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The impact of the productivity dispersion across employers on the labor's income share

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Abstract

I study the distribution of income across the factors of production within the canonical on-the-job search framework. I show that, by weakening the competition between employers, a mean-preserving spread of the employers' productivity distribution decreases the share of the production output that the workers receive. This result is particularly intriguing in light of the rising productivity dispersion and the declining labor share in many countries.

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1. Introduction

The global rise in the capital's share of income since the 1970s is attracting sustained attention. Piketty and Zucman (2014) document for eight developed countries that the capital shares increased from about 15–25 percent in the 1970s to 25–35 percent in 2010. While the capital-output ratios have risen, the average returns to capital failed to decrease sufficiently in order to preserve the initial capital and labor shares. Karabarbounis and Neiman (2014) find that the decline in the labor share of income occurs within the vast majority of countries and industries.[1]

Many countries have also experienced a surge in the productivity dispersion across employers and in wage inequality over the last decades. Dunne et al. (2004) find that the wage and productivity dispersion substantially increased in U.S. manufacturing in 1975 to 1992 and that "virtually the entire increase in overall dispersion in hourly wages for U.S. manufacturing workers in 1975 to 1992 is accounted for by the between-plant components" (Dunne et al., 2004, pg. 399). Barth et al. (2014), Faggio et al. (2010) and Berlingieri et al. (2017) document similar patterns in other U.S. industries and in other countries.[2] The rising heterogeneity among employers has been put forward not only as an explanation for the increase in within-group wage inequality, i.e., wage dispersion among observably identical workers, but also as an explanation for the increase in between-group wage inequality, in particular, the skill premium (e.g., Card et al., 2013; Stijepic, 2018).[3]

In the present paper, I complement the literature by additionally exploring the contribution of the rising productivity dispersion across employers to the recent

[1]The stability of the labor's share of income has been a fundamental feature of macroeconomic models at least since the work of Kaldor (1957). Most of the theoretical literature on structural change and growth focuses on paths that are characterized by a constant aggregate labor share of income (e.g., Kongsamut et al., 2001; Ngai and Pissarides, 2007; Foellmi and Zweimüller, 2008). See Stijepic (2015, 2017a,c) for a geometrical approach to structural-change modeling.

[2]Two prominently discussed sources of the rise in the productivity dispersion across firms are globalization and technological change. For instance, the large and already productive firms are more likely to gain access to foreign markets, so that trade liberalization tends to amplify the disparities in revenue productivity (e.g., Tybout, 2008; Bernard et al., 2007). Another example is that increases in organizational size are usually associated with rising complexity and problems in communication and coordination, so that advances in information and communication systems are beneficial to the large and already productive organizations (e.g., Gremillion, 1984).

[3]Stijepic (2016) documents the comovement of the skill premium with the differential employer-size wage premium between high-skill and low-skill workers in U.S. manufacturing during the postwar era, suggesting that differences between small and large employers play a potentially important role in explaining the recent increases in wage inequality.

trends in capital and labor shares. My paper is motivated by the study of Cahuc et al. (2006). In the canonical on-the-job search model, a key determinant of the workers' income share is the competition between employers that results from the workers' search for better jobs while employed. Indeed, Cahuc et al. (2006) estimate the workers' exogenous bargaining power to be only modest once on-the-job search is taken into account. In other words, workers' search for better jobs while employed suffices to explain the share of the output that the workers are able to appropriate.

I show that a mean-preserving spread of the employers' productivity distribution decreases the share of the production output that the workers receive in the canonical on-the-job search model. Intuitively, a highly dispersed environment weakens the workers' ability to expose, through on-the-job search, the highly productive firms to a fierce competition. In contrast, linear transformations of the productivity distribution do not alter the factor income distribution. In that sense, homogeneous productivity growth across all productivity classes does not affect the labor's income share. Only heterogeneous productivity growth may have an impact on the labor's income share by inducing changes in the productivity dispersion across employers.

Making use of U.S. Census data, Autor et al. (2017) document a rise in sales concentration among firms within industries over the recent decades, where industries with larger increases in concentration also have larger declines in the labor share. In order to explain the trends, the authors propose a heterogeneous-firm model with a non-standard production function and imperfect competition in the product market, but perfect competition in the factor markets. The key idea is that information technologies and globalization favor "superstar" firms that tend to have smaller labor shares. In contrast, the mechanism in the present paper relies on imperfect competition in the labor market. In particular, I show that the workhorse model of Burdett and Mortensen (1998) readily generates a fall in the labor share in the presence of rising productivity dispersion across firms.

This paper is structured as follows. In Section 2, I introduce the canonical on-the-job search model and characterize the equilibrium. In Section 3, I analyze the impact of a mean-preserving spread of the employers' productivity distribution on the workers' output share. Section 4 draws some conclusions.

2. The Canonical On-the-Job Search Model

Let p denote a firm's productivity, which I assume to be Pareto distributed in the economy, i.e., $\Gamma_{p_0}(p) = 1 - (p_0/p)^z$ for $z > 2$, $p_0 > 0$ and $p \geq p_0$. Firms post job offers that are associated with fixed wage contracts, w. Workers and firms are risk neutral. Without loss of generality, let the measures of the sets of workers and firms equal unity.

Employed workers receive the wage offered by the respective firm. I normalize the flow income enjoyed by unemployed workers to zero. Both unemployed and employed workers are contacted by firms according to a Poisson process at rate $\lambda > 0$. Employed workers transition into unemployment at rate $\delta > 0$. Let κ denote the ratio of the job-offer arrival rate, λ, to the transition rate into unemployment, δ, i.e., $\kappa = \lambda/\delta$. Workers' optimal behavior follows a simple rule. When information about job opportunities arises, employed workers quit their current job for the new one provided that the new wage offer exceeds the current one. Given a flow income of zero, unemployed workers accept any positive wage offer.

Let u be the equilibrium measure of the set of unemployed workers, let $F(w)$ be the wage offer distribution, i.e., the equilibrium proportion of firms offering a wage no greater than w, and let $G(w)$ be the cross-sectional wage distribution, i.e., the equilibrium proportion of employed workers receiving a wage no greater than w. In the steady state, the flow of unemployed workers into employment, λu, equals the flow of employed workers into unemployment, $\delta(1-u)$. Therefore, the steady-state measure of the set of unemployed workers is $u = 1/(1+\kappa)$. In the steady state, the flow of unemployed workers into firms offering a wage no greater than w, $\lambda F(w)u$, equals the flow of employed workers into unemployment, $\delta G(w)(1-u)$, and into higher paid jobs, $\lambda(1-F(w))G(w)(1-u)$. Therefore, the steady-state cross-sectional wage distribution is $G(w) = F(w)/(1+\kappa(1-F(w)))$.

A firm with a workforce of mass l and a wage w loses workers when they transition into unemployment, δl, or are poached by other firms that offer higher wages, $\lambda(1-F(w))l$. The firm attracts workers who are unemployed, λu, or poaches workers from firms that offer lower wages, $\lambda G(w)(1-u)$. Hence, the firm's steady-state workforce is $l(w) = \kappa(1+\kappa(1-F(w)))^{-2}$. Following Burdett and Mortensen (1998), I assume that firms maximize their steady-state profits:

$$\pi(p) = \max_{w} \{(p-w)l(w)\} \tag{1}$$

The firm's optimization problem consists in the trade-off that is induced by the ambivalent effect of the offered wage on profits. A higher wage decreases the profits per worker, but allows the firm to attract and to retain more workers.

2.1. The Equilibrium

Firms of equal productivity choose the same wage strategy in equilibrium. Hence, there is no wage dispersion among equally productive firms. Intuitively, a continuous productivity distribution leaves no room for wage dispersion among equally productive firms. In the case of a discrete productivity distribution, firms of the same productivity typically do not choose the same wage posting strategy. Furthermore, more productive firms offer higher wages. Intuitively, more productive firms enjoy higher marginal revenues for a given posted wage. Hence, they find it optimal to offer higher wages in order to attract and to retain more workers. Formally, there exists a non-decreasing equilibrium wage offer function, denoted by $w(p)$, so that $F(w(p)) = \Gamma_{p_0}(p)$ (see, e.g., Bontemps et al., 2000).

Let $\Psi(p)$ be the labor productivity distribution, i.e., the equilibrium proportion of workers employed in firms of a productivity no greater than p. Analogously to the steady-state cross-sectional wage distribution, the steady-state labor productivity distribution is $\Psi(p) = \Gamma_{p_0}(p)/(1+\kappa(1-\Gamma_{p_0}(p)))$. Therefore, the average worker productivity in the steady-state equilibrium, denoted by $\bar{p}$, is

$$\bar{p} = \int_{p_0}^{\infty} x d\Psi(x) = (1+\kappa)p_0 \int_0^1 \frac{(1-x)^{-1/z}}{(1+\kappa(1-x))^2} dx, \tag{2}$$

where I use a change of variables formula in order to integrate over the firm productivity ranks, $\Gamma_{p_0}(p)$, instead of the firms' actual productivities, p.

The first-order condition with respect to the posted wage, w, of the firm's maximization problem in Equation (1) is $(p-w)dl/dw(w) = l(w)$. With the equilibrium relation $F(w(p)) = \Gamma_{p_0}(p)$, it follows $2\kappa\gamma_{p_0}(p)(p-w(p))/(1+\kappa(1-\Gamma_{p_0}(p))) = dw/dp(p)$, where $\gamma_{p_0}(p)$ denotes the density that is associated with the productivity distribution, $\Gamma_{p_0}(p)$. With the boundary condition $w(p_0) = 0$, this linear differential equation admits the solution

$$w(\Gamma) = 2p_0\kappa\,(1+\kappa(1-\Gamma))^2 \int_0^{\Gamma} \frac{(1-x)^{-1/z}}{(1+\kappa(1-x))^3} dx \quad \text{for} \quad \Gamma \in [0,1], \tag{3}$$

where I use a change of variables formula in order to rewrite wages in terms of firm productivity ranks, Γ.[4] Therefore, the workers' average wage is

$$\bar{w} = \int_{p_0}^{\infty} w(\Gamma_{p_0}(x)) d\Psi(x) = 2p_0\kappa(1+\kappa) \int_0^1 \frac{(1-x)^{1-1/z}}{(1+\kappa(1-x))^3} dx. \tag{4}$$

The overall wage income in the economy is $\bar{w}(1-u)$. The overall output that is generated in the economy amounts to $\bar{p}(1-u)$. Therefore, the labor's income share is simply $\bar{w}/\bar{p}$.

[4] It is optimal for the least productive firm to offer a wage of zero. Otherwise, the firm could decrease its wage offer without reducing its steady-state workforce and, hence, increase its profits.

2.2. The Equilibrium under a Mean-Preserving Firm Productivity Spread

Let the mean-preserving spread of the firm productivity distribution, $\Gamma_{p_0}(\cdot)$, be denoted by $\Gamma^*_{p_0^*}(\cdot)$. Specifically, I assume the firm productivities above the threshold $p_x \in (p_0, \infty)$ to increase by a factor of $P > 1$. Furthermore, I rescale the initial productivities by the factor p_0^*/p_0, where $\int_{p_0^*}^{\infty} x d\Gamma^*_{p_0^*}(x) = \int_{p_0}^{\infty} x d\Gamma_{p_0}(x)$ so that the average firm productivity is unaltered. Hence, the transformed productivities, p^*, as a function of the initial productivities, p, are $p^*(p) = P^{\mathbb{1}\{p>p_x\}}(p_0^*/p_0)p$, where $\mathbb{1}\{p > p_x\}$ is an indicator function that equals one if $p > p_x$ but is zero otherwise. Therefore, the mean-preserving spread of the productivity distribution is

$$\Gamma^*_{p_0^*}(p^*) = \begin{cases} 1 - \left(\frac{p_0^*}{p^*/P}\right)^z & \text{if } p^* > Pp_x^* \\ 1 - \left(\frac{p_0^*}{p_x^*}\right)^z & \text{if } Pp_x^* \geq p^* \geq p_x^* \\ 1 - \left(\frac{p_0^*}{p^*}\right)^z & \text{if } p_x^* > p^* \geq p_0^* \\ 0 & \text{otherwise} \end{cases}.$$

All variables under the mean-preserving productivity spread, $\Gamma^*_{p_0^*}(\cdot)$, are denoted by an asterisk.

The wage offer function under the mean-preserving productivity spread is

$$w^*(\Gamma^*) = 2p_0^*\kappa\,(1 + \kappa(1 - \Gamma^*))^2 \int_0^{\Gamma^*} \frac{P^{\mathbb{1}\{x>\Gamma_x^*\}}(1 - x)^{-1/z}}{(1 + \kappa(1 - x))^3} dx \quad \text{for} \quad \Gamma^* \in [0, 1], \quad (5)$$

where $\mathbb{1}\{x > \Gamma_x^*\}$ is an indicator function that equals one if $x > \Gamma_x^* = \Gamma^*_{p_0^*}(p_x^*)$ but is zero otherwise. I note that the equilibrium wage offer function is necessarily continuous. Otherwise, a firm above the discontinuity could decrease its wage offer without reducing its steady-state workforce and, hence, increase its profits. The average wage is

$$\bar{w}^* = (p_0^*/p_0)\bar{w} + (p_0^*/p_0)(P - 1)\bar{w}', \quad (6)$$

where $\bar{w}' = 2p_0\kappa(1+\kappa) \int_{\Gamma_x^*}^1 (1-x)^{1-1/z} (1 + \kappa(1 - x))^{-3} dx$. Analogously, the average worker productivity under the mean-preserving productivity spread is

$$\bar{p}^* = (p_0^*/p_0)\bar{p} + (p_0^*/p_0)(P - 1)\bar{p}', \quad (7)$$

where $\bar{p}' = (1 + \kappa)p_0 \int_{\Gamma_x^*}^1 (1 - x)^{-1/z}(1 + \kappa(1 - x))^{-2} dx$.

Figure 1 depicts the firm's productivity and wage offer as a function of the firm's productivity rank under the initial productivity distribution and under the mean-preserving productivity spread. Notably, as the productivity rank, Γ, approaches one, the productivity of the firm, p, approaches infinity but the wage offered by the firm, w, converges to a finite value.

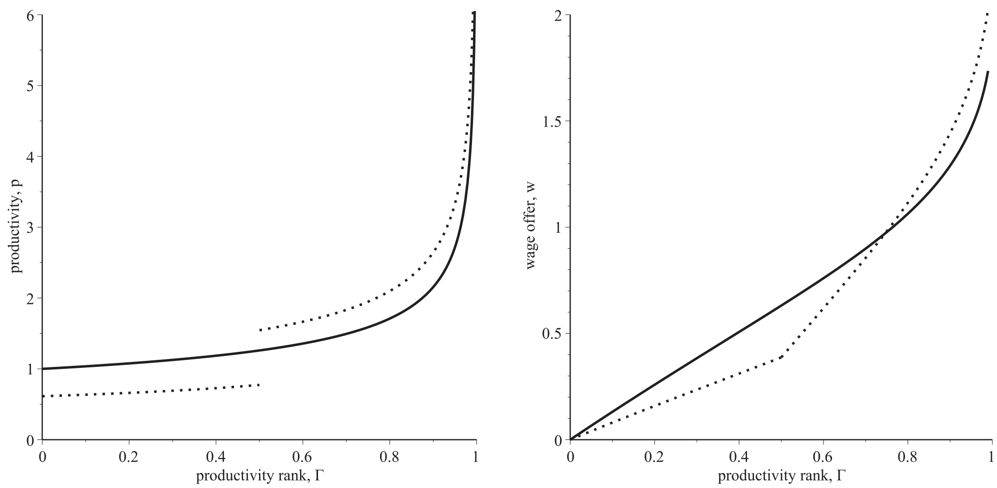

Figure 1: The productivity of the firm (left-hand side) and the wage offered by the firm (right-hand side) as a function of the firm's productivity rank under the initial productivity distribution (solid line) and under the mean-preserving productivity spread (dotted line). Parametrization: $p_0 = 1$, $z = 3$, $\kappa = 2$, $\Gamma_x = 0.5$, $P = 2$.

3. Productivity Dispersion and the Labor's Share of Income

The workers' rent share is not merely an exogenous constant in the model of Burdett and Mortensen (1998), but motivated by the workers' search for better jobs while employed. The ratio of the job-finding rate to the transition rate into unemployment, κ, is a key determinant of the share of the production output that the workers are able to appropriate. Intuitively, κ is the average number of outside contacts per employment spell. The more firms are expected to interact during an employment spell, the lower is the employers' monopsonistic power. Hence, the higher is the rent share that the workers are able to appropriate.[5]

The following two propositions characterize the relation between the firm productivity distribution and the labor's income share:

Proposition 1 (Labor's Share and Linear Productivity Transformations). *A linear firm productivity transformation does not affect the labor's income share in*

[5]On-the-job search and the employers' monopsonistic power play a supposedly important role in explaining wages. For instance, Ransom and Oaxaca (2010) estimate labor supply elasticities at the firm level in the U.S. retail grocery industry, finding that the difference in supply elasticities between women and men explains well the lower relative pay of women. Manning (2003) provides a detailed exposition of the dynamic monopsony model.

the steady state, i.e., the ratio $\bar{w}/\bar{p}$ is invariant to firm productivity transformations of the form θp for $\theta \in (0, \infty)$.

PROOF. It immediately follows that the average wage and the average productivity under the linear firm productivity transformation θp are $\theta\bar{w}$ and $\theta\bar{p}$, respectively. $\square$

Proposition 2 (Labor's Share and Productivity Dispersion). *The labor's share of income under the initial firm productivity distribution, $\bar{w}/\bar{p}$, exceeds that under the mean-preserving firm productivity spread, $\bar{w}^*/\bar{p}^*$, in the steady state.*

PROOF. By Equation (6) and Equation (7), $\bar{w}/\bar{p} > \bar{w}^*/\bar{p}^*$ is equivalent to $\bar{p}'/\bar{p} > \bar{w}'/\bar{w}$. The latter inequality is

$$\int_{\Gamma_x^*}^{1} \varphi(x)dx \bigg/ \int_{0}^{1} \varphi(x)dx > \int_{\Gamma_x^*}^{1} \tilde{\varphi}(x)\varphi(x)dx \bigg/ \int_{0}^{1} \tilde{\varphi}(x)\varphi(x)dx,$$

where $\varphi(x) = (1-x)^{-1/z}/(1+\kappa(1-x))^2$ and $\tilde{\varphi}(x) = (1-x)/(1+\kappa(1-x))$. The above inequality is satisfied since $\tilde{\varphi}(x)$ is decreasing in x.[6] $\square$

Intuitively, the workers' share of the production output is predominately determined by the between-firm competition that results from the workers' search for better jobs while employed. However, the workers' ability to expose the high-productivity firms to a fierce competition is limited, since there is only a limited number of firms that represent serious competitors to those firms. A relative increase in the productivity of the high-productivity firms further weakens the competition that those firms are exposed to. Hence, the labor's income share falls.

4. Conclusion

I show that a mean-preserving spread of the employers' productivity distribution decreases the share of the production output that the workers receive in the canonical on-the-job search model. In contrast, linear productivity transformations do not alter the factor income distribution. In that sense, homogeneous productivity growth across all productivity classes does not affect the labor's income

[6] This proof and the proof of Proposition 5 in Stijepic (2017b) share the same basic structure. Jensen (2018) provides a detailed exposition of the underlying concepts.

share. Only heterogeneous productivity growth may have an impact by inducing changes in the productivity dispersion across employers.

Notably, large and productive firms are more likely to gain access to foreign markets. Therefore, international trade tends to amplify the disparities in revenue productivity. The literature argues that the rising revenue productivity dispersion translates into rising wage inequality (e.g., Felbermayr et al., 2018; Stijepic, 2017b; Egger et al., 2013; Egger and Kreickemeier, 2012, 2009; Amiti and Davis, 2012; Helpman et al., 2010; Davidson et al., 2008). The present paper's findings suggest that globalization, by favoring the large and productive firms, may also lead to a decline in labor income shares.

All in all, the rising productivity dispersion across employers that many countries have experienced over the last decades may have not only contributed to the increase in the wage inequality within and between worker groups but also to a decline in the labor's share of income.

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