage points instead of the 4.3 witnessed for men from 1993 to 2001.

2.2 The wage determination process and previous empirical results

While in the long run we can expect that changes in productivity are reflected in wages, it is the wage-determination process that importantly shapes wages in the short run. Below we briefly describe the evolution of the wage setting mechanism in Slovenia, starting with the system that Slovenia inherited from Yugoslavia.

As in other communist countries, wage determination in Yugoslavia was highly regulated and wages were sharply compressed in comparison to capitalist firms (Haltiwanger and Vodopivec, 2003). The government set each firm's total "socially warranted" wage bill which was partially contingent upon a firm's success but largely influenced by egalitarian principles, and thus above-average firms cross-subsidized below-average firms via a massive system of discretionary taxes and subsidies (Vodopivec, 1993). Individual workers' base wages within a firm were set by wage scales that were proposed by the firm's Worker's Council and voted on through a firm-wide referendum. Following its independence from Yugoslavia in 1991, Slovenia reformed its wage-setting mechanism. Collective bargaining agreements, which are legally binding for all firms, assumed a major role in the wage determination process. These collective bargaining agreements mandate minimum pay scales based on characteristics such as education, labor market experience (for example, stipulating a 0.5 percent wage increase for each additional year of tenure), and overtime. Despite the high level of disaggregation in the collective bargaining agreements, the system allows for idiosyncratic deviations in wages, which may arise on a firm-specific or even worker-specific basis, since the collective bargaining agreement generally prescribes a wage floor. Empirical results indicate that the system still allows for considerable flexibility in

the wage determination process in practice (Haltiwanger and Vodopivec, 2003), allowing for sufficient variation for meaningful analysis.

The preceding discussion highlights the difficulty of measuring changes in the wage determination during the process of transition: a multitude of different forces, each potentially affecting certain subsets of the population differently, were acting in tandem. Thus, being able to compare both relative wages and productivities is crucial to accurately disentangling the numerous potentially confounding factors, and is a significant advantage of the data used in this study.

3. Data

The data used to construct the longitudinal matched employer-employee database were compiled using several administrative databases that cover the universe of Slovenian workforce participants and business subjects in the non-agricultural business sector. They include two databases incorporating individual-level data on wages and demographic characteristics and two databases with data on firms. The individual databases are described in greater detail below.

1. The **business registry** keeps information about the births and deaths, as well as changes of selected attributes, of both legal and physical business subjects, as well as of public institutions. The register is "transaction-based," that is, only births, deaths, and changes are recorded. The register was maintained by the Statistical Office of Slovenia until 2003; this task has since been assumed by the Agency for Public Statistics and Services.

2. **Accounting data** is provided by all legal business subjects once a year, and it provides a rich set of variables both from income statements and balance sheets, as well as information on the industry, location, number of workers, and months of operation within a year of the firm. The register was maintained by the Statistical Office of Slovenia until 2003; this task has since been assumed by the Agency for Public Statistics and Services.
3. The **work history database** includes detailed information on workers in formal-sector jobs, including data on age, educational attainment, gender, and employer. The database is maintained by the Statistical Office of the Republic of Slovenia.
4. The **workers' earnings database** includes information on earnings for workers employed in formal sector jobs, number of hours worked in regular time and overtime, and the duration of the earnings period, allowing for wage rates to be calculated across workers. The database is maintained by the Pension and Disability Fund.

It is important to note that the data used for the present study span the calendar years during the 1992-2001 period. During the period immediately prior to 1992, Slovenia experienced hyperinflation, which makes the reliability of data prior to 1992 highly suspect. Despite a change in accounting standards (specifically, a revaluation of assets) in 1994, the inclusion of the labor quality controls mitigates the effects of such changes; in addition, the primary focus of this study is the relationship between the relative wage and productivity differentials in a given year. In order to construct a matched employer-employee database, the worker- and firm-level databases were merged according to the universal firm identifier codes used for tax purposes. In addition, unique

identification codes for workers and firms, respectively, allowed the data to be linked across time to create a panel database.

4. Methodology for estimating wage and productivity differentials

Ideally, measuring the relationship between wages and productivity would involve relating an individual workers' wage with that worker's effect, at the margin, on the firm's total output. An obvious problem in attempting to link the two in an empirical model is that while measuring an individual workers' wage is relatively straightforward, obtaining a meaningful estimate of his or her marginal productivity is usually not.[6]

The approach used in this study draws on the model employed by Hellerstein, Neumark, and Troske (1999), in which production functions and wage equations are estimated at the level of the firm, allowing for direct comparisons of the wage and productivity differentials. Below, we review the methodology, and examine how the availability of panel data can add to this framework.

Model for estimating productivity differentials

Consider a simple production function in which value-added output Y is a function of capital inputs K and a quality of labor aggregate QL. Using a translog production function, the model can be described as

$$\ln Y = \ln(A) + \alpha \ln(K) + \beta \ln(QL) + g(K,QL) + \gamma_i X_i + \mu \qquad (1)$$

where g(K,QL) represent the second order terms of the translog production function, $\gamma_i X_i$ is a vector of dummy variables capturing firm characteristics such as ownership type and industry, and μ is the stochastic error term.

[6] A notable exception arises in cases where workers are self-sufficient and independent labor inputs, e.g. Lazear's (2000) study of glass installers in an auto glass manufacturing plant.

For each firm, assume for simplicity that we can differentiate workers based on a single characteristic, their gender, and that workers are perfectly substitutable inputs with potentially different marginal products. If we define φ_F to denote the productivity of women relative to men, such that $MPL_{women}/MPL_{men}= \varphi_F$, we can define QL as

$$QL=L(1+ (\varphi_F-1) F/L) \quad (2)$$

were L is the total number of workers in the firm, F is the number of women in the firm, and φ_F is the marginal productivity of women relative to men. Substituting equation (2) into equation (1) yields a firm level production from which φ_F can be estimated.

The actual data permit us to distinguish the each firms workforce not only based on gender, but also by education and age. Workers are classified into six education groups (completed elementary school, vocational school, high school, 2-year college, and at least 4-year college) and four age categories (less than 30 years old, 30-39, 40-49, more than 50 years old). A firm's workforce can thus be fully described by each of the 48 possible combinations that these multiple dimensions capture, and obtaining exact estimates for each of these groups would require including 47 terms for the productivity differential (φ's) in the production function.

In order to reduce the dimensionality of the problem, a simplifying restriction on the model is imposed. The productivity differentials of workers in one demographic category are assumed to be equal for those same types of workers in another demographic category. Thus, for example, the productivity differentials of young women (those in the first age category, less than 30 years old) relative to young men are assumed to be equal to the productivity differentials of the oldest women (those more than 50 years old) relative to the oldest men. Similarly, the productivity differentials of the youngest

women relative to the oldest women are constrained to be equal to the productivity differentials of the youngest men relative to the oldest men. With these simplifying restrictions, the quality of labor term becomes

$$QL = [L + (1+(\varphi_F - 1) F] \cdot [1 + (\varphi_{EDU2}-1) EDU2 + (\varphi_{EDU3}-1) EDU3 + (\varphi_{EDU4}-1) EDU4 + (\varphi_{EDU5}-1) EDU5 + (\varphi_{EDU6}-1) EDU6] \cdot [1 + (\varphi_{AGE2}-1) AGE2 + (\varphi_{AGE3}-1) AGE3 + (\varphi_{AGE4}-1) AGE4] \quad (3)$$

where EDU2-EDU6 reflect the number of workers with completed elementary school, vocational school, high school, 2-year college, and at least 4-year college, respectively; and AGE2, AGE3 and AGE4 reflect the number of workers aged 30-39, 40-49, and over 50 years, respectively. Note that because of the way the coefficients are defined, productivity differentials between different groups should be interpreted based on whether the coefficients are different from one, and not zero. Thus, a finding that φ_F = 1.25 would imply that women are 25% more productive than men.

Model for estimating wage differentials

In order for the wage differentials to be directly comparable to the productivity differentials in the model described above, the model used in this study deviates from those typically used in studies analyzing the determinants of wages and is outlined below.

For the purposes of explaining the model, assume again that workers can be differentiated based on only one demographic characteristic, their gender. Since we have matched employer-employee data containing information on each person's earnings in a given year, we can come up with a total wage bill for employers if we sum up the individual level earnings. That is, we begin by considering the individual level-wage equations in levels

$$w_{i,j} = w_M M_{i,j} + w_F F_{i,j} \quad (4)$$

where $M_{i,j}$ and $F_{i,j}$ are dummy variables for men and women, respectively, for the i-th worker in firm j, and w_M and w_F are the individual wages of men and women. Summing this equation over all workers yields firm level wage bills, which can be expressed as

$$w = w_M (L - F) + w_F F \quad (5a)$$

Defining λ_F as the relative wage of women to men ($\lambda_F = w_M/w_F$), we have

$$w = w_M (L - F) + \lambda_F \; w_M F = \; w_M (L + (\lambda_F - 1) F) \quad (5b)$$

or, equivalently,

$$\ln(w) = \ln(w_M (L + (\lambda_F - 1) F)) \quad (6)$$

Equation (5) thus yields estimates of wage differentials that are directly comparable to the marginal productivity differentials obtained from (1).

Since the firm-level wage data contains demographic information on not only gender but also the other characteristics described above, the actual equation estimated is

$$\ln(w) = \ln(w_{base}) + \ln\{[(1+(\lambda_F - 1) F] \cdot [1 + (\lambda_{EDU2}-1) EDU2 + (\lambda_{EDU3}-1) EDU3 + (\lambda_{EDU4}-1) EDU4 + (\lambda_{EDU5}-1) EDU5 + (\lambda_{EDU6}-1) EDU6] \cdot [1 + (\lambda_{AGE2}-1) AGE2 + (\lambda_{AGE3}-1) AGE3 + (\lambda_{AGE4}-1) AGE4] \cdot \} + \gamma_i X_i + \mu \quad (7)$$

where w_{base} is the wage of individuals in the omitted group, the wage differential coefficients λ correspond to their respective definitions for equation (3), $\gamma_i X_i$ is a vector of dummy variables capturing firm characteristics such as ownership type and industry, and μ is the stochastic error term.

Estimating the equation in (5) along with the augmented production function in (1) yields directly comparable measures of marginal productivity (φ) and wage differentials (λ). Note that the restrictions of equiproportionate distributions of wage

differentials across varying demographic characteristics are retained as in (3), and that the coefficients again need to be interpreted based on whether they differ from 1, and not 0.

In addition to the specifications above, another set of regressions tests the hypothesis that changes in wage differentials were influenced by significant shifts in the composition of the labor force. By classifying individuals based on their employment history (i.e., based on whether they were employed at the beginning and/or end of the 1992-2001 period) and including this variable in the labor quality term described above, we can determine how the entry and exit of specific groups from employment influenced wage and productivity differentials over time.

One final point about the methodology concerns a fundamental issue of identification in the model (Hellerstein *et al*, 1999). The marginal productivity differentials arise from the covariation across firms in the composition of their workforce and their output. Thus, a finding that one demographic group tends to be less productive than a second demographic group could have two distinct explanations: a.) the first group could be less productive relative to the second group within a given firm, or b.) the first group could tend to be clustered in low-productivity firms, with the productivity of both groups generally the same within firms. This identification problem is further investigated for the wage equations below (we have individual level wage data), and the results indicate that intra-firm wage heterogeneity accounts for the majority of the wage variation.

5. Cross Country Comparisons

Before presenting the regression results from the Slovenian data, we first survey the results of existing studies that employ a similar methodology in order to establish a

baseline for comparison. To the author's knowledge, no such studies have yet been done for transition economies; the studies include mainly developed market economies (USA, Israel, Norway, France, Finland) and one developing country, Ghana. The results from the former are helpful in understanding the productivity differentials associated with various demographic characteristics in countries without the burden of a socialist legacy. Furthermore, they illustrate the extent to which we would expect relative wages correspond to relative productivity in a long-run, competitive equilibrium and the relative importance of other factors, such as long-term incentive contracts or discrimination. The results of these studies are summarized in Table 1 (note that φ and λ respectively refer to the productivity and wage differentials of the specified group relative to the omitted group):

<Table 1>

Several stylized facts emerge from these findings. First, the marginal productivity of women is consistently lower than that of men, as the estimates for φ generally range from 0.75 to 0.9. The estimates for women's wage differentials appear to be slightly lower than their productivity differentials, although the difference tends to be statistically insignificant (and thus we cannot interpret the disparity as evidence of discrimination). Second, better educated workers are more productive, with the most educated (skilled) workers approximately twice as productive as the least educated (skilled). Their wage differentials also appear to be slightly lower than their productivity would warrant, indicating a certain degree of wage compression. Third, the relationship between productivity and job tenure or age can be interpreted as (weakly) concave, although the evidence for this is hardly conclusive. In general, the relative wage and productivity

differentials appear to correspond fairly closely by age and education, and to a lesser extent by gender.

5.) Results

The results are presented in the following sequence. For the purposes of placing the data in a comparative context, we first present the results of standard, individual-level wage regressions. We augment these results with individual-level wage equations estimated with firm fixed-effects to examine the identification problem discussed above. Next, we present the results of the firm-level wage and productivity regressions, examining their evolution over time and investigating the effect of worker flows on relative wages and productivity.

6.1) Worker-level Wage Regressions

Table 2 below presents estimates from individual-level wage regressions using data for the entire 1992-2001 period; both include the same control variables that are used in the base firm-level wage equation and production function estimates.[7] The first column presents a model with a standard Mincer specification. We see that the wage-experience profile is weakly concave, that the wage premium associated with education varies from 9 percent for those with completed elementary school to 112 percent for those with a 4-year college education relative to individuals with unfinished elementary school, and that there is a considerable (21 percent), statistically significant gender wage gap. The second column examines within firm wage differentials by adding firm fixed effects to the regression in column 1. The age coefficients appear only slightly affected

[7] We use dummy variables for the demographic characteristics instead of the more commonly used continuous variables to parallel the specification used in calculating the firm-level wage and productivity differentials.

by the inclusion of firm-level fixed effects, and that most of the variation in wages tends to arise within firms across different types of workers. The lower wage disparity between men and women indicates that women tend to work in lower paying firms than men, while the slight decrease in the coefficients for education indicates a slightly lower dispersion of wages within firms than in the entire sample. In general, however, only a small share of the variation in wages is attributable to varying wage levels *across* firms, and most of the variation arises *within* firms. Consequently, the methodology for estimating firm-level wage equations by aggregating individual-level wage equations to the firm level for the purposes of estimating the firm-level wage equations should yield broadly valid results.[8]

<Table 2>

6.2) Productivity and Wage Differentials, 1992-2001

We now turn to the results of estimations of equations (1) and (7) on the firm-level data spanning the 1992-2001 period. Due to the way the parameters enter the model, the regressions are estimated using nonlinear least squares. Note that while these results are useful for establishing baseline comparisons, they mask the considerable variation that occurred over time.

<Table 3>

Age. The results indicate that for the 1992-2001 period as a whole, workers 30 or over are less productive than those under 30 years of age. This difference ranges from 4 percent for workers 30-39 years old to 6.8 percent for workers 50 or over. By contrast,

[8] To the extent that the fixed effects estimates are closer to zero than the standard wage regression estimates, the results of the firm-level regressions will tend to be biased towards understating (compressing) the economy-wide wage differentials; under the null hypothesis of competitive labor markets, a similar caveat applies to the productivity differentials.

the relative wage differentials indicate that older workers earn a wage premium that ranges from 8.7 percent for workers 30-39 years old to 43 percent for those 50 or over, and the difference between the marginal productivity and wage differentials is statistically significant. These results indicate a significant deviation from the equilibrium wage relativities we would observe under competitive labor markets.

Education. The differentials associated with education show very large differences in productivity, but comparatively small differences in wages. Workers with completed elementary education are 38 percent more productive than those with uncompleted elementary education, while those with at least four year college degrees are 320 percent more productive; however, the wage premiums associated for these two groups are only 15 and 160 percent, respectively. In general, with the exception of vocational school graduates, the wage premiums paid to educated individuals tend to be about half of what their marginal product of labor would warrant.

Gender. Interestingly, women appear to be 12 percent less productive than men, but the firm-level wage equations indicate their wages are only 5 percent lower. The latter results are at odds with individual-level wage regressions reported above, which indicate that women are paid significantly less than men. How can we reconcile these findings? Note that the fixed-firm-effects differential for women (-14.3 percent) is smaller in magnitude than the differential from the standard wage equation (-21 percent), indicating that women tend to work in firms with generally lower wages, and thus the firm-level wage equation differentials are smaller in magnitude than the economy-wide wage differentials.

The other coefficients are also of some interest. Most of the second order coefficients of the translog production function are significant, indicating that the marginal rate of substitution between capital and labor is not constant. It is also interesting to note that the standard errors of the coefficient estimates are consistently higher in the production function estimates. This may indicate a higher degree of heterogeneity amongst firms in their productivity than in their wage policies, and corroborate the finding indicate that collective bargaining agreements impose restrictions that result in less variation than individuals' productivity differentials would warrant.

6.3) Productivity and Wage Differentials by Year, 1992-2001

The figures below, which plot the coefficients for cross-sectional estimations of the above firm-level regressions with specifications identical to those described above, illustrate the dramatic changes that occurred over the 1992-2001 period.

<Figure 1a>

Age. Turning first to the marginal productivity differentials, we see a dramatic decline across all groups of older workers. In 1992, older workers were more productive than young workers, with workers 50 years and over 40.5% more productive than workers under 30. By 1995, the differences in productivity across age groups are no longer statistically significant; after 1997, workers who are older than 40 are significantly *less* productive than those under 30 – about 13 percent less productive, on average, in 2001 for both workers aged 40-49 and those 50 and over. Interestingly, out of all the cross-sectional estimates for the Slovenian data, the age-productivity profile in 1992 most closely resembles the weakly concave profile documented by the other studies. Although

the lack of data prior to 1992 precludes us from a definitive answer, it appears that that the age-productivity profiles in socialism were similar to those observed in developed market economies, and that the restructuring accompanying the transition to market sharply disrupted this relationship.

How did this fall in the productivity of older workers affect their relative wages? There was a significant decrease in the wage premium associated with older workers: for workers over 50, from 84.4 percent in 1992 to 18.1 percent in 2001. Despite this dramatic fall, however, relative wages for workers aged 30 or above do not fall below parity with workers under 30; instead, they appear to be bounded by the wage floor prescribed in collective bargaining agreements (which specify a one percent wage increase per two years of work experience). The end result is that the fall in relative productivity is disproportionately larger than the fall in relative wages. This result is shown in Figure 1b, which graphs the ratio of relative productivity to relative wages from Figure 1a.

<Figure 2a>

The fact that the ratio is generally lies under parity and is decreasing indicates that older workers are being progressively paid more than their marginal productivity differentials would warrant, and that wages are in fact *not* approaching their equilibrium wage relativities.

<Figure 2a>

Education. Similarly dramatic results are evident in the related coefficients for education. Between 1992 and 2001, the most educated workers experienced a 45 percent increase in their productivity relative to workers with uncompleted elementary school (from 2.58 to 3.75); for 2-year college and high school graduates, the increases were 22

and 13 percent, respectively. The relative wage differentials also became more dispersed over the observation period; for 4-year college graduates, their relative wage differentials increased from 1.59 to 2.02.

<Figure 2b>

As shown in Figure 2b, the increases again failed to keep pace with increases in productivity; for the most educated workers, the 27 percent increase in wages over this period lagged behind their 45 percent increase in productivity. Thus, the increased wage differentials observed in Slovenia during the course of transition can be attributed to underlying increases in the productivity of educated workers: the effects of increases in the demand for educated were large enough to counteract relative labor supply shifts. In fact, due at least partly by the sheer magnitude of the productivity increases, the ratio between marginal productivity and relative wages were slightly closer to parity in 1992 than they were in 2001.

<Figure 3>

Women. The relative wage and productivity differentials of women show a slight deterioration in gender equality, both in terms of relative wages and productivity. However, compared to the changes observed in the differentials by age and education, the magnitude of these changes is very small.

6.4) Sensitivity Checks for Productivity and Wage Differentials by Year, 1992-2001

In order to test the hypothesis that changes in relative wages and productivity across different age groups are attributable to a survivor bias that favored certain subsets

of workers, the results from this section are based on categorizing workers into four groups based on their employment history over the 1992-2001 period:

a.) separated - individuals employed in 1992, but not in 2001,

b.) newly hired - individuals employed in 2001, but not in 1992,

c.) employed throughout - individuals employed in 1992 and 2001, and

d.) employed in the interim - individuals employed in neither 1992 nor 2001.

Workers in each of these groups are assumed to be qualitatively different inputs in the firm-level production functions with potentially different marginal products. Similarly, they are assumed to have potentially different relative wages in the firm-level wage equations. In each of the cases discussed below, the omitted group is comprised of individuals less than 30 years old who were employed neither in 1992 nor 2001.[9]

The results indicate that, with the exception of productivity differentials for the youngest workers, workers in the "employed throughout" category consistently witnessed both the highest productivity and wage differentials, workers with interim employment witnessed the lowest, while new hires and separations were consistently in between.[10] Also, the general trend of decreasing relative productivity and wages is consistent across all the older age groups.

<Figures 4, 5, 6>

[9] Note that throughout the analysis, individuals are grouped into age categories based on their age in each respective year. Thus, the analysis presented here does not track specific cohorts across time, and most individuals will fall into a different age category in 2001 then they did in 1992. Analyses whose results are not presented indicated that, with the exception of the youngest group, tracking cohorts instead of age categories did not substantively change the conclusions.

[10] The results from the first age group, individuals under 30 years old, do not contain statistically significant results; this is largely due to the fact that how the groups are defined sharply limits the number of people in these groups (e.g. the "employed throughout" category contains only those who were employed at age 20 or younger and were also employed 10 years later).

Figures 4, 5, and 6 show the relative productivity and wage differentials across individuals aged 30-39, 40-49, and over 50, respectively, grouped based on their employment in 1992 and 2001. With the exception of a few point estimates, the most productive and highest paid workers tend to be those who were employed throughout; conversely, the least productive and lowest paid workers tend to be the interim employed (employed in neither 1992 nor 2001). The graphs confirm that the dramatic fall in the productivity of workers over 29 years was not due to the exit of less productive workers from labor force, but was broad-based and reflected the general trend of falling productivity for older workers. The relative wages of older workers appear to have fallen dramatically as well, but they failed to drop towards equilibrium wage relativities.

7. Conclusion

This paper examines the evolution of wage and productivity differentials using matched employer-employee panel data from Slovenia for the 1992-2001 period. The results offer unique insight into a question that other studies of wage determination in transition economies do not directly address – namely, how has the transition to a market economy affected the relative wages and productivity of older workers, educated workers, and women. We investigate several possible explanations for the observed trends, including changes in institutions, shifts in relative labor supply, skill-biased technical change affecting labor demand, and outright discrimination.

The results indicate that the transition to a market economy dramatically altered the relative productivity differentials associated with education and age, but not gender. The increases in productivity changes by education were dramatic, with increases greatest

among the most educated. The marginal productivity of older workers fell considerably, with the decreases greatest among the oldest groups of workers. We interpret this as evidence of a decrease in the marginal product of firm- or industry- specific human capital driven by increased job and worker flows and by a decreased relevance of experience obtained under socialism in a market economy. Relative labor supply shifts that could have reversed the observed trends – decreases in labor force participation rates among the oldest workers and increases in the share of educated workers – were insufficiently large to counteract these other factors.

Interestingly, the large changes in the marginal productivity differentials were accompanied by smaller changes in the relative wage differentials, thus yielding little convergence between relative wages and marginal productivity. How can this finding be explained, given that studies for developed market economies indicate that the ratio of the two generally falls within a few percentage points of parity, as we would expect in a stylized steady-*state* equilibrium? First, the sheer size of some of the changes in the marginal productivity differentials associated with education and age was tremendous, making it difficult for wages to adjust. For example, for workers with at least a 4-year college degree, marginal productivity differentials grew at an annualized rate of 4.3 percent over the 1992-2001 period. Second, collective bargaining agreements appear to exert a considerable influence on wages, thus preventing necessary adjustments from taking place. The effects seem particularly visible in the wages of older workers, who are guaranteed pay increases in line with their tenure, and who in 2001 continued to command a wage premium over workers under 30 despite their lower marginal productivity. Interestingly, the 18 percent wage differential for workers aged 50 and over

is remarkably similar to the minimum wage that collective bargaining agreements would require for a worker with roughly 36 years of work experience.

The results have several important policy implications. First, as Slovenia increases the retirement age in order to counter the effects of an aging population, the stipulations about the returns to experience need to be reformed. Numerous studies have documented the lower probability of exit from unemployment for older workers, and the results of this study suggest that rigid wage stipulations play an important explanatory role. Second, although education continues to be undervalued to a similar degree as it was during socialism, the surge in undergraduate education enrollment suggests this has not necessarily led to allocative inefficiencies from an undersupply of skilled labor. Indeed, the generous benefits afforded to Slovenian students may compensate for their lower future wages.

Compared to other transition economies, Slovenia had among the most liberal price, wage and foreign-trade regimes at the onset of transition, and it also exhibited the smallest degree of liberalization during the course of transition (World Bank, 2002). We know that wage liberalization brought about dramatic changes in other transition economies, and the results of this study clearly illustrate the complex nature of the relationship between wages and productivity. For countries that adopted a faster pace of reform and operated under a more regulated system under socialism, the changes relative productivity differentials may have been even more dramatic.

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Table 1: Empirical evidence from firm-level estimates of productivity (φ) and wage (λ) differentials

	Country	Coefficients on Female dummies	Coefficients on Education/Skill dummies	Coefficients on other dummies	N
Hellerstein, Neumark and Troske (1999)	USA	φ = 0.84, λ = 0.55*	…	Aged 35-54: φ = 1.15, λ = 1.19 Aged 50+: φ = 1.19, λ = 1.18 (Base group: under 35 years of age)	3,102
Hellerstein and Neumark (1999)	Israel	φ =0.8, λ = 0.75	Technical engineers: φ = 2.0, λ = 1.7 Engineers: φ = 4.0, λ = 2.25 (Base group: unskilled workers)	…	998
Haegeland and Klette (1999)	Norway	φ =0.83, λ = 0.82	Low Education: φ = 1.10, λ = 1.20 Medium Education: φ = 1.55, λ = 1.50 High Education: φ = 1.80, λ = 1.82 (Base group: less than 11 years of education)	8-15 years of experience: φ = 1.62, λ = 1.39 15 + years of experience: φ = 1.33, λ = 1.38 (Base group: less than 8 years of experience)	7,122
Jones (2001)	Ghana	φ = 0.45, λ = 0.86	Primary schooling: φ = 1.08, λ = 1.3 Secondary schooling: φ = 1.54, λ = 1.56 Tertiary schooling: φ = 1.79, λ = 1.56 (Base group: no primary school)	…	278 for φ's, 1211 for λ's
Crepon, Deniau, and Perez-Duarte (2002)	France	φ = .89, λ = 0.86	Skilled: φ = 1.20, λ = 1.17 Highly skilled: φ = 1.88, λ = 1.73 (Base group: unskilled workers)	Aged 25-35: φ = 1.22, λ = 1.23 Aged 35-50: φ = 1.10, λ = 1.27 Aged 50+: φ = 1.11, λ = 1.41 (Base group: less than 25 years old)	23,292
Illmakunnas, Maliranta and Vainiomaki (2004)	Finland	…	…	2-5 years tenure: φ = 1.04, λ = 1.03 5-10 years tenure: φ = 1.0, λ = 1.05 11-20 years tenure: φ = .95, λ = 1.07 (Base group: 1-2 years tenure)	28,737

Notes: (*) denotes instances where the difference between the productivity (φ) and wage (λ) differential is statistically significant by gender. Figures from Illmakunnas, Maliranta and Vainiomaki (2004) and Crepon, Deniau, and Perez-Duarte (2002) refer to imputed values based on author's calculations. The coefficients should be interpreted based on whether they are different from 1. For example, estimates of φ = 1.25 and λ = 1.35 for women would indicate that the MP_L of women is 25 percent greater than that of men, while their wages are 35 percent greater.

Table 2: Worker-level Wage Regressions, 1992-2001

Dependent variable is Log(Wages)	Standard Wage Regression (1)	Firm Fixed Effects (2)
Age		
30-39 years old	0.148	0.147
	(0.001)	(0.001)
40-49 years old	0.260	0.249
	(0.001)	(0.001)
50+	0.319	0.304
	(0.002)	(0.001)
Education		
Completed elementary school	0.088	0.075
	(0.001)	(0.001)
Vocational school	0.203	0.185
	(0.001)	(0.001)
High school	0.449	0.411
	(0.002)	(0.001)
2-year college	0.839	0.809
	(0.003)	(0.002)
4-year college	1.123	1.059
	(0.004)	(0.002)
Gender		
Women	-0.210	-0.143
	(0.001)	(0.001)
R^2	0.473	…
N	654,630	654,630

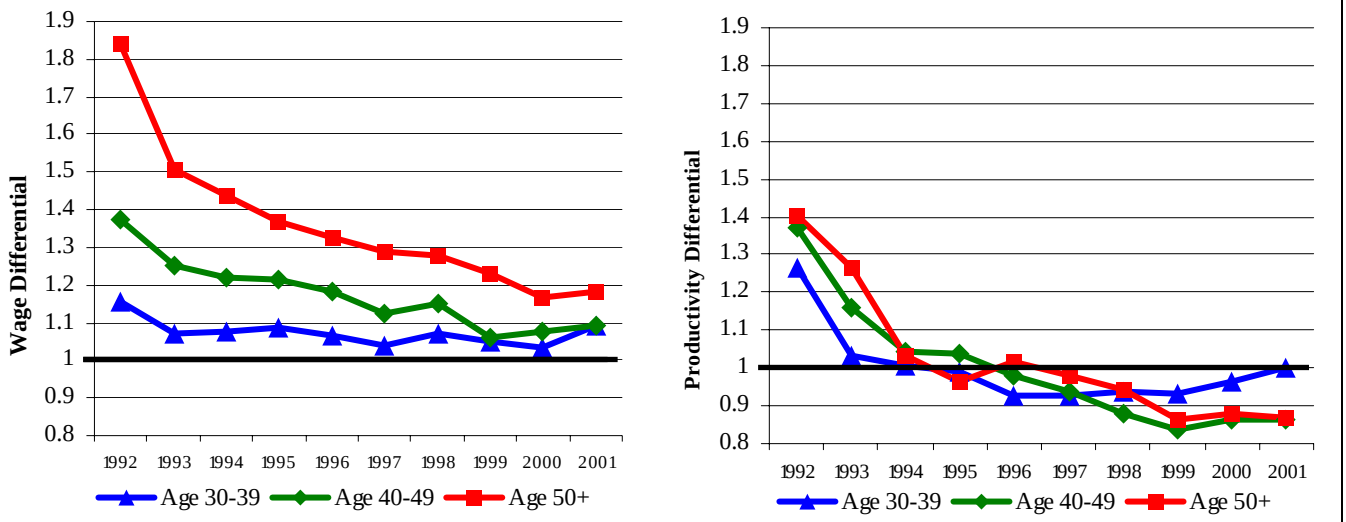
Notes: Robust standard errors of the estimates are reported in parentheses. Estimates of the intercept are not reported. The base category comprises of men less than 30 years old with unfinished elementary education. Other control variables included in specification (1) are controls for ownership type, rural location, firm size, and industry and year dummies. Specification (2) excludes the time-invariant control variables.

Table 3: Firm-level Production Function and Wage Equations Estimates, using complete data from 1992-2001

	Production Function (1)	Wage Equation (2)	Wald P-value (3)
log(Labor)	1.233		
	(0.009)		
log(Capital)	-0.011		
	(0.007)		
$(\log(\text{Labor}))^2$	0.018		
	(0.001)		
$(\log(\text{Capital}))^2$	0.020		
	(0.001)		
log(Labor · Capital)	-0.053		
	(0.001)		
Age			
30-39 years old	0.960	1.087	0.000
	(0.011)	(0.008)	
40-49 years old	0.935	1.178	0.000
	(0.011)	(0.009)	
50+	0.932	1.430	0.000
	(0.016)	(0.015)	
Education			
Completed elementary school	1.375	1.152	0.001
	(0.061)	(0.028)	
Vocational school	1.640	1.444	0.008
	(0.067)	(0.031)	
High school	2.629	1.866	0.000
	(0.106)	(0.040)	
2-year college	3.308	2.165	0.000
	(0.138)	(0.049)	
4-year college	4.198	2.612	0.000
	(0.171)	(0.057)	
Gender			
Women	0.880	0.954	0.000
	(0.007)	(0.005)	
R^2	0.920	0.958	
N	102,814	102,814	

Notes: The results are estimated using non-linear least squares. Standard errors of the estimates are reported in parentheses. The third column presents p-values for the Wald test for the equality of the corresponding coefficients in that row. Estimates of the intercept are not reported. The base category comprises of men less than 30 years old with unfinished elementary education. Other control variables included in both equations are controls for ownership type, rural location, and industry and year dummies.

Figure 1a: Differences in Relative Wages and Marginal Productivity by Age, 1992-2001



Omitted group: Individuals less than 30 years old.

Figure 1b: Ratio of Relative Productivity Differential to Relative Wage Differential by Education, 1992-2001

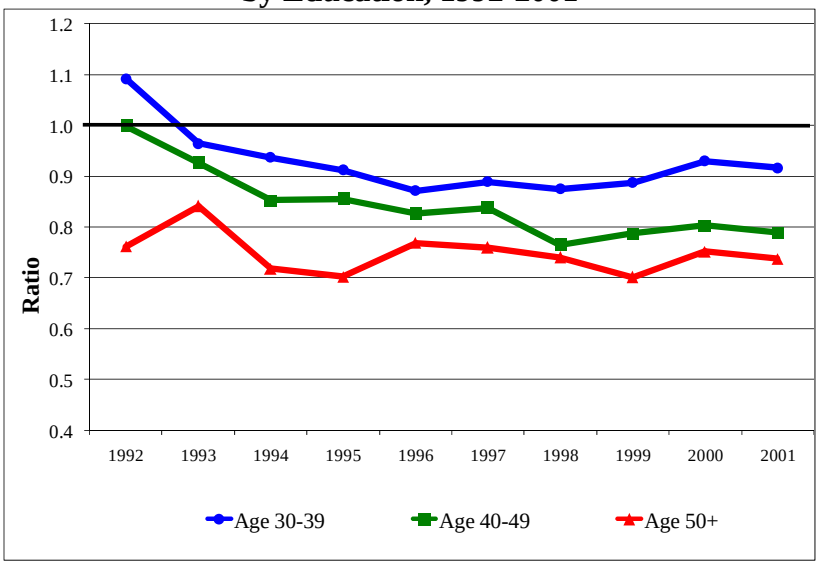
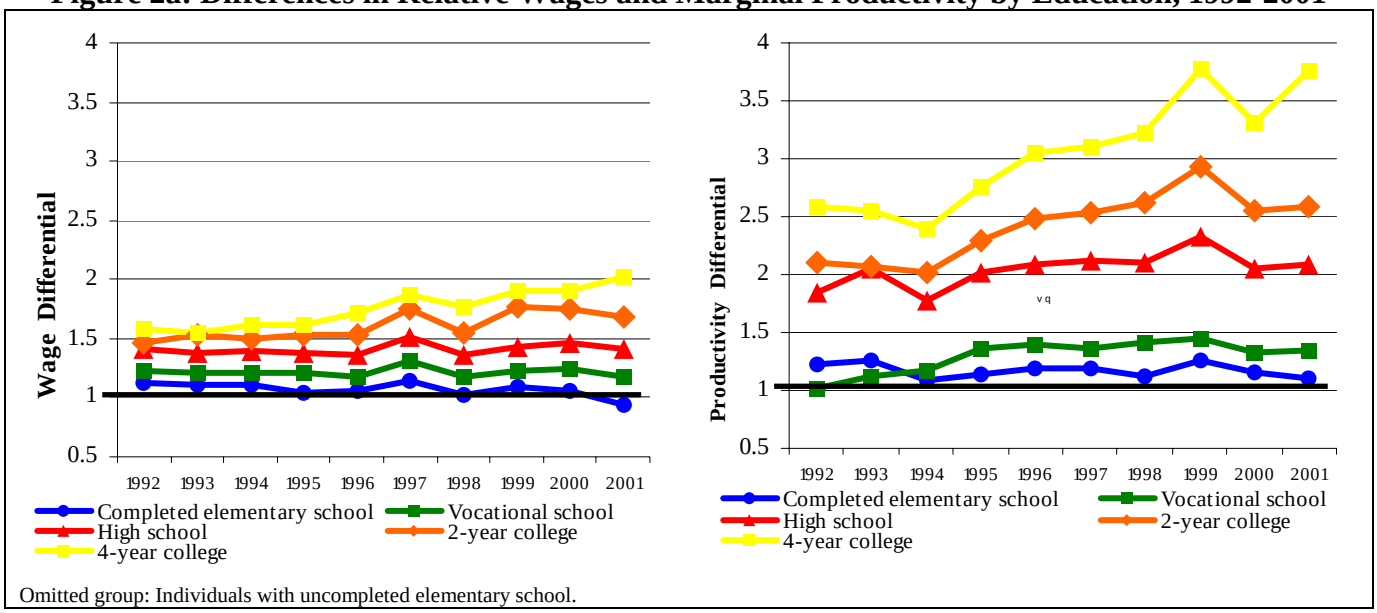


Figure 2a: Differences in Relative Wages and Marginal Productivity by Education, 1992-2001



Omitted group: Individuals with uncompleted elementary school.

Figure 2b: Ratio of Relative Productivity Differential to Relative Wage Differential by Education, 1992-2001

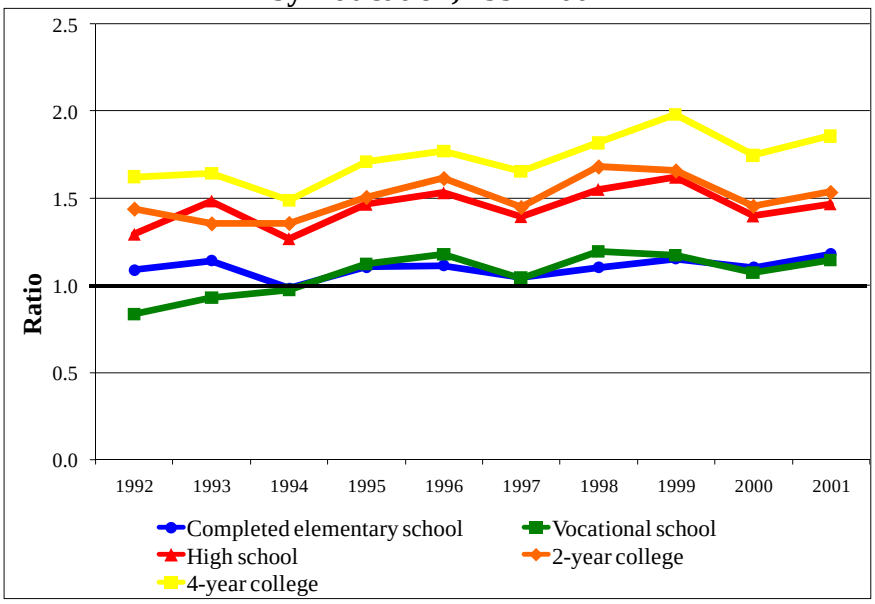
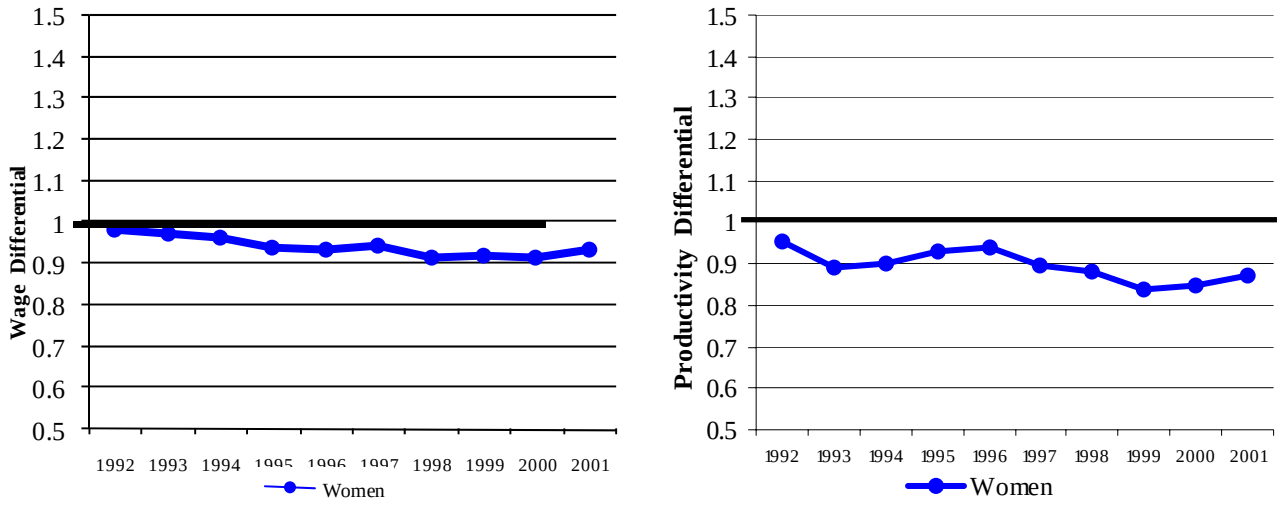
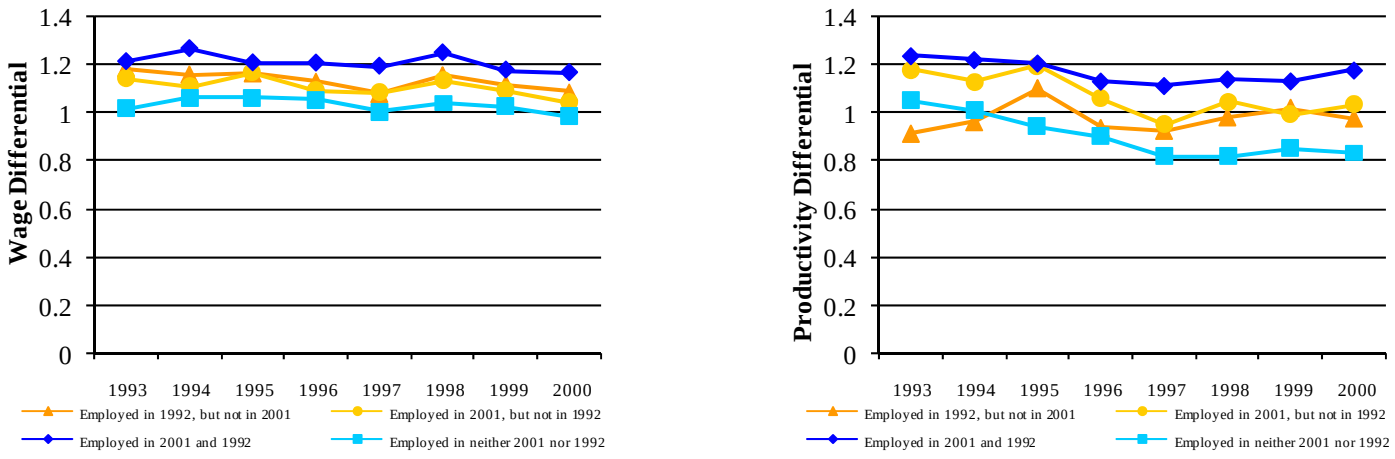


Figure 3: Differences in Relative Productivity and Wages by Gender, 1992-2001



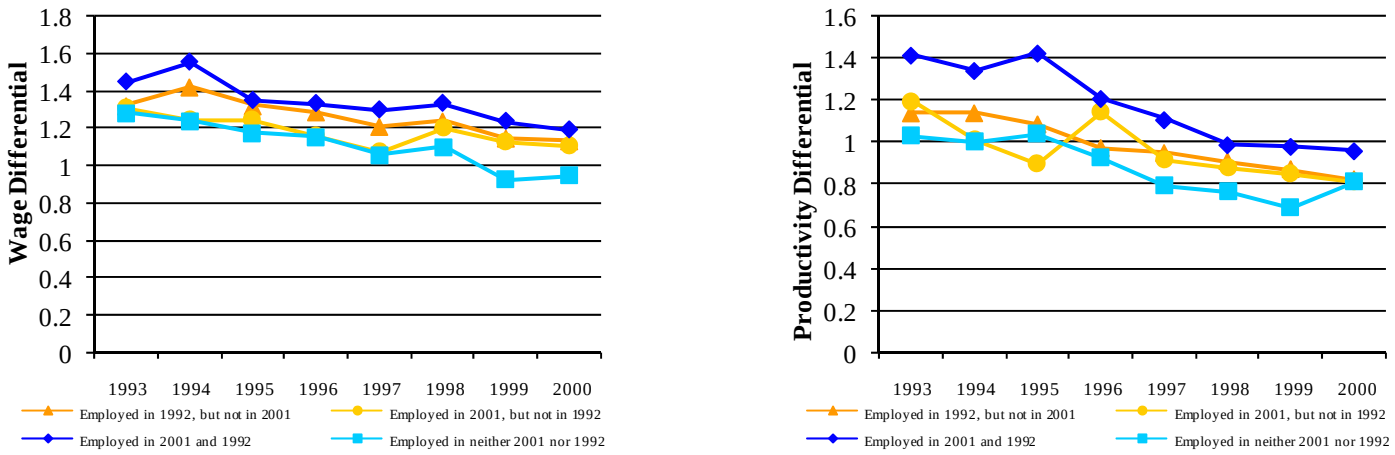
Omitted group: Men.

Figure 4: Differences in Relative Productivity and Wages across Individuals with Different Work Histories Individuals Aged 30-39



Base group: Individuals aged 18-29 who were employed in neither 2001 nor 1992.

Figure 5: Differences in Relative Productivity and Wages across Individuals with Different Work Histories Individuals Aged 40-49



Base group: Individuals aged 18-29 who were employed in neither 2001 nor 1992.

Figure 6: Differences in Relative Productivity and Wages across Individuals with Different Work Histories Individuals Aged 50+

Base group: Individuals aged 18-29 who were employed in neither 2001 nor 1992.