



# What do computers really do? Computerization, fading pay-setting institutions and rising wage inequality



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## ARTICLE INFO

### Article history:

Received 10 February 2015

Received in revised form 25 June 2015

Accepted 11 July 2015

Available online 18 July 2015

### Keywords:

Rising wage inequality

Labor unions

Computerization

## ABSTRACT

In this paper we advance the argument that the widespread assumption that computerization and institutional changes are independent explanations for the resurgence of wage inequality is inaccurate. Instead we posit for complex dynamics between computerization and fading pay-setting institutions, arguing that the latter is a mechanism by which the former operates. To test our argument that computerization increases wage inequality not only via the mechanisms specified by skill-biased Technological Change, but also indirectly through structural processes, we utilize longitudinal U.S. industrial-level data on computerization, pay-setting institutions, and wage inequality. Estimating Error Correction Models, we find a stronger longitudinal association between computerization and wage inequality in industries where labor processes were subject to both computerization and the breakup of pay-setting institutions (such as labor unions) than in industries where these institutions never had much of a presence. These findings provide some evidence that computerization operates also through the mechanism of weakening labor market institutions.

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## 1. Introduction

The resurgence of inequality since the late 1970s in rich countries, which was most prompt, substantial, and prominent in the US, is one of today's most widely discussed and controversial issues. Most economists argue that market forces have been primarily responsible for the rise in wage inequality. Pointing to technological changes, they maintain that computer technology is complementary to human capital, meaning that at the same level of human capital, productivity is much higher when computer technology is used. That being the case, the diffusion of computers has led to an increase in the relative demand for high-skilled workers that tend to use computers, thereby raising their wages relative to less-skilled workers that do not use computers (Acemoglu & Autor, 2011). At the same time that demand for skilled workers rose, there was a slowdown in the growth in numbers of college graduates, thereby raising the wages of highly educated workers even more (Goldin & Katz, 2008). The demand for less-skilled workers, on the other hand, has stagnated or even declined as computers enhanced processes of automation (Autor, Levy, & Murnane, 2003). This explanation, known as Skill-Biased Technological Change (SBTC),

implies that computerization is the main explanation for rising wage inequality, at least among the bottom “99 percent” of wage and salary workers (Autor, 2014).

On the other side of the argument are sociologists and political scientists who stress the role of political forces – especially the weakening of labor unions – as driving rising wage inequality in the United States (Card, Lemieux, & Riddell, 2004; Lin & Tomaskovic-Devey, 2013; Kristal & Cohen, 2015; Moller, Alderson, & Nielsen, 2009; Western & Rosenfeld, 2011), the United Kingdom (Machin, 1997), Germany (Card, Heining, & Kline, 2012), and Israel (Kristal & Cohen, 2007). Supporting the political argument, comparative studies show that the weakness of pay-setting institutions in the US, labor unions in particular, explain why income inequality is the highest in the US (Alderson & Nielsen, 2002; Beckfield, 2006; Bradley, Huber, Moller, Nielsen, & Stephens, 2003; Brady, 2003; Garnero, Kampelmann, & Rycx, 2014; Iversen & Soskice, 2006; Rueda & Pontusson, 2000).

There is a consensus among researchers that both fading pay setting institutions and computerization are the main factors responsible for rising inequality in the US and Europe (Lemieux, 2008; Piketty, 2014; Western & Rosenfeld, 2011). The disagreement is about the relative importance of the two factors. Results of empirical studies comparing the size of these effects appear to depend on the specific research design. A cross-countries study found institutions to be more important (OECD, 2011), while a time-series US study found the opposite (Wolff, 2006). A recent

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US study (Kristal & Cohen, 2015) that measured these effects at the industry level found institutions (de-unionization and the stagnation in minimum wage) to be twice as important as computerization for explaining rising inequality.

While the distinction between technology and political forces is assumed to be clear-cut, we put forward a new perspective that underlines the complex dynamics between technology and politics in the wage determination process, arguing that the latter is a mechanism by which the former operates. Specifically, we posit that computer-based technologies have changed the social relations at workplace in fundamental ways that has enhanced union decline and the weakening of other pay-setting institutions such as internal labor markets, which in turn has boosted wage inequality. We test our argument in the US, in which these processes should be more evident than in European countries with strong deliberative institutions (Hall & Soskice, 2001) where less adversarial labor unions and employers are better equipped to deal with labor-saving technological changes than their U.S. counterparts. To get as close as possible to the dynamics of the workplace with aggregate data, we utilize longitudinal industrial-level data on computerization, pay-setting institutions and wage inequality<sup>1</sup>. We empirically test our thesis by estimating whether there is an interaction between computerization and fading pay-setting institutions in the wage determination process. In support of our complementary thesis to the canonical SBTC thesis, we present evidence for variation in the longitudinal relations between computerization and wage inequality across industries experiencing more and less institutional change; variation that indicates that computerization operates also through the mechanism of weakening institutions.

This paper's contribution, then, is to clarify the question regarding the mechanisms through which computerization affects inequality. The core notion of this new "structural perspective" (Kalleberg, Wallace, & Althaus, 1981; Tomaskovic-Devey, 2014) we advance is that computerization increases wage inequality not only via the mechanisms specified by SBTC, but also through structural processes related to institutional factors. In her study of the decline in labor's share of national income, Kristal (2013b) demonstrates that computerization reduced the labor's share (and increased corporate profits) also indirectly by exacerbating union decline. Here we develop and expand this thesis that computerization operates through the mechanism of weakened institutions to explain the surge in wage inequality, a different dimension of economic inequality<sup>2</sup>. Although we do not test directly the mechanisms through which computerization enhanced fading pay-setting institutions, our findings for an interaction effect provide an essential step toward validating the feasibility of such mechanisms.

The remainder of this paper is structured as follows. In Section 1 we elaborate the new structural perspective that computerization inhibits unionization and harms other pay-setting institutions,

<sup>1</sup> To test the effect of computerization on inequality we need data on computer technology at the establishment, industry, or country level for a long period of time. While there is a huge variance between industries in the use of computer technology, there is less variance between OECD countries in their use of computer technology. Evidently, the ideal design would be a cross national time-series study within industries. However, to the best of our knowledge, no country other than the US provides data on computerization, unionization, and inequality for a large enough number of industries nor for a long enough period of time.

<sup>2</sup> While both wage inequality and the share of capitalists' profits in national income (compared to labor compensation) have increased since the late 1960s, these dimensions of inequality differ substantially in the sources of income and classes of people to which they apply (Kristal, 2013a; Piketty, 2014). Wages at the top of the wage distribution, for example, have fueled wage inequality among workers but grew at a much slower pace than corporate profits, allowing capitalists to grab the lion's share of the fruits of (relatively slow) economic growth. Empirically, too, these two dimensions of inequality are not highly correlated.

thereby indirectly affecting inequality via institutional mechanisms rather than merely due to "market forces". In Section 2 we describe the longitudinal industry data, measures, and method of analysis. In Section 3 we estimate the associations between computerization and wage inequality across industrial sectors and detailed industries that faced more and less institutional change. In the Conclusions, we summarize and discuss the implications of the findings for the canonical accounts for rising wage inequality.

## 2. Computerization and institutional change

While there is a consensus that computerization explains part of rising inequality, there is less agreement on the precise mechanisms through which it affects wage inequality (Card & DiNardo, 2002; Handel, 2007). Recently, a few studies have questioned the assumption that the invisible hand of the market is the main mechanism through which computerization increases inequality (DiMaggio & Bonikowski, 2008; Hanley, 2014; Kristal, 2013b; Guy & Skott, 2008). Indeed, the mechanisms through which fading pay-setting institutions have driven wage inequality are self-explicating and supported by empirical evidence. By contrast, the mechanisms of supply, demand, and returns to productivity, through which according to the SBTC computers have led to the growth in wage inequality, are relatively vague and difficult to measure, and it is therefore nearly impossible to accumulate direct empirical evidence for such mechanisms.

While SBTC surely has a role in explaining rising inequality, it is rather restrictive to assume that computers have impacted the labor market and wage inequality solely via skills and productivity, as it had profound impact on various structural aspects of the production process and on the relations among workers. We have some evidence that it has affected union decline (Kristal, 2013b). Plausibly enough, computerization may have accentuated many additional post-1970 developments in rich countries' labor markets, especially in the US, from the rise of nonstandard employment relations, to outsourcing abroad and the substitution of foreign merchandise for domestic products. While computer technology is not the main cause of these labor market transformations, we posit that computer-based technologies enhanced these processes, thereby increasing wage inequality via various mechanisms.

What are the possible mechanisms through which computerization contributes to fading pay-setting institutions? Begin with union decline. Two main mechanisms are discussed by past research. First is the well-known effect of downsizing manufacturing jobs: computers enhanced automation of the production process and prompted firms to utilize computer equipment in tasks previously performed manually by blue-collar, mostly unionized workers, downsizing many unionized manufacturing jobs and leading to union decline (Fligstein & Shin, 2007; Kristal, 2013b; Milkman, 1995). A second plausible mechanism links union decline to skill polarization of the workforce. Previous studies suggest that new computer technologies had highly polarizing effects on the workforce: skilled workers experienced up-skilling, while many production workers underwent de-skilling (Burriss, 1998; Vallas & Beck, 1996). This skill polarization has not only increased wages at the top via SBTC, but also fueled wage gaps via structural factors: it deepens divisions among workers and may have undermined workers' solidarity, thereby reducing the likelihood of working-class cohesion and collective action (Kristal, 2013b). One manifestation of this polarization among organized workers has been the ongoing process of decentralization in collective bargaining agreements that have contributed to rising wage inequality since the early 1980s (Western & Rosenfeld, 2011).

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