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Employer market power: models and methods

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Abstract
It is now widely recognized that employers hold some wage-setting power over workers, and several recent reviews cover the resulting surge of research on monopsony. We take a high-level view, introducing the idea of the employment probability function (EPF) which describes how workers are assigned to firms as a way to link disparate parts of the current literature. The paper discusses different approaches to specifying the EPF and how they lead to different approaches for estimating employer power. The paper has some new results - the adding-up condition for pass-through parameters, how failures of log-concavity can lead to segmentation and how models of idiosyncratic preferences and frictions can be combined in a single framework. It also points out gaps in the existing literature e.g. on the sign of the super-elasticity, the role of employer choice, and truly dynamic models.

Keywords: employer power; monopsony; firm labour supply elasticity; pass-through; labour market competition
JEL codes: D43; J21; J31; J42; J63

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1 Introduction

It is now widely recognized that most employers have some market power over their workers. A number of recent reviews (Manning, 2021; Card, 2022; Azar and Marinescu, 2024a,b; Kline, 2025; Berger et al., 2024, 2026; Caldwell et al., 2026b) summarize, with different emphases, the surge in both empirical and theoretical work on monopsony in the last 15 years building on an older literature (see surveys by Ashenfelter et al. 2010; Boal and Ransom 1997; Manning 2003, 2011, and of course the original conceptualization in Robinson 1933).

There is broad agreement on the main sources of employer market power (search frictions, preference heterogeneity and concentration), the degree of such monopsony power (high quality estimates of firm labour supply elasticities are typically in the range of 2-5), and an ever-expanding set of applications to topics in labour economics and other fields.

There is little point in another review covering much the same ground or even a review of the reviews. So this review tries to take a high-level view, explain how some parts of the literature that are currently disparate can fit together, providing some new results, pointing out where common modeling assumptions may sometimes have unintended consequences and identifying gaps in current knowledge and possible directions for future research. It does not aim to be encyclopedic, citing representative examples of research in different areas though not all of them.

The paper introduces the idea of the employment probability function (EPF) which describes how workers are assigned to firms as a way to view much of the existing literature. The plan of the paper is as follows. The next section introduces the EPF, discusses plausible properties and their implications and shows how other approaches in the literature can be reduced to an EPF. Then we consider the profit-maximizing choice of wages deriving how wages should respond to external shocks ('pass-through') from changes in demand, competitor wages, or non-employment income. Methods to estimate market power are placed in this context. We then consider how market power changes as the number of employers in a market changes, e.g. from mergers or non-competes. Finally we discuss how models need to change if employer choice is to be incorporated and the relationship between dynamic and static models.

2 The Employment Probability Function

At the heart of models of monopsony is a model of how individual workers are matched to firms. Denote by θ_{ift} the probability that individual i works for firm f at time t: we will call this the employment probability function (EPF). We can allow for the individual to have no job - use the convention $f = 0$ (as in Caldwell et al., 2026b) to denote non-employment. Later in this review we consider dynamic models but we simplify for now by only considering static models and dropping the t subscript.

There are three approaches taken in the literature to modeling this matching process (i) direct specification of the employment probability function (e.g. Manning, 2006), (ii) specification of a direct utility function (e.g. a random utility model as in Card et al., 2018), or (iii) specifying an indirect utility function (e.g. Langella and Manning, 2021). In approaches (ii) and (iii) the EPF can be derived. Because the vast majority of workers have only one job at a time, it is natural for the approaches to be based on discrete choice modelling from Industrial Organisation.

2.1 Direct Specification of the Employment Probability Function

The employment probability function may depend on the characteristics of the worker x_i, the offer and characteristics of the own-firm but also the offer and characteristics of other firms in the market. In this review, we assume that the wage is a choice variable for the firm and that choice is made conditioning on the wages offered by other firms i.e. the assumption is of Bertrand-Nash competition.[1] Because the wage will be a particular focus of interest we split the firm characteristics into the vector of offered wages to individual i - denoted by $\boldsymbol{W}_i$ (non-employment income is the first element in the vector denoted W_{i0}) - and other firm characteristics denoted $\boldsymbol{z}_i$. These vectors

[1] Some papers (e.g. Berger et al. (2022); Azar and Marinescu (2024a); Deb et al. (2024)) assume Cournot-Nash competition in which firms choose their level of employment and condition on the employment levels chosen by other firms. It is the assumption about the behaviour of other firms that is important as one can always model the choice of a point on a given labour supply curve by the choice of wage or employment. Generally a Cournot assumption makes markets less competitive as hiring workers away from other firms leads those other firms to raise their wages to maintain their employment making it harder to gain a competitive advantage over others making raising wages. In contrast, the wages of other firms do not respond (by assumption) in the Bertrand case.

are subscripted by i but contain within the offers from different firms. So the EPF might be written as:

$$\theta_{if} = \theta\left((W_{i0}, W_{i1}, .., W_{iF}), (z_{i0}, z_{i1}, ., z_{iF}), x_i\right) = \theta\left(\boldsymbol{W}_i, \boldsymbol{z_i}, x_i\right) \tag{1}$$

The individual characteristics that might be relevant include standard demographics like age, gender, education, race and residential location but could also include variables like search intensity. The relevant firm non-wage characteristics could include variables like firm location and ‘amenities’ that affect the attractiveness of jobs but also hiring activity. Some characteristics on both the worker and firm side might be exogenous but others could be chosen by individuals and firms. The specification in (1) is general enough to allow for the interaction of individual and firm characteristics to matter e.g. the length of commute or different firm amenities being valued differently by different types of workers.

2.1.1 Plausible Properties for the Employment Probability Function

Any legitimate employment probability function must obviously satisfy the following property:

Probability Property: The EPF must lie between zero and one and sum to one for every individual across firms and non-employment.

Though trivial the Probability Property has some bite as it rules out an EPF that is iso-elastic in the own-wage over its whole range because that implies a probability above 1 if the wage is high enough. This is unfortunate because iso-elastic functions often lead to convenient theoretical and empirical equations. But iso-elasticity is possible over some range and can be a reasonable approximation more generally.

If a sufficiently rich set of worker and firm characteristics are included in the employment probability function it could be that the outcome is determinate in which case θ_{if} would be a binary variable taking the value one for the chosen option and zero for all the others. In this case each firm f could work out the lowest wage needed for individual i to accept their offer i.e. they have the potential (not necessarily realized) to act as a perfectly discriminating monopsonist. Such a binary employment probability function could not be differentiable everywhere which is inconvenient.

As we want to use the model for understanding firms' offered wages, it is also more realistic to assume that the firm cannot observe all the factors that influence workers' choices so cannot know the minimum wage acceptable to each worker. From the perspective of the employer, the EPF will then satisfy the following property.

Differentiability Property: The employment probability function is everywhere continuously differentiable in wages.

The Differentiability Property captures the key idea in monopsony that the labour supply curve to an individual firm is not infinitely elastic in the offered wage. It rules out perfect competition which would imply that increasing the wage from infinitesimally below to infinitesimally above competitor wages flips the employment probability function from zero to one. Perfect competition is the limit of the employment probability function as choices become more sensitive to the wage and this is the right way to see perfect competition - a limiting special case rather than a benchmark model deserving the prominence it has often been given in the past.

The next property relates to how changes in a firm's wage affects the employment probability function.

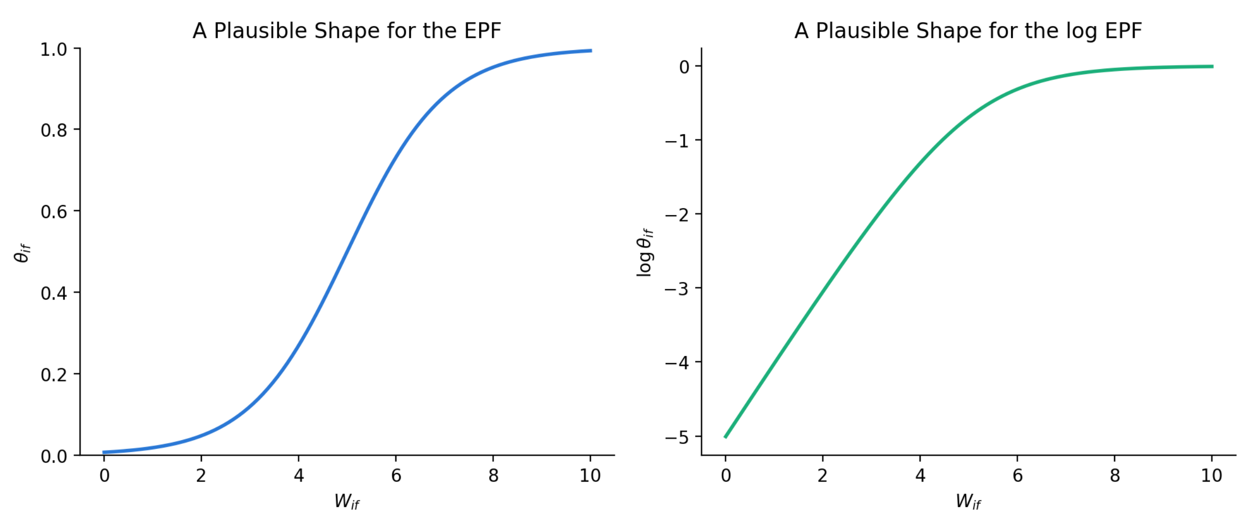
Monotonicity Property: The employment probability function is non-decreasing in the own-wage.

The Monotonicity Property seems natural if, conditional on firm wages, the EPF only reflects worker choice as increasing the own-wage must, ceteris paribus, make working for the firm more attractive. This property makes the employment probability function akin to a labour supply function in competitive markets in which, conditional on market wages, workers decide how much (if at all) to work. Most of the literature assumes firms are on their labour supply curves but the EPF might also reflect employer choice in which case an employer may refuse to employ the worker if the wage is too high, violating the Monotonicity Property - section 8.4 discusses further. One might think that an employer would never choose a wage this high so we can impose monotonicity in the relevant region. But there are two reasons why imposing monotonicity may not be so innocuous. First, there may be constraints on how much employers can vary wages across workers e.g. because of internal equity concerns (see Akerlof and Yellen 1990; Amior and San 2026; Breza et al. 2018; Dube et al. 2019; Dube 2026 for evidence on this). If the employer has to pay a common wage to workers who differ in their productivity the firm may refuse to employ some workers whose productivity is below the offered wage. Second, there may be external constraints on the wage e.g. because of the minimum wage or unions which affect the incentive to employ workers. For most of this review we will follow the bulk of the literature and assume that the EPF represents worker choice alone. But employers rejecting job applicants is common so this is a limitation of the existing literature: we return to this in section 8.

It might seem natural assumption to assume the employment probability at firm f is negatively affected by the wages offered by other competitor firms as firms are rivals competing for workers. But, a later section discusses why this might not always be the case (see section 7). An assumption on this is not needed for the moment because competitor wages will be assumed exogenous when considering how each firm chooses its wages. Similarly we might expect a rise in non-employment income to reduce the EPF for all firms.

As the employment probability function must lie between zero and one it is plausible to draw it as something like that shown in Figure 1a. The relationship between $log\theta_{if}$ and W_{if} might then plausibly look like what is drawn in Figure 1b.

Figure 1: Plausible shapes for the employment probability function.



This implies the following property:

Log Concavity (Wages) Property: The log of the EPF is concave in the own wage

The motivation for the log concavity assumption has been based on intuition but, as emphasized by Kline (2025), it has some important implications discussed later in this review, see e.g. section 4). One might go further and make a stronger assumption namely that the EPF satisfies:

Log Concavity (Log Wages) Property: The EPF is log-concave in $logW_{if}$.

Log-concavity in log wages implies log-concavity in wages but the reverse is not true.

Log-concavity in log wages implies that the elasticity of the EPF with respect to the own wage $\varepsilon_{if} = \frac{\partial log\theta_{if}}{\partial logW_{if}}$, the super-elasticity, is non-increasing in the own-wage. The elasticity is important because it is a natural measure of the market power of the firm. So log-concavity in the log wage implies the elasticity is declining in the wage so a firm's market power increases as it raises its wage. The super-elasticity must be negative for high enough wages because the EPF is bounded above by one, but this need not be true over the whole range. Many popular choices for the EPF are log-concave in the log wage but whether the super-elasticity is positive or negative should be an empirical question and section 6.1 discusses it in more detail.

A final property relates to how the EPF changes when all wages change in the same proportion (including the 'wage' from non-employment). A natural assumption is that the allocation of workers is unaffected by this which is the following property:

HoD0 Property: The employment probability function is HoD0 in the wages and utility from non-employment, $\boldsymbol{W_i}$

The HoD0 Property implies that only relative wages matter for the employment probability and, by implication the same is true for the elasticity of the EPF and the super-elasticity. The HoD0 Property is shown to have some usefulness in 5.1. The discussion so far has been very general so let us consider some specific examples commonly used in the literature.

2.1.2 The Level 1 Model: Multinomial Logit (MNL)

The first is the multinomial logit (MNL) EPF which has the form:

$$\theta_{if} = \frac{e^{\beta(W_{if})+\gamma(z_{if})}}{\sum_g e^{\beta(W_{ig})+\gamma(z_{ig})}} \tag{2}$$

where $\beta\left(W_{if}\right)$ is an increasing differentiable function of the own-wage and $\gamma\left(z_{if}\right)$ other factors affecting choice. This EPF satisfies the Probability, Differentiability and Monotonicity Properties. The MNL only satisfies the HoD0 property if $\beta\left(W_{if}\right) = \beta log W_{if}$ which is the most common assumption.[2]

(2) implies the elasticity of the EPF can be written as::

$$\varepsilon_{if}^{\theta} = \frac{\partial\beta(W_{if})}{\partial log W_{if}} \left(1 - \theta_{if}\right) \tag{3}$$

If $\frac{\partial\beta(W_{if})}{\partial log W_{if}} = \beta$ (the HoD0 property is satisfied) and θ_{if} is increasing in the wage, a higher wage implies a lower elasticity i.e. the EPF is log-concave in the log-wage and the super-elasticity is negative.[3] If you don't want to assume log-concavity of the EPF in the log wage one could choose a different functional form for $\beta\left(W\right)$ but this would come at the cost of losing the HoD0 property (and mean that the elasticity changes over time if there is general wage growth).

2.1.3 The Level 2 Model: Nested Logit

As is well-known from the IO literature (2) imposes strong assumptions on the nature of the EPF. The 'level-2' model is probably the nested logit (NL) model with two levels. In the upper nest workers are choosing between markets (which could be area or occupation or industry) or between employment and non-employment, denoted by m, while in the lower nest they are choosing between firms within a market. This structure has been used by Azar et al. (2022a); Lamadon et al. (2022);

[2]Though not universal: Card et al. (2018) use $log(W - B)$ where B is described as a "reference wage level".

[3]Note that Card et al. (2018) assume that each firm is small in relation to the market as a whole so treat θ_{if} as approximately zero. But this can only be an approximation because if the wage became larger enough it would no longer be plausible to assume the firm is small in relation to the market as a whole.

Berger et al. (2022) inter alia. In the lower nest assume that there is a MNL structure with $\beta(W_{if}) = \beta log W_{if}$ so the probability of choosing firm f in market m given market m i chosen is given by:

$$\theta_{if|m} = \frac{e^{\beta log W_{ifm} + \gamma_{ifm}}}{\sum_g e^{\beta log W_{igm} + \gamma_{igm}}} \tag{4}$$

The choice of market in the upper nest can be written as:

$$\theta_{im}^m = \frac{e^{\beta^m IV_{im} + \gamma_{im}^m}}{\sum_g e^{\beta^m IV_{ig} + \gamma_{ig}^m}} \tag{5}$$

where:

$$IV_{im} = \frac{1}{\beta} log \sum_f e^{\beta log W_{ifm} + \gamma_{ifm}} \tag{6}$$

IV_{im} is what is sometimes called the inclusive value and has the interpretation of the expected utility for individual i from working in market m (more loosely, it can be thought of as a wage index for market m). The EPF can then be written as $\theta_{ifm} = \theta_{if|m}\theta_{im}^m$ and the elasticity as:

$$\varepsilon_{ifm}^{\theta} = \frac{\partial log \theta_{ifm}}{\partial log W_{ifm}} = \frac{\partial log \theta_{if|m}}{\partial log W_{ifm}} + \frac{\partial log \theta_{im}^m}{\partial IV_{im}} \frac{\partial IV_{im}}{\partial log W_{ifm}} \tag{7}$$

which can be written as:

$$\varepsilon_{ifm}^{\theta} = \beta \left(1 - \theta_{if|m}\right) + \beta^m \left(1 - \theta_{im}^m\right) \theta_{if|m} \tag{8}$$

This EPF satisfies the Probability, Differentiability, Monotonicity and HoD0 properties. For log-concavity in the log wage note that a rise in the wage raises both $\theta_{if|m}$ and θ_m - inspection of (8) shows the elasticity falls (implying log concavity in the log wage or a negative super-elasticity) if $\beta^m \leq \beta$ but can fail if $\beta^m \geq \beta$. We return to this example in section 2.2.

2.1.4 Level 3+ Models

Multinomial and nested logit models are the workhorse models used in the monopsony literature at the moment. But IO moved away from these models some time ago - the go-to model these days perhaps being the mixed multinomial logit in which there is heterogeneity in the β parameters as in Volpe (2024).[4] There are other less-explored possibilities e.g. one might introduce a search like model in which workers have a choice of two options chosen at random with a logit choice between the two. This would lead to an EPF of the form:

$$\theta_{if} = \lambda \sum_{g} \frac{e^{\beta(W_{if})+\gamma(z_{if})}}{e^{\beta(W_{if})+\gamma(z_{if})} + e^{\beta(W_{ig})+\gamma(z_{ig})}} \tag{9}$$

where λ is the probability of being in the worker's choice set.

The advantage of working with EPFs is that they are a direct approach to the variables of interest and that they are flexible. If, for example, we want to introduce the hiring intensity of firms as a factor that influences the employment probability, one simply adds this as one of the firm characteristics in the function. The disadvantage is that there is no micro-foundation and an EPF could conceivably be inconsistent with utility-maximizing behaviour. This means that it is hard to do welfare analysis using this approach, something that is easier with the other approaches.

2.2 Specifying the Direct Utility Function (Random Utility Models)

This approach specifies the utility for individual i from working for firm f - denote this by $U_{if} = U\left(W_{if}, z_{if}, x_i\right)$. Note that the utility from working for firm f only depends on the offer from that firm, not from those offered by other firms.

The worker chooses the firm offering the highest utility so the employment probability function is simply:

$$\theta_{if} = I\left(U_{if} = max_g U_{ig}\right) \tag{10}$$

[4] Though these models have their problems as well - see Train (2009) who also outlines some other possibilities

where $I()$ is the indicator function.[5]

If the employer observes all the factors influencing worker choice, they could work out exactly the minimum wage required to get the worker to accept, the reservation wage. The EPF would then jump from zero to one at the reservation wage, violating the Differentiability Property. As it is unrealistic to assume the employer can observe the reservation wage, the typical approach is to assume there is a component of utility, ξ_{if}, unobserved by the employer when determining their offer. Writing utility as $U_{if} = U\left(W_{if}, z_{if}, x_i, \xi_{if}\right)$ (10) then becomes:

$$\theta_{if} = Pr\left[U_{if} = max_g U_{ig}\right] \tag{11}$$

where the expectation is over the joint distribution of $\boldsymbol{\xi}_i$, the vector of unobserved components.

The unobserved utility component is typically interpreted as a idiosyncratic amenity affecting the true utility of the worker. But one could assume that U_{if} is 'decision' utility which differs from true utility because of the worker's uncertainty about the utility of a job or because of optimization error. For example, if wages are not observed by the worker (because many vacancies do not post wages) application decisions have to be based on the expected wage. Workers may then not end up applying for the jobs with the highest utility but this is not because of an idiosyncratic amenity.[6]

In the literature a common way to specify U_{if} is the additive random utility model (ARUM) where:

$$U_{if} = V_{if} + \sigma\xi_{if} \tag{12}$$

where $V_{if} = V\left(W_{if}, z_{if}, x_i\right)$

We have chosen to multiply ξ_{if} by σ. Typically, papers normalize so that $\sigma = 1$. This can be done without any loss of generality because workers are assumed to choose the best available option so any monotonic transformation of utility will lead to the same observed behaviour. From

[5]This formulation assumes there is only one firm offering the highest level of utility: in the interest of simplicity we ignore the case where there are ties in which case there is a degree of freedom in the model in determining which firm is chosen.

[6]Several papers have examined the extent of misinformation about wages Jäger et al. (2024) or pay transparency policies (Mas, 2017; Baker et al., 2023) which reduce uncertainty about outside options allowing workers to make better decisions, though Cullen and Pakzad-Hurson (2023) argues these policies may have other, less desirable side-effects

the ARUM and an assumption on the joint distribution of ξ_{if} one can derive the EPF.[7] Doing so is not hard but involves some tedious algebra so is in Online Appendix C.1.

The EPF derived from an ARUM must necessarily satisfy the Probability, Differentiability, and Monotonicity properties with regard to V_{if}. A result is that if the cdf $F(\boldsymbol{\xi_i})$ is log-concave then the derived EPF will be log-concave in V_{if}.[8] If V_{if} is concave in the wage, this result implies the EPF is log-concave in the wage while V_{if} being concave in the log wage implies log-concavity of the EPF in the log-wage. Finally the EPF will be translation-invariant in $\boldsymbol{V_i}$ (meaning adding a constant to the utility of every option leaves choice probabilities unchanged) and this translates to HoD0 in the wages if $\boldsymbol{V_i}$ is log-linear in the wage.

The discussion so far has been very general so let us consider a specific, familiar example. If ξ_{if} is independently identically distributed across options with a type 1 extreme value (or Gumbel distribution) plus the normalisation $\sigma = 1$ then the EPF takes the MNL form described earlier in (2). As is usual in discrete choice models, one can think of the coefficient on a regressor not just as a measure of how much utility depends on the regressor but the ratio of this to the extent of heterogeneity in the idiosyncratic component across firms; greater sensitivity of choice to changes in regressors can be interpreted as lower heterogeneity in ξ (a lower σ) or the regressor being more important in determining utility.

The NL model with $\beta \geq \beta^m$ can be rationalized as an ARUM but $\beta^m > \beta$ may not be consistent with an ARUM. But there are non-ARUM models that can rationalise $\beta^m > \beta$. The ARUM assumes workers observe $\boldsymbol{\xi}_i$ when making choices even though the NL model is often analyzed in a sequential way. Change this and assume there is one error for the upper nest, one for the lower nest (both assumed to be Gumbel and independently distributed). Assume the upper nest (the 'market') has to be chosen before you know the error in the lower nest. This leads to a NL model: Online Appendix C.2 works through the algebra. It is now consistent with utility maximization to have

[7] One can also derive an ARUM from an EPF if the EPF satisfies the Probability, Differentiability, Monotonicity properties and is log-concave in V_{if} with, in addition, a symmetry condition (sometimes called rationalizability) $\frac{\partial \theta_{if}}{\partial W_{jf}} = \frac{\partial \theta_{jf}}{\partial W_{if}}$

[8] See Kline (2025) for discussion of which distributions are log-concave; a simple-minded conclusion is that most distributions you have seen are. There is a long tradition of using the assumption of log-concavity to derive results in search models (e.g. Bagnoli and Bergstrom, 2005; Burdett, 1981).

$\beta^m > \beta$.

The advantage of deriving the EPF from an ARUM rather than just specifying the EPF directly is that the choice model is micro-founded in utility maximization. That strength can also be its weakness as it limits the form of the EPF. For example, suppose that firm's hiring intensity influences the EPF. This can be readily incorporated in the direct formula for the EPF. One can incorporate it in the ARUM by having hiring intensity as one of the variables that 'affects' utility. But this is a bit contrived and one could not interpret this as true worker welfare.

2.2.1 Additive and Multiplicative Random Utility Models

The discussion so far has been in terms of additive random utility models. But the literature also has multiplicative random utility models with utility specified in the following way:

$$U_{if} = e^{\beta(V_{if})} e^{\sigma \xi_{if}} \tag{13}$$

The notation in (13) has been chosen to make clear the equivalence to the ARUM - take logs of (13) and we have the ARUM, (12). Both specifications have the same predictions for observed behaviour (utility functions are only identified up to a monotonic transformation). If ξ_{if} has a Gumbel distribution then $e^{\sigma \xi_{if}}$ has a Frechet distribution. Where the Gumbel distribution is almost always normalized on the variance, MRUMs are often normalized on the marginal utility of V and σ termed the Frechet parameter.

While for every ARUM there is an equivalent MRUM (and vice versa) with the same implications for choices, the use of additive or multiplicative form has implications for welfare analysis because the log of the expected utility for an MRUM is not expected utility of the equivalent ARUM - this is because the log of the expectation is not the expectation of the log. This difference can be extreme. For example if the Frechet parameter is less than one, expected utility in the MRUM is undefined while it is always well-defined for the ARUM.

2.3 Specifying The Indirect Utility Function

From an ARUM one can derive expected utility as:

$$EU_i = G\left(\boldsymbol{V}_i\right) = \mathbb{E}\max\left(V_{if} + \xi_{if}\right) \tag{14}$$

For the MNL model this is:

$$EU_i = log\sum_f e^{V_{if}} \tag{15}$$

One can think of EU_i as an indirect utility function as it is utility as a function of pay-offs. One might then think of starting by specifying the indirect utility function for individual i, $EU_i(\boldsymbol{V})$. Then the Daly-Zachary-Williams theorem says that if this function is increasing and convex in its arguments and translation-invariant (meaning that $EU_i(\boldsymbol{V} + v) = EU_i(\boldsymbol{V}) + v$ for scalar v) then this can be used as expected utility and the associated EPF satisfies:

$$\theta_{if} = \frac{\partial EU_i(\boldsymbol{V})}{\partial V_{if}} \tag{16}$$

The EPF derived from the indirect utility function must necessarily satisfy the Probability, Differentiability and Monotonicity properties discussed in the previous section if V_{if} is an increasing, continuously, differentiable function of the own wage. If V_{if} is concave in the own wage, then the EPF will be log-concave in the wage while it will be log-concave in the log-wage if V_{if} is concave in the log wage. The HoD0 property is satisfied if V_{if} is linear in the log wage

The attraction of specifying the indirect utility function is that it is directly useful for welfare analysis, is flexible to encompass a wider range of modelling choices (e.g. nested logit with many levels of nest) while requiring only one function avoiding the blizzard of notation sometimes seen in papers specifying the direct utility function: for these reasons it could be more widely used. The disadvantage is that it is hard to model cases where the employment probability function includes variables like hiring intensity that do not directly affect worker utility.

2.4 The Relationship Between the Three Approaches

All three approaches deliver an employment probability function. The three approaches have their advantages and disadvantages so which is the best approach depends on the application - this is reflected even in this review where we sometimes use one approach rather than another.

3 Total Labour Supply to the Firm

The discussion so far has been about the employment probability function of an individual worker. Total labour supply to the firm is given by the sum of the EPFs over all individuals in the economy (though for many individual-firm combinations the EPF may always be equal to zero):

$$N_f = \sum_i \theta_{if} \tag{17}$$

which in a simple clear way shows how this can be related to the individual employment probability functions. We assume that the Law of Large Numbers holds so the total labour supply can be treated as non-stochastic even if the probability of any individual working for the firm is stochastic. So far we have used notation that allows for the possibility that offered wages are individualized. it is convenient - and often realistic - to assume that firms have an internal pay structure (that we will treat as fixed) so that offered wages can be written as $logW_{if} = logW_f + \omega_i$ where W_f can be thought of as the firm's pay policy and ω_i is about within-firm pay differentials. We will consider changes in W_f.

If the firm is choosing the level of W_f the elasticity of the labour supply curve to the firm as a whole with respect to W_f can be written as:

$$\varepsilon_f^N = \frac{\partial logN_f}{\partial logW_f} = \frac{\sum_i \theta_{if}\varepsilon_{if}}{\sum_i \theta_{if}} \tag{18}$$

i.e. a weighted average of the elasticities of the individual EPFs where the weights are the probability of individual i choosing firm f, i.e. the EPF.

The Probability (reinterpreted to mean employment must be less than the total number of workers), Differentiability, Monotonicity and HoD0 properties of the individual EPFs translate to the firm-level supply function N_f. But the sum of log-concave functions is not necessarily log-concave so the log-concavity properties do not necessarily carry across. A trivial (though commonly used, including in this review) case when the firm-level labour supply function will be log-concave is if all workers are identical (so the $'i'$ subscripts can be dropped): then $N_f = \theta_f L$ where L is the total number of workers. More generally, there are a set of mathematical results on when a sum of log-concave functions is log-concave. For example if the EPF can be written as $\theta(\beta log W_f + \gamma x_{if})$ for a log-concave function $\theta()$ and the distribution of x_{if} is log-concave then Prékopa's theorem says that the expected value of θ over the distribution of x must also be log-concave. This covers the case where x_{if} is normally distributed.[9] But these results do not cover the case where x_{if} has a discrete distribution, something we discuss in section 4.3.

4 The Profit-Maximizing Choice of Wages

4.1 The Profit Function

Assume the revenue function of firm f can be written as $A_f Y_f \left[N_f\right]$ where A_f can be thought of as being a productivity or demand shock and Y_f a concave function of total employment.

Profits can then be written as:

$$\Pi_f = A_f Y_f \left[N_f \left(\boldsymbol{W}\right)\right] - W_f N_f \tag{19}$$

where we have written the firm-level labour supply function as a function of wages alone ignoring the other arguments in the interests of simplicity. Employers will be assumed to choose wages to maximize current profits. We assume they treat the wages offered by other firms as exogenous.

[9] See Kline (2025) for a more extensive discussion of when mixtures of distributions satisfy different concavity conditions.

4.2 The Mark-Down Equation

Obviously, there must be at least one solution to the profit maximization problem which, given the differentiability assumption, must be a solution to the first-order condition for profit maximization which can be written as the well-known mark-down equation:

$$W_f = \frac{\varepsilon_f^N}{1 + \varepsilon_f^N} MRPL_f \tag{20}$$

where ε_f^N is the elasticity of the labour supply curve facing the firm and $MRPL_f$ is the marginal product of labour in firm f. The term $\frac{\varepsilon_f^N}{1+\varepsilon_f^N}$ is referred to as the mark-down so wages are a mark-down on the marginal revenue product. The more elastic is the labour supply curve to the firm, the lower the mark-down.

Any profit-maximizing wage must satisfy (20) but solutions may not be unique. Kline (2025) notes that log-concavity in the wage of the firm-level labour supply function is sufficient for (20) to have a unique solution which maximizes profits.[10] One might think potential multiple solutions to the mark-down equation (rooted in a failure of log-concavity) is a potential inconvenience but the next section shows, through a simple example, why it might be interesting.

4.3 Segmentation in labour Markets

Suppose there are two types of workers in the economy. Each group has a MNL labour supply curve but the labour supply elasticity β is different for the two groups. Assume firms see themselves as small so do not influence the denominator in (2) so that the wage elasticity of the supply of type j workers to the firm is β_j. Both groups are equally productive with marginal product A. If firms can wage discriminate and pay different wages to the two groups then there will be a lower wage offered to the low-elasticity group as in (20). But suppose firms are constrained to offer the same wage to both types of workers. At any chosen wage W_f, the markdown equation must be satisfied with the elasticity of the labour supply curve to firm f being, following (18), a weighted average

[10] Though not necessary - Kline (2025) also discusses weaker sufficient conditions

of the two types where the weight on type-1 depends on the share of type-1 workers which will depend on the wage offered by this firm and others i.e. we will have:

$$\varepsilon_f^N = \alpha(W_f, \boldsymbol{W_{-f}})\beta_1 + \left[1 - \alpha(W_f, \boldsymbol{W_{-f}})\right]\beta_2 \tag{21}$$

where $\alpha(W_f, \boldsymbol{W_{-f}})$ is the share of type-1 workers if this firm pays W_f and others pay $\boldsymbol{W_{-f}}$. The elasticity lies between the two elasticities that would apply if firms could wage discriminate. If all firms are identical one might expect a symmetric equilibrium in which all firms pay the same wage and the share of type-1 workers will be α, their share in the population. (21) will be satisfied with the population value of α and the markdown equation (20) then determines the wage. In the single-wage equilibrium an increase in the low-elasticity type leads to a bigger mark-down - Amior and Manning (2026) use this idea to explain how migration may depress wages for locals if the labour market for migrants is less competitive than that for locals.

However, the single-wage equilibrium may not exist. To see how this can occur imagine that the type-2 labour market becomes more and more competitive i.e. we have $\beta_2 \to \infty$. (21) seems to say that $\varepsilon_f^N \to \infty$ so the markdown and profits would go to zero. But we know that strictly positive profits are possible by offering a low wage and only focusing on the type-1 workers. The profit function may not be globally concave in the wage and there can be two solutions to the mark-down equation so two wages in equilibrium. The low-wage firms overwhelmingly hire type-1 workers while the high wage firms hire both. Online Appendix D goes through the derivation. The two-wage equilibrium could be interesting as it resembles a segmented labour market in which some firms go for a high-wage strategy and others a low-wage strategy. The idea that labour markets are often segmented in this way is an old one in economics (e.g. see Reich et al. 1973 or the surveys in Leontaridi 1998 or Taubman and Wachter 1986). But it does require two distinct groups - if there were many groups with a distribution of elasticities then one might expect a continuous wage distribution to be the equilibrium. But there are cases - men/women, migrants/locals, white/black - where there are a few discrete categories and segmentation may be useful for understanding wage differentials between these groups.

There are other examples of a failure of log-concavity in the literature. Perhaps the best-known example is the search model of Burdett and Mortensen (1998) discussed in more detail later.

4.4 Estimating Market Power from the Markdown Equation

Suppose we manage to estimate the revenue function of the firm. We can then estimate the marginal revenue product of labour and compare it to the wage - using (20) the gap would be an estimate of the markdown and the level of employer market power. This way of deriving market power from the markdown equation is normally done differently. Re-write (20) as:

$$\frac{W_f N_f}{A_f Y_f} = \frac{\varepsilon_f^N}{1+\varepsilon_f^N} \frac{\partial log Y_f}{\partial log N_f} \tag{22}$$

The left-hand side is labour's share of total revenue. The final term on the right-hand side is the elasticity of revenue with respect to employment. Under perfect competition the two should be equal but under imperfect competition the gap is an estimate of employer market power. A number of papers (e.g. Yeh et al., 2022,Wong, 2025) have taken this approach to estimate the extent of monopsony power. Many of these papers estimate a physical production function when the formula is contaminated by possible product market power and develop an approach using other inputs (e.g. materials) whose markets are assumed to be perfectly competitive. This is not needed if one estimates a revenue function (Hashemi et al., 2022; Treuren, 2022) which is often easier than estimating a physical production function because firm-level prices may not be available. Nonetheless, revenue function estimation is known to be hard (see De Loecker and Syverson (2021) for a recent survey) and the estimated markdowns will be sensitive to the method used. To illustrate what might go wrong imagine that one estimates a common Cobb-Douglas production function across firms so the revenue elasticity is measured as a constant. As the labour share varies across firms one would conclude there was a lot of variation in market power across firms and that the firms with lower labour shares necessarily have more monopsony power. But it is also possible that every firm has the same level of market power but the importance of labour in production (e.g. the exponent on labour in a Cobb-Douglas production function) varies across firms. Unless this is modelled, inference will be wrong. Note that these methods seem to be able (unlike other methods discussed later) to estimate labour market power without the need for an instrument or any variation in the components of (20). This is deceptive: some variation is needed to estimate the revenue function and instruments may be important for that.

4.5 Wage-Posting vs. Wage Bargaining

This review focuses on models in which it is assumed that, in the absence of constraints like minimum wages or unions, employers unilaterally set wages, i.e. we have wage-posting. Even with wage-posting employers would like to individualize wages, to act as a discriminating monopsonist. Employers would like to find a way to pay equally productive workers different wages if their reservation wages are different. The process of discovering reservation wages can resemble a process of negotiation as the worker is reluctant to reveal their reservation wage but may also be trying to work out the employer's maximum willingness to pay, something the employer will not want to reveal. The strand of literature that models wage determination as an explicit bargain between an individual worker and firm (e.g. Cahuc et al., 2006, Shimer, 2006) often assumes perfect information on productivity and outside options which assumes away the main issue (see Kline, 2025, for a possible way forward). There is good evidence that many firms engage in individual wage negotiation to some extent (Hall and Krueger, 2012, Brenzel et al., 2014, Caldwell et al., 2026c) and a number of papers try to estimate how much negotiation there is (Wong, 2025, Lachowska et al., 2022, Carvalho et al., 2023, Di Addario et al., 2023). With perfect information, individual wage negotiation reduces the markdown (see Wong (2025) for one example of this) but cannot push wages above the marginal revenue product let alone produce a mark-up on the competitive wage. In this regard individual wage bargaining is different from collective bargaining where unions may push wages above what would be the marginal product of labour in a competitive market, trading-off losses in employment against wage gains for workers who remain employed. In individual negotiation the worker will never want to push the wage past the point where they would lose their job [11]. With imperfect and asymmetric information, it is less clear whether individualizing wages and negotiation leads to higher or lower wages overall.

5 Pass-through: The response of wages to shocks

The firm's optimal wage will, in general, depend on the demand shock, the wages offered by other firms and the value of non-employment (as well as other factors). Write this optimal solution as $W_f^* = \Omega_f\left(A_f, \boldsymbol{W}_{-f}\right)$ where $\boldsymbol{W}_{-f}$ denotes the vector of wages excluding the own-firm wage but including the value of non-employment. If the firm-level labour supply function satisfies the HoD0 property (as we have argued has some plausibility) the wage function must be HoD1 in $\left(A_f, \boldsymbol{W}_{-f}\right)$ i.e. a doubling of the demand shock, competitors' wages and the value of non-employment leads to a doubling of the firms own-wages . To see this note that because labour supply is HoD0 a doubling of the own wage results in a doubling of profits if $\left(A_f, \boldsymbol{W}_{-f}\right)$ has doubled.

5.1 The adding-up condition on pass-through

The HoD1 property of the optimal wage function (which derives from the HoD0 property of the EPF) has an important implication. Suppose we estimate the elasticity of wages with respect to demand shocks, competitor wages and the utility from non-employment, what are sometimes called pass-through parameters. These elasticities must add to 1: this is the adding-up condition.[12]

The simplest example of the adding-up condition is if the firm's revenue function has constant returns so $MRPL$ is proportional to A and so ε is a constant so the labour supply curve facing the firm is iso-elastic.[13] Then, from (20), the elasticity of wages with respect to A is one. But a rise in

[11] Though there may be hold-up issues in which the ex post marginal revenue product is above the ex ante because of the need for investments and workers may not be able to commit not to negotiate a wage above the ex ante marginal product

[12] Note this labour supply being HoD0 is a sufficient but not necessary condition for the adding-up result; the necessary condition is that the elasticity is HoD0. To give an example an iso-elastic labour supply function is consistent with the adding-up property but is not necessarily HoD0

[13] As noted above, the labour supply function cannot be globally iso-elastic but it might locally.

competitor's wages or non-employment income have no effect on wages as, under the assumptions made, these variables appear nowhere in (20). Their pass-through elasticities are zero. One can see that the sum of the elasticities is equal to one - the adding-up condition - but in a rather extreme way - the pass-through elasticity for demand shocks is 1 and the other elasticities are zero.

5.2 Pass-through From Demand Shocks

As pointed out by Kline (2025) there are many estimates of the pass-through from demand shocks to wages, all less than one suggesting the labour supply curve is not iso-elastic. Mertens et al. (2026, Online Appendix Figure A1) provide a recent review focusing on causal estimates, with a median of 0.1 (p90-p10 range of 0.04-0.35).

To consider how this might be explained, take the mark-up equation and differentiate to get the response of the optimal wage while allowing the elasticity and $MRPL = AY'(N)$ to be endogenous. In this case one can show (details are in Online Appendix B.1) that the pass-through elasticity for demand shocks can be written as:

$$\frac{\partial \log W_f}{\partial \log A_f} = \frac{1}{1 - \frac{\phi_f^N}{1+\varepsilon_f^N} - \varepsilon_f^N \varepsilon_f^{MRPL}} \tag{23}$$

where ϕ_f^N is the elasticity of the elasticity - the super-elasticity and ε_f^{MRPL} is the elasticity of the marginal revenue product with respect to employment.

There are two channels by which the model predicts pass-through from demand shocks will be tend to be less than one. First, there is the 'concave revenue function' channel: if $\varepsilon^{MRPL} < 0$ i.e. the revenue function is strictly concave in employment (very likely if the firm has some market power in the product market). The intuition is that as a firm raises wages and employment in response to the demand shock, the marginal product begins to fall, reducing the incentives to raise wages.

Second: there is the 'declining labour supply elasticity' channel. Pass-through from demand shocks will also tend to be less than one if the super-elasticity is negative i.e. the labour supply elasticity falls as the wage rises. The intuition for pass-through less than one in this case is that as wages rise the firm has more market power leading the mark-down to rise so wages rise less than proportionately with the demand shock A.

5.3 Pass-through from Non-employment Income and Competitors' Wages

We can also use (20) to estimate the pass-through from other shocks. Online Appendix B.1 shows the pass-through from an increase in W_g (which could be a competitor wage or non-employment income) can be written as[14]:

$$\frac{\partial \log W_f}{\partial \log W_g} = \frac{1}{1 - \frac{\phi_f}{1+\varepsilon_f^N} - \varepsilon_f^N \varepsilon_f^{MRPL}} \left[\frac{1}{1+\varepsilon_f^N} \frac{\partial log \varepsilon_f^N}{\partial log W_g} + \varepsilon_f^{MRPL} \frac{\partial log N_f}{\partial log W_g} \right] \tag{24}$$

$$= \frac{\partial \log W_f}{\partial \log A_f} \left[\frac{1}{1+\varepsilon_f^N} \frac{\partial log \varepsilon_f^N}{\partial log W_g} + \varepsilon_f^{MRPL} \frac{\partial log N_f}{\partial log W_g} \right] \tag{25}$$

This shows that the pass-through from other wages is through two channels. First, the 'concave revenue function' channel - if a change in the other wage changes employment and this changes marginal revenue. Second, an 'elasticity' channel: if the change in the other wage alters the elasticity of the labour supply curve. For example, higher non-employment incomes might be expected to raise wages if, as is plausible, a more attractive outside option reduces employment, raising $MRPL$ and reduces the firm's market power (the HoD property implies elasticities are HoD which limits the extent to which they can vary independently).

The literature on pass-through from non-employment income and competitor wages is much smaller than the literature on the pass-through from demand shocks. A partial list of papers, organized by the parameter they speak to, is given in Table 1 in Appendix A: the estimates are quite dispersed.

There are a few studies of the pass-through from the wages of individual competitor firms. Derenoncourt and Weil (2025) find negligible pass-through from voluntary wage raises of large employers in the US, Fonseca and Santarrosa (2025) estimate an elasticity of 0.12 from Brazilian

[14] see Online Appendix B.2 for the application of the formula to the NL model

auction shocks, and Staiger et al. (2010) estimate elasticities of 0.2 to 0.35 from nearby wage increases in the US.

Finding the pass-through from competitor wages can be hard because a firm has many competitors. One way to reduce the dimensionality is to construct an 'outside options index'. Many popular models suggest a suitable index e.g. the denominator in (2) for which a practical first-order approximation might be $\sum_g \theta_{ig} log W_g$. Caldwell and Danieli (2024) suggest another approach.

Also relevant is the literature on spillovers from minimum wages (e.g. Lee, 1999, Autor et al., 2016,Fortin et al., 2021,Demir, 2022) and collective bargaining (e.g. Dodini et al. 2026; Bassier 2022). It is hard, however, to use these studies to derive a pass-through parameter which is also likely to depend on the institutions (Bassier and Budlender, 2025).

There is little consensus on the pass-through from the value of non-employment, with low elasticities below 0.05 implied by Jäger et al. (2020); Ahammer et al. (2026), versus a higher elasticity of 0.7 in Muralidharan et al. (2023) (a low-income setting).

The available evidence is too scant to allow a conclusion about whether the adding-up condition is satisfied or not. Further research in this area would be helpful.

5.4 Can We Use Pass-through Estimates to Infer Market Power?

Pass-through elasticities are interesting because they tell us about the transmission mechanism of shocks through the labour market. But can they help us answer some other questions e.g. the extent of market power. Under perfect competition the pass-through from demand shocks to own-wages is zero (look at (27) with $\varepsilon = \infty$[15]) while the pass-through from the max of non-employment income and other wages is one. Deviations from this prediction can be used to reject perfect competition but, by inspection of (23), it should be apparent that one cannot use a passthrough estimate to estimate the extent of market power without assumptions on functional forms or evidence on the super-elasticity and the concavity of the revenue function. To see how functional forms might

[15]This requires $\varepsilon^{MRPL} < 0$ but assuming constant returns and perfect competition where one firm's productivity can differ from others is not a well-defined model as all employment will be at the highest productivity firm

help suppose the labour supply curve at firm level has the MNL form (2). Then $\varepsilon_f^N = \beta(1-\theta_f)$ and $\phi_f^N = -\beta\theta_f$. If the share of the firm's employment in the market is observable and with an assumption about ε_f^{MRPL} (perhaps constant returns so this is zero) one can then use (23) to back-out the labour supply elasticity from an estimate of pass-through from demand shocks. There may be situations in which using functional forms to achieve identification is justified but it is best to be aware this is what is happening.

5.5 Amenities and Pass-Through

Firms may also vary in the attractiveness of the non-wage aspect of the job - what are called amenities. Amenities may be exogenous or endogenous, chosen by the firm. For the moment consider exogenous amenities and assume that the attractiveness of working in firm f depends on its wage W_f relative to a negative amenity Φ_f i.e. on W_f/Φ_f [16]. The tools developed so far allow us to consider what happens when Φ_f rises. Define $\tilde{W}_f = W_f/\Phi_f$ (the adjusted wage) and $\tilde{A}_f = A_f/\Phi_f$ (adjusted demand). Then the profit function can be written as (we only include the own firm effects in labour supply for notational convenience):

$$\Pi_f = A_f Y_f\left[N_f\left(W_f/\Phi_f\right)\right] - W_f N_f = \Phi_f\left[\tilde{A}_f Y_f\left[N_f\left(\tilde{W}_f\right)\right] - \tilde{W}_f N_f\right] \tag{26}$$

Note that the expression for the profit function in square brackets is the same as in (19) but in terms of amenity-adjusted wages and demand shock. The solution must be the same. One can convert this to actual wages using $W_f = \Phi_f\Omega_f$ where Ω_f is the optimal adjusted wage as a function of adjusted demand shocks and adjusted other wages. If the pass-through from demand shock is less than one this immediately says that firms with worse amenities will pay higher wages, but not by enough to fully compensate for the disamenity. Regressions to value amenities that regress log earnings on the amenity will typically under-value the amenity for this reason. A similar approach can be used

[16]This formulation assumes that all workers value the amenity equally so it is a vertical amenity. For some amenities it is more plausible to assume the value of an amenity varies with the type of worker and, in some cases, what is attractive to one worker might turn off others. The formulation also assumes that the income elasticity of the demand for the amenity is 1, a poor assumption given many amenities seem to be luxury goods

to analyze the incidence of labour taxes or mandated benefits as discussed in Kline (2025).

6 Estimating Labour Market Power Through Labour Supply Elasticities

From (20) the gap between the wage and marginal revenue product is a function of the elasticity of the labour supply curve facing the individual firm: this is an attractive way to estimate market power. There are excellent reviews of the approaches and estimates elsewhere (Caldwell et al., 2026b) so here we concentrate on some basic principles.

The basic idea is to look at how demand shocks affect wages and employment. We have already discussed the wage effect but it is simple to derive the pass-through to employment from the demand shock is straightforward as the effect can only be through the impact on wages. So we have:

$$\frac{\partial \log N_f}{\partial \log A_f} = \varepsilon_f^N \frac{\partial \log W_f}{\partial \log A_F} \tag{27}$$

Immediately one can see that by comparing (23) with (27) that the ratio of the two (the Wald estimator) gives us an estimate of the labour supply elasticity under the assumption that firms are on their labour supply curves. This is the approach that has been most commonly taken to estimating labour market power: find a demand shock, argued to be exogenous to use as an instrument and then either implement as the Wald estimator or use IV. In an IV regression of employment on wages using a demand shock as an instrument the pass-through equation for wages is the first-stage.

(Caldwell et al., 2026b, Table 1 and Appendix B) provide a thorough review of estimates of employer power. For the approach above using demand shocks, they find an average firm labour supply elasticity across nine studies of about 4. Illustrative recent examples include Kroft et al. (2025), Dhyne et al. (2025), Amodio and De Roux (2024), and Lobel (2024) [17].

[17] Most of these studies use an instrument external to the firm but some use an internal instrument based on firm-level outcomes assuming that, conditional on covariates, these outcomes are uncorrelated with possible shocks to the labour supply curve. This is a very strong assumption

The literature has explored heterogeneity in labour supply elasticities to consider whether differential employer power helps explain pay gaps between groups. Hirsch et al. (2010), Ransom and Oaxaca (2010) and Sharma (2023) find lower elasticities for women than men, and Le Barbanchon et al. (2021); Card et al. (2016) find evidence consistent with the implication of this. Similar arguments are given for immigrant-native gaps (Allan and Townsend, 2024; Amior and Stuhler, 2024; Naidu et al., 2016), and racial gaps (Gerard et al., 2018). There is also some research on how elasticities vary over time e.g. Webber (2022), Hirsch et al. (2018) and Garcia-Louzao and Ruggieri (2023) or across areas e.g. Hirsch et al. (2022).

6.1 Estimating the Super-Elasticity: Does Market Power Rise or Fall as Firms Raise Wages?

Most of the empirical literature on labour supply elasticities implicitly assumes a zero super-elasticity. Earlier sections have emphasized how it is unlikely that the labour supply elasticity is a constant and that it is hard to rationalize observed levels of pass-through with a constant elasticity.

One can have a non-zero super-elasticity via an assumption on functional form. For example, if the firm has a labour supply curve of the MNL form, (2), then taking logs we have:

$$logN_f = \beta logW_f + \gamma(z_f) - log\sum_g e^{\beta(W_g)+\gamma(z_g)} \tag{28}$$

The final term is a constant for all firms in the same market so one could estimate (28) using a regression of log plant employment and log plant wages and a market fixed effect, instrumenting wages as described in the previous section. This gives an estimate of β from which one could derive a firm-level elasticity using (3) - see Deb et al. (2022) for an application of this general idea though in the nested logit model. This strategy leads to a negative super-elasticity but it derives from the functional form of the MNL model (2). Jarosch et al. (2024) and Gottfries and Jarosch (2026) take a different 'granular' approach to model that large firms have more market power.

But there are at least two reasons why the super-elasticity could be positive. First, consider the elasticity in the NL model (7). As discussed earlier $\beta > \beta^m$ is a sufficient condition for higher wages to be associated with more market power. But if $\beta^m > \beta$ (i.e. competition at the market level is bigger than between firms within a market) it is possible that, over some range, market power is decreasing in the wage though eventually θ_m^m will rise sufficiently high to turn the super-elasticity negative. In this model market power might be highest for intermediate levels of wages.

A second reason why raising wages might reduce market power is if the market consists of individuals who differ in their labour supply elasticity with some being more responsive to wages than others - see Volpe (2024) who provides some evidence this is relevant in practice [18]. As wages rise the composition of the firm's workforce shifts towards workers with more elastic labour supply, potentially increasing the average labour supply elasticity from the perspective of employers. We have already seen an example of this when we discussed labour market segmentation.

The sign of the super-elasticity should be an empirical question but few papers take this approach and the identification assumptions used might not be ideal. A direct approach to estimating the super-elasticity would be to look for evidence of non-linearity in the relationship between log employment and log wages: that might be a useful area for future research.

7 Employer Market Power as the Choice Set Increases

In all the models so far the set of firm being considered by workers has been treated as fixed. But what happens if the choice set changes? This might be relevant when thinking about the impact of market concentration (one reason why concentration indices might change is because of a change in the number of firms in the market) but also about the impact of the size of workers' consideration sets (it is probably unrealistic to think workers actively consider all possible options), the impact of non-competes (which restrict workers' choice of firms) and mergers between competitors in the labour market.

Our intuition is probably that as the choice set expands the market becomes more competitive.

[18] In IO this is the popular mixed multinomial logit model

This is the case in the MNL model - add an extra firm to the denominator of (2) and the market share of other firms falls, increasing the labour supply elasticity - but one might wonder how general this result is.

Online Appendix E shows that in an ARUM with identical, independently distributed idiosyncratic errors, in a symmetric equilibrium a sufficient condition for the elasticity of labour supply to an individual firm to increase with the number of firms is if $g(\xi)$ is log-concave, a stronger condition than log-concavity of the cdf $G(\xi)$. Symmetry is important: the Online Appendix also shows why the result need not go through with asymmetry.

A further question is what happens to competitiveness as the choice of employers becomes very large. We think of a competitive labour market as one in which a worker has lots of options. But in many commonly-used functional forms for the labour supply function market power does not disappear as the choice set for workers becomes large. In the MNL model with C identical firms the market share of any individual firm in a symmetric equilibrium will be $\frac{1}{C}$ and the elasticity of the labour supply curve facing the firm will be $\beta\left(1-\frac{1}{C}\right)$ which tends to β as $C \to \infty$.

Online Appendix E investigates the generality of this in the context of an ARUM with iid idiosyncratic shocks and C identical firms. It shows that a necessary and sufficient condition for the elasticity to become infinite as $C \to \infty$ is that the limit of the hazard rate of the distribution (assumed continuous) as $\xi \to \xi_{max}$ is infinite. The intuition is that in this case the distribution of the gap between the firm with the highest and the second-highest amenity collapses to zero. And if two firms have the same very high amenity then the choice between them will just be based on the wage, making the market perfectly competitive. While most of the have hazard rates with a finite limit a model that doesn't is Bhaskar and To (1999) who assume that workers and firms are uniformly distributed on the edge of a circle (in this case the maximum value of the idiosyncratic component corresponds to a 'distance' of zero).

The functional form assumptions made above are strong yet are crucial for the results. There is a risk that functional-form choices made for convenience often carry unintended substantive consequences. There are other models in which a market with many firms could be less competitive than one that is more concentrated - this is related to the earlier idea that the super-elasticity might be positive. Consider the NL model with $\beta^m > \beta$. Assume there is a job that requires some ex ante training paid for by workers who have a relatively free choice at the start of their careers about the type of training to do. They will only invest in training if the ex post wage can compensate for the cost of training. But ex post, the training costs are sunk and the wage may be low if the ex post market has many small firms. Having larger firms may internalize the externality - they recognize that the wage they offer influences how many workers train (see Méndez and Van Patten, 2022, for an application of this type of idea). This might be relevant for jobs in construction and nursing where, in many countries, employers complain about 'shortages' of workers.

7.1 Concentration and Wages

A growing literature finds wages are lower in more concentrated markets (Azar et al., 2022b; Benmelech et al., 2022; Rinz, 2022; Azar and Marinescu, 2024a,b), typically measuring concentration using the Herfindahl-Hirschman Index (HHI). To see why concentration might be relevant, consider the MNL model (2) where the labour supply elasticity at firm-level is a negative function of the firm's market share as given by (3). The average elasticity experienced by workers would then be:

$$\varepsilon = \sum \theta_f \varepsilon_f^N = \beta \sum \theta_f (1 - \theta_f) = \beta \left(1 - \sum \theta_f^2\right) = \beta \left(1 - HHI\right). \tag{29}$$

Perhaps the clearest and best quality evidence on the impact of the size of the choice set on wages comes from quasi-experimental shocks to concentration such as through mergers, with negative effects of concentration on wages found by Arnold (2025), Prager and Schmitt (2021), Schubert et al. (2025), and Wiltshire (2025), though Felix (2026) finds no net effect. Finding a negative link between HHI and wages could also be taken as indirect (because it is at market not firm level) evidence that the super-elasticity is negative.

Also relevant are the studies that find non-compete and no-poaching restrictions (which reduce worker choice of employers), reduce wages (Callaci et al., 2024; Gibson, 2025; Johnson et al., 2025; Naidu, 2010); see a review by Starr (2026). Finally, Sharma (2025); Delabastita and Rubens (2025) find evidence of explicit employer collusion which decreases wages and employment.

8 Employer Choice

In all the models so far it has been assumed that the only choice variable for the employer which influences labour supply is its wage and that the employer accepts all workers who want to work at that wage. That is a poor description of the way labour markets work - if I turn up at the office of the Chair of the Economics department of my choice and say I am ready to work, they are probably more likely to call security than to point me in the direction of my new office.

There are two aspects to discuss here - first that firms have other decisions apart from wages that influence labour supply and second, that they may turn away some workers who want to work for them at the offered terms and conditions.

8.1 The Reallocation Effect of the Minimum Wage

To show that employer choices other than wages are needed, consider the impact of a minimum wage in a monopsonistic labour market where all firms have a constant returns technology but differ in the level of productivity A. Assume that labour as a whole is inelastically supplied and distributed across firms according to the simplest MNL model [19]. In the absence of the minimum wage, the high productivity firms will offer a higher wage and have higher employment. Now consider the introduction of a minimum wage but below the level of the productivity of the worst firm. The lowest-productivity, lowest-wage firms have to raise their wage to the new minimum. As they do this, their market share rises at the expense of the higher-productivity firms. Those firms see their market share decline reducing their market power and inducing them to raise wages somewhat but not by as much as the lowest-wage firms have been forced to do. The consequence

[19] This assumption means that employment will not change with the minimum wage, in line with the evidence of Card and Krueger (1995); Wiltshire et al. (2025); Dube and Lindner (2024); Cengiz et al. (2019)

is that wage inequality declines, which might be thought a good thing. But there is a reallocation of labour towards the low-productivity firms so aggregate productivity falls.

However Dustmann et al. (2022), Rao and Risch (2026), Engbom and Moser (2022) and Haanwinckel (2023) find the opposite, that the minimum wage reallocates labour from less to more productive firms. To rationalize this requires introducing some other aspect of employer choice.

8.2 Hiring Activity

Firms can influence their labour supply through hiring activities. In US manufacturing the 90th percentile of plant level employment is something like 100x the 10th percentile of plant level employment - we suspect differences in hiring rates between these plants are bigger than the differences in separations rates and cannot be purely explained by differences in wages. Differences in recruitment intensity may be needed to explain the observed distribution of plant sizes. The importance of recruiting activity has been recognised for a long time Manning (2003, 2006) but still rarely figures in empirical work (exceptions are Bloesch et al. 2026; Heise and Porzio 2022) - the recent availability of vacancy data perhaps gives a chance to address this omission.

Recognizing the importance of recruitment activity can explain the reallocation effect of the minimum wage. With it, the low-productivity firms find their profit per worker reduced encouraging them to cut back on recruitment activity (as in Berger et al., 2025, Azar et al., 2024 and Dickens et al., 1999). In the extreme case the minimum wage might make them exit the market completely.

8.3 Amenities

Firms also have some choice over the non-wage aspect of jobs. There is a lot of evidence that amenities are important (see Mas, 2025, for a recent review) but they are intrinsically hard to study. While earnings have one dimension, can be easily measured, and it is natural to assume that all workers prefer more to less, amenities are many-dimensional, difficult to measure and possibly valued differently by different types of workers (some recent research tries to overcome these difficulties e.g. Sockin, 2022). A number of papers seek to rank firms' amenities (Roussille and

Scuderi, 2025, Sorkin, 2018, Caldwell et al., 2026a) and to investigate how concentration affects provision (Adams et al., 2026; Colonna et al., 2025; Dube et al., 2022). More research in this area is needed.

8.4 Employers Off Their labour Supply Curve

All of the models described above have the feature that, conditional on the choices of the firm (wages, hiring activity, amenities), they remain on their labour supply curve accepting all workers who want their jobs. Being off the labour supply curve would make no sense - firms could reduce labour supply by cutting hiring activity, saving money. That seems wrong - we know that employers say 'no' to many job applicants. The simplest model that can explain this is one in which workers differ in their productivity A, but the firm (perhaps because of internal equity considerations) can only set a single wage W. Assume that the number of workers of productivity A who want to work at wage W is given by $n(W, A)$. For convenience assume this labour supply curve is iso-elastic so can be written as $n(W, A) = W^{\varepsilon} n(A)$ The employer will, however, only want to employ workers with $A \geq W$. Given this profits will be given by;

$$\Pi = \int_W (A - W) n(W, A) dA \tag{30}$$

which reflects the fact that the employer will turn away workers with $A < W$. Online Appendix F shows that the first-order condition for the wage has the form of the markdown equation (20) with the marginal revenue product equal to the average productivity among employed workers. That seems like the standard monopsony model. But there are important differences: consider a small increase in the wage from the level chosen by the monopsonist. In the standard case, employment must increase as the firm moves up its labour supply curve. But in this model the firm also becomes more selective - it turns down a higher fraction of workers who want to work for them (violating the EPF monotonicity property) - and average productivity rises. The Online Appendix shows that employment might go up or down. Efficiency wage models - what Caldwell et al. (2026b) christen monergony have a similar feature (see also Emanuel and Harrington, 2026, Kline, 2025).

9 Dynamic Models

The models used so far have been entirely static motivating employer market power by the assumption that jobs are imperfect substitutes in the eyes of workers (measured by β in the MNL model). The discussion has ignored entirely the strand of literature that sees the source of employer monopsony power as rooted in labour market frictions i.e. that it costs time and money for workers to change jobs. This section discusses this strand of the literature. It makes a distinction between dynamic models that are converted to a static equivalent for theoretical or empirical purposes, and truly dynamic models where the dynamics are an essential feature.

The best-known model of a dynamic turned static model is Burdett and Mortensen (1998), the canonical theoretical model of how frictions can generate monopsony power. In Burdett and Mortensen ex ante identical firms are assumed to set wages once-for-all trying to maximize steady-state profits. The workers, both employed and unemployed, receive occasional job offers accepting the offer with the highest wage. Jobs are assumed destroyed at a constant exogenous rate. Equilibrium is found by working out steady-state employment for every wage distribution and then finding the wage distribution that does not lead to an increase in profits for any deviation. Famously, even though both firms and workers are ex ante identical, the equilibrium is a continuous wage distribution. As the markdown equation must remain true for every wage chosen in equilibrium but multiple wages are chosen we know there must be a continuum of solutions to the markdown equation, a spectacular failure of log-concavity. The degree of market power is related to the ratio of arrival rates of job offers for the employed to the job destruction rate.

9.1 Integrating Idiosyncrasy and Frictions

The sources of monopsony power identified in static and search models probably all have some element of truth to them (Sockin et al., 2025, show non-disclosure agreements restrict information flows and Jäger et al., 2024, show that workers misperceive outside wages and quits respond to more accurate information though Caldwell et al., 2025 shows workers have some understanding of outside options) but it has been hard to combine in a single model [20]. One can think of both the static and Burdett-Mortensen model as special cases of a more general model. The static models (e.g. Card et al., 2018) typically assume all firms are in the choice set at all times but that jobs are imperfect substitutes. These models are static but if workers always have a choice of all employers this can be thought of as an infinite arrival rate of job offers. In contrast, search models (e.g. Burdett and Mortensen (1998)) assume the consideration set is very restricted, that there is at most only one choice of employer available at any time or two if the worker is currently employed (they have the option of remaining in their current job). However, jobs are assumed to be perfect substitutes so, faced with two offers, workers always take the one with the highest wage

This way of viewing the two models suggests a way of developing a more general model and that is sketched in this section and developed in more detail in Online Appendix G - Albrecht et al. (2018) take a similar approach. Assume both employed and unemployed workers receive opportunities to get or change jobs at a rate λ [21]. Assume δ is the exogenous job destruction rate. Also assume that when the worker has the opportunity to get or change jobs they have a choice of a set of firms C other firms chosen at random (this is the size of their consideration set). Search models usually have $C = 1$. Workers' utility in a job is given by the ARUM which leads to the MNL model for the choice between firms but we assume that any wage offer above B is always preferable to non-employment. [22]. With this notation Burdett-Mortensen is the case ($\beta = \infty$, $C = 1$, $\lambda < \infty$) and the static model is ($C > 1$, $\beta < \infty$, $\lambda = \infty$), both special cases of a more general model.

A first question is whether there is a single wage equilibrium if all firms are identical. The Online Appendix derives the markdown formula for a single wage equilibrium. The markdown is bigger the lower is λ/δ (the measure of competition in the Burdett-Mortensen model), C and β

[20] There are some attempts - (Albrecht et al., 2018; Langella and Manning, 2021; Berger et al., 2024; Caldwell et al., 2026b)

[21] This means the reservation utility level will be the utility from unemployment as accepting or refusing a job has no consequences for future job opportunities. This is just to keep things simple to clarify the key ideas; one can generalize to the case where job offer arrival rates are different for the employment and unemployed

[22] This is just to simplify to focus on the key idea

(the measures in the MNL model). It also shows that it is better for workers to have many offers simultaneously (a high C) than fewer offers arriving more frequently (a high λ) even if the total arrival rate λC is the same. The intuition is that there is more competition between employers when workers have simultaneous offers. This is important because in many labour markets (not the vitally important academic one though) single offers is the norm.

But the single-wage equilibrium may not exist. Assume $C = 1$, imagine fixing λ/δ and increasing β. The labour market is becoming more competitive so wages in any single-wage equilibrium rise and profits fall. But employers have another option: give up trying to compete with the other firms and only go after workers who are leaving unemployment [23]. These workers have only one wage offer so you don't directly face competition with other firms and will accept a low wage. This result makes intuitive sense - as λ/δ becomes very high and β very low we approach the static model which has a single-wage equilibrium. But as β becomes high and λ/δ low we approach the Burdett Mortensen model where a single wage equilibrium does not exist.

The intuition is very similar to the earlier model of labour market segmentation: there are two groups of workers, employed and unemployed with different degrees of competition in their labour markets so the labour supply curve might not be log-concave with the possibility then of multiple solutions to the markdown equation.

9.2 Estimating Market Power Using Separation and Hiring Elasticities

The steady-state level of employment can be written as $N = R/s$ where R is the flow of recruits and s the separation rate. The long-run elasticity of the labour supply curve can then be written as the elasticity of the recruitment rate (expected to be positive) minus the elasticity of the separation rate (expected to be negative): the short-run elasticity is lower (Bassier and Manning (2025).

There is a large literature estimating the sensitivity of separations to the wage (e.g. Bassier et al., 2022, Dube et al., 2019, Derenoncourt and Weil, 2025). Often use is made of a theoretical result (Manning, 2003, 2011) that the recruitment elasticity is the same as the separations elasticity

[23] We thank Rob Shimer for pointing this out to us.

under some assumptions. There are a few separate estimates of the recruitment elasticity (e.g. Dal Bó et al., 2013, Datta, 2023, Hirsch et al., 2026) and some other studies (e.g. Azar et al., 2022a, Bassier et al., 2025) that look at how applications and vacancy durations respond to wages (which is related, though distinct, from hiring as not all applications are successful).

9.3 Truly Dynamic Models

Although a dynamic model, the Burdett-Mortensen model (and the extension sketched above) is solved by writing it as a static problem. That is partly because firms are assumed to set wages once-for-all but can also be done if assume wages are set one period at a time in an unchanging environment (Manning, 2025). Although this is not a very good description of the world, it is a considerable challenge to have truly dynamic models. In a truly dynamic model, the firm has state variables (e.g. the current workers), the environment (demand shocks, competitor wages) is changing in ways that cannot be perfectly foreseen. Solving the model requires assumptions on the extent of commitment to future wages that are possible for firms and the extent to which workers are forward-looking. The EPF will depend on who the worker worked for last period, the value they attach to different jobs which will depend not just on current wages but expected future wages. All of this is very difficult so one might wonder if it is worth the bother. The problem is that seeing the labour market through the lens of a static model may lead to incorrect conclusions - for example, Bassier and Manning (2025) show that estimating a static labour demand curve when the world is dynamic typically leads to bias in the estimates of market power.

10 Conclusion

This paper has tried to link disparate parts of the current monopsony literature through the use of the employment probability function. It has some new results - the adding-up condition for pass-through parameters, how failures of log-concavity can lead to segmentation and how models of idiosyncratic preferences and frictions can be combined in a single framework. It also points out gaps in the existing literature e.g. on the sign of the super-elasticity, the role of employer choice, and truly dynamic models. Though there is now overwhelming evidence that employers have some market power over their workers, there is much more we need to understand.

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Online Appendix

A Additional tables and figures

Table 1: Empirical papers relevant to pass-through to wages cited in Section 5.3

Authors (year)	Journal	Method	Data	Pass-through estimate
Panel A. Minimum wages (MW): spillovers up the wage distribution to uncovered workers				
Lee (1999)	QJE	Cross-state variation in gap between state median wages and federal/state MW	US CPS, 1979–1991	Falling real MW explains much of rise in the 50-10 gap once spillovers included
Autor et al. (2016)	AEJ: Applied	Reassessment of Lee (1999): instruments state median-MW gap with legislated MW	US CPS, 1979–2012	Confirms Lee (1999) result, though with lower effect; MW spillovers large, but measurement error possible
Cengiz et al. (2019)	QJE	Bunching estimator over the wage distribution; 138 state MW events, DiD	US, 1979–2016	Spillovers up to \$3 above hourly MW (40% of overall wage increase)
Gopalan et al. (2021)	JoLE	State MW changes, 6 large events over 2014-2015 with controls from bordering states	US payroll data, 2010–2015	Spillovers up to \$2.50 above hourly MW, but only firms with high low-wage share
Engbom and Moser (2022)	AER	Cross-state variation in state median-MW gap, and structural model	Brazil admin and survey data, 1985–2018	Far-reaching spillovers; MW accounts for 45% of the large fall in earnings inequality
Dustmann et al. (2022)	QJE	DiD using individuals and local area exposure/gap before introduction of national MW	Germany admin data, 2011–2016	Spillovers for workers just above MW, partly through worker reallocation
Panel B. Union and sectoral agreement spillovers to uncovered firms				
Staiger et al. (2010)	JoLE	DiD of legislated rise in VA hospital nurse pay, testing spatial spillovers	US VA Personnel Surveys, 1990–1992	Wages at closer non-VA (competitor) hospitals rise more; CWE 0.2 to 0.35
Fortin et al. (2021)	JoLE	Distributional DiD approach using changes in state-industry unionization rates	US CPS, 1979–2017	Spillovers of unionization on nonunion wages similar to direct effects of unionization
Bassier (2022)	WP	Event study of large changes in collective bargaining wage agreements	South African admin matched to CBAs, 2008–2018	Firms with more flows to covered firms raise wages more; CWE≈0.4–0.8
Demir (2022)	WP	Event study of introduction of sectoral MW	Germany admin data	Wages of low-wage jobs with higher flows to covered sector rise

continued on next page

Table 1 continued from previous page

Authors (year)	Journal	Method	Data	Pass-through estimate
Card and Cardoso (2022)	JEEA	Increases in sectoral wage floors for different parts of the wage distribution	Portugal admin data matched to CBAs, 2008–2016	Pass-through to those above the floor of 50%, extending even to higher-paid workers
Panel C. Cross-Wage-Elasticity (CWE) of wages to outside option wages				
Caldwell and Harmon (2019)	WP	IV of ex-coworkers' firm shocks	Danish matched admin, 2008-2016	Outside option labour demand shocks increase wages (unclear CWE)
Jäger et al. (2024)	QJE	Survey + info experiment	German survey + matched admin, 1975-2019	10% rise in outside-option wage beliefs raises quits 11% [$\implies$ CWE 0.5]
Fonseca and Santarrosa (2025)	WP	RD (random close auctions)	Brazilian procurement + RAIS, 2009-2018	CWE= 0.12: Wages rise 0.23% in response to 2% rise, firm size no effect
Derenoncourt and Weil (2025)	QJE	Event study of firm voluntary min wages	US payroll microdata, 2013–2023	Negligible spillovers to other employers
Panel D. Elasticity of wages to value of non-employment				
Ahammer et al. (2026)	AEJ: Applied	RD of UI age/experience cutoffs	Austrian UI admin data, 1998-2018	1% rise in potential UI duration $\rightarrow$ 0.18% effort reduction [$\implies$ 0.05 elasticity]
Amodio et al. (2025)	AER	IV of electrification + Structural	Peruvian manuf. firm survey data, 2004-2011	Self-employment acts as outside option reducing monopsony (unclear elasticity)
Jäger et al. (2020)	QJE	DiD of UI benefit reforms	Austrian SS admin, 1972-2020	Negligible elasticity (reject larger than \$0.03 for a \$1 rise)
Muralidharan et al. (2023)	ECMA	RCT of publics works rollout	Indian household survey, 2010-2012	Beneficiary earnings +14%,; +10% private-sector wages (0.71 elasticity)
Panel E. Superelasticity of firm labor supply (i.e. wage elasticity of firm labour supply elasticity)				
Bassier et al. (2022)	JHR	Event study IV of matched switcher separations	US (Oregon) UI admin, 2000-2017	Average ≈0.35 with top quartile -0.1.
Webber (2015)	Labour Economics	OLS of separations on wages	US LEHD UI data, 1985-2008	Average ≈1.3
Kline (2025)	HoLE	Theoretical prediction from Frechet distribution	N/A	-3
Panel F. Elasticity of marginal revenue product to employment				

continued on next page

Table 1 continued from previous page

Authors (year)	Journal	Method	Data	Pass-through estimate
De Loecker et al. (2020)	QJE	Production-function	US public firm financials (Compustat), 1955–2016	Average markup ≈1.61 in 2016 (implies -0.54 elasticity in model)
Deb et al. (2024)	ECMA	Structural	US Census, 1997–2011	Average markup ≈2.16 in 2016 (implies -0.38 elasticity under CES)
Kline (2025)	HoLE	Calibrations from reviews	N/A	≈ -0.3

Notes: Panels follow the categorization in Section 5.3. Estimates are summarized headline figures from each paper. Square brackets indicate our imputations assuming a firm labour supply elasticity of 4. Journal abbreviations: AEJ:Applied = *American Economic Journal: Applied Economics*; AER = *American Economic Review*; ECMA = *Econometrica*; HoLE= *Handbook of Labor Economics*; JHR = *Journal of Human Resources*; JoLE = *Journal of Labor Economics*; QJE = *Quarterly Journal of Economics*; REStud = *Review of Economic Studies*; WP = working paper or unpublished manuscript at time of writing.

B Pass-through Formulae

B.1 Passthrough from Other Wage Shocks

Taking logs of the markdown equation (20),

$$log(W_f) = log(\frac{\varepsilon_f^N}{1+\varepsilon_f^N}) + log(A_f) + log(Y'(N_f))$$

Then:

$$\begin{aligned}
\frac{\partial log(W_f)}{\partial log(A_f)} &= \frac{\partial log(\frac{\varepsilon_f^N}{1+\varepsilon_f^N})}{\partial log(W_f)} \frac{\partial log(W_f)}{\partial log(A_f)} + 1 + \frac{\partial log(Y'(N_f))}{\partial log(N_f)} \frac{\partial log(N_f)}{\partial log(W_f)} \frac{\partial log(W_f)}{\partial log(A_f)} \\
&= 1 + \frac{\phi_f^N}{1+\varepsilon_f^N} \frac{\partial log(W_f)}{\partial log(A_f)} + \varepsilon_f^{MRPL} \varepsilon_f^N \frac{\partial log(W_f)}{\partial log(A_f)}
\end{aligned}$$

where ϕ_f^N is the super-elasticity, the elasticity of the elasticity. This, rearranged, gives (23).

For the pass-through from another wage, say W_g, (which could be non-employment income) we have:

$$\begin{aligned}
\frac{\partial log(W_f)}{\partial log(W_g)} &= \frac{\partial log(\frac{\varepsilon_f^N}{1+\varepsilon_f^N})}{\partial log(W_f)} \frac{\partial log(W_f)}{\partial log(W_g)} + \frac{\partial log(\frac{\varepsilon_f^N}{1+\varepsilon_f^N})}{\partial log(W_g)} \\
&\quad + \frac{\partial log(Y'(N_f))}{\partial log(N_f)} \left[\frac{\partial log(N_f)}{\partial log(W_f)} \frac{\partial log(W_f)}{\partial log(W_g)} + \frac{\partial log(N_f)}{\partial log(W_g)} \right] \\
&= \frac{\partial log(W_f)}{\partial log(A_f)} \left[\frac{1}{1+\varepsilon_f^N} \frac{\partial log \varepsilon_f^N}{\partial log W_g} + \varepsilon_f^{MRPL} \frac{\partial log N_f}{\partial log W_g} \right]
\end{aligned}$$

B.2 Nested Logit competitor wage passthrough

Following 2.1.3, specialize the upper nest to employment/nonemployment, and let $u \equiv 1 - \theta_{i,emp}^m$ denote the nonemployment probability. A competitor wage W_k affects ε_f through lowering $\theta_{if|m}$ (standard logit substitution) and raising $\theta_{i,emp}^m$ (a higher competitor wage makes employment more attractive at the upper nest). The two cross-partials are:

$$\frac{\partial \theta_{if|m}}{\partial \log W_k} = -\beta\, \theta_{if|m} \theta_{ik|m}, \qquad \frac{\partial \theta^m_{i,emp}}{\partial \log W_k} = \beta^m\, \theta^m_{i,emp} (1-\theta^m_{i,emp})\, \theta_{ik|m}. \tag{31}$$

Differentiating (8) and substituting (31):

$$\frac{\partial \varepsilon_f}{\partial \log W_k} = \theta_{if|m}\theta_{ik|m}\Big[\beta(\beta-\beta^m u) - (\beta^m)^2 u(1-u)\Big], \tag{32}$$

Similarly to the derivation in B.1 above, the competitor-wage pass-through is then:

$$\frac{\partial \log W_f}{\partial \log W_k} = \frac{\partial \log W_f}{\partial \log A_f} \cdot \frac{1}{\varepsilon_f(1+\varepsilon_f)} \cdot \frac{\partial \log \varepsilon_f}{\partial \log W_k}, \tag{33}$$

with $\partial \log W_f / \partial \log A_f$ given by (23).

C The EPF and Additive Random Utility Models

C.1 Deriving the EPF from an ARUM

This section shows how to derive an EPF from a general ARUM in which $U_{if} = V_f + \xi_{if}$ where the joint distribution of $\boldsymbol{\xi}$ is represented by $G(\boldsymbol{\xi})$ - this does not assume the idiosyncratic errors are independently or identically distributed. Fix the idiosyncratic error for firm f as ξ_{if} and denote the cdf of all the other errors conditional on this as $G_{-f}(\boldsymbol{\xi}_{-f}|\xi_{if})$ and the marginal density of ξ_{if} by $g_f(\xi_{if})$. Given ξ_{if}, firm f will be chosen if $\xi_{ik} \leq V_f - V_k + \xi_{if}$. This means that the probability of firm f being chosen can be written as:

$$\theta_{if}(\boldsymbol{V}) = \int G_{-f}(V_f + \xi_{if} - \boldsymbol{V}_{-f}|\xi_{if}) g_f(\xi_{if}) d\xi_{if} \tag{34}$$

This EPF will automatically satisfy the probability, differentiability and monotonicity properties if $G(\boldsymbol{\xi})$ is continuously differentiable. The HoD0 property will be satisfied if V_f is a linear function of $logW_f$. On log-concavity, Prekopa's theorem can be used to show that if the joint density of the idiosyncratic errors are log-concave then the EPF will be log-concave in $\boldsymbol{V}$. If V_f is linear in log wages this log-concavity transfers to log-concavity of the EPF in log wages.

C.2 An EPF That Cannot Be Derived from an ARUM

This section provides a micro-foundation for a sensible EPF that cannot be derived from an ARUM in which individuals make choices with full awareness of the utility from every option. It has the form of the nested logit model. Assume that the utility from working for firm f in market m is given by:

$$U_{ifm} = \beta logW_{fm} + \alpha_{im}^{m} + \alpha_{ifm} + \sigma\xi_i^m + \xi_{ifm} \tag{35}$$

ξ_i^m is a market-level idiosyncratic component common to all firms in the market while ξ_{ifm} is specific to a firm within the market. Assume that all the idiosyncratic components are independently, identically distributed with a type-1 extreme value distribution (Gumbel). But, differently from the nested logit we assume that the individual has to choose the market before they have knowledge of ξ_{ifm} which is assumed to be revealed only after the market has been chosen but before the firm has been chosen. This model is best solved recursively. Given the choice of the market the probability of choosing firm f in market m is given by the familiar MNL logit form:

$$\theta_{ifm} = \frac{e^{\beta logW_{ifm}+\alpha_{ifm}}}{\sum_g e^{\beta logW_{igm}+\alpha_{igm}}} \tag{36}$$

From this one can derive the expected utility (inclusive value) from choosing market m net of the idiosyncratic component is proportional to:

$$IV_{im} = \frac{1}{\beta} log \sum_f e^{\beta logW_{ifm}+\alpha_{ifm}} \tag{37}$$

This expected utility together with the idiosyncratic component at the market level then leads to the following probability for the choice of market:

$$\theta_{im}^{m} = \frac{e^{\beta^m IV_{im} + \alpha_{im}^m}}{\sum_g e^{\beta^m IV_{ig} + \alpha_{ig}^m}} \tag{38}$$

In this model all possible values of β and β^m are possible e.g. the idiosyncratic component might be less important at the market level than at the firm level.

Note that the observed choice and expected utility in this sequential model are exactly the same as the nested logit model with simultaneous choice. But they have different assumptions about the distribution of the errors.

D Labour Market Segmentation

This section contains a simple example to show how a failure of log-concavity in the firm's labour supply curve can lead identical firms to offer different wages. There are two worker types who both have MNL EPFs but with different have wage elasticity parameters: assume $\beta_1 < \beta_2$. Utility is assumed to be given by $\beta_s \log W$ Assume a fraction α of the workforce is type 1. Workers are always employed (no outside option). There is a unit mass of identical firms each with a constant returns revenue function with marginal product of labour A for both types of worker.

Suppose there are at most two wages offered (W_1, W_2) with a fraction μ of firms post W_1 and fraction $(1 - \mu)$ post W_2. Then the labour supply of type-s workers to a firm posting wage W is proportional to:

$$N_s(W) \;=\; \frac{e^{\beta_s \log W}}{\mu\, e^{\beta_s \log W_1} + (1-\mu)\, e^{\beta_s \log W_2}}. \tag{39}$$

We assume each firm thinks it is sufficiently small as to take the denominator as given in deciding on its own wage so the labour supply curve of each type of worker is a constant β_s.Total labour supply to the firm is

$$N(W) \;=\; \alpha\, N_1(W) + (1-\alpha)\, N_2(W). \tag{40}$$

From (39) we have that:

$$\frac{\partial N_s}{\partial W} \;=\; \frac{\beta_s}{W}\, N_s(W). \tag{41}$$

Aggregating:

$$\frac{\partial N}{\partial W} \;=\; \frac{\alpha\, \beta_1\, N_1(W) + (1-\alpha)\, \beta_2\, N_2(W)}{W}. \tag{42}$$

so that the elasticity is given by:

$$\varepsilon = \frac{\beta_1 \alpha N_1(W) + \beta_2 (1-\alpha) N_2(W)}{\alpha\, N_1(W) + (1-\alpha)\, N_2(W)}. \tag{43}$$

The profit from posting wage W is given by:

$$\Pi \;=\; (A - W)\, N(W). \tag{44}$$

from which the first-order condition $\partial \Pi / \partial W = 0$ can be written as:

$$W = \frac{\varepsilon}{1+\varepsilon} A \tag{45}$$

where the elasticity is given by (43).

D.1 Symmetric Single-Wage Nash Equilibrium

We start by looking for a symmetric single-wage equilibrium in which all firms post the same wage W^* in which case the share of type-1 workers in every firm must be α the population share.

Substituting into (45) this leads to the following mark-down equation:

$$W^* = \frac{\bar{\beta}}{\bar{\beta}+1} A, \qquad \Pi^* = \frac{A}{\bar{\beta}+1}, \qquad \bar{\beta} = \alpha \beta_1 + (1-\alpha) \beta_2. \tag{46}$$

The elasticity of the labour supply curve will be a weighted average of the two elasticities using the population weights and we then have the usual markdown formula.

D.2 Possible Non-Existence of the Single-Wage Equilibrium

The single-wage W^* is always a *local* maximum of the profit function but not necessarily a global maximum. To see this imagine increasing $\beta_2 \to \infty$. As this happens we also have $\bar{\beta} \to \infty$ which implies, from (46) the markdown and profits go to zero. This cannot be an equilbirium as non-zero profits are available by offering a low-wage, to attract only the inelastic type-1 workers. To see that strictly positive profits are possible a firm offering a wage strictly below A will attract some type-1 workers making strictly positive profits.

D.3 The Two-Wage Equilibrium

Now consider the possibility of a two-wage equilibrium which will be a triple (W_1^*, W_2^*, μ^*) with (we can assume) $W_1^* < W_2^*$ and μ^* the share offering the low-wage. The labour supply at the two offered wages will be given by:

$$N_s(W_1^*) = \frac{1}{\mu^* + (1-\mu^*)\,(W_2^*/W_1^*)^{\beta_s}} \tag{47}$$

$$N_s(W_2^*) = \frac{(W_2^*/W_1^*)^{\beta_s}}{\mu^* + (1-\mu^*)\,(W_2^*/W_1^*)^{\beta_s}} \tag{48}$$

The triple must satisfy the first-order conditions at W_1^* and W_2^* and the two offered wages must offer the same level of profit and no other wages offer higher profit. These conditions can be written as:

(i) **FOC at W_1^***:

$$N(W_1^*;\, \mu^*, W_1^*, W_2^*) \;=\; (A - W_1^*)\, \frac{\partial N}{\partial W}\Big|_{W=W_1^*}, \tag{49}$$

(ii) **FOC at W_2^***:

$$N(W_2^*;\, \mu^*, W_1^*, W_2^*) \;=\; (A - W_2^*)\, \frac{\partial N}{\partial W}\Big|_{W=W_2^*}, \tag{50}$$

(iii) **Equal profit**:

$$\Pi(W_1^*;\, \mu^*, W_1^*, W_2^*) \;=\; \Pi(W_2^*;\, \mu^*, W_1^*, W_2^*), \tag{51}$$

(iv) Both W_1^* and W_2^* are *global* maxima of $\Pi(W;\, \mu^*, W_1^*, W_2^*)$ over $W \in (0, A)$.

Together, conditions (i)–(iii) form a 3×3 nonlinear system in (W_1^*, W_2^*, μ^*), which can be solved numerically while condition (iv) can be verified ex post on a dense wage grid.

To illustrate Table 2 shows the equilibrium as β_2 rises, with $\alpha = 0.5$, $\beta_1 = 0.5$, $A = 5$. The two-wage columns (W_1^*, W_2^*, μ^*, Π_{TW}) are filled only when the two-wage equilibrium exists.

Table 2: Equilibrium transition as β_2 rises ($\alpha = 0.5$, $\beta_1 = 0.5$, $A = 5.0$)

β_2	β_2/β_1	SW	W^*	Π^*	W_1^*	W_2^*	μ^*	Π_{TW}
3	6	Yes	3.182	1.818	–	–	–	–
5	10	Yes	3.667	1.333	–	–	–	–
6	12	Yes	3.824	1.176	–	–	–	–
7	14	No	3.947	1.053	1.740	3.997	0.191	1.156
8	16	No	4.048	0.952	1.697	4.177	0.469	1.271
10	20	No	4.200	0.800	1.672	4.388	0.688	1.394
15	30	No	4.429	0.571	1.667	4.623	0.847	1.512
20	40	No	4.556	0.444	1.667	4.727	0.898	1.558

Three patterns are notable. First, as β_2 grows the low wage W_1^* converges to $W_{\mathrm{low}} = A\beta_1/(\beta_1 + 1)$, the type-1 monopsony wage — firms posting W_1^* are effectively maximising profit from type-1 workers alone. Second, the high wage W_2^* approaches A as $\beta_2 \to \infty$, reflecting near-perfect competition for the elastic type-2 workers. Third, the mixing share μ^* rises with β_2: most firms post the low wage, with only a thin fringe posting the high wage to attract the (increasingly mobile) type-2 workers.

Note that the comparative statics of this model can also be non-standard. In the single-wage regime profit equals $A/(1+\bar{\beta})$ which is strictly decreasing in β_2 because raising the elastic type's elasticity raises $\bar{\beta}$ and reduces the markdown.

At the transition where the single-wage equilibrium breaks down, the two-wage equilibrium that emerges has profit above the single-wage profit because some firms are now offering low-wages. Once in a two-wage equilibrium profit is strictly increasing in β_2 As the elastic type becomes more responsive, firms can more effectively segment — posting a very low wage to harvest inelastic type-1 workers cheaply, while a thin fringe of high-wage firms captures the elastic type-2 workers at near-competitive wages. The profit minimum therefore occurs at the transition point. Before it, competition from elastic workers erodes the markup. After it, firms route around that competition by wage segmentation. The non-monotonicity is therefore a direct consequence of the discrete regime change from pooling (single wage) to segmentation (two wages).

Note also that the type-1 inelastic workers can be made worse off if the type-2 workers become more elastic and this causes the flip from a single to a two-wage equilibrium or we are already in the two-wage equilibrium.

Note that in this simple example there is always one equilibrium - either a one or two wages. Both cannot co-exist. But in more complicated models it is possible that there might be multiple equilibria.

E Market Power As the Choice Set Increases

We think of a competitive labour market as one in which a worker has lots of options. But does employer market power always fall as an extra firm is added to the choice set? And does market power go to zero as the number of firms in the choice set goes to infinity? This part of the Appendix addresses these questions.

We first consider the case where the worker has C firms in their choice set and employment is always preferred to unemployment. We use an ARUM in which utility of individual i at firm

f is given by $U_{if} = V_f + \xi_{if}$. Assume the idiosyncratic component is identically, independently distributed across firms with a cdf $G(\xi)$ assumed to be log-concave. Denote the minimum and maximum possible values of the idiosyncratic error by ξ_{min}, ξ_{max} (these might be infinite). Assume that all firms apart from firm f offer utility V and consider the labour supply curve to firm f as it varies its offer V_f.

For a given value of the idiosyncratic component in firm f, ξ, a worker will choose this firm if the utility available from this firm is lower than that available in all other firms which is $G\left(V_f - V + \xi\right)^{C-1}$. We then need to integrate over possible values of ξ so the EPF can be written as:

$$\theta\left(V_f; C\right) = \int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) G\left(V_f - V + \xi\right)^{C-1} d\xi \tag{52}$$

from which the elasticity of labour supply with respect to V_f can be written as (note that this can be converted to an elasticity with respect to the wage with an assumption about how W_f affects V_f):

$$\epsilon = \left(C-1\right) \frac{\int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) g\left(V_f - V + \xi\right) G\left(V_f - V + \xi\right)^{C-2} d\xi}{\int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) G\left(V_f - V + \xi\right)^{C-1} d\xi} \tag{53}$$

Evaluating at a symmetric equilibrium $V_f = V$ we have that:

$$\epsilon = C\left(C-1\right) \int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right)^2 G\left(\xi\right)^{C-2} d\xi \tag{54}$$

as the numerator of (53) will be $1/C$. Integrating by parts we have that:

$$\begin{aligned} \epsilon &= C\left[g\left(\xi\right) G\left(\xi\right)^{C-1}\right]_{\xi_{min}}^{\xi_{max}} - C\int_{\xi_{min}}^{\xi_{max}} g'\left(\xi\right) G\left(\xi\right)^{C-1} d\xi \\ &= Cg\left(\xi_{max}\right) - C\int_{\xi_{min}}^{\xi_{max}} \frac{g'\left(\xi\right)}{g\left(\xi\right)} g\left(\xi\right) G\left(\xi\right)^{C-1} d\xi \end{aligned} \tag{55}$$

and integrating the final term by parts leads to:

$$\epsilon = Cg\left(\xi_{max}\right) - \left[\frac{g'\left(\xi\right)}{g\left(\xi\right)} G\left(\xi\right)^{C}\right]_{\xi_{min}}^{\xi_{max}} + \int_{\xi_{min}}^{\xi_{max}} \left[\frac{g'\left(\xi\right)}{g\left(\xi\right)}\right]' G\left(\xi\right)^{C} d\xi \tag{56}$$

which can be written as:

$$\epsilon = \left[Cg\left(\xi_{max}\right) - \frac{g'\left(\xi_{max}\right)}{g\left(\xi_{max}\right)} + \int_{\xi_{min}}^{\xi_{max}} \left[\frac{g'\left(\xi\right)}{g\left(\xi\right)}\right]' G\left(\xi\right)^{C} d\xi\right] \tag{57}$$

Now consider how the elasticity varies with the number of firms in the choice set by differentiating (57) with respect to C leads to:

$$\frac{\partial \epsilon}{\partial C} = g\left(\xi_{max}\right) + \int_{\xi_{min}}^{\xi_{max}} \left[\frac{g'\left(\xi\right)}{g\left(\xi\right)}\right]' \left[logG\left(\xi\right)\right] G\left(\xi\right)^{C} d\xi \tag{58}$$

The first term is obviously non-negative. The second term is positive if the density $g(\xi)$ is log-concave because log concavity of $g\left(\xi\right)$ implies that $\left[\frac{g'(\xi)}{g(\xi)}\right]' \leq 0$ and $logG\left(\xi\right) \leq 0$. Log-concavity of $g(\xi)$ implies log-concavity of $G(\xi)$ but not vice-versa so this is a stronger condition Bagnoli and Bergstrom (2005).

Now differentiate again to give:

$$\frac{\partial^2 \epsilon}{\partial C^2} = \int_{\xi_{min}}^{\xi_{max}} \left[\frac{g'\left(\xi\right)}{g\left(\xi\right)}\right]' \left[logG\left(\xi\right)\right]^2 G\left(\xi\right)^{C} d\xi \tag{59}$$

If $g(\xi)$ is log-concave this must be non-positive proving concavity, that the marginal effect of an extra firm falls as more and more firms are added. The next section discuss what happens to employer market power as the number of firms becomes very large.

E.1 The elasticity of labour supply as $C \to \infty$

This section shows that if the hazard rate of $g(\xi)$ is continuous in the vicinity of the upper tail then a necessary and sufficient condition for market power to go to zero as $Z \to \infty$ is that the hazard rate goes to zero in the tail of the distribution. Define:

$$\bar{G}(\xi) = 1 - G(\xi), \qquad h(\xi) = \frac{g(\xi)}{\bar{G}(\xi)} \tag{60}$$

the survival function and hazard rate, respectively. Then

$$g(\xi) = h(\xi)\bar{G}(\xi), \tag{61}$$

and define:

$$I_C = \int g(\xi)^2 G(\xi)^{C-1}\, d\xi = \int h(\xi) g(\xi) \bar{G}(\xi) G(\xi)^{C-1}\, d\xi. \tag{62}$$

Making the change of variables

$$q = G(\xi), \qquad dq = g(\xi)\, d\xi, \tag{63}$$

yields

$$I_C = \int_0^1 h(G^{-1}(q))(1-q)q^{C-1}\, dq. \tag{64}$$

Hence

$$\varepsilon = C(C-1)I_C = C(C-1)\int_0^1 h(G^{-1}(q))(1-q)q^{C-1}\, dq. \tag{65}$$

To prove sufficiency assume that

$$h(\xi) \longrightarrow 0 \qquad \text{as } \xi \to \xi_m ax, \tag{66}$$

where $\xi_m ax$ is the upper endpoint of the support.

Let $\tau > 0$. By (66), there exists $q_0 < 1$ such that

$$h(G^{-1}(q)) \leq \tau, \qquad q \geq q_0. \tag{67}$$

Split the integral in (64) as

$$I_C = I_{1,C} + I_{2,C}, \tag{68}$$

where

$$I_{1,C} = \int_0^{q_0} h(G^{-1}(q))(1-q)q^{C-1}\,dq, \tag{69}$$

$$I_{2,C} = \int_{q_0}^{1} h(G^{-1}(q))(1-q)q^{C-1}\,dq. \tag{70}$$

Using (67),

$$\begin{aligned} I_{2,C} &\leq \tau \int_{q_0}^{1} (1-q)q^{C-1}\,dq \\ &\leq \tau \int_0^1 (1-q)q^{C-1}\,dq = \frac{\tau}{C(C+1)}, \end{aligned} \tag{71}$$

since

$$\int_0^1 (1-q)q^{C-1}\,dq = \frac{1}{C(C+1)}. \tag{72}$$

Therefore,

$$C(C-1)I_{2,C} \leq \tau\frac{C-1}{C+1} \leq \tau. \tag{73}$$

Next, let

$$M = \sup_{0\leq q\leq q_0} h(G^{-1}(q))(1-q), \tag{74}$$

which is finite provided the hazard rate is locally bounded. Then

$$I_{1,C} \leq M \int_0^{q_0} q^{C-1}\,dq = M\frac{q_0^C}{C}, \tag{75}$$

and hence

$$C(C-1)I_{1,C} \leq M(C-1)q_0^C \longrightarrow 0, \tag{76}$$

since $q_0 < 1$.

Combining (68), (73), and (76),

$$\limsup_{C\to\infty} C(C-1)I_C \le \tau. \tag{77}$$

Since $\tau > 0$ is arbitrary,

$$C(C-1)\int g(\xi)^2 G(\xi)^{C-1}\,d\xi \longrightarrow 0. \tag{78}$$

To prove necessity assume that the hazard rate $h(\xi)$ is continuous in a neighbourhood of the upper endpoint ξ_max, and that

$$C(C-1)\int g(\xi)^2 G(\xi)^{C-1}\,d\xi \longrightarrow 0. \tag{79}$$

As before,

$$C(C-1)\int g(\xi)^2 G(\xi)^{C-1}\,d\xi = \int_0^1 h(G^{-1}(q))\,d\mu_C(q), \tag{80}$$

where

$$d\mu_C(q) = C(C-1)(1-q)q^{C-1}\,dq. \tag{81}$$

Moreover,

$$\int_0^1 d\mu_C(q) = \frac{C-1}{C+1} \longrightarrow 1, \tag{82}$$

and for every $q_0 < 1$,

$$\mu_C([0,q_0]) = C(C-1)\int_0^{q_0}(1-q)q^{C-1}\,dq \longrightarrow 0. \tag{83}$$

Hence $\{\mu_C\}$ is an approximate identity concentrating at $q = 1$.

Since h is continuous at ξ_max, the function

$$q \mapsto h(G^{-1}(q))$$

is continuous at $q = 1$. Therefore,

$$\int_0^1 h(G^{-1}(q))\, d\mu_C(q) \longrightarrow h(\xi_m ax). \tag{84}$$

Combining (79), (80), and (84) yields

$$h(\xi_m ax) = 0.$$

Since continuity implies

$$\lim_{\xi \to \xi_m ax} h(\xi) = h(\xi_m ax),$$

it follows that

$$\lim_{\xi \to \xi_m ax} h(\xi) = 0. \tag{85}$$

This establishes the necessity.

E.2 The Importance of Symmetry

This section shows that in an asymmetric situation, it is no longer necessarily the case that more firms leads to more competition even under the assumptions made previously about log-concavity of the distribution and density functions. To see this write (52) as:

$$\theta\left(V_f; C\right) = \int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) G_C\left(V_f - V + \xi\right) d\xi \tag{86}$$

where $G_C\left(V_f - V + \xi\right) = G\left(V_f - V + \xi\right)^{C-1}$. From this we can derive:

$$\frac{\partial log\theta\left(V_f; C\right)}{\partial V_f} = \frac{\int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) G_C\left(V_f - V + \xi\right) \frac{\partial log G_C\left(V_f - V + \xi\right)}{\partial V_f} d\xi}{\int_{\xi_{min}}^{\xi_{max}} g\left(\xi\right) G_C\left(V_f - V + \xi\right) d\xi} \tag{87}$$

This can be written as:

$$\frac{\partial log\theta\left(V_f;C\right)}{\partial V_f}=\mathbb{E}\left(\frac{\partial logG_C\left(V_f-V+\xi\right)}{\partial\xi}\right)\tag{88}$$

where the expectation is with respect to the probability measure $g(\xi)\,G_C\left(V_f-V+\xi\right)$.

Now consider adding another firm j to the choice set with cdf of its idiosyncratic error given by $G_j\left(V_f+\xi\right)$ (one can embed V_j in the cdf itself. Now the probability of choosing firm f can be written as:

$$\theta'\left(V_f;C\right)=\int_{\xi_{min}}^{\xi_{max}}g(\xi)\,G_C\left(V_f-V+\xi\right)G_j\left(V_f+\xi\right)d\xi\tag{89}$$

From this we can derive:

$$\frac{\partial log\theta'\left(V_f;C\right)}{\partial V_f}=\frac{\int_{\xi_{min}}^{\xi_{max}}g(\xi)\,G_C\left(V_f-V+\xi\right)\left(G_j\left(V_f+\xi\right)\frac{\partial logG_C\left(V_f-V+\xi\right)}{\partial V_f}+g_j\left(V_f+\xi\right)\right)d\xi}{\int_{\xi_{min}}^{\xi_{max}}g(\xi)\,G_C\left(V_f-V+\xi\right)G_j\left(V_f+\xi\right)d\xi}\tag{90}$$

This can be written as:

$$\frac{\partial log\theta\left(V_f;C\right)}{\partial V_f}=\frac{\mathbb{E}\left(\frac{G_j\partial logG_C}{\partial\xi}+g_j\right)}{\mathbb{E}\left(G_j\right)}\tag{91}$$

where the expectation is again with respect to the probability measure $g(\xi)\,G_C\left(V_f-V+\xi\right)$. Comparing (91) with (88) we have:

$$\begin{aligned}\frac{\partial log\theta'\left(V_f;C\right)}{\partial V_f}-\frac{\partial log\theta\left(V_f;C\right)}{\partial V_f}&=\\ \mathbb{E}\left(G_j\right)\left[\mathbb{E}\left(g_j\right)+\mathbb{E}\left(G_j\frac{\partial logG_C}{\partial\xi}\right)-\mathbb{E}\left(\frac{\partial logG_C}{\partial\xi}\right)\mathbb{E}\left(G_j\right)\right]&\\ =\mathbb{E}\left(G_j\right)\left[\mathbb{E}\left(g_j\right)+Cov\left(G_j,\frac{\partial logG_C}{\partial\xi}\right)\right]&\end{aligned}\tag{92}$$

The first term is positive but the second term is negative as G_j is increasing in its argument but log-concavity means that $\frac{\partial logG_C}{\partial\xi}$ is decreasing.

The idea that adding more firms might not necessarily make markets more competitive can be found in IO in a number of papers, e.g. Perloff and Salop (1985); Gabaix et al. (2016).

F A Simple Model with Employer Selection

Profits can be written as:

$$\Pi = \int_W (A - W)N(W, A)dA = W^\varepsilon \int_W (A - W)n(A)dA \tag{93}$$

The first-order condition for the wage can be written as:

$$W = \frac{\varepsilon}{1+\varepsilon} \frac{\int_W An(A)dA}{\int_W n(A)dA} = \frac{\varepsilon}{1+\varepsilon}\bar{A} \tag{94}$$

where $\bar{A}$ is the average level of productivity among employed workers. Now consider a small increase in the wage from the monopsony wage. The response of employment is given by:

$$\frac{\partial logN}{\partial logW} = \varepsilon - \frac{Wn(W)}{\int_W n(A)dA} \tag{95}$$

The first term is the standard but the second is a negative labour demand effect that can be larger. If, for example, A has a Pareto distribution then the second term is the Pareto parameter provided W exceeds the lower support of the distribution. More detail on this type of model can be found in Hirsch et al. (2026).

G Integration of Static and Burdett-Mortensen Models

We will consider a simple version of Burdett-Mortensen in which job offers arrive at a rate λ, the same for both employed and unemployed. Each time job offers arrive, there are C of them. Jobs are destroyed at an exogenous rate δ.

For illustrative purposes we assume that the unemployed always accept any job offer of at least

B. and reject any offer below that [24] This means that the unemployment rate will be given by:

$$u = \frac{\delta}{\delta + \lambda} \tag{96}$$

as in the classic Burdett-Mortensen model.

When choosing between wage offers we assume the workers have a ARUM leading to a MNL model for choice. We assume the idiosyncratic component is permanent so a worker who prefers one job to another now will prefer it for ever.

To derive the extent of employer market power we need the wage elasticity of the labour supply curve to a firm that pays a wage W_f. This will depend on the wages offered by other firm which the worker receives offers from. Because we are looking for a single-wage equilibrium (and to decide whether it exists) we assume that all other firms are paying W and consider the labour supply of a deviating firm.

A useful trick given our assumptions is the following. Whenever workers become unemployed, all previous job opportunities become void; the worker is forced to start the process of finding a good job again. Index by x the number of sessions the worker has had to take or change jobs since last becoming unemployed. Denote by $\eta(x)$ the fraction of workers at every point in time who have had x opportunities. The fraction of workers who have had x sessions follows the recursion $(\delta + \lambda)\eta(x) = \lambda\eta(x-1)$ and $\eta(0) = u$ so:

$$\eta(x) = \left(\frac{\lambda}{\delta + \lambda}\right)^x \eta(0) = \left(\frac{\lambda}{\delta + \lambda}\right)^x \frac{\delta}{\delta + \lambda} \tag{97}$$

To keep things simple assume that the overall set of firms is so large that a firm is never sampled twice. Then a worker who has had x sessions will have sampled Cx different jobs. From these jobs, the worker will take the best option: the order that these jobs will have been received does not matter;

[24] This is to make the model as simple as possible. Natural alternatives would be to assume the utility from unemployment has a random idiosyncratic component so the choice between non-employment and work is a MNL model. Or that there is a NL model with the upper nest being the employment/non-employment choice.

An individual firm will hire a worker who has had x (> 0) sessions if they are one of the firms being considered (this happens with probability proportional to Cx) and if they are the best option. The probability they are the best option if they pay W_f and all other firms pay W is $\frac{W_f^{\beta}}{W_f^{\beta}+(Cx-1)W^{\beta}}$ This means that labour supply to a firm that pays W_f will be proportional to:

$$N_f\left(W_f, W\right) = C\sum_{x=1}^{\infty}\eta\left(x\right)x\frac{W_f^{\beta}}{W_f^{\beta}+(Cx-1)W^{\beta}} \tag{98}$$

The derivative with respect to $\log W_f$ is then given by:

$$\frac{\partial N_f\left(W_f, W\right)}{\partial \log W_f} = \beta C\sum_{x=1}^{\infty}\eta\left(x\right)x\left[\frac{W_f^{\beta}(Cx-1)W^{\beta}}{\left(W_f^{\beta}+(Cx-1)W^{\beta}\right)^2}\right] \tag{99}$$

Note that, conditional on x the labour supply curve is log-concave in log-wages. But, as noted before, the sum of log-concave functions may not be log-concave and this will turn out to be the potential source of the failure of the single-wage equilibrium to exist. Evaluating at $W_f = W$ (as must be the case in a symmetric equilibrium) we have that employment is proportional to :

$$N_f\left(W, W\right) = \sum_{x=1}^{\infty}\eta\left(x\right) = \frac{\lambda}{\delta+\lambda} \tag{100}$$

. and the derivative evaluated at $W_f = W$ is:

$$\frac{\partial N_f\left(W, W\right)}{\partial \log W_f} = \beta\sum_{x=1}^{\infty}\eta\left(x\right)\left(1-\frac{1}{Cx}\right) \tag{101}$$

from which the elasticity in the single wage equilibrium must satisfy:

$$\varepsilon_f^N = \frac{\delta+\lambda}{\lambda}\beta\sum_{x=1}^{\infty}\eta(x)\left(1-\frac{1}{Cx}\right) = \beta\left[1-\frac{\ln(1+k)}{Ck}\right] \tag{102}$$

where $k = \lambda/\delta$. The first-order condition for profit maximization will be the usual mark-down equation which, if all firms have a constant returns revenue function, for a single-wage equilibrium can be written as:

$$W = \frac{\varepsilon_f^N}{1+\varepsilon_f^N} A \tag{103}$$

The elasticity is strictly increasing in β,C and k as would be predicted. Note also that if we fix the total rate of arrival of job offers λC, the elasticity is declining in k. It is better for workers to receive many job offers occasionally than fewer more frequently.

G.1 The Existence of a Single-Wage Equilibrium

So far we have derived an equation for the single-wage equilibrium if it exists but have not shown it exists. In a single-wage equilibrium profits are given by:

$$\Pi = \frac{1}{1+\varepsilon_f^N} \frac{\lambda}{\lambda+\delta} A \tag{104}$$

We can then imagine a single firm deviating and check whether alternative wages offer higher profits - if so the single wage equilibrium cannot exist. The simplest way to see the single-wage equilibrium might not exist is to note that if $\beta \to \infty$ the single-wage equilibrium has profits going to zero. But strictly positive profits are available at other wages.

In what follows we derive a sufficient condition for the single-wage equilibrium to exist. Imagine $C = 1$ and a firm offers B, the minimum wage acceptable to the unemployed and that whenever the workers of this firm have another offer they always quit. This firm will then only ever recruit from unemployment. Its separation rate will be $\lambda + \delta$ and its recruitment rate $\lambda u = \frac{\lambda\delta}{\lambda+\delta}$ so its profits are:

$$\Pi_B = (A-B)\frac{\lambda\delta}{(\lambda+\delta)^2} \tag{105}$$

which is independent of β. One can then see that there is a threshold value of β above which the single-wage equilibrium fails to exist as the level of profit in the single-wage equilibrium is lower than the level of profit in the strategy just described. This is a sufficient condition not a necessary one - in reality a firm paying B would not lose all workers to other jobs when they receive an offer and would recruit some because of the idiosyncrasy in preferences. And wages other than B might be more profitable. But this example suffices to show the single wage equilibrium may fail to exist.

For $C > 1$ this argument does not work as a low-wage firm always faces competition from at least one other firm when recruiting the unemployed. We have failed to find a situation in which the single wage equilibrium fails to exist when $C > 1$ but we do not have a proof. Where the single-wage equilibrium does not exist, we have also not derived what the equilibrium looks like. We leave that to others.

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