Wage Bargaining with On-the-job Search: A Structural Econometric Model

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Abstract. We write and estimate a simple theoretical model with strategic wage bargaining and on-the-job search and use it to take another look at the determinants of inter-industry wage differentials. There are three essential determinants of wages in our model: productivity, worker mobility (i.e. the extent of labor market frictions), and the workers' bargaining power. We find that, even though taking account of job-to-job mobility matters in the determination of wages, inter-industry differentials are mainly due to differences in productivity and bargaining power.

1 Introduction [V. preliminary and incomplete]

When there is on-the-job search, employees can find new jobs. Thus, employers sometimes compete over the same employee. As far as we are aware, most previous contributions that have introduced wage bargaining in a context where on-the-job search is allowed neglect the analysis of the negotiation that occurs between the employee who finds a new job and his two potential employers.[1] It is commonly assumed that wages are continuously renegotiated. This implies that the employee chooses the match yielding higher surplus, and continuously negotiates the wage with his current employer only (see e.g. Pissarides, 2000, Mortensen and Pissarides, 1999).

This approach has one major drawback: it neglects the impact of between-firm competition for workers on wages. Postel-Vinay and Robin (2001, 2002) have focused on this issue in a framework where employers make take-it-or-leave-it offers and labor contracts can be renegotiated by mutual agreement only. In this context, on-the-job search allows employees to contact alternative employers, whom they can bring into Bertrand wage competition with their current employer. Postel-Vinay and Robin show that this competition either results in a wage rise or in a job mobility. The present paper extends this approach by assuming that an employer cannot make take-it-or-leave-it offers, but instead must enter a strategic wage bargaining process with the worker and the other employer. In this perspective, we construct simple strategic bargaining game that try to reflect the most prominent features of the negotiation and the renegotiation of employment contracts. Namely, we make a sharp distinction between negotiation on new matches and renegotiation on continuing jobs. The former always gives rise to separation in case of disagreement. The latter, triggered by employees who received an outside offer, allows the parties to continue under the terms of the current contract in case of disagreement. Hence, our model explains when renegotiations occur and suggests that negotiation and renegotiation put

[1] A remarkable exeption is the paper by Dey and Flinn (2000). See at the end of this Introduction for more on that paper.

the parties in different situations. We believe that taking the issue of renegotiation seriously is important to properly identify the determinants of wage differentials in imperfectly competitive labor markets.

Main results. First, we derive equations that explain wages as function of worker ability, firm productivity, matching frictions and the bargaining power of workers. Our first contribution is to provide closed-form expressions for wages and wage distributions that hinge on these four elements in a unified theoretical model.

Second, we estimate the bargaining power of workers in the presence of on-the-job search. Usual estimates of the bargaining power rest on simple static models that evaluate the surplus of a job as the difference between productivity and an outside wage that depends on the worker's characteristics and macroeconomic variables such as the unemployment rate and the mean wage in the economy (Blanchflower et al., 1996, Van Reenen, 1996). This rules out any distinction between the influence of search frictions, that determine the extent of between-firm competition for workers, and that of the "bargaining power" of workers. It is nonetheless important to evaluate the separate contributions of each of those two elements on wages for many purposes. For instance, according to the so-called Hosios-Pissarides condition, the labor market is efficient if the surplus share accruing to workers takes a certain value, hinging on properties of the matching function (Hosios, 1990, Pissarides, 2000). From this perspective, estimating the bargaining power is a first step towards a proper evaluation of labor market efficiency. Also, reducing the workers' bargaining power can be thought of as a policy to cut unemployment. A biased measure of this bargaining power, that does not disentangle labor market frictions from wage bargaining effects can cause the implementation of policies aiming at reducing the workers' bargaining power when it is not needed. Our empirical application indeed shows that ignoring on-the-job search causes substantial upward biases in the bargaining power estimates.

Third, we use our model to take another look at the determinants of inter-industry wage differentials. There are three essential determinants of wages in our model: productivity, worker mobility (i.e. the extent of labor market frictions), and the workers' bargaining power. We find that, even though taking account of job-to-job mobility matters in the determination of wages, inter-industry differentials are mainly due to differences in productivity and bargaining power.

Related literature. Probably the paper most closely related to ours is Dey and Flinn (2000). They represent the negotiation process by the Nash bargaining solution. Our approach relies on an explicit non-cooperative bargaining game that allows a precise definition of the strategic interactions at work in the wage renegotiation. Moreover, we do estimate the workers' bargaining power.

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2 Theory

We first describe the characteristics and objectives of workers and firms. The matching process and the negotiation game that workers and firms play to determine wages is then detailed. In the third and last subsection, the steady-state general equilibrium of this economy is characterized.

2.1 Workers and firms

We consider a labor market in which a measure M of atomistic workers face a continuum of competitive firms, with a mass normalized to 1, that produce one unique multi-purpose good. Time is continuous, workers and firms live forever. The market unemployment rate is denoted by u. The pool of unemployed workers is steadily fueled by layoffs that occur at the exogenous rate δ.

Workers have different professional skills. A given worker's ability is measured by the amount ε of efficiency units of labor she/he supplies per unit time. The distribution of ability values in the population of workers is exogenous, with cdf H over the interval $[\varepsilon_{\min}, \varepsilon_{\max}]$. We only consider continuous ability distributions and further denote the corresponding density by h.

Summing over all employee ability values for a given firm defines the efficient firm size. The returns to efficient labor are assumed constant and the marginal productivity of efficient labor is denoted as p. Firms differ in the technologies that they operate, meaning that parameter p is distributed across firms with a cdf Γ over the support $[p_{\min}, p_{\max}]$. This distribution is assumed continuous with density γ. The marginal productivity of the match (ε, p) of a worker with ability ε and a firm with technology p is εp.

A type-ε unemployed worker receives an income flow of εb, with b a positive constant, which he has to forgo from the moment he finds a job. Being unemployed is thus equivalent to working at a "virtual" firm of labor productivity equal to b that would operate on a frictionless competitive labor market, therefore paying each employee their marginal productivity, εb.

Workers discount the future at an exogenous and constant rate $\rho > 0$ and seek to maximize the expected discounted sum of future utility flows. The instantaneous utility flow enjoyed from a flow of income x is $U(x) = x$.[2] Firms seek to maximize profit.

2.2 Matching and wage bargaining

Firms and workers are brought together pairwise through a sequential, random and time consuming search process. Specifically, unemployed workers sample job offers sequentially at a Poisson rate λ_0. As in the original Burdett and Mortensen (1998) paper, employees may also search for a better job while employed. The arrival rate of offers to on-the-job searchers is λ_1. The type p of the firm from which a given offer originates is assumed to be randomly selected in $[p_{\min}, p_{\max}]$ according to a *sampling distribution* with cdf F (and $\overline{F} \equiv 1 - F$) and density f. The sampling distribution is the same for all workers irrespective of their ability or employment status. Note that we *a priori* assume no connection between the probability density of sampling a firm of given type p, $f(p)$, and the density $\gamma(p)$ of such types in the population of firms. When a match is formed, the wage contract is negociated between the different parties according to

[2] This is merely for simplicity. The theoretical model is tractable with an arbitrary utility function (provided that intertemporal transfers be ruled out), and the empirical analysis can in principle be conducted for any CRRA specification (see Postel-Vinay and Robin, 2002).

the following rules.

2.2.1 Assumptions

Wages are bargained over by workers and employers in a *complete information* context. In particular, all the agents that are brought to interact by the random matching process are perfectly aware of eachother type. All wage and job offers are also perfectly observed and verifiable. Specifically, we make the following three assumptions on wage strategies and wage contracts:

Assumption A1 *Wage contracts stipulate a fixed wage that can be renegotiated by mutual agreement only.*

Assumption A1 implies that renegotiations occur only if one party can credibly threaten the other to leave the match for good if the latter refuses to renegotiate. In our framework, renegotiations can be triggered only when employees receive outside offers. The assumption of renegotiation by mutual agreement captures an important and often neglected feature of employment contracts (see the enlightening survey by Malcomson, 1999).

The following two assumptions describe the structures of the negotiation game that is played by an unemployed worker and an employer (Assumption A2), and of the renegotiation game that is played by a currently employed worker, his current employer and a poaching employer (Assumption A3).

Assumption A2 *When an unemployed worker meets a firm, the wage is determined according to the following bargaining game:*

1. *The firm makes a wage offer;*
2. *The worker either accepts the offer and signs the contract, or (s)he rejects it;*
3. *In case of rejection at step 2, some time elapses. Then:*

- *With probability β, the worker makes a wage offer;*
- *With probability $1-\beta$, the firm makes a wage offer;*

4. *The player who has received the offer at step 3 either accepts it and signs the contract, or rejects it. In case of rejection the match ends and the worker remains unemployed.*

Assumption A3 *An employed worker who receives an outside job offer renegotiates his/her wage according to the following game:*

1. *The poaching firm makes a wage offer;*
2. *The worker either rejects the offer and stays with his/her incumbent employer under the pre-existing contract, or (s)he accepts it;*
3. *Som time elapses; then, firms make simultaneous non-cooperative wage offers;*
4. *The worker either accepts one of them and signs a contract, or (s)he rejects both offers;*
5. *In case of rejection at step 4, some time elapses. Then:*
   - *With probability β, the worker makes wage offers to both employers;*
   - *With probability $1-\beta$, the firms make simultaneous non-cooperative wage offers.*
6. *Any player who has received an offer at step 5 either accepts or rejects it. In case of disagreement at step 6, the worker's decision at step 2 prevails: either the match with the incumbent employer continues under the terms of the contract existing prior to the renegotiation process or the worker stays at the poaching firm under the terms of the contract signed at step 2. In case of agreement between the worker and either firm, a new contract is signed. The worker chooses among the firms if both accept the offer (s)he made at step 5.*

Assumptions A2 and A3 describe two very simple strategic negotiation games adapted from Osborne and Rubinstein (1990). The seminal contributions of Binmore, Rubinstein and Wolinsky (1986) and Osborne and Rubinstein (1990) have shown that the Nash sharing rule can be derived from strategic bargaining games that are very useful to properly define the threat payoffs. Obviously, any strategic bargaining game is necessarily peculiar. Our game has been designed to provide a simple and tractable tool to understand the renegotiation process triggered by the between-firm competition for workers. In particular, a game with finite horizon has been chosen for the sake of simplicity, although we expect that the same type of results could be derived from infinite horizon games.

The structure of the negotiation game that is played between two firms and an initially employed worker is somewhat more intricate than that of the game between a firm and an unemployed worker, as a first subgame (steps 1 and 2), in which the worker maneuvers to get himself an optimal credible threat point, precedes the renegociation subgame (steps 3 to 6).

It is worth insisting on the fact that whenever the worker is offered an outside option, the pre-existing contract with the incumbent employer does go on if no agreement is reached. This is an important difference with the negotiation on new matches—between unemployed workers and firms—that are dissolved in case of disagreement. We view this assumption as more in accordance with actual labor market institutions than the usual one according to which matches always break up in case of renegotiation failure (Pissarides, 2000, Mortensen and Pissarides, 1999). It is indeed considered in most OECD countries, that an offer to modify the terms of a contract does not constitute a repudiation. Accordingly, a rejection of the offer by either party leaves the pre-existing terms in place, which means that the job continues under those terms if the renegotiation fails (Malcomson, 1999, p. 2,321).

2.2.2 Wage contracts and job mobility

We now exploit the preceding series of assumptions to derive the precise values of wages and the job mobility patterns.

The subgame perfect equilibria of the two bargaining games described above are characterized in Appendix A.1. In both games the worker receives a share β of the match rent. The rent of a match between a type-ε unemployed worker and a type-p job amounts to $V(\varepsilon, \varepsilon p, p) - V_0(\varepsilon)$. Accordingly, the wage bargained on a match between a type-ε unemployed worker and a type-p firm, denoted by $\phi_0(\varepsilon, p)$, solves:

$$V(\varepsilon, \phi_0(\varepsilon, p), p) = V_0(\varepsilon) + \beta \left[V(\varepsilon, \varepsilon p, p) - V_0(\varepsilon)\right]. \tag{1}$$

This equation merely states that a type-ε unemployed worker matched with a type-p firm gets his reservation utility, $V_0(\varepsilon)$, plus a share β of the rent accruing to the job.

The assumption of long term contracts, renegotiated by mutual agreement only, implies that wages can be renegotiated only if employees receive new job offers. Moreover, an employee paid a wage w in a type-p firm and who receives an outside offer from a type-p' firm is willing to trigger a renegotiation only if firm p' is competitive enough:

If $p' \leq p$, the worker stays at the type-p firm, because the match with the type-p' firm is associated with a lower rent. However, the employee can get wage increases if p' is sufficiently high in regard of his/her current wage, w. If the employee triggers a renegotiation (by accepting the poacher's first offer at step 2), he eventually stays at his initial firm (the type p firm) with a new wage $\phi(\varepsilon, p', p)$ as defined by equation (2) below

$$V(\varepsilon, \phi(\varepsilon, p', p), p) = V(\varepsilon, \varepsilon p', p') + \beta \left[V(\varepsilon, \varepsilon p, p) - V(\varepsilon, \varepsilon p', p')\right]. \tag{2}$$

Obviously, the employee decides to trigger a renegotiation only if it is a way to get a wage increase, i.e. if the productivity parameter of the new match, p', exceeds a threshold value, denoted by $q(\varepsilon, w, p)$, that satisfies:

$$\phi(\varepsilon, q(\varepsilon, w, p), p) = w. \tag{3}$$

Let us insist a bit on the role played by the game structure at this point. Note that

$$\begin{aligned} V\left(\varepsilon, \varepsilon q(\varepsilon, w, p), q(\varepsilon, w, p)\right) &= V(\varepsilon, w, p) - \frac{\beta}{1-\beta}\left[V(\varepsilon, \varepsilon p, p) - V(\varepsilon, w, p)\right] \\ &\leq V(\varepsilon, w, p) \end{aligned}$$

(with strict inequality if $w < p$). The attentive reader will thus have noticed that an outside offer from a type p' firm can result in a wage increase even when $V(\varepsilon, \varepsilon p', p') < V(w, p)$, i.e. even when the poacher's productivity is so low that it can't even afford to compensate the worker for his/her pre-existing value $V(\varepsilon, w, p)$. This result from the existence of steps 3 to 6, which ensure that the worker can credibly threaten to accept the weaker firm's offer at step 2, even in cases where that offer is lower than what (s)he worker would have gotten at status quo. In other words, in order to force his/her incumbent employer to renegotiate, the worker is willing to "take the chance" of accepting a very unattractive offer from the poacher because he knows that it is then in the interest of his/her incumbent employer to attract him back with a wage increase at later stages of the renegotiation game.

If $p' > p$, the outside offer creates a rent equal to $V(\varepsilon, \varepsilon p', p') - V(\varepsilon, \varepsilon p, p)$. The renegotiation game thus implies that the worker moves to the type-p' job, where he gets a wage $\phi(\varepsilon, p, p')$ that solves:

$$V(\varepsilon, \phi(\varepsilon, p, p'), p') = V(\varepsilon, \varepsilon p, p) + \beta \left[V(\varepsilon, \varepsilon p', p') - V(\varepsilon, \varepsilon p, p) \right]. \quad (4)$$

It can be seen that an employee who moves from a type-p to a type-p' firm gets a value equal to the maximum that (s)he could get from staying at the type-p firm, plus a share β of the new match rent. Note that the wage $\phi(\varepsilon, p, p')$ obtained in the new firm can be smaller than the wage w paid in the previous job, because the worker expects larger wage raises in firms with higher productivity.

To sum-up, one of the following three situations may arise when a type-ε worker, paid a wage w by a type-p firm, receives a type-p' job offer:

(i) $p' \leq q(\varepsilon, w, p)$, and nothing changes.

(ii) $p \geq p' > q(\varepsilon, w, p)$, and the worker obtains a wage raise $\phi(\varepsilon, p', p) - w > 0$ from his current employer.

(iii) $p' > p$, and the worker moves to firm p' for a wage $\phi(\varepsilon, p, p')$ that may be greater or smaller than w.

Before we go any further, we should note that Dey and Flinn (2000) have reached similar sharing rules to those just derived in a similar framework by applying the Nash bargaining solution. Our contribution shows that this result can be derived from a precisely defined strategic bargaining game compatible with job continuation when renegotiations fail. Moreover, Dey and Flinn focus on the renegotiation issue in a more complex framework with mutidimensional employment contracts stipulating wages and health insurance provisions. Due to this added complexity, they are unable to come up with closed-form expression for wages and wage distributions.

The precise form of wages can be here obtained from the expressions of lifetime utilities (see Appendix A.2 for the corresponding algebra). The wage $\phi(\varepsilon, p', p)$ of a type-ε worker, currently working at a type-p firm and whose last job offer was made by a type-p' firm, is defined by:

$$\phi\left(\varepsilon, p', p\right) = \varepsilon \cdot \left(p - (1-\beta)\int_{p'}^{p} \frac{\rho + \delta + \lambda_1 \overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx\right). \tag{5}$$

This expression shows that the returns to on-the-job search depend on the bargaining power parameter β. It can be seen that outside offers trigger wage increases within the firm only if employers have some bargaining power. In the limiting case where $\beta = 1$, the worker appropriates all the surplus up-front and gets a wage equal to εp, whether or not (s)he searches on the job. In the opposite extreme case, where $\beta = 0$, the wage increases as outside offers come since all offers from firms of type $p' \in (q(\varepsilon, w, p), p]$ provoke within-firm wage raises.

The wage $\phi_0(\varepsilon, p)$, obtained by a type-ε unemployed workers when matched with a type-p firm, writes as:

$$\phi_0(\varepsilon, p) = \varepsilon \cdot \left(p_{\inf} - (1-\beta)\int_{p_{\inf}}^{p} \frac{\rho + \delta + \lambda_1 \overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx\right), \tag{6}$$

where $p_{\inf}$ is the lowest viable marginal productivity of labor. The latter is defined as the productivity value that is just sufficient to compensate an unemployed worker for his forgone value of unemployment, given that he would be paid his marginal productivity, thus letting the firm with zero profits. Analytically:

$$V(\varepsilon, \varepsilon p_{\inf}, p_{\inf}) = V_0(\varepsilon)$$

$$\Updownarrow$$

$$p_{\inf} = b + \beta(\lambda_0 - \lambda_1) \int_{p_{\inf}}^{p_{\max}} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx$$

It appears that $p_{\inf}$ differs from the unemployment income if workers have positive bargaining power. For instance, $\varepsilon p_{\inf}$ is greater than the unemployment income flow εb if the arrival rate of job offers to unemployed workers λ_0 is larger than the arrival rate to employees, λ_1. In that case, accepting a job reduces the efficiency of future job search. The worker needs to be compensated for this loss through a wage higher than his unemployment income. Operating firms thus have to be able to afford wages at least equal to $p_{\inf}$, which imposes the obvious condition that they be at least as productive as $p_{\inf}$. It is worth noting that the lower support of *observed* marginal productivities, that we denote by $p_{\min}$, can be strictly larger than the lower support of *viable* productivities $p_{\inf}$, for instance if free entry is not guaranteed on the search market.

The definition (6) of $\phi_0(\varepsilon, p)$ together with the latter equation defining $p_{\inf}$ shows that entry wages, received by individuals who exit from unemployment, are not necessarily higher than the unemployment income. It actually appears that those wages are always smaller than the unemployment income if workers have no bargaining power, because accepting a job is a means to obtain future wage raises. Entry wages obviously increase with the bargaining power parameter β.

2.3 Steady-state equilibrium

We know from what precedes that a type ε employee of a type p firm is currently paid a wage w that is either equal to $\phi_0(\varepsilon, p) = \phi(\varepsilon, p_{\inf}, p)$, if w is the first wage after unemployment, or is equal to $\phi(\varepsilon, q, p)$, with $p_{\inf} \leq p_{\min} < q \leq p$, if the last wage mobility is the outcome of a bargain between the worker, the incumbent employer and another firm of type q. The cross-sectional distribution of wages therefore has three components: a worker fixed effect (ε), an employer fixed effect (p) and a random effect (q) that characterizes the most recent wage mobility. In of this section we determine the joint distribution of these three components.

In a steady state a fraction u of workers is unemployed and a density $\ell(\varepsilon, p)$ of type-ε workers is employed at type-p firms. Let $\ell(p) = \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} \ell(\varepsilon, p) d\varepsilon$ be the density of employees working at type-p firms. The average size of a firm of type p is then equal to $M\ell(p)/\gamma(p)$. We denote the corresponding cdfs with capital letters $L(\varepsilon, p)$ and $L(p)$, and we denote as $G(w|\varepsilon, p)$ the cdf of the (not absolutely continuous, as we shall see) conditional distribution of wages within the set of workers of ability ε within type-p firms.

We now proceed to the derivation of these different distributional parameters by increasing order of complexity. The steady state assumption implies that inflows must balance outflows for all stocks of workers defined by a status (unemployed or employed), a personal type ε, a wage w, an employer type p. The relevant flow-balance equations are spelled out in Appendix A.3. They lead to the following series of definitions/results:

- *Unemployment rate:*

$$u = \frac{\delta}{\delta + \lambda_0}. \tag{7}$$

- *Distribution of firm types across employed workers:* The fraction of workers employed at a firm with mpl less than p is

$$L(p) = \frac{F(p)}{1 + \kappa_1 \overline{F}(p)}, \tag{8}$$

with $\kappa_1 = \frac{\lambda_1}{\delta}$, and the density of workers in firms of type p follows from differentiation as

$$\ell(p) = \frac{1 + \kappa_1}{\left[1 + \kappa_1 \overline{F}(p)\right]^2} f(p). \tag{9}$$

- *Distribution of matches:* The density of matches (ε, p) is

$$\ell(\varepsilon, p) = h(\varepsilon)\ell(p). \tag{10}$$

- *Within-firm distribution of wages:* The fraction of employees of ability ε in firms with mpl p is

$$G(w|\varepsilon,p) = \left(\frac{1+\kappa_1 \overline{F}(p)}{1+\kappa_1 \overline{F}\left[q(\varepsilon,w,p)\right]}\right)^2 = \left(\frac{1+\kappa_1 L\left[q(\varepsilon,w,p)\right]}{1+\kappa_1 L(p)}\right)^2. \tag{11}$$

Equation (7) is standard in equilibrium search models (see BM) and merely relates the unemployment rate to unemployment in- and outflows.

Equation (8) is a particularly important empirical relationship as it will allow us to back out the sampling distribution F from its empirical counterpart L.[3]

Equation (10) implies that, under the model's assumptions, the within-firm distribution of individual heterogeneity is independent of firm types. Nothing thus prevents the formation of highly dissimilar pairs (low ε, high p, or low p, high ε) if profitable to both the firm and the worker. This results from the assumptions of constant returns to scale, scalar heterogeneity and undirected search.

Finally, equation (11) expresses the conditional cdf of wages in the population of type ε workers hired by a type p firm. What the pair of equations (10,11) shows is that a random draw from the steady-state equilibrium distribution of wages is a value $\phi(\varepsilon,q,p)$ where (ε,p,q) are three random variables such that

(i) ε is independent of (p,q),

(ii) the cdf of the marginal distribution of ε is H over $[\varepsilon_{\min},\varepsilon_{\max}]$,

(iii) the cdf of the marginal distribution of p is L over $[p_{\min},p_{\max}]$, and

(iv) the cdf of the conditional distribution of q given p is $\widetilde{G}(\cdot|p)$ over $\{p_{\inf}\}\cup[p_{\min},p]$ such that

$$\begin{aligned}\widetilde{G}(q|p) &= G\left(\phi(\varepsilon,q,p)|\varepsilon,p\right)\\ &= \frac{\left[1+\kappa_1\overline{F}(p)\right]^2}{\left[1+\kappa_1\overline{F}(q)\right]^2}\end{aligned}$$

[3] It is exactly the same equilibrium relationship as between the distribution of wage offers and the distribution of earnings in the BM model.

for all $q \in \{p_{\inf}\} \cup [p_{\min}, p]$. The latter distribution has a mass point at $p_{\inf}$ and is otherwise continuous over the interval $[p_{\min}, p]$.

3 Empirical implementation

3.1 Data

We use the dataset constructed by Crépon and Desplatz (2002). This dataset covers the period 1993-1997 and contains the accounting information (total compensation costs, value added, current operating surplus, gross productive assets, ..., and an Auerbach-type measure of the user cost of capital) of the BRN firm-data source ("*Bénéfices Réels Normaux*"), collected by the French National Statistical Institute (INSEE) and supposedly exhaustive of all private entreprises (not establishments) with a sales turnover of more than 3.5 million FRF (about 530,000 Euros) and liable to profit tax.[4] Note that the necessary "cleaning" of this administrative data source (mainly outlier detection and construction of the capital cost variable) let them retain only about 30% of all the firms present in the original sample (87,371 firms). In addition, Crépon and Desplatz used the DADS worker data source ("*Déclarations Annuelles de Données Sociales*") to compute labor costs and employment, at the enterprise level, for different worker categories (skill, age, sex). The DADS data are based on mandatory employer (establishments) reports of the earnings of each salaried employee of the private sector subject to French payroll taxes over one given year. This very large dataset was thus "collapsed" by enterprise and skill category and then merged with the BRN dataset.[5]

Aggregating worker wages and labor into two skill categories ("skilled" and "unskilled")[6] we have formed four panels of firm data on value-added, employment by skill and average wage by skill, covering the period 1993-1997 and corresponding to the following eleven distinct

[4] The BRN is a subset of a larger firm sample, the BIC, "*Bénéfices Industriels et Commerciaux*".

[5] For more information on these datasets, we refer to the paper by Crépon and Desplatz and to Abowd, Kramarz and Margolis (1999) for another very precise description of the same data sources and others.

[6] The unskilled category comprises unskilled manual workers and trade employees. The skilled category comprises skilled manual workers, administrative employees (secretaries, ...), engineers, and all employees with some managerial function in the firm.

industries:

1. Intermediate goods 2. Investment goods 3. Consumption goods	Manufacturing
4. Construction	
5. Transportation	
6. Wholesale, food 7. Wholesale, nonfood 8. Retail, food 9. Retail, nonfood	Trade
10. Hotels & catering 11. Personal services	Services

Table 1 contains some descriptive statistics for selected variables. Comments here.

< **Table 1 about here.** >

Finally, estimating the model requires data on worker mobility. We use the French Labor Force Survey ("*Enquête Emploi*") which is a three-year rotating panel of individual professional trajectories similar to the American CPS ("Current Population Survey"). We prefer to use the LFS panel instead of the larger DADS panel as the latter is known to be affected by large attrition biases. Moreover, the LFS is precisely designed to study unemployment and worker mobility.

3.2 Productivity estimates

The values and distribution of firms' marginal productivities p are crucial determinants of wages in the structural model. Since these marginal productivities are not directly observable in the data, their construction is a key step in the estimation procedure. A central principle that we want to stick with in the design of this procedure is that the productivity parameters p should *not* be constructed to *a priori* fit the wage data, but should rather be identified from value-added data alone. This, we believe, is the only way to get credible estimates of the bargaining power β, which in turn will be identified by the connection that exists in the data between wages and productivity.[7]

The construction of the p's and their distributions for each labor category from value-added data requires some additional structure on the production technology.

Further assumptions on the production technology. The population of workers is clustered into two statistical categories called "skilled" and "unskilled". We assume that each category of workers faces the same transition rate values denoted as $\delta_s, \lambda_{0s}, \lambda_{1s}$ (resp. $\delta_u, \lambda_{0u}, \lambda_{1u}$) for, respectively, skilled and unskilled workers. Idem for the values of non market time b_s and b_u.

Moreover, the observed skill type does not necessarily capture all the productive heterogeneity of workers. Specifically, there are $M = M_s + M_u$ workers (unskilled + skilled) in the economy and $h(\varepsilon) = \frac{M_s}{M} h_s(\varepsilon) + \frac{M_u}{M} h_u(\varepsilon)$ is the density of workers with "true" professional ability ε, some of them belong to the so-called skilled category (the density of abilities being $h_s(\varepsilon)$ in that category). Some belong to the unskilled category (with a corresponding density $h_u(\varepsilon)$ of unobserved ability types).[8]

Firms use labor and capital as inputs to a constant-returns to scale technology. The labor input is an aggregate of skilled and unskilled labor constructed as follows. Let $M_j = M_{sj} + M_{uj}$ be the size of some firm j, comprising M_{sj} observationally skilled workers and M_{uj} observationally unskilled. Denoting the density of type-ε skilled (resp. unskilled) workers employed by some firm j by $h_{sj}(\varepsilon)$ (resp. $h_{uj}(\varepsilon)$), the total amount of efficient labor employed by this firm is

$$L_j = M_{sj} \int \varepsilon h_{sj}(\varepsilon)\, d\varepsilon + M_{uj} \int \varepsilon h_{uj}(\varepsilon)\, d\varepsilon. \tag{12}$$

Finally designating capital by K_j, we specify firm j's total per-period output (value-added) as:

$$Y_j = A_j K_j^{\chi} L_j^{1-\chi}, \tag{13}$$

[7] It is therefore essential that our dataset contain information on both individual wages and value-added. In the absence of the latter, Postel-Vinay and Robin (2002) had to rely on the sole wage data to construct the p's using the structural relationship implied by the model between p and the conditional mean wage $E(w|p)$.

[8] Both densities may have different supports, meaning $h_u(\varepsilon) \cdot h_s(\varepsilon) = 0$ for all ε, in which case the observable skill variable would indeed allow to partially sort workers by effective ability ε.

where A_j is a firm-specific productivity parameter, and χ is between 0 and 1 and is also common to all firms.

Capital has a (possibly firm-specific) real user cost c_j and can be adjusted instantly and at no cost. The condition defining the optimal capital stock is therefore satisfied at all times:

$$\chi \frac{Y_j}{K_j} = c_j. \tag{14}$$

Plugging this back into (13), we get a reduced-form expression of our production function:

$$Y_j = \theta_j L_j, \qquad \text{where } \theta_j = A_j^{\frac{1}{1-\chi}} \left(\frac{\chi}{c_j} \right)^{\frac{\chi}{1-\chi}}. \tag{15}$$

Costless and immediate adjustement of capital also solves the well-known appropriation—or "hold-up"—problem: productivity gains from investment cannot be appropriated by workers through the wage bargain, as investment is assumed to be fully reversible. As a consequence, what is really shared in the bargain is value added *net of capital costs*, i.e. $Y_j - c_j K_j$. With our specification:

$$Y_j - c_j K_j = (1-\chi) Y_j = (1-\chi) \theta_j L_j. \tag{16}$$

It is evident from equation (16) that the marginal value to firm j of a worker with ability ε is $p_j \varepsilon \equiv (1-\chi) \theta_j \varepsilon$, irrespective of his/her observed skill type. Of course one expects that the statistical skill category is correlated with the true ability and that

$$\int \varepsilon h_u(\varepsilon) \, d\varepsilon \leq \int \varepsilon h_s(\varepsilon) \, d\varepsilon. \tag{17}$$

The assumptions of constant returns to scale, of costless and immediate adjustment of capital and of perfect substitutability of workers thus imply that the markets for observationally skilled and unskilled workers are perfectly segmented and that, according to the theory laid out in the preceding section, there is no sorting within each observationally homogeneous category of workers:

$$h_{sj}(\varepsilon) = h_s(\varepsilon) \quad \text{and} \quad h_{uj}(\varepsilon) = h_u(\varepsilon). \tag{18}$$

Moreover, equation (9) in Section 2.3 gives the following expression for firm sizes:

$$M_{kj} = \frac{1+\kappa_{1k}}{\left[1+\kappa_{1k}\overline{F}_k(p_j)\right]^2} \cdot \frac{f_k(p_j)}{\gamma(p_j)} \qquad \text{for } k = s \text{ or } u, \tag{19}$$

where $\kappa_{1k} = \lambda_{1k}/\delta_k$, where $F_s(p)$ (resp. $F_u(p)$) are the sampling distributions of p_j's in the populations of skilled and unskilled workers, respectively, and where $\gamma(p)$ (resp. $\Gamma(p)$) is the density (resp. cdf) of p_j's in the population of firms, that is the distribution of

$$\begin{aligned} p_j &= (1-\chi)\,\theta_j \\ &= (1-\chi)\,A_j^{\frac{1}{1-\chi}}\left(\frac{\chi}{c_j}\right)^{\frac{\chi}{1-\chi}} \end{aligned}$$

induced by the distribution of (A_j, c_j) across firms. Because one can multiply ε by any constant and divide A_j by this constant indifferently we shall normalize the distribution of p_j so that the mean of $\ln\theta_j$ in the population of firms equal zero.

Estimation of the production technology. The production equation that we take to the data is the following logged version of (15):

$$y_{jt} = \ln\theta_j + \ln\left(M_{ujt} + \alpha M_{sjt}\right) + \eta_{jt}, \tag{20}$$

where y_{jt} is the log value-added of firm j at date t, M_{ujt} (resp. M_{sjt}) is the number of unskilled (resp. skilled) workers employed by firm j at date t, and η_{jt} is an error term independent of the fixed effect $\ln\theta_j$. Note that the mean value of ε among unskilled workers was normalized to 1. (While $\alpha = \int \varepsilon h_s(\varepsilon)\,d\varepsilon$ denotes the same mean value among skilled workers. One thus expects $\alpha > 1$.)

We also posit the following empirical relationship between date-t employment and its steady-state counterpart:

$$\ln M_{kjt} = \ln M_{kj} + \omega_{kjt}, \tag{21}$$

with ω_{kjt} an error term independent of θ_j. This last equation points at two potential sources of endogeneity of M_{kjt} in (20): one is the correlation between M_{kj} and θ_j, and the other is the possible correlation between η_{jt} and ω_{kjt}.

We estimate equation (20) by GMM, considering the following sets of moment restrictions:

- **ABN3:**

$$\Delta\eta_{jt} \perp \left\{\ln M_{kjt-4}; (\ln M_{kjt-4})^2; \ln M_{sjt-4}\cdot \ln M_{ujt-4}\right\},\ t=5;$$

- **ABN2** equals (ABN3) plus:

$$\Delta\eta_{jt} \perp \left\{\ln M_{kjt-3}; (\ln M_{kjt-3})^2; \ln M_{sjt-3}\cdot \ln M_{ujt-3}\right\},\ t=5,4;$$

- **ABV3** equals (ABN3) plus:

$$\left(\ln\theta_j + \eta_{jt}\right) \perp \left\{\Delta\ln M_{kjt-3}; (\Delta\ln M_{kjt-3})^2; \Delta\ln M_{sjt-3}\cdot \Delta\ln M_{ujt-3}\right\},\ t=5;$$

- **ABV2** equals (ABV3) plus:

$$\left(\ln\theta_j + \eta_{jt}\right) \perp \left\{\Delta\ln M_{kjt-2}; (\Delta\ln M_{kjt-2})^2; \Delta\ln M_{sjt-2}\cdot \Delta\ln M_{ujt-2}\right\},\ t=4,5.$$

The sets (ABN3) and (ABN2) of moment restrictions correspond to the estimation of the first-differenced model instrumented by lagged values of the RHS variables dated at least $t-\ell$, $\ell = 4,3$. It is implicitly assuming that η_{jt} is orthogonal to the past of $\omega_{kj,t-\ell+1}$. The sets (ABV3) and (ABV2) are nested in sets (ABN3) and (ABN2) and add the restrictions which validates the estimation of the model in levels instrumented by lagged values of first-differenced RHS variables.[9]

The share of capital in value-added, χ, is simply estimated by the sample mean of $c_j K_j/Y_j$.

3.3 Worker mobility

Another key determinant of wages is the parameter $\kappa_1 = \frac{\lambda_1}{\delta}$, which measures the average number of outside job offers a worker receives between two unemployment spells. Since outside job offers are the source of wage increases in the model, we expect that more "mobile" workers (those

[9] The justification of the validity of these estimation procedures, inspired from Arellano and Bond (1991) and Arellano and Bover (1995) and applied to the non linear model (20), can be found in Chamberlain (1992). Chamberlain shows how a polynomial expansion of the set of instrumental variables (or *via* any L_2-complete sequence of functions) provides a sequence of estimators approximately attaining the information bound.

with higher values of κ_1) should on average exhibit steeper wage-tenure profiles. However, what κ_1 essentially determines is the duration of job spells. Thus again, we want κ_1 to be identified from job duration data rather than wage data.

As all job transition processes are Poisson, all corresponding durations are exponentially distributed. In this Section we are interested in the distribution of job spell durations t, which have the following density, conditional on p:

$$\mathcal{L}\left(t|p\right) = \left[\delta + \lambda_1 \overline{F}\left(p\right)\right] \cdot e^{-\left[\delta+\lambda_1 \overline{F}(p)\right]t}, \tag{22}$$

where we know from equation (9) that p is distributed in the population of employed workers according to the density:

$$\ell\left(p\right) = \frac{1+\kappa_1}{\left[1+\kappa_1 \overline{F}(p)\right]^2} f\left(p\right).$$

Because it is impossible to match the LFS worker data with the BRN firm data, we shall treat p as an unobserved heterogeneity variable, that is: we integrate out p from the joint likelihood of p and t, $\ell\left(p\right)\mathcal{L}\left(t|p\right)$, and maximize the unconditional likelihood, $\mathcal{L}\left(t\right) = \int_{p_{\min}}^{p_{\max}} \ell\left(p\right)\mathcal{L}\left(t|p\right)dp$, to get an estimate of δ and κ_1.[10] This method of unconditional inference applied to labor market transition parameters was first explored by van den Berg and Ridder (2000). It has the additional advantage of yielding estimates of the transition rate parameters that are robust to any specification error in the estimation of the productivity parameters θ_j for all firms j.

3.4 The wage equation

We now turn to the last step of our estimation procedure, in which we combine the wage data with our productivity parameter estimates from step 1 to estimate a wage equation, which will identify the workers' bargaining power β.

Given our knowledge of wage determination (equation (5)) and the (conditional) wage distribution (equation (11)), we can derive the conditional mean wage $E\left(w|p\right)$ for each skill category

[10] In practice we have to take into account the fact that the panel covers a fixed number of periods so that some job durations are censored. It is easy to account for such right censoring. Moreover, the unconstrained likelihood can be analytically developed into simple functions of exponentials and exponential-integral functions.

(skilled and unskilled),[11] the empirical counterpart of which is the firm-level average wage. Equation (A17) in the Appendix shows that:

$$E(w|p) = E(\varepsilon) \cdot \left[p - \frac{\left[1+\kappa_1 \overline{F}(p)\right]^2}{(1+\kappa_1)^2} \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} \left[\phi(\varepsilon, p_{\min}, p) - \phi(\varepsilon, p_{\inf}, p)\right] h(\varepsilon) d\varepsilon \right.$$
$$\left. - \left[1+\kappa_1 \overline{F}(p)\right]^2 \int_{p_{\min}}^{p} \frac{E(\varepsilon)(1-\beta)\left[1+(1-\sigma)\kappa_1 \overline{F}(q)\right]}{\left[1+(1-\sigma)\kappa_1 \beta \overline{F}(q)\right]\left[1+\kappa_1 \overline{F}(q)\right]^2} dq \right].$$

This expression can be further simplified. First, we should take account of the fact that $E(\varepsilon) = \alpha$ (α_s or α_u depending on which skill category we consider) is estimated in step 1 together with p_j for all firms. Second, we can notice that if $p_{\inf} = p_{\min}$ (which amounts to assuming free entry and exit of firms on the search market), then the second term in the right hand side vanishes. We shall henceforth adopt this assumption.[12] We thus now have:

$$E(w|p) = \alpha \left[p - \left[1+\kappa_1 \overline{F}(p)\right]^2 \int_{p_{\min}}^{p} \frac{(1-\beta)\left[1+(1-\sigma)\kappa_1 \overline{F}(q)\right]}{\left[1+(1-\sigma)\kappa_1 \beta \overline{F}(q)\right]\left[1+\kappa_1 \overline{F}(q)\right]^2} dq \right]. \quad (23)$$

Equation (9) implying that $F(p) = \frac{(1+\kappa_1)L(p)}{1+\kappa_1 L(p)}$, our knowledge of κ_1 and of the value of p for each firm let us construct $F(p)$ using the empirical cdf of p_j's in the population of workers to estimate $L(p)$.

Denoting the observed firm-level mean wage of labor category k ($= s$ or u), at date t, in firm j, by $\overline{w}_{kjt}$, we will obtain a value of β_k (the bargaining power of workers of category k) by fitting the theoretical mean wage $E\left(w|\widehat{p}_j; \widehat{F}_k, \widehat{\alpha}_k, \widehat{\kappa}_{1k}, \beta_k\right)$ that one computes using (23) to $\overline{w}_{kjt}$ using (weighted) nonlinear GLS.[13]

3.4.1 Results

The production function. The GMM estimation results of equation (20) are gathered for our eleven sectors in Table 2. Given the lack of precision of the results obtained with the Arellano-Bond-type estimators (ABN2 and ABN3), we only report those obtained from the

[11] To simplify the notation, we shall omit in this section the skill index "s" or "u".

[12] Unconstrained estimations always lead to the conclusion that $p_{\inf}$ ideed equals $p_{\min}$.

[13] We also need a value for the discount rate ρ which appears in $\sigma = \rho/(\rho+\delta)$. We normalize it for everyone to an annual value of 0.15.

Arellano-Bover-type estimator ABV2, which is the most precise (results from the ABV3 estimator are very close to those obtained with ABV2).

< Table 2 about here. >

The first thing we notice is that α is always significantly greater than 1: skilled workers are everywhere more productive than unskilled workers. The ratio of skilled to unskilled productivity (α) is highest in Manufacturing and Transportation, closely followed by Trade and Personal services. This ratio is somewhat lower in Construction and Hotels. The taxonomy that seems to emerge from a look taken at α roughly parallels the one that is suggested by wage ratios (see Table 1 and the discussion of it).

Worker mobility. The ML estimates of δ, λ_1 and, most importantly, κ_1 are reported in Table 3. Since those estimates were obtained from LFS data, the relatively small number of observations forced us to aggregate our eleven sectors into five "broader" industries: Manufacturing, Construction, Transportation, Trade, and Services.

In terms of κ_1, i.e. the average number of outside contacts that a worker gets over a period out of unemployment, skilled workers are always more mobile than unskilled workers. Now looking at the sheer frequency of such contacts, which is measured by λ_1, again we find that skilled workers get more frequent outside offers than unskilled workers, except in Services and Transportation where the difference between the two labor categories is in favor of the unskilled (although probably not significantly so in the Service sector). Finally, the rate of job termination δ is everywhere higher for the unskilled than for the skilled.

< Table 3 about here. >

The average duration of an employment spell (i.e. the average duration between two unemployment spells), $1/\delta$, ranges from 10 to 36 years, while the average waiting time between two outside offers, $1/\lambda_1$, lies between 3.3 and 17 years. Workers are relatively less mobile in

Manufacturing and Transportation than elsewhere, where they tend to have both lower job separation and job-switching rates. Concerning the Transportation sector, the relatively large share of State-owned companies in this industry may explain that result. Unskilled worker turnover is remarkably high in the Service sector, probably due to the relatively more frequent use of fixed-duration contracts in that sector.[14]

Bargaining power. The first two columns in Table 4 displays the estimated values of β for each category of labor. Also, the top two panels in Figure 1 plot the predicted and observed wages against the empirical cdf $\Gamma(p)$ for one of the 11 sectors under consideration (we took the first sector in the list—the Intermediate goods industry—as our example). A glance at those Figures shows that the model is remarkably good at predicting wages, given the fact that we only had one free parameter (β) to fit wage data.

< **Table 4 about here.** >

< **Figure 1 about here.** >

Concerning the values of β reported in Table 4, one can make the following general comments. The bargaining power of workers is generally relatively high in Manufacturing and in Transportation (especially for unskilled workers), and relatively low in Trade. Even though Hotels are classified as part of the Service sector, they are closer (as far as β's go) to the pattern observed in Trade with their relatively low β's. Personal services are somewhere in between. Finally, Construction is a bit atypical with zero bargaining power for unskilled workers and the highest value of β for skilled workers.

Even though there is no such thing as a Trade Union in our theoretical model, which assumes individual bargaining, it is interesting to look at Table 4 in the light of studies on union density in France (e.g. Furjot, 2000). Manufacturing and Transporation are industries where

[14]The average stock percentage of fixed-duration contracts in our LFS sample is 4.6% in Construction, 5.5% in Trade, 4.3% in Manufacturing, and as high as 16.3% in Services.

firms are larger on average (see also Table 1) and older, with a well established unionist tradition. Conversely, Trade and Personal services are industries where unions density is weakest. The special case of Construction is a bit more problematic. Construction is among the least unionized industries in France. Looking at Table 1, one sees that it is also a sector with relatively small firms, and a very unskilled labor intensive technology. We might add that Construction is also a sector where the proportion of immigrant workers (or workers of non-French origin) is highest (12.5% versus 4.4% on average in other sectors, in 1999). All this might help explain the contrast between the very low bargaining power of unskilled workers and the very high β of skilled workers in that sector.

More comments.

4 Discussion

The importance of job-to-job mobility. As we argued in the Introduction, the conventional approach to evaluating the workers' bargaining power ignores job-to-job mobility. Our model offers a simple way of assessing the bias in the estimation of β resulting from this simplification. Ignoring job-to-job mobility indeed amount to forcing $\kappa_1 = 0$ in the wage equations (23) and (**??**). The former takes a particularly simple form if one imposes $\kappa_1 = 0$:

$$E\left(w|p, \kappa_1 = 0\right) = \beta\alpha p + \left(1 - \beta\right)\alpha p_{\min}. \tag{24}$$

we will obtain a value of β_k (the bargaining power of workers of category k)

We thus obtain an estimator of the bargaining power *in the absence of on-the-job search* (which we denote by β_0) by fitting the theoretical mean wage computed using (24) to $\overline{w}_{kjt}$, again using (weighted) nonlinear GLS.[15] The results are gathered in the last two columns of Table 4. Comparison of the first and last two columns in Table 4 reveals two things. First, the bargaining power is always overestimated when one ignores job-to-job mobility. The extent

[15] Note that using this regression is roughly equivalent to simply computing the share of wages in marginal products, i.e. to divide the sectoral mean wage of category k from Table 1 by the relevant α_k. Both methods yield very similar results.

of this upward bias varies across skill groups and sectors, but the bias always seems to be there. This was expected as on-the-job search is a means by which an employee can force his/her employer to renegotiate his/her wage upward. Neglecting on-the-job search biases the workers' bargaining power upward to make it fit the actual share of compensation costs in value-added. Second, however, we note that, notwithstanding this upward bias, the ranking of industries/labor categories by increasing order of bargaining power is preserved when one ignores on-the-job search.

Inter-industry wage differences. Going back to the theoretical model, one can derive the market-average (real) wage by simply integrating the conditional mean wage (23) with respect to the distribution of workers across firms (9):

$$E\left(w|\theta;F,\alpha,\chi,\kappa_1,\sigma,\beta\right)=\alpha\left(1-\chi\right)\theta_{\min}$$
$$+\,\alpha\left(1-\chi\right)\left(1+\kappa_1\right)\int_{\theta_{\min}}^{\theta_{\max}}\frac{\overline{F}\left(x\right)}{1+\kappa_1\overline{F}\left(x\right)}\cdot\left(1-\frac{\left(1-\beta\right)\left[1+\kappa_1\left(1-\sigma\right)\overline{F}\left(x\right)\right]}{\left[1+\beta\kappa_1\left(1-\sigma\right)\overline{F}\left(x\right)\right]\left[1+\kappa_1\overline{F}\left(x\right)\right]}\right)dx. \tag{25}$$

This obviously depends on the entire set of structural parameters, which are specific to each sector and labor categories. According to our structural model, inter-sectoral differences in mean wages reflect differences in this set of structural parameters, which of course includes the workers' bargaining power β, but also worker mobility parameters (κ_1 and δ), and "productivity effects" (worker productivity parameters α_u and α_s, the share of capital χ, and the distributions of firm fixed-effects θ_j). A natural question to ask is then which parameters in that set are most important in determining inter-sectoral wage differences.

There is no unique or straightforward way to answer this question. Here we propose two types of experiments that we think are informative on this issue. The first experiment is simply to look at the "sensitivity" of the predicted mean wage to changes in a series of structural parameters. Specifically, we consider shifting three distinct parameters: the bargaining power β, the "worker mobility" parameter κ_1—which can be interpreted as a measure of how far away our labor market is from the Walrasian paradigm—, and a "productivity" parameter $\alpha(1-\chi)$— a 1 percent increase of which amounts to 1 percent upward productivity shock imposed on all firms present on the maket.[16] We then proceed to the computation of the predicted log average wage for each sector/skill category:

$$\ln \widehat{\overline{w}}_k = \ln E\left(w|\widehat{\theta}_j; \widehat{F}_k, \widehat{\alpha}_k, \widehat{\chi}_k, \widehat{\kappa}_{1k}, \widehat{\sigma}_k, \widehat{\beta}_k\right)$$

using equation (25), and look at the following three numbers:

1. The elasticity of $\ln \widehat{\overline{w}}_k$ with respect to $\alpha(1-\chi)$:

$$\frac{\partial \ln \widehat{\overline{w}}_k}{\partial \ln[\alpha(1-\chi)]}. \tag{26}$$

   From equation (25), this obviously equals one for all sectors and skill levels. Again, this measures the percentage increase in mean wages caused by a 1 percent increase in the productivity of all firms.

2. The following partial derivative:

$$\frac{\partial \ln \widehat{\overline{w}}_k}{\partial \beta}. \tag{27}$$

   This measures the percentage increase in $\ln \widehat{\overline{w}}_k$ caused by a unit increase in the bargaining power. (Thus, raising β by, say, 0.1 entails a percentage increase in the average wage $\widehat{\overline{w}}_k$ of 1/10 times the above number.) Since β is comprised in $[0,1]$, we believe that this partial derivative is more meaningful than the corresponding elasticity.

3. And finally:

$$\frac{\partial \ln \widehat{\overline{w}}_k}{\partial \kappa_1}. \tag{28}$$

   Similarly, this measures the percentage increase in $\ln \widehat{\overline{w}}_k$ caused by a unit increase in κ_1. We also think this is a natural number to look at (rather than the corresponding

[16] We thus do not consider changes in the sampling distribution $F(\cdot)$ of firm fixed effects. The mean of $\ln\theta$ is normalized at zero for all sectors, and the general "shape" of $F(\cdot)$ is not very different from one market to the other.

elasticity), since what κ_1 measures is the average number of contacts with an outside potential employer that a worker makes between two unemployment spells (i.e., according to Table 3, over a typical period of $1/\delta \simeq 20$ years). The above number therefore tells the percentage increase in $\widehat{\overline{w}}_k$ that one should expect if workers were to get one extra outside offer on average every $1/\delta$ years.

Table 5 contains the corresponding numbers for each of our four sectors. The first column in that Table reports the empirical log average wage $\ln \overline{w}$. The second column shows the log average wage $\ln \widehat{\overline{w}}$ predicted by equation (25) and the parameter estimates obtained earlier. Column 3 reports the prediction error. The following three columns contain our three numbers of interest (26), (27) and (28) computed using our set of estimates.[17] Finally, the last two columns show the values taken by (27) and (28) under the assumption of no on-the-job search, i.e. with $\kappa_1 = 0$ and β taking the values from the last two columns of Table 4. We now comment on the figures contained in Table 5.

< Table 5 about here. >

First, the fourth column in Table 5 repeats that mean wages are proportional to any scale factor of the production function. Hence, raising the productivity of all firms (by increasing $1-\chi$) or raising the productivity of the average worker (by increasing α) by one percentage point raises the market mean wage—in fact, it raises *all* firm-level mean wages—by one percentage point. Note that a crucial assumption for this result is that the efficiency of job search (as measured by λ_1) be independent of the firms' types, which wouldn't generically be the case if one were to endogenize e.g. the workers' search efforts (see Christensen et al, 2001).

Column 5 in Table 5 contains a measure of the sensitivity of average wages to changes in the bargaining power of workers. What those numbers tell us is that if one were to increase the bargaining power of all workers by, say, 0.1, then average wages would be increased by roughly 2

[17] The theoretical formulae for (26), (27) and (28) are not reported in the paper. They are available upon request.

to 6 percentage points, depending on the sector and worker category. Also, as can be seen from a comparison of columns 7 and 5 of Table 5, ignoring on-the-job search doesn't seem to affect much the sensitivity of $\ln \widehat{\overline{w}}$ to changes in β: wages are only slightly more sensitive without on-the-job search (with values of (27) ranging from 4.0 to 7.7 percent).

Finally, the impact of changes in κ_1 is measured in column 6 of Table 5. Giving the workers one extra outside offer on average per employment spell (i.e. increasing κ_1 by 1) entails a (modest) average wage increase of 2 to 11 percentage points. What is most interesting is to look at what happens if one ignores employed job search. Supposing that workers don't search on-the-job (i.e. $\kappa_1 = 0$), what happens to wages if one allows them to get one outside offer per employment spell? The rightmost column in Table 5 tells us that the impact on wages would then be a 13 to 35 percent increase! Our sensitivity measure of predicted mean wages to changes in κ_1 is an order of magnitude larger at $\kappa_1 = 0$ than at $\kappa_1 =$ its estimated value. The dependence of $\ln \widehat{\overline{w}}$ on κ_1 is thus highly nonlinear: for fixed values of all other structural parameters, using an error-ridden value of κ_1 to predict the market average wage has little consequence so long as that value is in the correct order of magnitude (let's say between 2 and 5, from Table 3). But completely ignoring on-the-job search (i.e. using $\kappa_1 = 0$) causes a severe underestimation of the average wage.

This set of comparative statics calculations is informative about *how* the predicted (log) average wage depends on various parameters of interest, but it has little to say about the *relative* importance of those parameters in explaining inter-group wage differences. It is meaningless indeed to "compare", e.g. a one percent increase in productivity with a increase of 0.1 in the level of the bargaining power. A complementary approach to the problem of inter-group wage differences is to consider the series of counterfactual experiments gathered in Tables 6 and 7.

< **Tables 6 and 7 about here.** >

We begin by looking at Table 6. The column labelled "Predicted $\ln \widehat{\overline{w}}$" reports the predicted value of the log average wage for all sectors and labor categories. The number in parentheses in that same column is the percentage gap between the predicted sectoral average wage and the predicted average wage in the Intermediate goods sector (which we take as our reference), proxied by the log-difference $\left(\ln \widehat{\overline{w}} - \ln \widehat{\overline{w}}_{ref.}\right)$. For instance, looking leftmost cell of the "Investment goods" row, we see that the predicted average unskilled wage for the Investment goods sector is $\exp(4.55)$, and is 19.8% higher than the predicted average unskilled wage in the Intermediate goods sector (which equals $\exp(4.36)$, as reported on the first row of the Table).

The four "Couterfactual" columns are constructed in the same way, with the difference that some parameters are given the value estimated for Manufacturing. For instance, the second row cell in the "$p = p_{ref.}; \alpha = \alpha_{ref.}$" column indicates that, if the value of α and the values and distributions of p (i.e. the productivity parameters) were the same for unskilled workers in the Investment goods sector as in the Intermediate goods sector—all other structural parameters keeping their estimated values—, then the average unskilled wage in the Investment goods sector would be $\exp(4.39)$, which is 3.4% more than the average unskilled wage in the Intermediate goods sector. The remaining three "Counterfactual" columns repeat the same experiment with the bargaining power parameter β, the job-to-job mobility parameter κ_1, and finally the bargaining power and the productivity parameters together. In sum, what these counterfactual experiments are supposed to answer is the question "How much of the distance between the mean wage in sector S and the mean wage in the Intermediate goods sector do we cover if we give such parameter of sector S the value that it takes in the Intermediate goods sector?"

The numbers in Table 6 indeed give a striking answer to this question: practically all the action is shared between productivity and the bargaining power. Otherwise stated, cross-sectoral differences in job-to-job mobility are of little help to explain cross-sectoral differences in average wages. To see this, we just have to compare the "Predicted $\ln \widehat{\overline{w}}$" column and the last "Counterfactual" column, where the productivity scale parameters (α and p) and the bargaining power (β) are given their values from the Intermediate goods sector. By doing so, we practically fill all the wage gap between the Intermediate goods sector and all other industries. Note that this is consistent with the conclusion we drew from Table 5: using an erroneous value of κ_1 to predict log mean wages doesn't matter too much if that value is far enough from zero. Of course there are cross-sector differences in worker mobility (see Table 3), but the estimates of κ_1 are sufficiently positive in all sectors that those differences don't matter much (as far as wages go...)

Finally, Table 7 uses the same protocol to study inter-skill wage differences (i.e. the skill premia). Again, we see that cross-skill differences in mobility are not very powerful as an explanation of the differences between skilled and unskilled wages. Again, we see that the triple (α, p, β) does most of the job.

5 Conluding remarks

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Appendix

A Details of some theoretical results

A.1 Wage bargaining

A.1.1 Bargaining with unemployed workers

The subgame perfect equilibrium of the strategic negotiation game on matches with an unemployed worker is obtained by backward induction. For the sake of simplicity, it is assumed that the value of a vacant job, Π_0 is always zero. In step 4, the type-p firm accepts any offer w such that $w \leq \varepsilon p$, and the type-ε worker accepts any offer w yielding $V(\varepsilon, w, p) \geq V_0(\varepsilon)$. Therefore, at step 3, the worker offers $w = \varepsilon p$, and the employer offers w such that $V(\varepsilon, w, p) = V_0(\varepsilon)$. At step 2, the worker refuses any offer that leaves him with less than his expected discounted utility, which amounts to $e^{-\rho\Delta} \cdot [\beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V_0(\varepsilon)]$, where $\Delta \to 0$ denotes the delay between steps 2 and 3. At step 1, the employer offers the lowest possible wage $\phi_0(\varepsilon, p)$ that the worker will accept, which satisfies:

$$V(\varepsilon, \phi_0(\varepsilon, p), p) = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V_0(\varepsilon). \tag{A1}$$

The worker accepts the wage $\phi_0(\varepsilon, p)$ in step 2 because he prefers to secure this offer rather than going on a process that does not raise his expected utility. Notice that it is the existence of a short delay between steps 2 and 3 that ensures existence and uniqueness of this subgame perfect equilibrium with instantaneous agreement in step 2 (see Osborne and Rubinstein, 1990).

A.1.2 Renegotiations

Renegotiations on continuing jobs occur when employees receive job offers and use them to claim wage increases. The renegotiation game is also solved by backward induction. Let us consider a situation in which a type-ε employee on a type-p job and earning a wage w receives a job offer from a type-p' employer. Let us denote as w_1' the wage offer made by firm p' at step 1, and w_3 and w_3' the wage offers made by firms p and p' at step 3. We assume that if the worker receives two offers yielding the same value, (s)he chooses to stay with the incumbent employer.

Step 6. Decisions at step 6 are straightforward: firms accept any offer increasing their profits, and the worker accepts any offer increasing his/her contract values, in comparison to their fallback payoffs.

Step 5. At step 5, the worker makes offers with probability β, and the firms make simultaneous offers with probability $1-\beta$.

Claim 1 *If the worker makes the offers, (s)he moves to or stays at the firm with highest mpl,* $\max(p, p')$*, and obtains a contract value depending on his/her decision at step 2 as in the following table*

	Worker's decision at step 2:	
	Accepts $V(\varepsilon, w_1', p')$	*Keeps* $V(\varepsilon, w, p)$
$p' > p$	$\begin{cases} V(\varepsilon, \varepsilon p', p') & \text{if } V(\varepsilon, \varepsilon p, p) > V(\varepsilon, w_1', p') \\ V(\varepsilon, w_1', p') & \text{if } V(\varepsilon, \varepsilon p, p) \leq V(\varepsilon, w_1', p') \end{cases}$	$V(\varepsilon, \varepsilon p', p')$
$p \geq p'$	$V(\varepsilon, \varepsilon p, p)$	$\begin{cases} V(\varepsilon, \varepsilon p, p) & \text{if } V(\varepsilon, \varepsilon p', p') > V(\varepsilon, w, p) \\ V(\varepsilon, w, p) & \text{if } V(\varepsilon, \varepsilon p', p') \leq V(\varepsilon, w, p) \end{cases}$

Proof of this claim. The worker offers $V(\varepsilon, \varepsilon p, p)$ to the type-p firm and $V(\varepsilon, \varepsilon p', p')$ to the type-p' firm. The firm with highest market power ($\max(p, p')$) eventually wins the worker as $p < p'$ implies $V(\varepsilon, \varepsilon p, p) < V(\varepsilon, p', p')$.

As to the value of the resulting contract, one can derive it as follows: If $p' > p$, p' accepts the wage $\varepsilon p'$ offered by the worker only if, at step 3, the worker has not already signed with firm p' a contract w_1' such that $V(\varepsilon, \varepsilon p, p) \leq V(\varepsilon, w_1', p')$. In such a case, if p' rejects the worker's offer at step 6, the employee still prefers to stay at p' with wage w_1'. Conversely, if $p' < p$, a wage $\varepsilon p'$ is effectively signed with firm p only if, at step 3, the worker has not rejected the offer w_1' made by firm p'. In which case, if firm p rejects the worker's offer at step 6, the employee still prefers to stays at firm p with wage w if $V(\varepsilon, w, p) \geq V(\varepsilon, \varepsilon p', p')$. ■

Claim 2 *If firms make offers, they enter a Bertrand game won by the firm with highest mpl,* $\max(p, p')$*, at the end of which the worker obtains the contract value depending on his/her decision at step 2 as in the following table*

	Worker's decision at step 2:	
	Accepts $V(\varepsilon, w_1', p')$	*Keeps* $V(\varepsilon, w, p)$
$p' > p$	$\begin{cases} V(\varepsilon, \varepsilon p, p) & \text{if } V(\varepsilon, \varepsilon p, p) > V(\varepsilon, w_1', p') \\ V(\varepsilon, w_1', p') & \text{if } V(\varepsilon, \varepsilon p, p) \leq V(\varepsilon, w_1', p') \end{cases}$	$V(\varepsilon, \varepsilon p, p)$
$p \geq p'$	$V(\varepsilon, \varepsilon p', p')$	$\begin{cases} V(\varepsilon, \varepsilon p', p') & \text{if } V(\varepsilon, \varepsilon p', p') > V(\varepsilon, w, p) \\ V(\varepsilon, w, p) & \text{if } V(\varepsilon, \varepsilon p', p') \leq V(\varepsilon, w, p) \end{cases}$

Proof of this claim. Let us first consider this game when $p' > p$. Since it is willing to extract a positive marginal profit from every match, the best the type-p firm can do to keep its employee is to offer him a wage exactly equal to εp yielding the value $V(\varepsilon, \varepsilon p, p)$ the worker. Accordingly, the employee accepts to move to (or to stay at) firm p' if firm p' offers at least $V(\varepsilon, \varepsilon p, p)$ (or $\max[V(\varepsilon, \varepsilon p, p), V(\varepsilon, w_1', p')]$).

Now consider the case $p' \leq p$. The type-p firm can keep its employee by offering $\max[V(\varepsilon, \varepsilon p', p'), V(w, p)]$ and can attract him/her back, if (s)he moved to firm p' at step 2, by offering $V(\varepsilon, \varepsilon p', p')$. ■

Step 4. At step 4, the worker rejects any offer that yields less than the expected utility that (s)he can get by waiting until step 6. Therefore, (s)he rejects any offer that yields less than the value EV as in the following table:

	Worker's decision at step 2: Accepts $V(\varepsilon, w_1', p')$	Keeps $V(\varepsilon, w, p)$
$p' > p$	$\begin{cases} EV = \beta V(\varepsilon, \varepsilon p', p') + (1-\beta)V(\varepsilon, \varepsilon p, p) & \text{if } V(\varepsilon, \varepsilon p, p) > V(\varepsilon, w_1', p') \\ EV = V(\varepsilon, w_1', p') & \text{if } V(\varepsilon, \varepsilon p, p) \leq V(\varepsilon, w_1', p') \end{cases}$	$EV = \beta V(\varepsilon, \varepsilon p', p') + (1-\beta)V(\varepsilon, \varepsilon p, p)$
$p \geq p'$	$EV = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta)V(\varepsilon, \varepsilon p', p')$	$\begin{cases} EV = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta)V(\varepsilon, \varepsilon p', p') & \text{if } V(\varepsilon, \varepsilon p', p') > V(\varepsilon, w, p) \\ EV = V(\varepsilon, w, p) & \text{if } V(\varepsilon, \varepsilon p', p') \leq V(\varepsilon, w, p) \end{cases}$

Step 3. At step 3, employers make simultaneous offers. Both employers offer the lowest possible wage that attracts the worker (and still yields nonnegative profits). If $p' > p$, the preceding table of expected outcomes implies that the worker goes to the firm with productivity p', and gets a wage w_3' that solves:

$$V(\varepsilon, w_3', p') = \beta V(\varepsilon, \varepsilon p', p') + (1-\beta)V(\varepsilon, \varepsilon p, p)$$

if the worker has rejected (at step 2) the offer made by firm p' at step 1 or if (s)he has accepted it but $V(\varepsilon, \varepsilon p, p) > V(\varepsilon, w_1', p')$. Otherwise, firm p' offers the ongoing contract $w_3' = w_1'$ if the worker's decision at step 2 was to move to firm p' with wage w_1' and if $V(\varepsilon, \varepsilon p, p) \leq V(\varepsilon, w_1', p')$.

Things are symmetric when $p' \leq p$: The worker accepts p's offer and gets a wage w_3 that solves:

$$V(\varepsilon, w_3, p) = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta)V(\varepsilon, \varepsilon p', p')$$

if (s)he has accepted (at step 2) the offer made by firm p' at step 1 or if (s)he has rejected it but $V(\varepsilon, \varepsilon p', p') > V(\varepsilon, w, p)$, and firm p offers the ongoing contract, $w_3 = w$, if the worker's decision at step 2 was to stay at firm p with wage w and if $V(\varepsilon, \varepsilon p', p') \leq V(\varepsilon, w, p)$.

Step 2. At step 2, the worker accepts any wage offer w_1' from p' such that continuing the negotiation game with (w_1', p') as a threat point is preferable to continuing the negotiation game with (w, p) as a threat point. From the preceding paragraph, we see that (s)he accepts (w_1', p') in either one of the following two cases:

1. $p' > p$ and $V(\varepsilon, w_1', p') > \beta V(\varepsilon, \varepsilon p', p') + (1-\beta)V(\varepsilon, \varepsilon p, p)$, or
2. $p' \leq p$ and $V(\varepsilon, w, p) < \beta V(\varepsilon, \varepsilon p, p) + (1-\beta)V(\varepsilon, \varepsilon p', p')$.

The worker chooses to reject p''s offer in all other cases.

Step 1.

- If $p' > p$, to avoid a waste of time in unecessary negotiation, firm p' offers a wage $w_1' = \phi(\varepsilon, p, p')$, that the worker accepts and that solves:

$$V(\varepsilon, \phi(\varepsilon, p, p'), p') = \beta V(\varepsilon, \varepsilon p', p') + (1-\beta) V(\varepsilon, \varepsilon p, p). \tag{A2}$$

- If $p' < p$ and $V(\varepsilon, w, p) < \beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V(\varepsilon, \varepsilon p', p')$ (case 2 above), the worker accepts any wage offer from firm p'. At step 3, firm p gets the worker back by offering a wage $w_3 = \phi(\varepsilon, p', p)$ such that

$$V(\varepsilon, \phi(\varepsilon, p', p), p) = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V(\varepsilon, \varepsilon p', p'). \tag{A3}$$

- Finally, if p' is so low that $V(\varepsilon, w, p) \geq \beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V(\varepsilon, \varepsilon p', p')$, the worker always rejects p''s offer at step 2 and eventually (i.e. after step 3 has been played) stays at firm p under his/her pre-existing contract w.

This completes the characterization of the subgame perfect equilibrium of our bargaining game. It is worth introducing some extra notation at this point (for later use): we see that the minimal value of p' for which "something happens" (i.e. either causing a wage increase or an employer change) is $q(\varepsilon, w, p)$ such that

$$V(\varepsilon, w, p) = \beta V(\varepsilon, \varepsilon p, p) + (1-\beta) V(\varepsilon, \varepsilon q(\varepsilon, w, p), q(\varepsilon, w, p)). \tag{A4}$$

Note that

$$\begin{aligned} V(\varepsilon, \varepsilon q(\varepsilon, w, p), q(\varepsilon, w, p)) &= V(\varepsilon, w, p) - \frac{\beta}{1-\beta} \left[V(\varepsilon, \varepsilon p, p) - V(\varepsilon, w, p) \right] \\ &< V(\varepsilon, w, p) \end{aligned}$$

whenever $w < p$.

A.2 Equilibrium wage determination

Here we derive the precise closed-form of equilibrium wages $\phi_0(\varepsilon, p)$ and $\phi(\varepsilon, p, p')$ defined in equations (A1) and (A2) respectively. The first step is to derive the value functions $V_0(\cdot)$ and $V(\cdot)$. Time is discounted at rate ρ. Since offers accrue to unemployed workers at rate λ_0, $V_0(\varepsilon)$ solves the following Bellman equation:

$$(\rho + \lambda_0) \, V_0(\varepsilon) = \varepsilon b + \lambda_0 E_F \left\{ \max \left[V(\varepsilon, \phi_0(\varepsilon, X), X), V_0 \right] \right\}, \tag{A5}$$

where E_F is the expectation operator with respect to a variable X, which has distribution F. Using the definition (A1) to replace $V(\varepsilon, \phi_0(\varepsilon, p), p)$ by $\beta V(\varepsilon, p, p) + (1-\beta) V_0(\varepsilon)$ in the latter equation, we then show that:

$$\rho V_0(\varepsilon) = \varepsilon b + \lambda_0 E_F \left\{ \max\left(\beta\left[V(\varepsilon, \phi_0(\varepsilon, X), X) - V_0(\varepsilon)\right], 0\right)\right\}. \tag{A6}$$

We thus find that an unemployed worker's expected lifetime utility depends on his personal ability ε through the amount of output he produces when engaged in home production, εb, but also on labor market parameters such as the distribution of jobs and his bargaining power β.

Now turning to employed workers, consider a type-ε worker employed at a type-p firm. Since layoffs occur at rates δ, we may now write the Bellman equation solved by the value function $V(\varepsilon, w, p)$:

$$\begin{aligned}\left[\rho + \delta + \lambda_1 \overline{F}\left(q\left(\varepsilon, w, p\right)\right)\right] V\left(\varepsilon, w, p\right) &= w \\ &+ \lambda_1 \left[F(p) - F\left(q\left(\varepsilon, w, p\right)\right)\right] E_F \left\{V\left(\varepsilon, \phi\left(\varepsilon, X, p\right), X\right) | q\left(\varepsilon, w, p\right) \leq X \leq p\right\} \\ &+ \lambda_1 \overline{F}(p) E_F \left\{V\left(\varepsilon, \phi\left(\varepsilon, p, X\right), X\right) | p \leq X\right\} + \delta V_0(\varepsilon). \end{aligned} \tag{A7}$$

Let us denote by $p_{\max}$ the upper support of p. Equations (A4) and (A7), totgether with the bargaining rule (A2) allow us to rewrite (A7) as follows:

$$\begin{aligned}\left[\rho + \delta + \lambda_1 \overline{F}\left(q\left(\varepsilon, w, p\right)\right)\right] V\left(\varepsilon, w, p\right) &= w + \delta V_0(\varepsilon) + \\ &\lambda_1 \int_{q(\varepsilon,w,p)}^{p} \left[(1-\beta)V(\varepsilon, \varepsilon x, x) + \beta V(\varepsilon, \varepsilon p, p)\right] dF(x) + \\ &\lambda_1 \int_{p}^{p_{\max}} \left[(1-\beta)V(\varepsilon, \varepsilon p, p) + \beta V(\varepsilon, \varepsilon x, x)\right] dF(x). \end{aligned} \tag{A8}$$

Imposing $w = \varepsilon p$ in (A8), taking the derivative, and noticing that the definition (A4) of $q(\varepsilon, w, p)$ implies that $q(\varepsilon, \varepsilon p, p) = p$, one gets:

$$\frac{dV(\varepsilon, \varepsilon p, p)}{dp} = \frac{\varepsilon}{\rho + \delta + \lambda_1 \beta \overline{F}(p)}. \tag{A9}$$

Then, integrating by parts in equation (A8):

$$\begin{aligned}(\rho + \delta) V(\varepsilon, w, p) &= w + \delta V_0(\varepsilon) + \beta \lambda_1 \varepsilon \int_{p}^{p_{\max}} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx \\ &+ (1-\beta)\lambda_1 \varepsilon \int_{q(\varepsilon,w,p)}^{p} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx. \end{aligned} \tag{A10}$$

Again imposing $w = \varepsilon p$, the last equation in turn implies that

$$(\rho + \delta) V(\varepsilon, \varepsilon p, p) = \varepsilon p + \delta V_0(\varepsilon) + \beta \lambda_1 \varepsilon \int_{p}^{p_{\max}} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx. \tag{A11}$$

Noticing that $q\left(\varepsilon, \phi\left(\varepsilon, p', p\right), p\right) = p'$, an expression of $V\left(\varepsilon, \phi\left(\varepsilon, p', p\right), p\right)$ can be obtained from (A10):

$$\begin{aligned}(\rho + \delta) V\left(\varepsilon, \phi\left(\varepsilon, p', p\right), p\right) &= \phi\left(\varepsilon, p', p\right) + \delta V_0(\varepsilon) + \beta \lambda_1 \varepsilon \int_{p}^{p_{\max}} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx \\ &+ (1-\beta)\lambda_1 \varepsilon \int_{p'}^{p} \frac{\overline{F}(x)}{\rho + \delta + \lambda_1 \beta \overline{F}(x)} dx. \end{aligned} \tag{A12}$$

But, following the bargaining rule (A2), $(\rho+\delta) V(\varepsilon, \phi(\varepsilon, p', p), p)$ should also equal

$$(\rho+\delta)\left[\beta V(\varepsilon, \varepsilon p, p)+(1-\beta) V(\varepsilon, \varepsilon p', p')\right]$$

which, using (A11), writes as:

$$\beta \varepsilon p+(1-\beta) \varepsilon p'+\delta V_0(\varepsilon)+\beta^2 \lambda_1 \varepsilon \int_p^{p_{\max}} \frac{\overline{F}(x)}{\rho+\delta+\lambda_1 \beta \overline{F}(x)} dx+\beta(1-\beta) \lambda_1 \varepsilon \int_{p'}^{p_{\max}} \frac{\overline{F}(x)}{\rho+\delta+\lambda_1 \beta \overline{F}(x)} dx.$$

Equating this expression with the right hand side of equation (A12), one gets the following expression for the wage $\phi(\varepsilon, p', p)$:

$$\phi(\varepsilon, p', p)=\beta \varepsilon p+(1-\beta) \varepsilon p'-(1-\beta)^2 \lambda_1 \int_{p'}^p \frac{\varepsilon \overline{F}(x)}{\rho+\delta+\lambda_1 \beta \overline{F}(x)} dx. \tag{A13}$$

The lower support of the distribution of marginal productivities, $p_{\min}$, cannot fall short of the value $p_{\inf}$ such that $V(\varepsilon, \varepsilon p_{\inf}, p_{\inf})=V_0(\varepsilon)$. Using the definitions (A6), of $V_0(\varepsilon)$, and (A10), of $V(\varepsilon, w, p)$, this identity yields:

$$p_{\inf}=b+\beta(\lambda_0-\lambda_1) \int_{p_{\inf}}^{p_{\max}} \frac{\overline{F}(x)}{\rho+\delta+\lambda_1 \beta \overline{F}(x)} dx. \tag{A14}$$

(Note that the value of $p_{\inf}$ is independent of ε. This result holds true for any homogeneous specification of the utility function.) Finally, as the bargaining outcome implies (A13), the identity $V(\varepsilon, \varepsilon p_{\inf}, p_{\inf})=V_0(\varepsilon)$ implies the following alternative definition of $\phi_0(\varepsilon, p)$:

$$\phi_0(\varepsilon, p)=\phi(\varepsilon, p_{\inf}, p)=\beta \varepsilon p+(1-\beta) \varepsilon p_{\inf}-(1-\beta)^2 \lambda_1 \int_{p_{\inf}}^p \frac{\varepsilon \overline{F}(x)}{\rho+\delta+\lambda_1 \beta \overline{F}(x)} dx. \tag{A15}$$

A.3 Equilibrium wage distributions

The $G(w|\varepsilon, p) \ell(\varepsilon, p)(1-u) M$ workers of type ε, employed at firms of type p, and paid less than $w \in[\phi_0(\varepsilon, p), \varepsilon p]$ leave this category either because they are laid off (rate δ), or because they retire (rate μ), or finally because they receive an offer from a firm with mpl $p \geq q(\varepsilon, w, p)$ which grants them a wage increase or induces them to leave their current firm (rate $\lambda_1 \overline{F}[q(\varepsilon, w, p)]$). On the inflow side, workers entering the category (ability ε, wage $\leq w$, mpl p) come from two distinct sources. Either they are hired away from a firm less productive than $q(\varepsilon, w, p)$, or they come from unemployment. The steady-state equality between flows into and out of the stocks $G(w|\varepsilon, p) \ell(\varepsilon, p)$ thus takes the form:

$$\begin{aligned}
&\left\{\delta+\lambda_1 \overline{F}[q(\varepsilon, w, p)]\right\} G(w|\varepsilon, p) \ell(\varepsilon, p)(1-u) M \\
&=\left\{\lambda_0 u M h(\varepsilon)+\lambda_1(1-u) M \int_{p_{\min}}^{q(\varepsilon, w, p)} \ell(\varepsilon, x) dx\right\} f(p) \\
&=\left\{\delta h(\varepsilon)+\lambda_1 \int_{p_{\min}}^{q(\varepsilon, w, p)} \ell(\varepsilon, x) dx\right\}(1-u) M f(p),
\end{aligned} \tag{A16}$$

since $\lambda_0 u = \delta(1-u)$. Applying this indentity for $w = \varepsilon p$ (which has the property that $G(\varepsilon p|\varepsilon, p) = 1$ and $q(\varepsilon, \varepsilon p, p) = p$), we get:

$$\left\{\delta + \lambda_1 \overline{F}(p)\right\} \ell(\varepsilon, p) = \left\{\delta h(\varepsilon) + \lambda_1 \int_{p_{\min}}^{p} \ell(\varepsilon, x) dx\right\} f(p),$$

which solves as

$$\ell(\varepsilon, p) = \frac{1+\kappa_1}{\left[1+\kappa_1 \overline{F}(p)\right]^2} h(\varepsilon) f(p).$$

This shows that $\ell(\varepsilon, p)$ has the form $h(\varepsilon)\ell(p)$ (absence of sorting), and gives the expression of $\ell(p)$. Hence the equations (9) and (10). Equation (9) can be integrated between $p_{\min}$ and p to obtain (8). Substituting (8), (9) and (10) into (A16) finally yields equation (11).

A.4 Derivation of $E[T(w)|p]$ for any integrable function $T(w)$

The lowest paid type-ε worker in a type-p firm is one that has just been hired, therefore earning $\phi_0(\varepsilon, p) = \phi(\varepsilon, p_{\inf}, p)$, while the highest-paid type-ε worker in that firm earns his marginal productivity εp. Thus, the support of the within-firm earnings distribution of type ε workers for any type-p firm belongs to the interval $[p_{\inf}, p]$. Noticing that $\widetilde{G}(q|p) = G(\phi(\varepsilon, q, p)|\varepsilon, p)$ has a mass point at $p_{\inf}$ and is otherwise continuous over the interval $[p_{\min}, p]$, we can readily show that for any integrable function $T(w)$,

$$\begin{aligned}
E[T(w)|p] &= \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} \left(\int_{\phi(\varepsilon, p_{\min}, p)}^{\varepsilon p} T(w)\, G(dw|\varepsilon, p) + T(\phi_0(\varepsilon, p))\, G(\phi_0(\varepsilon, p)|\varepsilon, p)\right) h(\varepsilon) d\varepsilon \\
&= \left[1+\kappa_1 \overline{F}(p)\right]^2 \left\{\frac{1}{(1+\kappa_1)^2} \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} T(\phi_0(\varepsilon, p)) h(\varepsilon) d\varepsilon \right. \\
&\quad \left. + \int_{p_{\min}}^{p} \left[\int_{\varepsilon_{\min}}^{\varepsilon_{\max}} T(\phi(\varepsilon, q, p)) h(\varepsilon) d\varepsilon\right] \frac{2\kappa_1 f(q)}{\left[1+\kappa_1 \overline{F}(q)\right]^3} dq \right\} \\
&= \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} T(\varepsilon p) h(\varepsilon) d\varepsilon + \frac{\left[1+\kappa_1 \overline{F}(p)\right]^2}{\left[1+\kappa_1\right]^2} \int_{\varepsilon_{\min}}^{\varepsilon_{\max}} \left[T(\phi_0(\varepsilon, p)) - T(\phi(\varepsilon, p_{\min}, p))\right] h(\varepsilon) d\varepsilon \\
&\quad - \left[1+\kappa_1 \overline{F}(p)\right]^2 \int_{p_{\min}}^{p} \left[\int_{\varepsilon_{\min}}^{\varepsilon_{\max}} T'(\phi(\varepsilon, q, p)) \varepsilon h(\varepsilon) d\varepsilon\right] \frac{(1-\beta)\left[1+(1-\sigma)\kappa_1 \overline{F}(q)\right]}{\left[1+(1-\sigma)\kappa_1 \beta \overline{F}(q)\right]\left[1+\kappa_1 \overline{F}(q)\right]^2} dq. \quad \text{(A17)}
\end{aligned}$$

The first equality follows from the definition of $G(w|\varepsilon, p)$ as

$$G(w|\varepsilon, p) = \frac{\left[1+\kappa_1 \overline{F}(p)\right]^2}{\left[1+\kappa_1 \overline{F}(q(\varepsilon, w, p))\right]^2}$$

yielding

$$G'(w|\varepsilon, p) = \left[1+\kappa_1 \overline{F}(p)\right]^2 h(\varepsilon) \frac{2\kappa_1 f(q)}{\left[1+\kappa_1 \overline{F}(q)\right]^3} \cdot \frac{\partial q(\varepsilon, w, p)}{\partial w} dw.$$

The second equality is obtained with an integration by parts, deriving the partial derivative of $\phi(\varepsilon, q, p)$ with respect to q from (A13) as

$$\frac{\partial \phi(\varepsilon, q, p)}{\partial q} = (1-\beta)\varepsilon \cdot \frac{1+(1-\sigma)\kappa_1 \overline{F}(q)}{1+(1-\sigma)\kappa_1 \beta \overline{F}(q)}.$$

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TABLE 1: Sample descriptive statistics

Industry	No. of firms	No. of unskilled workers, (% of total)	No. of skilled workers, (% of total)	Mean firm size	Mean annual v.a. per capita	Mean share of capital in v.a.	Mean share of labor in v.a.	Mean annual compensation costs
Manufacturing								
Intermediate goods	7,020	1,120,777 (77.6%)	323,127 (22.4%)	Unsk.: 31.9 Skilled: 9.2	43,854	22.1%	70.5%	Unsk.: 24,067 Skilled: 48,288 Ratio: 2,0
Investment goods	5,504	872,054 (68.3%)	405,540 (31.7%)	Unsk.: 31.7 Skilled: 14.7	42,701	13.5%	74.9%	Unsk.: 24,572 Skilled: 46,255 Ratio: 1.9
Consumption goods	9,663	1,354,494 (75.8%)	433,479 (24.2%)	Unsk.: 28 Skilled: 9	41,672	18.5%	70.2%	Unsk.: 21,532 Skilled: 40,517 Ratio: 1.9
Construction	12,061	962,760 (81.8%)	213,898 (18.2%)	Unsk.: 16 Skilled: 3.5	36,310	11.7%	69.4%	Unsk.: 19,797 Skilled: 35,922 Ratio: 1.8
Transportation	2,948	339,688 (90.7%)	34,928 (9.3%)	Unsk.: 23 Skilled: 2.4	39,195	26.3%	68.7%	Unsk.: 22,987 Skilled: 37,029 Ratio: 1.6
Trade								
Wholesale, food	3,176	203,975 (70.9%)	83,710 (29.1%)	Unsk.: 12.8 Skilled: 5.3	47,269	19.0%	65.6%	Unsk.: 21,686 Skilled: 43,030 Ratio: 2.0
Wholesale, nonfood	9,193	552,795 (57.1%)	415,784 (42.9%)	Unsk.: 12 Skilled: 9	48,840	11.9%	72.0%	Unsk.: 22,557 Skilled: 43,708 Ratio: 1.9
Retail, food	3,689	366,835 (83.9%)	70,588 (16.1%)	Unsk. 19.9 Skilled: 3.8	33,504	18.1%	66.3%	Unsk.: 17,256 Skilled: 32,014 Ratio: 1.9
Retail, nonfood	8,623	268,062 (72.9%)	99,729 (27.1%)	Unsk.: 6.2 Skilled: 2.3	38,508	14.0%	70.0%	Unsk.: 19,324 Skilled: 34.087 Ratio: 1.8
Services								
Hotels & catering	2,229	101,371 (75.8%)	32,380 (24.2%)	Unsk.: 9.1 Skilled: 2.9	36,923	27.7%	64.1%	Unsk.: 17,769 Skilled: 27,024 Ratio: 1.5
Personal services	4,918	549,662 (73.4%)	199,179 (26.6%)	Unsk.: 22.4 Skilled: 8.1	35,143	14.2%	70.3%	Unsk.: 18,062 Skilled: 30,644 Ratio: 1.7

TABLE 2: Production Function Estimates[1]

Industry	$\chi = \frac{cK}{Y}$	α
Manufacturing		
Intermediate goods	0.22	1.85 (0.17)[2]
Investment goods	0.14	1.87 (0.14)
Consumption goods	0.19	1.70 (0.12)
Construction	0.12	1.54 (0.09)
Transportation	0.26	1.80 (0.25)
Trade		
Wholesale, food	0.19	1.66 (0.26)
Wholesale, nonfood	0.12	1.63 (0.09)
Retail, food	0.18	1.65 (0.20)
Retail, nonfood	0.14	1.55 (0.09)
Services		
Hotels & catering	0.24	1.32 (0.15)
Personal services	0.14	1.71 (0.14)

Notes: [1]The estimates were obtained by GMM with the set ABV2 of moment restrictions.
[2]Standard errors in parentheses.

TABLE 3: Transition Parameter Estimates[1]

Industry	Labor type	λ_1	$1/\lambda_1$	δ	$1/\delta$	$\kappa_1 = \frac{\lambda_1}{\delta}$
Manufacturing	Unskilled	0.058 (0.004)[2]	17.0	0.043 (0.001)	22.9	1.34 (0.11)
	Skilled	0.086 (0.010)	11.5	0.027 (0.001)	36.1	3.13 (0.52)
Construction	Unskilled	0.188 (0.018)	5.3	0.068 (0.003)	20.6	2.75 (0.35)
	Skilled	0.195 (0.048)	5.1	0.048 (0.005)	14.6	4.02 (1.30)
Transportation	Unskilled	0.142 (0.019)	7.04	0.043 (0.003)	23.3	3.30 (0.62)
	Skilled	0.065 (0.022)	15.4	0.028 (0.005)	35.7	2.34 (1.06)
Trade	Unskilled	0.115 (0.009)	8.6	0.063 (0.002)	15.8	1.83 (0.18)
	Skilled	0.231 (0.032)	4.3	0.043 (0.002)	22.8	5.28 (0.98)
Services	Unskilled	0.307 (0.019)	3.3	0.099 (0.002)	10.0	3.08 (0.25)
	Skilled	0.257 (0.031)	3.9	0.049 (0.002)	20.3	5.23 (0.84)

Notes: [1]Per annum.
[2]Standard errors in parentheses.

TABLE 4: Bargaining Power Estimates[1]

Industry	with OTJ search		without OTJ search	
	Unskilled	Skilled	Unskilled	Skilled
Manufacturing				
Intermediate goods	0.450 (0.004)[2]	0.685 (0.009)	0.616 (0.003)	0.834 (0.005)
Investment goods	0.526 (0.005)	0.512 (0.007)	0.659 (0.004)	0.713 (0.004)
Consumption goods	0.370 (0.004)	0.711 (0.008)	0.569 (0.003)	0.848 (0.004)
Construction	0.00 (—)	0.776 (0.010)	0.288 (0.002)	0.906 (0.005)
Transportation	0.434 (0.008)	0.713 (0.015)	0.733 (0.004)	1.00 (—)
Trade				
Wholesale, food	0.154 (0.004)	0.457 (0.004)	0.426 (0.003)	0.708 (0.007)
Wholesale, nonfood	0.148 (0.003)	0.462 (0.006)	0.439 (0.002)	0.741 (0.002)
Retail, food	0.092 (0.005)	0.540 (0.013)	0.387 (0.004)	0.831 (0.007)
Retail, nonfood	0.154 (0.004)	0.522 (0.009)	0.425 (0.003)	0.774 (0.005)
Services				
Hotels & catering	0.101 (0.005)	0.489 (0.014)	0.407 (0.004)	1.00 (—)
Personal services	0.238 (0.005)	0.285 (0.009)	0.494 (0.004)	0.612 (0.006)

Notes: [1]Estimates obtained with $\rho = 0.15$.
[2]Standard errors in parentheses.

TABLE 5: Comparative Statics on Mean Wages

Industry	Log mean wage $(\ln \overline{w})$	Predicted log mean wage $\left(\ln \widehat{\overline{w}}\right)$	Prediction error $\left(\ln \widehat{\overline{w}} - \ln \overline{w}\right)$	$\frac{\partial \ln \widehat{\overline{w}}}{\partial \ln \alpha} = \frac{\partial \ln \widehat{\overline{w}}}{\partial \ln (1-\chi)}$	$\frac{\partial \ln \widehat{\overline{w}}}{\partial \beta}$	$\frac{\partial \ln \widehat{\overline{w}}}{\partial \kappa_1}$	$\left.\frac{\partial \ln \widehat{\overline{w}}}{\partial \beta}\right\rvert_{\kappa_1=0}$	$\left.\frac{\partial \ln \widehat{\overline{w}}}{\partial \kappa_1}\right\rvert_{\kappa_1=0}$
Manufacturing								
Intermediate goods	Unsk.: 4.34	Unsk.: 4.36	Unsk.: 2.0%	Unsk.: 1	Unsk.: 0.45	Unsk.: 0.10	Unsk.: 0.61	Unsk.: 0.28
	Skilled: 5.08	Skilled: 5.15	Skilled: 7.0%	Skilled: 1	Skilled: 0.35	Skilled: 0.06	Skilled: 0.58	Skilled: 0.26
Investment goods	Unsk.: 4.48	Unsk.: 4.55	Unsk.: 7.5%	Unsk.: 1	Unsk.: 0.46	Unsk.: 0.10	Unsk.: 0.65	Unsk.: 0.29
	Skilled: 5.15	Skilled: 5.24	Skilled: 10.0%	Skilled: 1	Skilled: 0.37	Skilled: 0.05	Skilled: 0.64	Skilled: 0.28
Consumption goods	Unsk.: 4.25	Unsk.: 4.25	Unsk.: −0.1%	Unsk.: 1	Unsk.: 0.54	Unsk.: 0.11	Unsk.: 0.73	Unsk.: 0.33
	Skilled: 5.00	Skilled: 5.03	Skilled: 3.0%	Skilled: 1	Skilled: 0.36	Skilled: 0.06	Skilled: 0.65	Skilled: 0.26
Construction	Unsk.: 4.31	Unsk.: 4.34	Unsk.: 2.5%	Unsk.: 1	Unsk.: 0.45	Unsk.: 0.03	Unsk.: 0.52	Unsk.: 0.25
	Skilled: 5.00	Skilled: 5.02	Skilled: 2.8%	Skilled: 1	Skilled: 0.19	Skilled: 0.02	Skilled: 0.40	Skilled: 0.13
Transportation	Unsk.: 4.50	Unsk.: 4.42	Unsk.: −7.2%	Unsk.: 1	Unsk.: 0.28	Unsk.: 0.04	Unsk.: 0.47	Unsk.: 0.19
	Skilled: 5.19	Skilled: 5.09	Skilled: −9.9%	Skilled: 1	Skilled: 0.26	Skilled: 0.05	Skilled: 0.43	Skilled: 0.14
Trade								
Wholesale, food	Unsk.: 4.26	Unsk.: 4.23	Unsk.: −2.9%	Unsk.: 1	Unsk.: 0.62	Unsk.: 0.09	Unsk.: 0.77	Unsk.: 0.35
	Skilled: 4.95	Skilled: 4.96	Skilled: 1.6%	Skilled: 1	Skilled: 0.36	Skilled: 0.03	Skilled: 0.65	Skilled: 0.27
Wholesale, nonfood	Unsk.: 4.29	Unsk.: 4.28	Unsk.: −1.6%	Unsk.: 1	Unsk.: 0.59	Unsk.: 0.08	Unsk.: 0.73	Unsk.: 0.33
	Skilled: 4.97	Skilled: 4.99	Skilled: 1.8%	Skilled: 1	Skilled: 0.34	Skilled: 0.03	Skilled: 0.62	Skilled: 0.25
Retail, food	Unsk.: 3.97	Unsk.: 4.00	Unsk.: 3.0%	Unsk.: 1	Unsk.: 0.51	Unsk.: 0.07	Unsk.: 0.63	Unsk.: 0.29
	Skilled: 4.79	Skilled: 4.70	Skilled: −8.4%	Skilled: 1	Skilled: 0.25	Skilled: 0.02	Skilled: 0.48	Skilled: 0.17
Retail, nonfood	Unsk.: 4.13	Unsk.: 4.14	Unsk.: 0.3%	Unsk.: 1	Unsk.: 0.56	Unsk.: 0.08	Unsk.: 0.71	Unsk.: 0.33
	Skilled: 4.83	Skilled: 4.78	Skilled: −5%	Skilled: 1	Skilled: 0.30	Skilled: 0.03	Skilled: 0.57	Skilled: 0.22
Services								
Hotels & catering	Unsk.: 3.65	Unsk.: 3.60	Unsk.: −4.9%	Unsk.: 1	Unsk.: 0.64	Unsk.: 0.04	Unsk.: 0.67	Unsk.: 0.29
	Skilled: 4.25	Skilled: 4.06	Skilled: −17.2%	Skilled: 1	Skilled: 0.29	Skilled: 0.03	Skilled: 0.46	Skilled: 0.15
Personal services	Unsk.: 4.03	Unsk.: 4.00	Unsk.: −2.5%	Unsk.: 1	Unsk.: 0.54	Unsk.: 0.05	Unsk.: 0.64	Unsk.: 0.28
	Skilled: 4.68	Skilled: 4.67	Skilled: −1.5%	Skilled: 1	Skilled: 0.40	Skilled: 0.03	Skilled: 0.63	Skilled: 0.27

TABLE 6: Interindustry wage differentials — Counterfactual Analysis

Industry		Predicted log mean wage $\left(\ln\widehat{\overline{w}}\right)$		Counterfactual $\ln\overline{w}$ when . . . $p=p_{ref.}$, $\alpha=\alpha_{ref.}$		$\beta=\beta_{ref.}$		$\kappa_1=\kappa_{1,ref.}$		$p=p_{ref.}$, $\alpha=\alpha_{ref.}$, $\beta=\beta_{ref.}$	
Manufacturing											
Intermediate goods	Unsk.:	4.36	(ref.)	—	(ref.)	—	(ref.)	—	(ref.)	—	(ref.)
	Skilled:	5.15	(ref.)	—	(ref.)	—	(ref.)	—	(ref.)	—	(ref.)
Investment goods	Unsk.:	4.55	(19.8%)[1]	4.39	(3.4%)	4.52	(16.3%)	—	—	4.55	(0%)
	Skilled:	5.24	(8.8%)	5.09	(−6.5%)	5.30	(14.8%)	—	—	5.24	(0%)
Consumption goods	Unsk.:	4.25	(−11.0%)	4.32	(−3.7%)	4.29	(−6.9%)	—	—	4.25	(0%)
	Skilled:	5.03	(−11.9%)	5.16	(0.9%)	5.02	(−12.9%)	—	—	5.03	(0%)
Construction	Unsk.:	4.34	(−1.9%)	4.17	(−18.7%)	4.5	(13.9%)	4.30	(−5.9%)	4.39	(2.9%)
	Skilled:	5.02	(−12.8%)	5.19	(3.4%)	5.01	(−14.6%)	5.02	(−13.0%)	5.16	(0.4%)
Transportation	Unsk.:	4.42	(6.4%)	4.39	(2.9%)	4.43	(6.9%)	4.39	(3.0%)	4.39	(3.5%)
	Skilled:	5.09	(−6.4%)	5.16	(4.0%)	5.08	(−7.1%)	5.09	(−5.9%)	5.15	(−0.6%)
Trade											
Wholesale, food	Unsk.:	4.23	(−12.6%)	4.23	(−12.8%)	4.39	(3.1%)	4.21	(−15.1%)	4.37	(1.3%)
	Skilled:	4.96	(−18.8%)	5.08	(−7.1%)	5.04	(−11.3%)	4.95	(−20.6%)	5.16	(0.8%)
Wholesale, nonfood	Unsk.:	4.28	(−8.1%)	4.23	(−12.8%)	4.43	(7.1%)	4.25	(−10.6%)	4.37	(1.3%)
	Skilled:	4.99	(−16.2%)	5.08	(−7.1%)	5.06	(−9.2%)	4.97	(−18.0%)	5.16	(0.8%)
Retail, food	Unsk.:	4.00	(−35.7%)	4.19	(−16.2%)	4.15	(−20.4%)	3.98	(−37.9%)	4.37	(1.3%)
	Skilled:	4.70	(−45.0%)	5.11	(−4.1%)	4.74	(−41.6%)	4.69	(−46.4%)	5.16	(0.8%)
Retail, nonfood	Unsk.:	4.14	(−22.2%)	4.23	(−12.8%)	4.28	(−7.7%)	4.11	(−24.5%)	4.37	(1.3%)
	Skilled:	4.78	(−37.2%)	5.11	(−4.7%)	4.83	(−32.5%)	4.77	(−38.7%)	5.16	(0.8%)
Services											
Hotels & catering	Unsk.:	3.60	(−75.5%)	4.23	(−12.4%)	3.78	(−58.1%)	3.55	(−80.7%)	4.39	(3.3%)
	Skilled:	4.06	(−108.9%)	5.09	(6.0%)	4.12	(−103.6%)	4.05	(−110.3%)	5.16	(0.8%)
Personal services	Unsk.:	4.00	(−35.7%)	4.30	(−5.7%)	4.10	(−25.6%)	3.96	(−39.9%)	4.39	(3.2%)
	Skilled:	4.67	(−48.7%)	5.01	(−14%)	4.80	(−35.6%)	4.64	(−51.0%)	5.16	(0.8%)

Note: [1]The term in parentheses is 100× the difference with the corresponding log mean wage in the Intermediate goods sector.

TABLE 7: Skill premium — Counterfactual Analysis

Industry		Predicted log mean wage $\left(\ln\widehat{\overline{w}}\right)$		Counterfactual unskilled $\ln\overline{w}$ when . . . $\alpha_u = \alpha_s$		$\beta_u = \beta_s$		$\kappa_{1,u} = \kappa_{1,s}$		$\alpha_u = \alpha_s$, $\beta_u = \beta_s$	
Manufacturing											
Intermediate goods	Unsk.:	4.36	(−79%)[1]	4.97	(−18%)	4.46	(−69%)	4.39	(−76%)	5.07	(−8%)
	Skilled:	5.15	(ref.)								
Investment goods	Unsk.:	4.55	(−69%)	5.18	(−6%)	4.55	(−69%)	4.59	(−65%)	5.17	(−7%)
	Skilled:	5.24	(ref.)								
Consumption goods	Unsk.:	4.25	(−68%)	4.78	(−25%)	4.41	(−62%)	4.29	(−74%)	5.09	(−2%)
	Skilled:	5.03	(ref.)								
Construction	Unsk.:	4.34	(−68%)	4.77	(−25%)	4.58	(−44%)	4.35	(−67%)	5.02	(−1%)
	Skilled:	5.02	(ref.)								
Transportation	Unsk.:	4.42	(−67%)	5.01	(−8%)	4.49	(−60%)	4.41	(−68%)	5.09	(0%)
	Skilled:	5.09	(ref.)								
Trade											
Wholesale, food	Unsk.:	4.23	(−73%)	4.74	(−22%)	4.39	(−57%)	4.30	(−66%)	4.90	(−6%)
	Skilled:	4.96	(ref.)								
Wholesale, nonfood	Unsk.:	4.28	(−71%)	4.76	(−23%)	4.43	(−56%)	4.34	(−65%)	4.92	(−7%)
	Skilled:	4.99	(ref.)								
Retail, food	Unsk.:	4.00	(−70%)	4.50	(−20%)	4.18	(−52%)	4.06	(−64%)	4.69	(−1%)
	Skilled:	4.70	(ref.)								
Retail, nonfood	Unsk.:	4.14	(−64%)	4.57	(−21%)	4.31	(−47%)	4.20	(−58%)	4.75	(−3%)
	Skilled:	4.78	(ref.)								
Services											
Hotels & catering	Unsk.:	3.60	(−46%)	3.88	(−18%)	3.79	(−27%)	3.63	(−43%)	4.07	(1%)
	Skilled:	4.06	(ref.)								
Personal services	Unsk.:	4.00	(−67%)	4.54	(−13%)	4.02	(−65%)	4.02	(−65%)	4.56	(−10%)
	Skilled:	4.67	(ref.)								

Note: [1]The term in parentheses is 100× the difference with the corresponding skilled log mean wage.

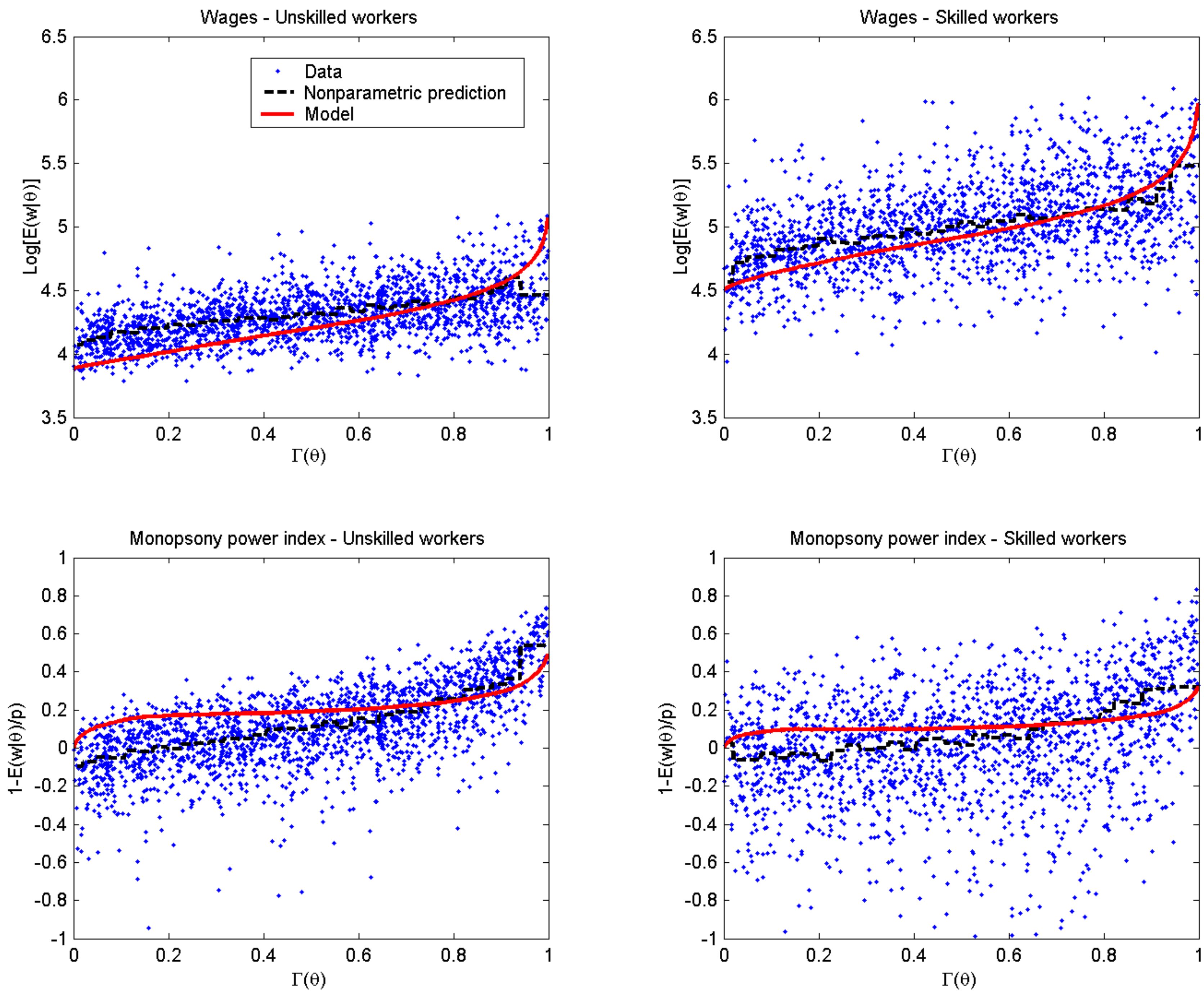

Fig. 1 - Illustrating the fit: the Intermediate goods sector