



Are computers driving real wages down?

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ABSTRACT

The annual growth in mean employee compensation plummeted from 2.6% in 1947–73 to 0.4% in 1973–2003. Using both time-series regression and pooled, cross-section, time-series regression analysis for 44 industries over the period 1953–2000, we find that earnings growth is positively related to overall productivity growth, capital investment excluding computers, and the unionization rate. We find also that computerization has a significant negative effect on earnings growth, but no evidence that the growth of skills or educational attainment has any statistically significant effect on earnings growth. The dominant factors explaining the slowdown in wage growth are decline in the unionization rate, slowdown in both TFP growth and overall capital investment, and acceleration in computer investment.

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1. Introduction

The US economy has undergone major structural changes over the post World War II (“postwar” for short) period. First, employment has shifted from goods-producing industries to services. Second, since the 1970s there has been a rapid increase in the introduction of new information-based technologies (IT), which has been accompanied by substantial adjustments in the operations and organizational re-structuring of firms.

In this paper, we consider how these sources of structural change have affected wage movements in the American economy. I focus particularly on the effects of the IT “revolution.” We also address a seeming paradox – namely, that while the skill and educational levels of the labor force have continued to rise after 1973, real wages have fallen. The trend changes slightly if we consider mean total work-

er compensation, which has increased somewhat since 1973. However, even in this case, employee compensation exhibits a substantially smaller rise than the increase in skills and schooling after the early 1970s.

The paper begins with a summary of some of the recent literature on wage trends in the US economy. Section 3 introduces the modeling framework and Section 4 presents statistics on trends in the real wage and employee compensation. Alternative wage series are used, including average hourly earnings of non-supervisory employees and the Employment Cost Index (ECI). Earnings trends are compared with trends in skills, schooling, and productivity.

Section 5 presents regression analysis to relate wage changes to productivity growth, capital investment, changes in computer investment, research and development (R&D) intensity, and average skill and educational levels. We also consider changes in minimum wages and union density. The regressions are performed at aggregate and industry level. Section 6 draws some conclusions.

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2. Review of previous literature

In contrast to the literature on rising earnings inequality, relatively little work has focused on average wages in the US, and particularly their slowdown since 1973. [Levy and Murnane \(1996a,b\)](#) point to skills as an important determinant of changes in earnings, with one of their major findings being that employers are screening employees for their possession of skills rather than years of schooling or college degree. Using two large sets of panel data on high school graduates in 1972 and in 1980, they examine whether there is a relation between math and reading scores on standardized tests, and earnings six years after graduating. They find that the correlation between earnings and test scores is higher for the 1980 panel than the earlier one, and that high math test scores in particular, are more highly correlated with wages for the later cohort of graduates. They identify several “basic skills” that are being more highly valued by employers: (i) ability to read and perform mathematics at 9th-grade level; (ii) effective oral and writing communications skills; (iii) ability to work effectively with colleagues from different social, racial, and ethnic backgrounds; and (iv) computer skills. The policy message based on these findings is that it is the content of education – that is, what the student actually learns – not the years of schooling, that is crucial to success in the labor market.

Some scholars have identified technology as the main determinant of wage changes. [Johnson and Stafford \(1993\)](#) argue that the erosion of large returns from American technological leadership has been the principal factor explaining the stagnation of American wages since 1973. [Acs and Danziger \(1993\)](#), using Current Population Survey (CPS) data for the period 1979–1989, report that average earnings have declined among male workers. They attribute this decline mainly to increases in the returns to education and experience, which they interpret as deriving mostly from technological change. They do not find any significant effect from shifts in industrial employment patterns, on the basis of 13 broad industry groupings.

[Autor et al. \(2003\)](#), using representative data on job task requirements for 1960–1998, find that computerization is associated with declining relative industry demand for routine manual and cognitive tasks, and increased relative demand for non-routine cognitive tasks. In particular, they find that computerization has led to the “creative destruction” of the skills and qualifications of lower skilled workers, leading to a fall in real wages at the bottom of the wage distribution. They computed that the sum of within-industry and within-occupation task changes emanating from computer usage explain between 30% and 40% of the observed relative demand shift favoring college versus non-college labor, in the period 1970–1998.

There are also two institutional factors that have been analyzed. [Freeman \(1993\)](#) argues that the decline in union power in the American economy and/or the decline in the real value of the minimum wage since the late 1960s, has removed the “safety net” that was supporting the wage level of unskilled workers and allowed it to fall. [Ferguson \(1996\)](#), using three-digit industry level data on unioniza-

tion, and aggregate time-series data on wages for the period 1978–1986, estimates that 18% of the increase in the gap between real wage growth and aggregate labor productivity growth can be ascribed to the decline in unionization, and that perhaps another 25% is due to the reduced ability of unions to raise wages.

[Gordon \(1996\)](#) argues that the changes in these two factors are part of a broader range of institutional changes that occurred in the 1980s, which allowed American corporate managers to exert increasing pressure on workers, partly in reaction to rising international competition. Gordon documents the decline in real wages of American workers and argues that the growing power of management and concomitant decline in worker power have been largely responsible for this trend. [Reich \(1998\)](#) takes issue with Gordon and reports that most of the increase in managerial labor occurred in the early part of the postwar period, when labor power was increasing.

There is a large literature on the effects of institutional factors on rising wage inequality. [Blackburn et al. \(1990\)](#) estimate that as much as 20% of the rising earnings differential in 1980–88 between college graduates and other educational groups could be due to de-unionization, and, on the other hand, that changes in the minimum wage have had a minimal impact. [Freeman \(1993\)](#) and [Card \(1992\)](#) estimate that between 10% and 20% of the increased wage inequality among men is due to the decline in unionization.

[Horrigan and Mincy \(1993\)](#) attribute less than a third of the declining share of earnings received by the bottom quintile of wage earners to the fall in the minimum wage. [DiNardo et al. \(1996\)](#), using a semi-parametric estimation technique on CPS data for 1979 to 1988, conclude that the decline in the real value of the minimum wage in this period accounted for up to 25% of the rise in male wage inequality and up to 30% of the rise in female wage inequality. [Fortin and Lemieux \(1997\)](#) estimate that some 30% of rising wage rate dispersion in the US was due to the decline in the real value of the minimum wage. [Lee \(1999\)](#), using regional data drawn from the CPS, and regional minimum wage levels over the 1980s, conclude that the decline in the real minimum wage accounts for as much as 70% of the rise in wage dispersion in the lower tail of the wage distribution among men, and from 70% to 100% among women, during that period.

[Card \(2001\)](#), using CPS data for the period 1973–1993, concludes that the decline in union membership accounts for 15–20% of the rise in male wage inequality, but that this trend does not explain much of the increased female wage inequality. Card also finds that the rise of unionization in the public sector has substantially slowed wage inequality in this sector.

There is cross-national evidence pointing to the importance of unionization and the minimum wage in explaining inequality differences. [Katz et al. \(1995\)](#) in comparing changes in wage inequality in the US, Great Britain, Japan, and France, find that in the case of France sharp rises in the national minimum wage and the strength of French labor unions prevented wage differentials from increasing in the period 1967–1987. [Blau and Kahn \(1996\)](#), using

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