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## Wage Dispersion and Overqualification as Entailed by Reder Competition

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### **Abstract:**

The expansion of higher education in the Western countries has been accompanied by a marked widening of wage differentials and increasing overqualification. While the increase in wage differentials has been attributed to skill-biased technological change that made advanced skills scarce, this explanation does not fit well with the observed increase in overqualification which suggests that advanced skills are in excess supply.

By “Reder-competition” I refer to the simultaneous adjustment of wage offers and hiring standards in response to changing labor market condition. I present a simple model of Reder competition that reproduces the simultaneous increase in wage differentials and overqualification in response to an increase in education.

*JEL: J31, J63, D43*

*Keywords: Hiring standards, employment criteria, selection wages, efficiency wages, mobility, skill-biased technical change, overeducation, wage dispersion, Reder competition*

*\*Paper prepared for the Conference of the International Society for the New Institutional Economics, Reykjavik, June 2007. Preliminary draft, please do not quote without permission. Department of economics, University of Munich, Schackstr. 4, 80531 Munich, Germany, [www.lrz.de/~ekkehart](http://www.lrz.de/~ekkehart), [schlicht@lmu.de](mailto:schlicht@lmu.de). I thank Johannes Ludsteck for helpful comments and for permission to reproduce Figure 2, and Oliver Nikutowski and Stephen Vaisey for kind permission to use the data underlying Figures 1 and 3.*

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## *1 Introduction*

Over the recent decades, labor market researchers have noticed two trends which, if taken together, pose a challenge to conventional theorizing: Wage dispersion grew significantly, and over-qualification increased as well. I do not want to review these findings here, nor discuss the endemic data problems. My intention is to just stipulate these trends and focus on the implied theoretical issue.

While the joint occurrence of widening skill margins and overqualification does not fit well into the standard framework of wage competition, it flows rather naturally from a more institutional view of labor market processes, which builds on Melvin REDER's(1955) analysis and will termed "Reder competition." This is closely related to some efficiency wage arguments dealing with the joint occurrence of overqualification and inequality such as that proposed by SKOTT (2006) which builds on discipline efficiency wages.<sup>1</sup>

The paper is organized as follows: Section 2 reviews some empirical findings concerning wage inequality and overqualification. Section 3 introduces the concept of Reder competition. The subsequent Sections 4 to 5 present a very simple model of Reder competition with the purpose to illustrate the concept. The model is used in the remaining Sections 6 to 11 explain the joint occurrence of wage dispersion and overqualification in terms of factors such as labor heterogeneity, skill latitude, labor mobility, and non-labor costs.

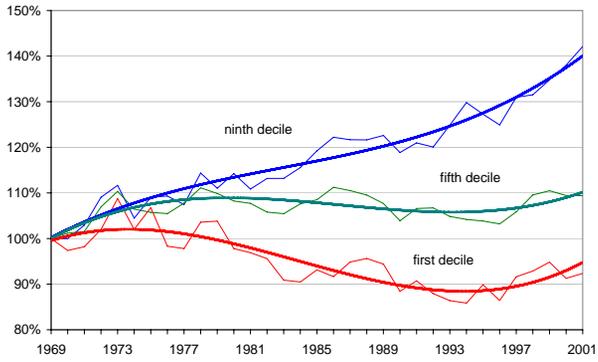
## *2 Wage Dispersion and Over-Qualification*

The increase in wage dispersion is illustrated, both for the US and Germany, in Figures 1 and 2, and the increase in overqualification in Figures 3 and 4.

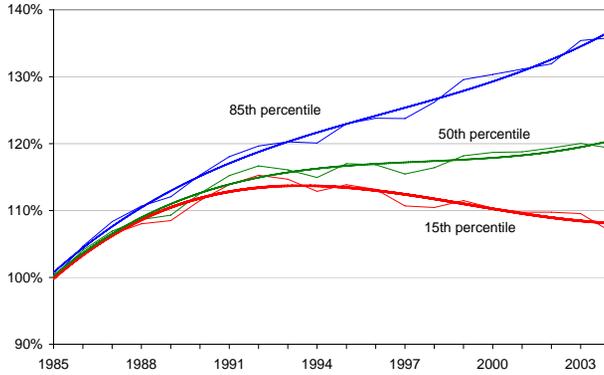
It is to be noted that the both trends materialized simultaneously in a period when educational systems expanded considerably, entailing a better skilled workforce. With unchanging labor demand, standard theory would

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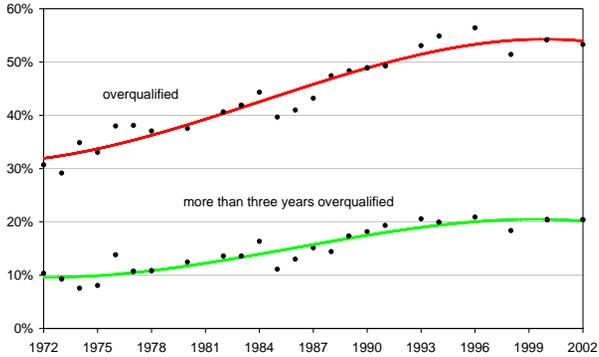
<sup>1</sup> I use the term "Reder competition" for lack of a better label. In view of STIGLER's (1980) Law of Eponymy ("No scientific discovery is named after its original discoverer" ), a non-eponymic label would be preferable, but maybe this is a case where Stigler's Law is refuted.



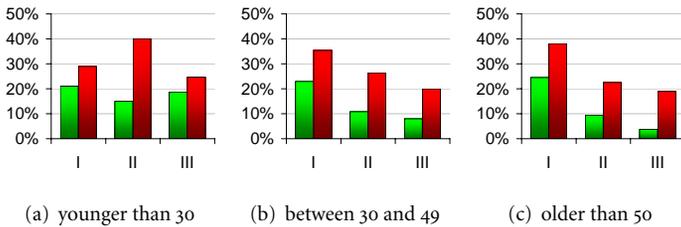
**Figure 1:** Wage dispersion in the US 1969-2001. (Data from NIKUTOWSKI (2006, 18)).



**Figure 2:** Wage dispersion in Germany 1984-2001. (Source: IAB, preliminary).



**Figure 3:** Overqualification in the US. (Data from VAISEY (2006))



**Figure 4:** Overqualification male, 1979 (left column of each pair) and 1998/99 (right column of each pair) for different skill and age groups. (I: basic qualification, II: professional qualification, III: university qualification. Data from LASZLO (2002)).

have predicted wage inequality to diminish rather than increase. To fill the gap, “skill biased technical change” has been invoked. In the words of ACEMOGLU (2002, 2): “The recent consensus is that technical change favors more skilled workers, replaces tasks previously performed by the unskilled, and exacerbates inequality.” This explanation in terms of increasing scarcity of advanced skills is not easily to reconcile, however, with “evidence that a substantial—and growing—number of American workers are overqualified for their jobs,” and that while “ in 1979 one in four workers thought that they could be replaced by less qualified workers, twenty years later one in three workers held that opinion.”<sup>1</sup> Seen from a conventional perspective, this would suggest an increasing oversupply, rather than a shortage of skills.<sup>2</sup> Another interpretation is possible, however, and will be outlined in the following sections.

### 3 *Reder Competition*

We consider labor markets that are characterized by the joint occurrence of the following features:

- Workers are heterogeneous.
- Workers are imperfectly mobile.
- Jobs exhibit skill latitude
- Firms pay job-specific wages.
- There is wage compression.

Workers are *heterogeneous* because they differ in many economically relevant attributes, like experience, trainability, skill, work attitudes, and preferences. If labor were homogeneous and previous work experience did not matter, any worker could easily be replaced by another one, and labor markets

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<sup>1</sup> VAISEY (2006, 855) and LASZLO (2002, 33, my translation), respectively. <sup>2</sup> Some researchers, such as GREEN *et al.* (2002) find no significantly rising trend in over-qualification, in spite of education inflation, yet with increasing shortage of advanced skills, the conventional view would suggest a declining trend in overqualification.

would be akin to spot markets, with firms hiring the services of workers for some days just as needed, rather than for prolonged periods, which is characteristic for modern labor markets. Without heterogeneity, we would observe neither long-term contracts, nor any screening of applicants, nor training, and perhaps not even firms as we know them. In contrast, modern labor markets are characterized by heterogeneity of labor.

Further, workers are *imperfectly mobile* because they cannot move costlessly from one location to another. With perfect mobility, perfect sorting of workers would be conceivable, even in presence of labor heterogeneity, but this is not what we observe. Because there is imperfect mobility, heterogeneity is economically important.

We shall assume also that the jobs under discussion exhibit *skill latitude* in the sense that the productivity of a job depends on the skill of the worker doing this job, rather than being independent of the worker's performance as long as some minimum skill requirements are met. A job on a production line would exhibit little latitude, while a sales representative would enjoy much job latitude in the sense that different workers may work in such a job with quite different success. If there is skill latitude, labor heterogeneity matters, as different workers can do the same job, but cannot do it equally well.<sup>1</sup>

*Job-specific wages* refer to wages that are fixed according to a wage-setting policy, rather than by individual bargaining. Examples for job-specific pay would be a pure time rate paid to all workers performing a certain job, or a piece rate, or an incentive system like the *Taylor plan*, *Halsey 50-50 plan*, or seniority pay.<sup>2</sup>

*Wage compression* refers to the empirical regularity that firms, given their wage policies, prefer better workers of poorer workers for any given job. This

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<sup>1</sup> Differences in trainability of new workers in absence of skill latitude would serve the same purpose. This would correspond to THUROW's (1975) idea that productivity rests in the jobs rather than in the workers, and that workers differ in "background characteristics" that affect training costs. <sup>2</sup> For actual wage-setting practices, see any textbook on compensation, such as MILKOVICH and NEWMAN (1999).

implies that more productive workers are relatively underpaid, compared to less productive workers who do the same job.<sup>1</sup>

With labor heterogeneity and skill latitude, the same job can be performed by workers with different ability, albeit with different perfection, and any worker meeting some minimum requirements is, in principle, employable. Firms very obviously distinguish between “good” and “bad” employees. This is a clear indication that labor heterogeneity and skill latitude are actually encountered in most firms.

When looking for workers, firms face a heterogeneous labor supply. They prefer the best applicants and thus face a trade-off between the wage they offer and the quality of workers they can hire: The better the wage offer, the more applicants will be available, and the more demanding can be the hiring standard implemented, entailing a more productive work force. The wage rate and the hiring standard must be conceived as determined simultaneously by the firms’ optimizing against the trade-off between the wage level and the hiring standard.

In other to fix ideas, we may conceive two extreme forms of labor market clearing:

- *Wage competition:* For a given hiring standard, the market may be cleared by adjusting the wage rate

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<sup>1</sup> FRAZIS and LOEWENSTEIN (2006, 3) find that “only 32 percent of differences in starting productivity are reflected in differences in starting wages,” and that “productivity growth of 10 percent results in wage growth of only 2.9 per cent. See also FRANK (1984), BISHOP (1987), and BEWLEY (1999, 85). Further, the studies by Bishop and by Franzis and Loewenstein are merely concerned with the relationship between wages and “productivity” in a quite narrow sense: Employers have rated workers on a “productivity scale of zero to one hundred, where one hundred equals the maximum productivity any of your employees can attain and zero is absolutely no productivity.” Wage compression, in their sense, refers to the wage ratios being below the productivity ratios, determined this way. Even if the authors would have found that there is no wage compression in their sense, there would be very substantial wage compression in the Marshallian sense, which is the relevant sense in our context. MARSHALL (1920, vi.iii.13) pointed this out as follows: “The corrected law then stands that the tendency of economic freedom and enterprise is generally to equalize efficiency-earnings in the same district: but where much expensive fixed capital is used, it would be to the advantage of the employer to raise the time-earnings of the more efficient workers more than in proportion to their efficiency.” Wage compression is used here as an assumption in order to simplify and shorten the argument. In the class of models underlying the present analysis, wage compression is obtained as result of competition if firms offer performance pay.

- *Job competition*: For a given wage rate, the labor market may be cleared by adjusting the hiring standard.

The view of wage competition—*viz.* treating labor markets in analogy to product markets—dominates contemporary labor market analysis. The other extreme, job competition, has been used by a minority of labor economists, following Lester THUROW (1975). Both views are incomplete. Labor markets characterized by skill latitude are best analyzed in terms of a combination of both extremes: Wages offers and hiring standards are determined simultaneously in response to market conditions. This is the type of labor market competition REDER (1955) has envisaged, and will be labeled accordingly:

- *Reder competition*: Labor markets are cleared by simultaneous adjustments of wages and hiring standards (and possibly other parameters).

Reder competition can not usefully be analyzed, however, by simply combining the views of wage competition and job competition, *viz.* by first treating the hiring standard as given and analyze wage formation, and than take wages given and consider the adjustment of hiring standards, because such a *ceteris paribus* treatment would fade out the interdependence of both mechanisms.<sup>1</sup> The following analysis focuses on the interdependence of hiring standards and wage setting.

#### 4 Selection Wages

Labor heterogeneity in conjunction with skill latitude involves workers who can perform a given job with different productivity while their pay does not reflect productivity differentials fully. This setting induces firms to offer wages in order to control the productivity of their work force. The market wages that arise from the interaction of firms engaging in this kind of wage

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<sup>1</sup> More specifically: As wage determination and the determination of hiring standards respond to the same set of market forces, it is not useful to fix one or the other under a *ceteris-paribus* clause, as is done in analyses emphasizing wage competition while assuming given skill demands, or emphasizing job competition while fixing wages. (See SCHLICHT (1985, Ch. 2) for a pertinent methodological discussion.)

setting are termed “selection wages.” This section illustrates this idea in a simple case.<sup>1</sup>

To capture labor heterogeneity and skill latitude, we consider just two grades of labor, *prolific* and *mediocre*. Both types of workers, the mediocre and the prolific, can perform the task under consideration, but with different efficiency: The prolific workers are more productive. Firms can distinguish the types costlessly when they hire them. Further we assume that the alternative employment for both types of workers is such that individual productivity differences do not matter—think of a conveyor belt. Their wage in this standardized employment functions as a reservation wage for the labor market under consideration. It is denoted by  $R$ .<sup>2</sup>

To capture wage compression, we assume that firms pay the same wage to mediocre and prolific workers.

While firms prefer to employ only prolific workers, not enough of them are available to produce the output demanded. Hence firms have to hire also mediocre workers. Firms can, however, increase the number of applicants—and also in particular of prolific applicants—by offering a wage above the going market rate. This would enable them to increase the share of prolific workers in their work force and enjoy higher productivity, but at the expense of higher labor costs.

We will assume here that all workers performing the job under consideration receive the same wage, regardless of their productivity. This captures, in the simplest form, the idea that wage differentials do not reflect productivity differentials fully—they don’t reflect them at all. At the same time, the assumption captures the empirically relevant case of a wage without a performance component. It can be shown that in the case of performance pay, wage compression will result and broadly similar results can be obtained, but the subsequent analysis focuses on the simple case of flat pay.

Consider, thus, an industry composed of a number of identical firms that operate under free entry and produce a certain good. Firm size is fixed in

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<sup>1</sup> Selection wages are a variety of efficiency wages, see SCHLICHT (1978, 2005). They are closely akin to self-selection wages studied by WEISS (1980), but do presuppose asymmetry of information. <sup>2</sup> This assumption can easily be relaxed in the sense that we may allow different reservation wages for both types of workers.

the sense that each firm can employ just  $n$  workers, regardless of whether they are mediocre or prolific.

The prolific workers have productivity  $x$ , and the mediocre workers have productivity  $y < x$ . Denote by  $q$  the fraction of prolific workers and by the remainder  $(1 - q)$  the fraction of mediocre workers in the work force. We shall refer to  $q$  as the *qualification structure*. As firms can assess the productivity of the applicants, they will hire all prolific workers who apply and fill the remaining job openings with mediocre applicants.<sup>1</sup>

Given the fraction of prolific workers  $q$  in the market with productivity  $x$  and the fraction of mediocre workers  $(1 - q)$  with productivity  $y < x$ , average productivity of the work force under consideration is

$$a = q \cdot x + (1 - q) \cdot y. \quad (1)$$

The average productivity of a firm's work force may deviate from average market productivity  $a$  if the share of prolific workers in a firm differs from the market average. Denote the share of prolific workers enjoyed by the firm under consideration by  $\rho$ . The entailed productivity of the firm's work force is

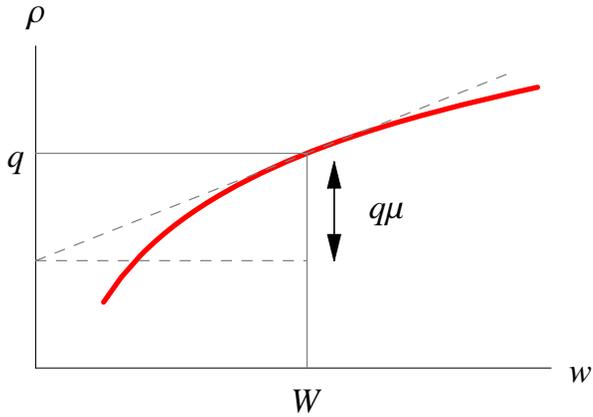
$$\begin{aligned} \alpha &= \rho \cdot x + (1 - \rho) \cdot y \\ &= \rho(x - y) + y. \end{aligned} \quad (2)$$

The share of prolific workers in the firm's workforce  $\rho$  will depend in turn on the wage offer  $w$  the firm makes, as compared to the going market wage rate  $W$ . If the firm pays above the market wage ( $w > W$ ), it will attract more prolific applicants and need hire only fewer mediocre workers. If the firm offers a wage below the market wage ( $w < W$ ), it will find fewer prolific applicants and has to hire more mediocre workers. This idea can be expressed by

$$\rho = q \cdot \left( 1 + \mu \cdot \log \left( \frac{w}{W} \right) \right) \quad (3)$$

where the constant  $1 > \mu > 0$  parametrizes *mobility*. It gives the elasticity

<sup>1</sup> Since there is no continuum of different workers with different productivity, firms cannot impose a hiring standard in this extremely simple setting, but the fundamental selection wage mechanism still applies: By increasing the wage offer, firms can attract more prolific workers and attain a higher productivity of their work force. For an analysis of the continuous case, see SCHLICHT (2005).



(a) zero profit

**Figure 5:** The share  $\rho$  of prolific workers in a typical firm as a function of the wage offer  $w$ . If the wage offer is equal to the market wage ( $w = W$ ), the share of prolific workers in the firm will be equal to the market share ( $\rho = q$ ).

of qualification for a typical firm in response to its wage offer:<sup>1</sup>

$$\mu = \left. \frac{\partial \rho}{\partial w} \cdot \frac{w}{\rho} \right|_{w=W}.$$

Equations (2) and (3) imply

$$\alpha = q \cdot \left( 1 + \mu \cdot \log \left( \frac{w}{W} \right) \right) \cdot (x - y) + y. \quad (4)$$

The industry is composed of a number of firms. Each firm has to invest in establishing a workshop for  $n$  workers. The capital outlays induce capital

<sup>1</sup> We exclude  $\mu \geq 1$  because it would be always optimal to pay maximum wages in this case, and the selection effect would not apply in any interesting way. The formulation (3) is selected for reasons of simplicity of exposition. A more general formulation such as  $\rho = q \cdot f \left( \frac{w}{W} \right)$  with  $f(1) = 1$ ,  $f' > 0$ , and  $f'' < 0$  would not change the argument or the results.

user costs (including normal profits) of  $C$ . With productivity  $\alpha$ , a firm's production will be  $\alpha \cdot n$ . For a product price  $p$ , sales receipts will be  $p \cdot \alpha \cdot n$ . With a wage rate  $w$ , the firm incurs labor costs  $w \cdot n$ . Further, it has to cover capital user costs  $C$ . The firm's profits will thus be equal to  $\Pi = p \cdot \alpha \cdot n - w \cdot n - C$ .<sup>1</sup>

For the subsequent argument it is convenient to express profits of the typical firm in per-capita terms. Denoting per-capita capital user costs by  $c = \frac{1}{n}C$ , these per-capita profits are given by

$$\begin{aligned}\pi &= p \cdot \alpha - w - c \\ &= p \cdot \left( q \cdot \left( 1 + \mu \cdot \log \left( \frac{w}{W} \right) \right) \cdot (x - y) + y \right) - w - c.\end{aligned}\quad (5)$$

Consider now market equilibrium. As all firms are alike, all firms will pay the same wage rate  $w$  which can be identified with the market wage rate  $W$ . Equilibrium requires two things: First, per-capita profits must be zero. Otherwise there would be market entry or market exit, changing conditions of supply and demand. Second, it must be optimal for each firm to set its wage rate  $w$  equal to the market wage rate  $W$ . Else the market wage rate would change.

The zero-profit condition at  $w = W$  is equivalent to

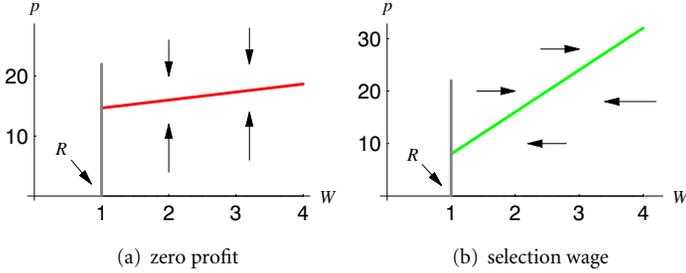
$$p = \frac{W + c}{q \cdot (x - y) + y}.\quad (6)$$

This condition is depicted as the “zero profit” curve in Figure 6(a). Above that curve, there are positive profits that induce market entry and reduce the price level, below there will be losses and market exit, driving the product price up.<sup>2</sup> As the minimum market wage is given by the reservation wage

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<sup>1</sup> For simplicity, other non-labor costs are neglected here. This simplification does not affect the argument nor the results. In order to take outlays for variable inputs into account, interpret  $p$  as the market price of the product *minus* the outlays for other factors of production per piece.

<sup>2</sup> If there is market entry, this will not only increase production, but also employment. This increase comes about through the employment of mediocre workers (as all prolific workers are already employed). This will reduce  $q$  and thereby shift the zero-profit curve up. This effect would not affect our conclusions but is neglected here in order to keep the argument simple.



**Figure 6:** The zero profit curve (a) gives all  $(W, p)$ -combinations where the zero-profit condition (6) is satisfied. The selection wage curve (b) gives all  $(W, p)$ -combinations where condition (9) is met. The parameters used are  $x = 1$ ,  $y = .5$ ,  $q = .5$ ,  $c = 10$ ,  $\mu = .5$  and  $R = 1$ . The parameters used are  $x = 1$ ,  $y = .5$ ,  $q = .5$ ,  $c = 10$ ,  $\mu = .5$  and  $R = 1$ .

$R$ , the zero profit curve is of relevance only for wages levels exceeding the reservation wage.

The conditions for a profit maximum with respect to  $w$  are

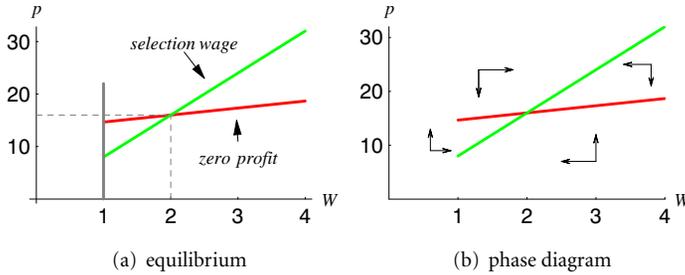
$$\frac{\partial \pi}{\partial w} = p \cdot q \cdot \mu \cdot (x - y) \frac{1}{w} - 1 = 0 \quad (7)$$

$$\frac{\partial^2 \pi}{\partial w^2} = -p \cdot q \cdot \mu \cdot (x - y) \frac{1}{w^2} < 0. \quad (8)$$

As the second-order condition (8) is always satisfied, the first-order condition (7) guarantees a profit maximum (if a maximum exists at all). At  $w = W$ , equation (7) implies

$$p = \frac{W}{q \cdot \mu \cdot (x - y)}. \quad (9)$$

We denote this equation as the “selection wage equation.” Its graphical representation is termed the selection wage curve and is depicted in 6(b).



**Figure 7:** (a) Market equilibrium is obtained where the zero profit curve and the selection wage curve cross. The phase diagram (b) indicates stability. (Parameter values as in Figure 6. Equilibrium is at  $W = 2$  and  $p = 16$ .)

The selection wage curve gives, for any wage level  $W$ , that price level that makes it optimal for the individual firm to set its wage  $w$  just equal to market wage  $W$ . Above this curve, the derivative  $\frac{\partial \pi}{\partial w}$  in (7) is positive at  $w = W$ . The typical firm will therefore set its wage above the market wage ( $w > W$ ). This will drive the market wage up. Below this curve, we will have  $\frac{\partial \pi}{\partial w} < 0$  at  $w = W$ , and the typical firm will set  $w < W$ . This will drive the market wage down.<sup>1</sup>

The crossing of the two curves gives the equilibrium combination of the wage level and the product price. Algebraically equations (6) and (9) can be solved for the equilibrium market wage rate and the equilibrium price. The equilibrium wage rate—which will be called the “selection wage”—is

$$\bar{W} = \frac{\mu q (x - y)}{q (x - y) (1 - \mu) + y} \cdot c \quad (10)$$

<sup>1</sup> The selection wage is a special case of what is known as an STIGLITZ (1973, 290) has termed an “efficiency wage.” This modern usage of the term “efficiency wage” refers to the wage rate, set by the firm, that minimizes the Marshallian efficiency-wage. The selection wage is an efficiency wage in this sense. In order to avoid confusion, it may be better to avoid the modern term in speak in the present context of “selection wages.”

and the corresponding equilibrium price is

$$\bar{p} = \frac{c}{y + q(x - y)(1 - \mu)}. \quad (11)$$

The equilibrium will be feasible only, if the equilibrium wage  $\bar{W}$  exceeds the reservation wage  $R$  of the workers. Otherwise the firms have to maximize their profits (5) under the additional constraint  $w \geq R$ , and would set  $w = R$ , entailing a market wage level  $W = R$  as would be expected with wage competition. The case of interest here (and where the wage competition mechanism is not applicable) relates to the case that the reservation is below the selection wage. If this is the case, any changes in the reservation wage would not affect the equilibrium wage (which is the selection wage) and the equilibrium price level. This an obvious deviation from the results that would be obtained from a model of wage competition.

## 5 Stability

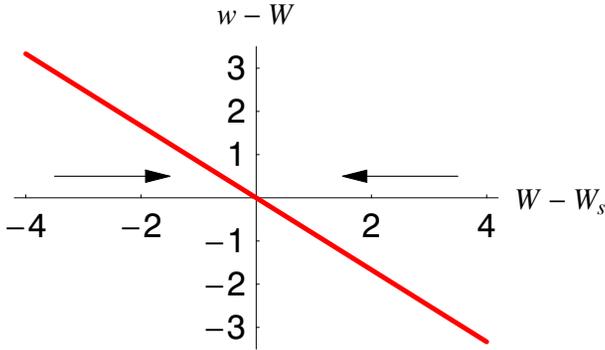
The phase diagram given in Figure 7 indicates stability. Another way to see this is the following. Assume that the prevailing wage level  $W$  initially differs from the equilibrium wage level  $\bar{W}$ . By combining (6) and (7), we obtain the profit-maximizing wage level  $w$  for the typical firm as

$$w = \frac{\mu(x - y)q}{(x - y)q + y} (W + c)$$

which implies together with (6) and (10)

$$w - W = -\frac{(1 - \mu)(x - y)q + y}{(x - y)q + y} (W - \bar{W}). \quad (12)$$

If the wage level is above the equilibrium wage level ( $W > \bar{W}$ ), each firm will set its wage  $w$  below the market wage level  $W$ . This drives the market wage level down until the equilibrium wage level is reached. Conversely, for  $W < \bar{W}$  the firms set  $w > W$ . This drives the wage level up to  $\bar{W}$ . This



**Figure 8:** If the market wage  $W$  is above the equilibrium wage  $\bar{W}$ , the typical firm will set its wage offer  $w$  below the market wage  $W$  (point A). This drives the market wage down. Conversely,  $W < \bar{W}$  induces  $w > W$ , and this drives the market wage up until equilibrium is reached and  $w = W = \bar{W}$  obtains. (Point B. Parameters as in Figure 6.)

establishes stability of adjustment. The graph of equation (12) is depicted in Figure and the direction of adjustment is indicated.<sup>1</sup>

Further, the equilibrium would be unstable if the wage rate exceeds the marginal value product of a mediocre worker. If this were the case it would not be profitable for any firm to hire a mediocre worker, and leave all jobs unmanned that cannot be filled with prolific workers. This condition is  $p \cdot x > W$ . Together with (10) and (11) it can be equivalently stated as

$$x > \frac{\mu q}{1 - \mu q} \quad \text{or} \quad \mu q < \frac{x}{1 + x}. \quad (13)$$

If the productivity  $x$  of the mediocre workers is too low, it would not be

<sup>1</sup> A formal analysis would proceed as follows. Denote the zero profit curve by  $p = a + bW$  and the selection wage curve by  $p = c + dW$  with  $a > c$  and  $b < d$ . The differential equation system  $\dot{p} = \kappa(a + bW - p)$ ,  $\dot{W} = \lambda\left(\frac{p-c}{d} - W\right)$  describes, for some positive speed parameters  $\kappa$  and  $\lambda$ , the adjustment described in the text. Its Jacobian  $\begin{pmatrix} -\kappa & \kappa b \\ \frac{\lambda}{d} & -\lambda \end{pmatrix}$  has a negative trace and a positive determinant. This establishes stability.

worthwhile to employ them. If mobility is high, the equilibrium wage level  $\bar{W}$  would be high, and mediocre workers were too expensive to employ, and the same would hold true if the ratio of prolific workers in the work force were too high.<sup>1</sup>

## 6 Increasing Heterogeneity and Latitude

Consider an increase of worker heterogeneity and skill latitude, in the sense that the productivity differential between prolific and mediocre workers in ceases while average labor productivity remains constant. We may formalize this by introducing a heterogeneity parameter  $h$  such that an increase in  $h$  increases the difference  $(x - y)$  but leaves average productivity  $qx + (1 - q)y$  unchanged. If we write the productivities  $x$  and  $y$  as functions of  $h$ , these functions must satisfy  $q \cdot x'(h) + (1 - q) \cdot y'(h) = 0$  and we can stipulate

$$x' > 0, \quad y' = -\frac{q}{1 - q}x' < 0.$$

An increase in heterogeneity  $h$  means that the productivity of the prolific workers increases and the productivity of the mediocre workers decreases while average productivity remains unaffected.

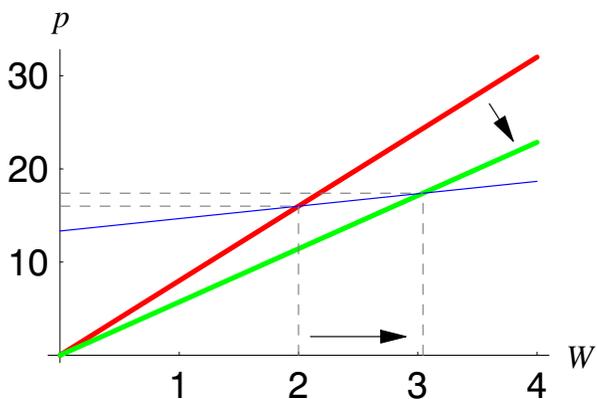
As average productivity remains unaffected, the zero-profit constraint (6) is not changed. Yet increasing heterogeneity enlarges the difference  $(x - y)$ . This decreases the slope of the selection wage curve. As a consequence, the equilibrium wage rate and the equilibrium price level increase (Figure 9).

The intuition for this result is that the selection wage aspect of wage setting becomes more important if heterogeneity increases. This induces firms to raise the wage level. In the aggregate this raises costs and prices.

## 7 Trends in Heterogeneity and Latitude

A closer look at the studies dealing with skill-biased technical change reveal that skill requirements have changed in all kinds of jobs, not just in the well-paying jobs. *AUTOR et al.* (2003, 1279, 1281) have noted: “The substitution

<sup>1</sup> Condition (13) is satisfied for the parameter values given in Figure 6. This establishes the possibility of such solutions.



**Figure 9:** An increase in heterogeneity reduces the slope of the selection wage curve while leaving the zero-profit condition unaffected. As a result, the equilibrium wage level and the equilibrium price level increase. (Parameters as in Figure 6, with  $x$  increased from 1 to 1.1 and  $y$  decreased from .5 to .4. The equilibrium wage level increases from 2 to 3 and the equilibrium price increases from 16 to 17.4.)

away from routine and toward nonroutine labor input was not primarily accounted for by educational upgrading; rather, task shifts are pervasive at all educational levels.” In a similar vein, SPITZ-OENER (2006, 237) has observed: “There has been a sharp increase in nonroutine cognitive tasks, such as doing research, planning, or selling, and a pronounced decline in manual and cognitive routine tasks, such as double-entry bookkeeping and machine feeding. . . . most of the task changes have occurred within occupations.” This suggests an increase of skill latitude. At the same time, the expansion of the educational systems has increased the number of educated workers, and it can be expected that the enlarging of the pool of educated workers has increased heterogeneity.

By the above argument, the increase in latitude and heterogeneity will

make it more profitable for firms to increase their wage offers in order to attract the more productive workers. At the market level, this will lead to higher wages, making education even more attractive. If we assume that additional education increases the supply both of prolific and of mediocre workers, we can expect an improving qualification structure to emerge. Consider how this will affect wage formation.

## 8 Changes in Qualification Structure

Another aspect of wage formation is captured by the proportion  $q$  of prolific workers in the workforce. Consider the effect of an increase in the number of prolific workers in the work force, *viz.* an increase in  $q$ . Such a change affects both the zero-profit line (6) and the selection wage curve (9). The zero-profit line will shift down, because an increase in the number of prolific workers increases productivity and reduces, for any given wage level, production costs per unit of output. At the same time, an increase in  $q$  will flatten the selection wage curve which would, by itself, induce a higher wage rate. The underlying mechanism is that, with an increase in the wage offer, a firm attracts more applicants. If the fraction of prolific workers amongst these applicants increases, a wage increase becomes even more effective as an instrument, as more prolific workers are around than can be attracted this way.

The joint outcome of both effects can be evaluated by again taking the appropriate derivatives of equations (10) and (11). We obtain

$$\frac{\partial \bar{W}}{\partial q} = \Theta^2 c (x - y) y \mu > 0 \quad (14)$$

$$\frac{\partial \bar{p}}{\partial q} = -\Theta^2 c ((x - y) (1 - \mu)) < 0 \quad (15)$$

and see that the selection wage effect pushes the wage level up, while the increased average productivity of labor abates costs and prices, overcompensating the cost increases brought about by the wage increase. Wages go up and prices go down. With the parameter values of Figure 6, an increase  $q$

from  $q = .5$  to  $q = .6$  increases the wage rate from  $W = 2$  to  $W = 2.3$  and decreases the price from  $p = 16$  to  $p = 15.4$ .

## 9 *Education and Overqualification*

Consider now the case that the jobs under consideration require some previous training. The higher the wage rate  $W$ , the higher will be the supply of trained workers, both prolific and mediocre. Firms will preferentially hire the prolific workers and fill the remaining vacancies with mediocre workers. If more workers train than are needed to fill all vacancies, we have overqualification.

Workers who consider training will face a lottery: They will turn out prolific or mediocre, with certain probabilities. If prolific, a worker will be hired at wage  $W$  with certainty, if mediocre only with a certain probability that decreases with increasing overeducation. With an increasing wage rate we would thus expect more training. This improves the qualification structure. The improvement of the qualification structure induces even higher wages and expanded training, along with increased overqualification. In this sense, the joint occurrence of increasing wage inequality and overeducation is brought about by Reder competition. The view fits well with the empirical observation that the increase in inequality seems to have been caused “predominantly by increasing wage dispersion within industries, rather than between industries” (WHEELER, 2005, 375). It fits also well with the other interpretation that overqualification is brought about by labor heterogeneity where the less able within an educational group do not find adequate employment and have to take jobs where their qualification is partially redundant (GREEN and MCINTOSH, 2002). Further, some authors have observed an increased wage premium from education and took this as “*prima facie* evidence against there being any over-investment in education” (GREEN *et al.*, 2002, 798). The above argument shows that such a conclusion may be doubted, as over-education may indeed be produce increased wage premia for education.

## 10 *Increasing Mobility*

The selection wage mechanism that brings about wage dispersion and overqualification has been described here as propelled by increasing heterogeneity and skill latitude. Other processes may produce the same result, however. To illustrate such a mechanism, consider an increase labor mobility. A conventional preconception would be that increase in the mobility of the workers—in the sense of a greater responsiveness to wage differentials—will render the labor market “more competitive,” thereby improving efficiency and decreasing production costs. This would lead in turn to reduced product prices. As will be seen presently, the outcome in the model discussed so far amounts to the opposite.<sup>1</sup>

Mobility is parametrized by  $\mu$ . An increase in  $\mu$  reduces the slope of the selection wage equation (9) in the  $(W, p)$  plane but leaves the zero-profit condition (6) unchanged. Hence both the wage level and the price level increase (Figure 10).

The intuition for this result is simple: With increased mobility, wage increases become more effective as a means for attracting prolific workers. This induces firms to raise their wages. For the industry as a whole, this increases costs and therefore the price of the product. We obtain wage increases and price increases in response to an increase in mobility.

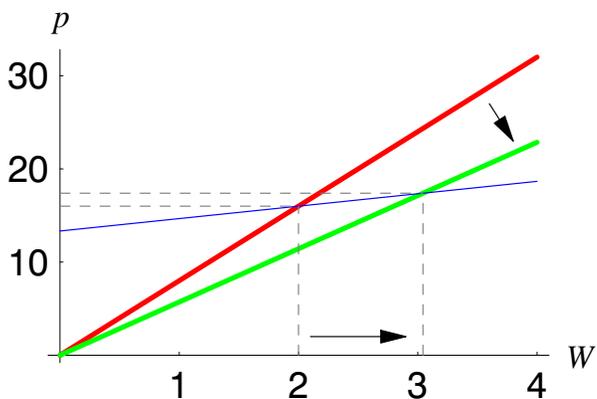
## 11 *Fixed Non-Labor Costs*

Still another mechanism leading to a similar outcome relates to an increase in fixed non-labor costs, such as capital costs.<sup>2</sup> An increase such costs can be captured by an increase in  $c$ . This shifts the zero-profit line (6) down

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<sup>1</sup> See also SCHLICHT (1978, 346) for a similar argument in the context of turnover wages.

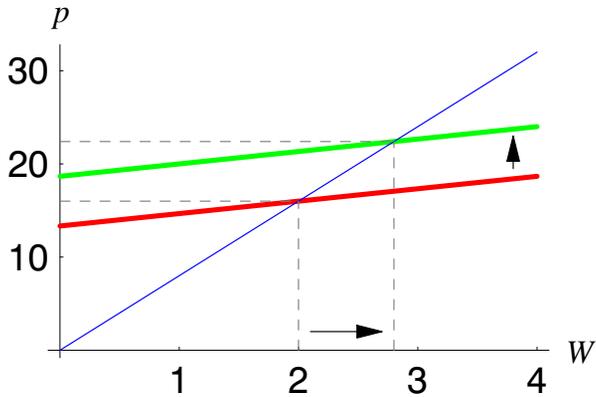
<sup>2</sup> Variable non-labor costs are not relevant for the present argument. They can be easily introduced into the argument by re-interpreting the product price. Denote by  $m$  the variable costs occurring unit. From the point of view of the firm it is equivalent whether to obtain a price of  $p$  with variable cost of zero, or a price of  $(p + m)$  with variable costs  $m$ . Hence substituting  $p$  by  $(p - m)$  in all previous formulae would suffice to take care of such variable costs. All our results would therefore be maintained. A change in variable costs would simply lead to a corresponding change in the product price while leaving the wage level unaffected.



**Figure 10:** An increase in mobility reduces the slope of the selection wage curve while leaving the zero-profit condition unaffected. As a result, the equilibrium wage level and the equilibrium price level increase. (Parameters as in Figure 6, and  $\mu$  increased from .5 to .7 The equilibrium wage level increases from 2 to 3 and the equilibrium price increases from 16 to 17.4.)

and leaves the selection wage equation (9) unaffected. Hence both the equilibrium wage and the equilibrium price will move up (Figure 11).

The intuition is straightforward again: If more capital is used, the product price increases. More productive workers produce more with the same equipment, and any productivity advantage becomes more valuable. As a consequence, productivity differentials among workers become more important to the firm, and the firm will have an incentive to offer higher wages in order to attract more prolific workers. As all firms behave in this manner, the wage level is pushed up. The subsequent process is as described above for the case of labor heterogeneity: Education becomes more attractive, and overqualification increases.



**Figure 11:** An increase in capital intensity raises the zero profit line while leaving the selection wage line unaffected. As a result, the equilibrium wage level and the equilibrium price level increase. (Parameters as in Figure 6, and  $c$  increased from 10 to 14 The equilibrium wage level increases from 2 to 2.8, and the equilibrium price increases from 16 to 22.4 .)

## 12 Conclusion

Reder competition emphasizes that firms offer wages to improve the quality of their work force. If a firm offers a higher wage, it has more applicants to select from, and will end up with better workers. Thus firms face a trade-off between wages and productivity. This induces them to set selection wages that balance the costs and benefits of offering higher wages.

Factors that render differences between workers more important induce firms to place more emphasis on selection and to increase wages. Such factors are labor heterogeneity, skill latitude, or labor mobility. All these factors would give rise to the joint occurrence of inequality and overqualification.

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