Granular Search, Concentration and Wages

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Abstract

This paper develops an approach to measuring labor market power that builds on the structure of a canonical search model. We relax the common assumption of a continuum of firms and assume that firms can commit not to compete with their own future job openings. This *granular* extension yields a micro-founded concentration index similar to the Herfindahl and a structural mapping between the index and labor market outcomes. Empirically, we define labor markets based on worker flows and then use our framework to quantify the consequences of market power in the Austrian labor market.

1   Introduction

An intuitively appealing approach to measuring the role of market power in the labor market is to compare measures of labor market concentration to measures of wages.[1] Under this intuition, rising concentration provides an explanation for the decline in labor share. In this paper, we develop a model that provides a structural relationship between concentration and wages. We take a textbook random search model (Pissarides (2000, chapter 1)) and relax the assumption of a continuum of firms. In this granular search model, we assume that firms can commit not to compete with their own future job openings. That is, a firm's future vacancies are not part of a worker's threat point in the wage bargain. As a consequence, market structure matters: If a firm accounts for a large share of job openings, then the firm offers a lower wage. What is more, if the structure of the labor market changes, then this change affects wages everywhere, even at employers with unchanged market share.

The model has a number of sharp empirical implications. First, the model-relevant notion of concentration depends on the sum over the square of the market share of each firm (i.e., the Herfindahl-Hirschman Index (HHI)), and also all the higher order terms, which places more weight on the largest firms in the economy. Second, the equilibrium average wage is decreasing in the concentration of employment. Third, the exercise of market power generates wage dispersion. Fourth, the elasticity of wages to concentration is increasing in concentration.

The model also implies that variation in concentration has a large effect on wages when worker bargaining power is low. In the model, concentration affects workers' outside options. At high levels of bargaining power, wages are essentially determined by the productivity of the match, and do not depend very much on the outside option. In contrast, at low levels of bargaining power, the wage is mainly determined by the outside option, which is affected by concentration. Given the standard view in the literature that workers have low levels of bargaining power, the model implies that wages are very sensitive to variation in concentration.

We extend the model to allow for productivity heterogeneity. The benchmark model has the counterfactual implication that larger firms—because they have more market power—pay less. As is well known, larger firms tend to pay more. To address this deficiency, we add productivity heterogeneity. Extending the model to allow for heterogeneity emphasizes a new economic force: what matters for wages is productivity-weighted concentration. From the worker's perspective, a labor market where the low-productivity (and low-wage) employer is large is less concentrated than a labor market where the high-productivity (and high-wage) employer is large. Hence, in terms of measurement, what matters for wages is not trends in concentration, but trends in productivity-weighted concentration.

To measure productivity-weighted concentration, we show that the model implies a closed-form

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[1]Boal and Ransom (1997) suggest that Bunting (1962) represents the earliest version of this regression. Bunting (1962, Appendix 16) finds a positive relationship between wages and concentration. Recently, there has been a surge of papers computing measures of concentration and relating these measures to wages. A presumably incomplete list includes: Azar, Marinescu, and Steinbaum (2017), Azar et al. (2018), Benmelech, Bergman, and Kim (2018), Hershbein, Macaluso, and Yeh (2018), Lipsius (2018), Qui and Sojourner (2019), and Rinz (2018).

and simple-to-compute inversion from wages and size to productivity. In the model, wages depend on the firm's size, the firm's productivity as well as the distribution of productivity across firms. Once we measure size and wages, we can back out productivity.

We then take our model to the data. We face the basic challenge of market definition: what counts as a labor market? We build on Nimczik (2018) to define labor markets based on worker flows. Formally, we use a stochastic block model to cluster firms on the basis of workers flows. This endogenous notion makes market definition an empirical question, rather than an *a priori* choice such as geography or industry (though we also report all measures at the level of geography and industry).

We measure concentration across several periods and relate the measure of concentration to trends in both the level of wages as well as the between-firm variance of earnings. We contrast trends in concentration when measured using the HHI, our model-based on notion of concentration as well as our productivity-weighted notion of concentration. We consider counterfactuals in which we keep primitives constant but suppose that firms set wages as if they were atomistic. We consider how the level of wages would change in these scenarios, we also consider how the variance of wages would change (once we have productivity heterogeneity, the wage distribution will not be degenerate in the absence of market power).

We view our approach as complementary to, but distinct, from papers that build on the "differentiated firms" framework of Card et al. (2018), including Berger, Herkenhoff, and Mongey (2018), Lamadon, Mogstad, and Setzler (2017), MacKenzie (2018) and Haanwinckel (2018). Those papers build static models of the labor market where workers' labor supply to a firm resembles consumer product demand. Coupled with a wage-setting protocol that resembles firms' product price setting decision, these papers deliver wage equations that provide an equilibrium microfoundation for the Robinson-style monopsony markdown. In contrast, this paper builds from the logic of a textbook (labor) search model.[2] The source of market power is distinct: in our model the elasticity of labor supply to all firms is the same (it is zero), but the "markdown" relative to productivity differs across firms and is a function of market power measured through size. Similarly, the mechanism in our model is also distinct from the commonly offered intuition for why concentration matters in the labor market; namely, that more concentrated markets facilitate collusion and potentially make wage setting more similar to monopsony.[3]

Our paper joins a literature that emphasizes variation in outside options in generating wage variation. Some examples include Beaudry, Green, and Sand (2012) and Caldwell and Danieli (2018). The key novelty is that we emphasize the role of employer size in affecting outside options.

We note that we are not the first paper to consider the role of finiteness in search models.

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[2]This distinction also helps explain how our paper relates to the broader literature computing labor supply elasticities to firms and interpreting this through the lense of monopsony models. See, for example, Webber (2015) and Webber (2018).

[3]For example, Bunting (1962, pg. 6) writes: "the concentration hypothesis—that, *ceteris paribus*, monopsonistic behavior is most likely to be observed where a few employers hire a large percentage of the labor force—becomes the statement that monopsony is most likely to exist, given conditions of labor supply, where the potential net gains are greatest."

Menzio and Trachter (2015) consider a large firm and a continuum of small firms in the product market. There is also a literature on market power in the directed search literature, e.g., Galenianos, Kircher, and Virag (2011).

2 Granular search

In this section, we take a standard partial equilibrium search model which has, however, only a finite number of firms that differ in the fraction of job openings. We assume that wages are set via Nash bargaining, but account for non-atomistic employers via the following key modification: We assume that employers can commit not to compete with their own future job openings. We then analyze the implications for wages. We start with the simplest version of the model to highlight the key mechanism. In subsequent sections we consider richer versions of the model.

2.1 Set-up

Consider a continuous time economy populated by a measure one of infinitely lived homogeneous workers. Workers are either employed, producing the economy's single, homogeneous good or they are unemployed. All agents discount the future at rate $r > 0$.

An agent who is employed experiences a separation shock at rate $\delta > 0$. In this event, the worker flows back into unemployment while the firm is left with no continuation value. An unemployed worker receives flow value $b < 1$.

There are N distinct employer in the market, indexed by i. Workers searching for a job encounter job openings at rate λ. Conditional on such an encounter, the probability that the job opening is at firm i is given by f_i and so $\sum_{i=1}^{N} = 1$. Firms do not differ along any other dimension and we normalize the flow output to one.

We let W_i denote the value of being employed at firm i, U the value of unemployment, J_i the value of filled vacancy at firm i, and V_i the value of an unfilled vacancy at firm i. We normalize $V_i = 0$.[4]

We assume that there is continuous Nash bargaining over the wage and let $\alpha \in [0, 1]$ denote the bargaining power of workers. The key novelty is that large employers can credibly commit to a particular threat that affects the worker's disagreement payoff in the wage bargain: Should the bargain break down and the worker match again with firm i in the same unemployment spell, firm i commits not to bargain with the worker.[5] We assume that the threat is only valid in the same

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[4]In Pissarides (2000, chapter 1), $V_i = 0$ because of a free entry condition. Here we do not have a free entry condition. A way to microfound $V_i = 0$ would be to follow Engbom (2017) and introduce an entity that owns the right to operate each of the firms and then rents the licenses. The rental fee would then ensure that $V_i = 0$.

[5]For readers who are uncomfortable with this form of commitment (because it is inconsistent with the lack of commitment in the extensive form game underlying the Nash bargaining solution), an alternative interpretation of our assumption is that there is a sufficiently large disutility cost to workers to returning to the same employer within the same unemployment spell ("returning hat in hand") that in equilibrium a worker does not. So workers do not view the current employer as a part of the outside option.

unemployment spell, and only until the worker matches with another employer.[6]

In a slight abuse of notation, we denote by U_i the value of an unemployed worker who—during the same spell—no longer qualifies for jobs at employer i. As a consequence, the net value of the employment relationship ("surplus") the pair bargains over is given by $S_i \equiv W_i - U_i + J_i$ where we assume that $V_i = 0$. With Nash bargaining, the wage implements a split such that the net value of working for i to the worker is

$$\alpha S_i = W_i - U_i \tag{1}$$

while the net value of having a worker to i satisfies

$$(1 - \alpha)S_i = J_i. \tag{2}$$

Finally, we already anticipate a result, namely that in equilibrium workers are willing to work for all firms i. That is $S_i \geq 0 \forall i$.

The unconditional value of unemployment U then satisfies

$$rU = b + \sum_i f_i(W_i - U), \tag{3}$$

while the continuation value in the event of a trade breakdown satisfies

$$rU_i = b + \sum_{j \neq i} f_j(W_j - U_i). \tag{4}$$

This states that the value of unemployment conditional on having met and rejected i is the possibility of the capital gain of matching with any other employer, times the probability of matching with any employer. Critically, if employer i is larger, then rejecting i's offer leads to a larger reduction in the job finding rate and so a worse outside option.

The value of being hired by firm i satisfies

$$rW_i = w_i + \delta(U - W_i), \tag{5}$$

where we highlight that, following an employment spell, a worker again qualifies for any job opening, regardless of any rejected offers in the past. The value of the match to the firm in turn satisfies

$$rJ_i = 1 - w_i - \delta J_i, \tag{6}$$

where a job has no continuation value to the employer after separation.

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[6]Within an unemployment spell, should a worker match with a firm $j \neq i$ she would, in the same unemployment spell, again qualify for jobs at firm j. We make this assumption for analytical tractability and do not think it is substantive for our results.

2.2 How to Measure Concentration

We are interested in the mapping between market structure—in particular, employment concentration—and equilibrium wages. Concentration is frequently measured via the HHI. But concentration has no inherent cardinality so the right choice of units depends on the question at hand.

To begin with, let $\tau \equiv \alpha \frac{\lambda}{\lambda + r} \frac{r}{\delta + r}$. τ summarizes how good the labor market is from the perspective of a worker through forces that are independent of concentration. That is, τ is small if the job finding rate is small, or if the separation rate is high, or if the bargaining power of workers is low. Furthermore, let $f^k \equiv \sum_i f_i^k$ such that $f^1 = 1$ and f^2 is the HHI index for employment shares in our labor market with $0 \leq f^2 \leq 1$. The following is a useful concentration index.

Definition 1. *Let concentration be measured as*

$$\mathcal{C} \equiv \frac{\sum_{k=2}^{\infty} \tau^{k-2} f^k}{1 + \tau \sum_{k=2}^{\infty} \tau^{k-2} f^k}.$$

This concentration index is distinct, yet very closely related to the standard HHI. First, note that the first element of the infinite sums is simply f^2, the HHI. Second, it shares the same bounds: In the limit with atomistic employers, we have that $\mathcal{C} = 0$, just like the HHI. In the limit of a single monopolistic employer, we have that $\mathcal{C} = 1$, just like the HHI.[7]

What differs between our index and the HHI is the inclusion of the additional higher order terms, (down)-weighted by τ. The higher-order terms place more weight on the size of the largest firms in the labor market than the HHI. Clearly, the higher order terms are particularly important if τ is large while $\mathcal{C}$ converges to the HHI as $\tau \to 0$.

2.3 Concentration, Average Surplus and Wages

To see why $\mathcal{C}$ is useful in mapping the connection between changes in market structure and worker compensation, let $\bar{w} \equiv \sum_i f_i w_i$ denote the average wage. All firms produce flow output of 1, so $\omega \equiv \frac{w_i - b}{1 - b}$ is the fraction of the net flow output produced by a worker-firm pair that goes to the worker. Let $\bar{\omega} \equiv \sum_i f_i \omega_i$. Our first result is the following:

Proposition 1. *The net present value of the (employment-weighted) average employment relationship is given by*

$$S^1 = \frac{1 - b}{r + \delta + \lambda \alpha (1 - \mathcal{C})}.$$

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[7]To see this, note that $f^k = 0 \ \forall k \geq 2$ in case of perfect competition while $f^k = 1 \ \forall k \geq 2$ in the case of a monopolist. In Appendix A we present an example of two economies where these two measures present different rankings. One economy consists of a monopsonist with a competitive fringe, and another consists of all equal-sized firms. By choosing the relative size of the monopsonist in comparison to the equal-sized firms, we can make these two measures move in opposite direction. The reason is that $\mathcal{C}$ places more weight on the largest firm (the monopsonist) than the HHI.

The equilibrium relation between average worker compensation and concentration in the labor market satisfies

$$\bar{\omega} = \alpha \left(\frac{r + \delta + \lambda(1 - \mathcal{C})}{r + \delta + \alpha\lambda(1 - \mathcal{C})} \right).$$

3   Discussion

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