

Worker Bargaining Power and Market Tightness: Theory and Evidence *

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Abstract

What determines worker bargaining power? This paper argues that bargaining power is an equilibrium outcome of labour market conditions: when alternative employers are easier to find, a worker's threat to walk away from a negotiation becomes credible, and the worker's bargaining power rises. I formalise this in a non-cooperative bargaining model in which workers and firms keep searching while they negotiate. In equilibrium, bargaining power is strictly increasing in labour market tightness. The model delivers an empirical counterpart: bargaining power is the pass-through of firm productivity into wages, which should therefore rise with tightness. Using French matched employer-employee data and measures of local labour market tightness, I find that a one euro increase in the hourly marginal product of labour raises the hourly wage by 5.2 cents at average tightness and by 7.1 cents one standard deviation above it, a 37% increase in pass-through.

Keywords: Bargaining power, labour share, non-cooperative bargaining, search and matching, monopsony

JEL Codes: C78, D83, J21, J31, J42, L13

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1 Introduction

When a worker and a firm enter an employment relationship, they create value. When this value increases, workers capture only part of the gain: a 10% increase in value added per worker raises wages by 0.5 to 1.5% (Card et al., 2018). The share captured by workers reflects their bargaining power, which varies systematically across countries, firms, worker types, and over time (Cahuc et al., 2006; Stansbury and Summers, 2020; Mengano, 2022; Bell et al., 2024). Labour market tightness, the number of vacancies per job seeker, is a natural candidate to explain this variation: workers should be able to capture more of the gains when they are more difficult to replace.

While the intuition is simple, formalising it has proved challenging. Once a worker and a firm meet to negotiate a wage, it is not obvious how opportunities elsewhere should affect the wage they negotiate. Hall and Milgrom (2008) argue that outside options should matter little, because the credible threat is to delay agreement rather than return to search. Others allow labour market competition to affect wages through other channels such as on-the-job search or threat points, while keeping the bargaining weight fixed (Cahuc et al., 2006; Jarosch et al., 2024). An open question is whether market conditions can alter bargaining power itself.

This paper shows that they can. I develop a theory of wage bargaining that combines three features. First, workers and firms bargain by *alternating offers*, taking turns to propose a wage. Second, there is *continued search*: while negotiating, both sides may be paired with new potential partners before the counteroffer is made. Third, these new opportunities do not mechanically end an ongoing negotiation. Agents make an *endogenous partner choice*, deciding whether to continue with their current partner or pursue the new one. If they choose a new partner, the previous negotiation breaks down before a counteroffer can be made. The key innovation is this third feature: by making partner choice endogenous, the model determines in equilibrium whether and how an outside opportunity affects the ongoing negotiation.

Together, these three features generate an endogenous risk that a negotiation breaks down after a rejected offer. This risk depends naturally on how easily each side finds an alternative partner, but also on bargaining roles. In equilibrium, each side obtains a larger value when acting as proposer than when acting as responder. An agent is therefore more reluctant to abandon a negotiation in which they are about to propose than one in which they would respond. Consequently, the probability that a negotiation survives differs depending on who rejected the previous offer: the worker or the firm.

The probability that a negotiation survives, in turn, determines the value of rejecting

an offer. In this alternating offers framework, the value of an agreement for each party is ultimately determined by the *value of rejecting*: whoever makes an offer must guarantee the other party a value at least as large as that of rejecting and continuing to negotiate. Importantly, obtaining a higher value does not necessarily imply greater bargaining power. What matters is the value of agreement *relative to the value of the outside option*, which is the value of continuing the search by abandoning the negotiation. This difference is each party's surplus, and the share of total surplus they obtain represents their bargaining power.

Labour market tightness affects these two values through opposing channels. Consider a worker who receives a wage offer from a firm. If the worker rejects, they become the proposer in the following round, provided the negotiation continues. First, a tighter labour market makes it less likely that the firm finds another worker and abandons the negotiation. The worker is therefore more likely to have the opportunity to voice their counteroffer. This raises the value of continuing to negotiate and, consequently, the value of the agreement the firm must offer.

However, a tighter labour market also increases the value of the worker's outside option, their unemployment value. An unemployed worker benefits from finding a new firm, regardless of who gets to propose. By contrast, a worker who has just rejected an offer already expects to propose in the ongoing negotiation. When they encounter a new firm that would propose, they choose to remain in the ongoing negotiation, where they have the more valuable role. This choice is optimal, but comes at the cost of foregoing an opportunity that would have been valuable if unemployed. As such opportunities become more frequent in a tighter labour market, the value of unemployment rises more than the value of continuing to negotiate through this channel. Since surplus is the difference between the value of agreement and the value of unemployment, this puts downward pressure on the worker's bargaining power.

Despite these opposing forces, the model delivers a sharp result. In the symmetric benchmark, where workers and firms are equally likely to make the first offer, worker bargaining power is strictly increasing in labour market tightness. I then allow the probability of making the first offer to differ across the two sides. The positive relationship continues to hold as long as market tightness sufficiently changes the relative ease with which workers and firms find alternative partners. The relationship remains positive across standard pairing technologies and a wide range of empirically plausible parameter values. It can reverse only when the firm's probability of finding another worker is almost unresponsive to tightness: in that case, the worker's opportunity cost of delay rises while the reduction in breakdown risk is negligible.

This benchmark isolates how bargaining power varies across labour markets that have

different degrees of market tightness, but abstracts from an important source of variation within them: matches differ in the total value they create. I therefore extend the model to allow for firm heterogeneity. A worker negotiating with a more productive firm requires a more attractive alternative before it becomes worthwhile to abandon the current negotiation. As the productivity of the current firm rises, a smaller fraction of the outside opportunities encountered by the worker therefore become credible alternatives. The extension implies that more productive firms pay higher wages, while workers capture a smaller share of increases in productivity. It also predicts that the effect of labour market tightness on worker bargaining power becomes weaker as firm productivity rises, and can turn negative at the top of the productivity distribution.

The theory provides a direct way to take these predictions to the data. In the model, worker bargaining power is equal to the pass-through of productivity into wages: the share of a marginal increase in productivity that is reflected in the worker’s wage. The model therefore predicts that pass-through should be higher in tighter labour markets. It further predicts that pass-through should decline with firm productivity, and that its sensitivity to labour market tightness should weaken as firm productivity rises.

I test these predictions using French matched employer–employee data linked to measures of local labour market tightness at the occupation-by-location-by-year level. I estimate industry-specific production functions to construct each firm’s hourly marginal revenue product of labour. At the worker level, I relate hourly wages to the marginal revenue product of the worker’s firm, local labour market tightness, and their interaction. The interaction is the key empirical object: it measures whether the pass-through of marginal revenue product into wages is higher in tighter labour markets, as predicted by the model.

Because local labour market tightness is jointly determined with wages, I instrument it using the leave-one-out average tightness of the same occupation in other locations. The instrument exploits occupation-wide shifts in labour demand that are common across locations, while excluding tightness in the worker’s own local labour market. The identifying variation therefore comes from changes in the demand for an occupation outside the worker’s own location. I additionally instrument the firm’s current marginal revenue product using its lag, addressing potential endogeneity and measurement error in the productivity measure.

The central prediction is strongly supported by the data. The pass-through of the firm’s marginal revenue product of labour into wages increases with labour market tightness. The interaction between marginal revenue product and local tightness is positive and robust across specifications. In my preferred specification with firm fixed effects, a one-euro increase in the firm’s hourly marginal revenue product of labour raises the worker’s hourly wage by about 5.2 cents at average labour market tightness. A one-standard-deviation increase in

tightness raises this pass-through by a further 1.9 cents, from 5.2 to 7.1 cents on the euro. This corresponds to a 37% increase in the degree of pass-through.

I next test the predictions of the heterogeneous firm extension and ask whether this bargaining mechanism operates differently across firms of different productivity. I rank firms by their revenue productivity within industry, location, and year and divide them into deciles. I then estimate productivity pass-through separately across these deciles, continuing to use the marginal revenue product of labour as the productivity measure whose pass-through into wages I estimate. The distinction is important: marginal revenue product determines how many cents of an additional euro generated by labour are passed on to wages, while the firm’s revenue productivity decile captures the type of firm with which the worker is bargaining. The results reveal substantial heterogeneity. Among firms in the lower part of the revenue productivity distribution, workers receive around 30–40 cents in higher wages for each additional euro of marginal revenue product. Pass-through then declines markedly across the distribution, falling to approximately 17 cents on the euro in the ninth revenue productivity decile and to about 4 cents among firms in the top decile. Workers bargaining with highly productive firms therefore capture a substantially smaller share of marginal increases in the firm’s marginal revenue product through their wages. The response of pass-through to labour market tightness also weakens toward the top of the revenue productivity distribution. The tightness interaction is economically sizeable across several lower and middle deciles, but close to zero among the most productive firms. These patterns are consistent with the mechanism of the model: when a match generates greater surplus, fewer outside opportunities are sufficiently attractive to constitute credible alternatives, weakening the role of outside opportunities in the wage bargain.

Related literature. This paper builds on bargaining theory and the literature studying wage bargaining in frictional labour markets. The seminal paper by Hall and Milgrom (2008) emphasises the cost of delaying agreement, while Rubinstein and Wolinsky (1985) allow search to continue during bargaining. I preserve both forces but make the decision to abandon an ongoing negotiation for a newly available partner endogenous. In contrast to these models, my model delivers bargaining weights that respond positively to the availability of outside options.

The model is closely related to Cahuc et al. (2006), where on-the-job search and outside offers generate competition between employers. Jarosch et al. (2024) show that workers cannot use other vacancies at their current employer as outside options, so larger employers effectively remove more alternatives from the worker’s choice set. My paper complements these models by endogenising the bargaining weight which is an exogenous parameter in these

models. Furthermore, these models do not generate the prediction that productivity pass-through increases with labour market tightness, allowing me to distinguish my mechanism empirically.

Closest to my central prediction, Mangin and Sedláček (2018) and Autor et al. (2023) also imply that tighter labour markets increase workers' share of productivity, through direct firm competition and lower monopsony markdowns, respectively. My mechanism instead arises from two-sided search during bargaining, in which both workers and firms can encounter alternative partners. A further distinction is distributional: my model predicts that bargaining power declines with firm productivity, a pattern I also find in the data.

The empirical analysis relates to two further literatures. First, a large literature documents incomplete rent sharing between firms and workers (Card et al., 2018), while recent work documents substantial variation in worker bargaining power and rent sharing over time (Stansbury and Summers, 2020; Mengano, 2022). My mechanism provides a potential explanation for these trends. Córdoba et al. (2023) show that the efficient bargaining weight under CES technology can vary with labour market tightness and can contribute to movements in the labour share. I instead derive the bargaining weight from a non-cooperative bargaining game and causally test its implications using worker–firm data. Second, recent empirical work shows that tighter labour markets raise wages, particularly toward the bottom of the wage distribution (Börschlein et al., 2024). Rather than estimating the effect of tightness on wages directly, I ask whether tightness changes the pass-through of firm productivity into wages, providing a direct test of whether the division of surplus varies with labour market conditions.

The remainder of the paper is organised as follows. Section 2 presents the benchmark bargaining model, characterises equilibrium bargaining power, and establishes its relationship with labour market tightness. Section 3 extends the framework to heterogeneous firms and examines how bargaining power varies with firm productivity. Section 4 describes the data and the construction of the main variables. Section 5 presents the empirical strategy, while Section 6 reports the results. Section 7 concludes.

2 Model

I develop a partial equilibrium model of a frictional labour market in which workers and firms bargain over wages while continuing to search for alternative partners.

2.1 Environment

The economy is populated by workers and firms. At any point in time, a mass N_u of workers are unemployed and searching for jobs, while a mass N_v of vacancies are available at firms, each with one position to fill. Labour market tightness is defined as $\theta = \frac{N_v}{N_u}$, the number of vacancies per unemployed worker.

Time is discrete and infinite. Agents are risk neutral and discount future payoffs by a common factor $\delta \in (0, 1)$. An employment relationship produces a period output p , of which the worker receives a wage w and the firm retains $p - w$. At the end of each period, the relationship is destroyed with exogenous separation probability $s \in (0, 1)$, after which the worker returns to unemployment and the firm reopens its vacancy. While unemployed, workers receive a period utility b , whereas firms incur a period cost c to maintain an unfilled vacancy. I assume that employment generates strictly positive joint surplus relative to continued search, $p - b + c > 0$.

Let V_i^0 denote the value of searching, measured at the start of a period, with $i \in \{w, f\}$, where w denotes a worker and f a firm. It depends on equilibrium behaviour and is deferred to Section 2.5. Given V_i^0 , the value of an employment relationship at wage w , measured at the start of a production period, satisfies

$$\begin{aligned} V_w(w) &= w + \delta[(1 - s)V_w(w) + sV_w^0], \\ V_f(w) &= p - w + \delta[(1 - s)V_f(w) + sV_f^0]. \end{aligned} \tag{1}$$

Workers and firms are paired through a frictional process. Each period, an unemployed worker is paired with a firm with probability $\lambda_w(\theta)$, while a firm with an open vacancy is paired with a worker with probability $\lambda_f(\theta)$, where both probabilities lie in $(0, 1)$. Higher market tightness increases the probability that a worker is paired with a firm and decreases the probability that a firm is paired with a worker:

$$\lambda'_w(\theta) > 0, \quad \lambda'_f(\theta) < 0. \tag{2}$$

Pairings are one to one, implying that $\lambda_w(\theta) = \theta\lambda_f(\theta)$. Pairing draws are independent over time, and each agent can be paired with at most one new partner per period.

I consider a stationary environment in which the masses of unemployed workers and vacancies remain constant over time. Workers and firms that leave the search market following an employment agreement are replaced by new entrants.

Throughout the analysis, I take N_u and N_v , and hence labour market tightness θ , as given. This allows me to isolate how tightness affects the division of surplus between workers and

firms. It also reflects the empirical setting, where different labour markets exhibit different levels of tightness. These differences may arise from productivity, labour supply, product market demand, or other factors. Rather than modelling their determinants, I study how bargaining outcomes vary with tightness.

2.2 Timing

Each period consists of a pairing stage followed by a bargaining stage. In the pairing stage, new worker and firm pairs are formed according to the pairing probabilities $\lambda_w(\theta)$ and $\lambda_f(\theta)$. For each new pairing, Nature selects the initial proposer, assigning the role to the firm with probability μ and to the worker with probability $1 - \mu$. In the baseline model, I set $\mu = 1/2$, so that workers and firms are equally likely to make the initial offer.

In the bargaining stage, a worker and a firm negotiate over the wage through the alternating offers protocol of Rubinstein (1982). The proposer offers a wage w , which the responder either accepts or rejects. If the offer is accepted, an employment relationship is formed, and production begins in the following period. Both agents leave the search market and are replaced by new entrants.

If an offer is rejected, the negotiation can continue into the following period, with the responder becoming the next proposer. Importantly, bargaining does not remove agents from the pairing process. Before the counteroffer is made, both parties return to the pairing stage and may be paired with alternative partners. Figure 1 illustrates the timing of a negotiation following a pairing.

All negotiations take place simultaneously, and an agent can attend at most one of them. Any negotiation that either party does not attend dissolves permanently, and the parties lose contact. An agent can therefore carry at most one ongoing negotiation from the previous period. Since each agent can also be paired with at most one new partner per period, they can have at most two available negotiations: an ongoing one and a newly formed one.

At the end of the pairing stage, after Nature's proposer draws, each agent chooses which negotiation, if any, to attend. These decisions are simultaneous. A negotiation proceeds to bargaining only if both parties choose to attend it.

2.3 Information and Markov strategies

We restrict attention to Markov strategies, common to all agents of the same type. Under these strategies, agents behave in the same way whenever they face the same bargaining opportunities. At the pairing stage, their decisions depend only on the negotiations currently available to them and their bargaining role in each. At the bargaining stage, wage offers

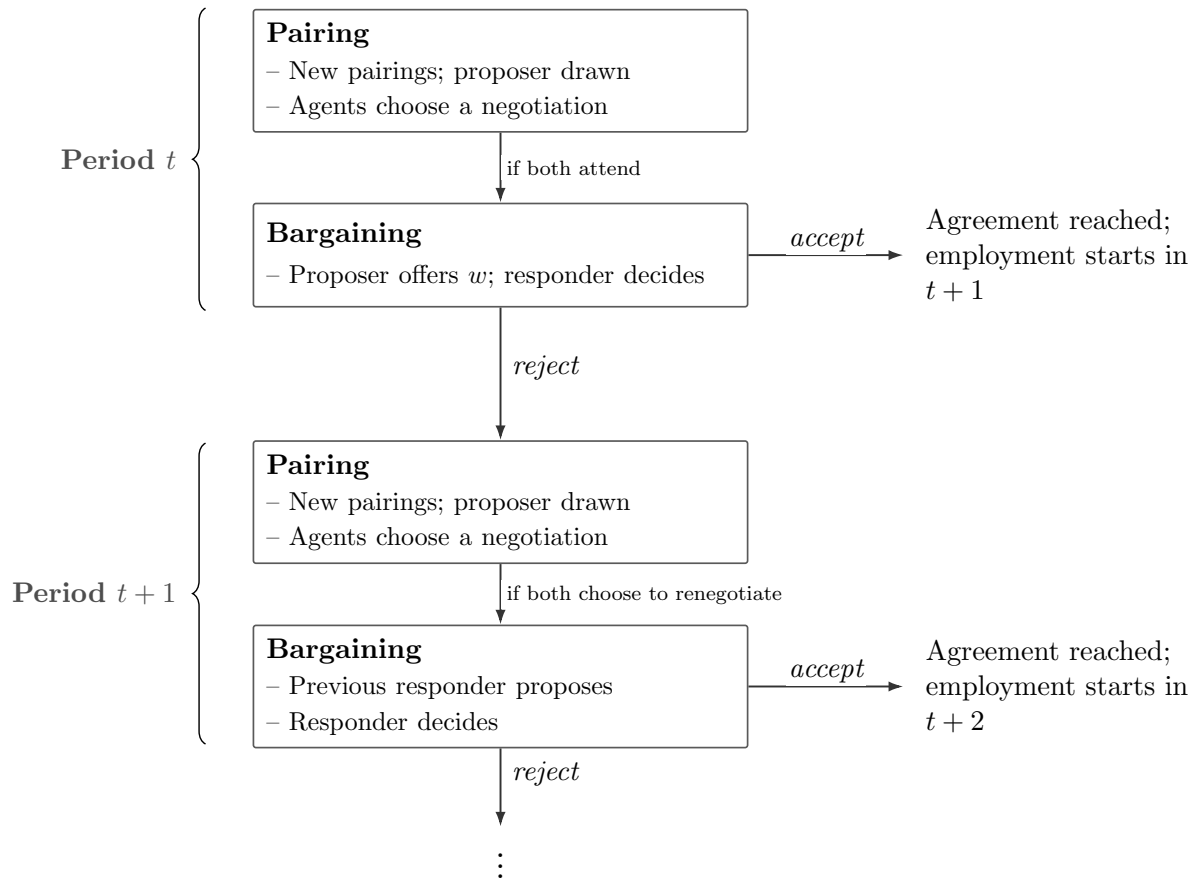


Figure 1: Timeline of a worker–firm negotiation. Following a rejection, both agents return to the pairing stage, and the negotiation resumes only if both choose to attend it.

depend only on the identity of the proposer, while acceptance decisions depend on the wage offered. Strategies are independent of calendar time, previously rejected offers, the duration of negotiations, and agents' past relationships.

At the pairing stage, an agent observes their available negotiations and the bargaining role they would occupy in each. For an ongoing negotiation, this role is determined by the previous rejection; for a new negotiation, it is determined by Nature's draw.

Formally, the state of agent i at the pairing stage is

$$s_i = (q_i^o, q_i^n), \quad q_i^o, q_i^n \in \{P, R, 0\}, \quad (3)$$

where P and R denote proposer and responder, respectively, and 0 indicates that a negotiation is unavailable. The superscripts o and n refer to ongoing and new negotiations.

An attendance strategy specifies which negotiation an agent chooses to attend in each state:

$$a_i(s_i) \in \{o, n, 0\},$$

where the choice set is restricted to available negotiations and 0 denotes attending neither. When an agent is indifferent between attending their only available negotiation and attending none, I adopt the convention that they attend.¹

Agents observe their own state but not the other negotiations available to their partners. Thus, an agent does not know whether a partner will choose to attend their common negotiation. Attendance decisions take into account both the bargaining role in each negotiation and the probability that the respective partner also attends. Since pairing draws are independent over time and strategies are Markov, an agent's beliefs about their partner's alternatives are given by the pairing probabilities and are never revised along the history of a negotiation.

At the bargaining stage, the state is simply the identity of the proposer. The proposer chooses a wage $w \in \mathbb{R}$ to offer, and the responder decides whether to accept or reject it according to a response rule $r_i(w) \in \{1, 0\}$, where 1 denotes acceptance and 0 rejection.

2.4 Equilibrium characterisation

Optimality of attendance decisions. At the pairing stage, an agent chooses which negotiation, if any, to attend. Let $V_i^a(s_i)$ denote the expected value to agent i of attendance

¹This allows us to rule out any equilibria in which agents do not attend any negotiations because they expect no one else to attend either, are therefore indifferent and do not attend any meeting.

choice a in state s_i . An optimal attendance strategy satisfies

$$a_i^*(s_i) \in \arg \max_{a \in A(s_i)} V_i^a(s_i), \quad (4)$$

where $A(s_i) \subseteq \{o, n, 0\}$ is the set of feasible attendance choices.

Optimal wage offers. The proposer chooses the wage that maximises their expected value, given the responder's response rule. Recall that $V_i(w)$ is the value of an employment relationship at wage w at the start of its first production period. Let $V_i^{\text{rej}}(P)$ and $V_i^{\text{rej}}(R)$ denote the continuation values following a rejection when acting as proposer and as responder, measured at the start of the following period. For proposer i facing responder j ,

$$w_i^* \in \arg \max_{w \in \mathbb{R}} \left\{ r_j^*(w) V_i(w) + (1 - r_j^*(w)) V_i^{\text{rej}}(P) \right\}. \quad (5)$$

Optimal response rule. The responder accepts an offer whenever the value of agreement is at least as large as the value of rejection:

$$r_i^*(w) = \begin{cases} 1, & \text{if } V_i(w) \geq V_i^{\text{rej}}(R), \\ 0, & \text{otherwise.} \end{cases} \quad (6)$$

Definition 1 (Markov perfect equilibrium) *A Markov perfect equilibrium consists of attendance strategies $a_i(s_i)$, wage offers w_i , response rules $r_i(w)$, and beliefs about partners' attendance decisions, such that:*

1. *Attendance decisions satisfy (4).*
2. *Wage offers satisfy (5).*
3. *Response rules satisfy (6).*
4. *The rejection values $V_i^{\text{rej}}(P)$ and $V_i^{\text{rej}}(R)$ are the continuation values obtained when all agents follow strategies satisfying (4),(5) and (6) at every subsequent decision point.*
5. *Beliefs about partners' attendance decisions are consistent with the strategies and the pairing process.*

Proposition 1 (Equilibrium characterisation) *There exists a unique Markov perfect equilibrium, characterised by the following strategies:*

1. **Bargaining.** *The firm offers w_f^* when proposing, while the worker offers w_w^* . The worker accepts any wage $w \geq w_f^*$, while the firm accepts any wage $w \leq w_w^*$.*

2. **Attendance.** *An agent with only one available negotiation attends it. When both an ongoing and a new negotiation are available, the agent attends the new negotiation, except when they are the proposer in the ongoing negotiation and the responder in the new one.*

Formally, the equilibrium attendance strategy is

$$a_i^*(s_i) = \begin{cases} o, & s_i \in \{(P, 0), (R, 0), (P, R)\}, \\ n, & s_i \in \{(0, P), (0, R), (P, P), (R, P), (R, R)\}, \\ 0, & s_i = (0, 0). \end{cases} \quad (7)$$

The proof of existence, uniqueness, and the equilibrium characterisation in Proposition 1 is provided in Appendix A.1. Here, I provide the intuition behind this result.

When two parties meet to bargain, they bargain by alternating offers. Delay is costly: future surplus is discounted, and the negotiation may break down if one party leaves for a new partner. A proposer therefore gains nothing from an offer that will be rejected. They make an offer the responder will accept and concede no more than they must. The wage they offer leaves the responder indifferent between accepting now and waiting to propose in the next round, and it is accepted at once. Because waiting is costly, the responder settles for less than they could secure as the proposer, so the proposer takes the larger share. This is the reason why the firm's wage offer is smaller than what the worker would ask: $w_f^* < w_w^*$.

As optimal wage offers make responders indifferent between accepting and rejecting, we need to pin down the equilibrium value of rejection. We therefore consider the equilibrium play after the last round ended with rejection.

In that case, if an agent is paired with two partners, the only two relevant factors are the probability that each partner shows up, and what that agent would be able to obtain if they do. The second consideration favours the partner with whom they would propose, since the proposer's share is the larger one. The first favours the new partner, because an ongoing partner may have left for a new negotiation of their own, while a newly arrived one cannot have: in equilibrium, all offers are immediately accepted so that no newly paired partner can be in an ongoing negotiation. Hence, an agent who is a responder in an ongoing negotiation, but a proposer in the new one would choose the new negotiation. This strategy induces the proposer in the ongoing negotiation to choose a new negotiation if they are proposer in the new one as well. Therefore, an agent who is a responder in both would choose the new one too. The only case in which the decision is not obvious is if an agent is a proposer in the old, but a responder in the new negotiation. As we will see when we characterise equilibrium

values, an agent chooses the ongoing negotiation in this case.²

2.5 Equilibrium values and surplus division

Having characterised the equilibrium strategies, we now derive the equilibrium values and the resulting division of surplus. Let the surplus accruing to the worker and the firm from an employment agreement at wage w , relative to continued search, be

$$S_w(w) = V_w(w) - V_w^0, \quad S_f(w) = V_f(w) - V_f^0. \quad (8)$$

In the generalised Nash bargaining solution, the worker's bargaining weight β determines the division of surplus according to

$$\frac{S_w(w)}{S_f(w)} = \frac{\beta}{1 - \beta}. \quad (9)$$

Our aim is to derive this division directly from the non-cooperative bargaining game, rather than imposing β as an exogenous parameter.

Proposition 1 establishes that all equilibrium offers are accepted immediately. The values of unemployment and an open vacancy therefore satisfy

$$\begin{aligned} V_w^0 &= b + \delta \left[(1 - \lambda_w) V_w^0 + \frac{\lambda_w}{2} (V_w(w_f^*) + V_w(w_w^*)) \right], \\ V_f^0 &= -c + \delta \left[(1 - \lambda_f) V_f^0 + \frac{\lambda_f}{2} (V_f(w_f^*) + V_f(w_w^*)) \right]. \end{aligned} \quad (10)$$

These values reflect the probability of being paired with a new partner and the equal probability of making the initial offer.

We next use the responder's indifference conditions to characterise the equilibrium wages and the corresponding surplus shares. Consider a worker receiving the firm's offer w_f^* . Upon rejection, the worker becomes the proposer in the ongoing negotiation in the following period. They may also be paired with a new firm, so indifference requires

$$\begin{aligned} V_w(w_f^*) &= b + \delta \left[\frac{\lambda_w}{2} V_w(w_w^*) \right. \\ &\quad \left. + \left(1 - \frac{\lambda_w}{2} \right) ((1 - \lambda_f) V_w(w_w^*) + \lambda_f V_w^0) \right]. \end{aligned} \quad (11)$$

²In Appendix A.1, I also show that there is no equilibrium in which a proposer in an ongoing negotiation abandons it in favour of the new negotiation where they are responder.

With probability $\frac{\lambda_w}{2}$, the worker is paired with a new firm in which they can propose. In equilibrium, they prefer this negotiation. Otherwise, they prefer the ongoing negotiation. The firm remains available with probability $1 - \lambda_f$, the worker gets to make their wage offer which is accepted in equilibrium. With probability λ_f , the firm has found a new worker and left, leaving the worker unemployed.

Similarly, a firm receiving the worker's offer w_w^* is indifferent between accepting and rejecting when

$$V_f(w_w^*) = -c + \delta \left[\frac{\lambda_f}{2} V_f(w_f^*) + \left(1 - \frac{\lambda_f}{2} \right) ((1 - \lambda_w) V_f(w_f^*) + \lambda_w V_f^0) \right]. \quad (12)$$

Subtracting the search values in (10) from the indifference conditions (11) and (12), and rearranging, we obtain the individual surplus equations:

$$\begin{aligned} S_w(w_w^*) &= \delta \left[S_w(w_w^*) - \underbrace{\lambda_f \left(1 - \frac{\lambda_w}{2} \right) S_w(w_w^*)}_{\text{Breakdown risk}} \right. \\ &\quad \left. - \underbrace{\frac{\lambda_w}{2} (S_w(w_w^*) + S_w(w_f^*))}_{\text{Outside opportunities}} \right], \\ S_f(w_f^*) &= \delta \left[S_f(w_f^*) - \underbrace{\lambda_w \left(1 - \frac{\lambda_f}{2} \right) S_f(w_f^*)}_{\text{Breakdown risk}} \right. \\ &\quad \left. - \underbrace{\frac{\lambda_f}{2} (S_f(w_f^*) + S_f(w_w^*))}_{\text{Outside opportunities}} \right]. \end{aligned} \quad (13)$$

These equations reveal two channels through which the availability of alternative partners affects bargaining.

The first is the risk that the original negotiation breaks down. Consider the worker's equation. Following rejection, the worker becomes the proposer in the ongoing negotiation, but the original firm may find another worker and leave. This occurs with probability λ_f . However, losing the original firm matters only if the worker has not already switched to a new negotiation in which they can propose, which happens with probability $1 - \frac{\lambda_w}{2}$. A higher probability that the firm finds an alternative therefore reduces the worker's continuation

surplus.

The second channel concerns the value of outside opportunities. Following rejection, the worker expects to propose in the next round. A new pairing does not improve on this bargaining position: the worker either obtains an equivalent opportunity to propose elsewhere or prefers to remain with the original firm.

By contrast, a worker without an ongoing negotiation benefits from any new pairing, whether as proposer or responder. The expected surplus from a new pairing is $\frac{1}{2}[S_w(w_w^*) + S_w(w_f^*)]$. A higher pairing probability therefore raises the value of searching. Since the worker's surplus is the value of an employment agreement minus the value of searching, an increase in the latter without a corresponding increase in the former reduces the surplus. The firm's equation has the symmetric interpretation.

These two channels can work in opposite directions. In a tighter labour market, workers are less likely to lose their current bargaining partner, strengthening their position. At the same time, their own outside opportunities become more valuable, reducing the surplus from maintaining a particular negotiation relative to continued search. The equilibrium division of surplus reflects the interaction of these forces.

Define $\beta_f = \frac{S_w(w_f^*)}{S_w(w_f^*) + S_f(w_f^*)}$ and $\beta_w = \frac{S_w(w_w^*)}{S_w(w_w^*) + S_f(w_w^*)}$ as the worker's surplus shares when the firm and worker propose, respectively. Combining the indifference conditions with (10) yields

$$\begin{aligned}\beta_f &= \frac{\delta(1 - \lambda_f)(2 - \lambda_w)}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]}, \\ \beta_w &= \frac{2 + \delta\lambda_w}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]}.\end{aligned}\tag{14}$$

The worker obtains a larger share when proposing than when responding, $\beta_w > \beta_f$, reflecting the proposer advantage established earlier. Since workers and firms are equally likely to make the initial offer, the worker's expected bargaining power is

$$\bar{\beta} = \frac{1}{2}(\beta_f + \beta_w) = \frac{1}{2} \left[1 + \frac{\delta(\lambda_w - \lambda_f)}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]} \right]. \tag{15}$$

First, we can notice that the worker's expected share equals one half when $\lambda_w = \lambda_f$, exceeds one half when $\lambda_w > \lambda_f$, and falls below one half when $\lambda_w < \lambda_f$. Since workers and firms differ only in their pairing probabilities, unequal bargaining power arises from differences in their access to alternative partners. Second, notice that the denominator reflects the frictions in the market. The product $(1 - \lambda_f)(1 - \lambda_w)$ is the probability that neither side is paired with an alternative between rounds, and it governs how far a given gap $\lambda_w - \lambda_f$ moves the split. When the market is more frictional, the fact that one side holds

market power matters less. As the market becomes more efficient, so that at least one side is likely to find an alternative between rounds, market tightness matters more for the division of surplus.

Proposition 2 formally establishes that the worker bargaining power increases with tightness.

Proposition 2 (Bargaining power and market tightness) *Worker's equilibrium bargaining power is strictly increasing in labour market tightness:*

$$\frac{\partial \bar{\beta}}{\partial \theta} > 0. \quad (16)$$

The proof is provided in Appendix A.2. A tighter labour market reduces the risk that a worker loses the opportunity to make a counteroffer, but also raises the value of searching relative to maintaining an ongoing negotiation. In the symmetric case, in equilibrium, the former effect dominates.

2.6 Equilibrium wages

Having characterised the equilibrium division of surplus, we now derive the wages agreed upon by workers and firms. Using (1) and (8), the individual surpluses can be expressed as

$$\begin{aligned} S_w(w) &= \frac{w - (1 - \delta)V_w^0}{1 - \delta(1 - s)}, \\ S_f(w) &= \frac{p - w - (1 - \delta)V_f^0}{1 - \delta(1 - s)}. \end{aligned} \quad (17)$$

Using the equilibrium bargaining shares β_f and β_w , we obtain the wages offered by the firm and the worker, respectively:

$$\begin{aligned} w_f^* &= \beta_f p + (1 - \delta) [(1 - \beta_f)V_w^0 - \beta_f V_f^0], \\ w_w^* &= \beta_w p + (1 - \delta) [(1 - \beta_w)V_w^0 - \beta_w V_f^0]. \end{aligned} \quad (18)$$

The expected equilibrium wage is

$$\bar{w} = \bar{\beta}(\theta)p + (1 - \delta) [(1 - \bar{\beta}(\theta))V_w^0 - \bar{\beta}(\theta)V_f^0]. \quad (19)$$

The wage equations have two main components. The first term is a share of the total revenue generated by the employment relationship p . The second and third terms reflect how market values of search for both sides affect wages. In particular, we can notice that

when worker bargaining power is 0, their wage simply equals their unemployment value. In contrast, when worker bargaining power is 1, they would obtain $p - (1 - \delta)V_f^0$, essentially compensating the firm just enough to exit the search market.

In these expressions, we take search values as given. This representation will be particularly useful for the empirical analysis as we will then need to separate between components that are specific to the match and those that are common to the market. Importantly, the wage equations here make explicit the role of endogenous bargaining power in the relationship between match productivity and wages.

Naturally, in the model, the values of continued search are themselves determined in equilibrium. Appendix A.1.2 derives these values, and Appendix A.3 provides the corresponding equilibrium wage expressions after substituting them.

Role of first mover probabilities. In the baseline analysis, we focused on the case in which firms and workers are equally likely to make the first offer, setting μ , firm's first mover probability to $\frac{1}{2}$. This case is instructive because it allows us to isolate market tightness as the only difference between the two sides of the market, without giving any side of the market an advantage. It also allows us to derive tractable expressions for bargaining power in equilibrium.

In practice, workers and firms may differ in their likelihood of making the first offer, as firms may be more likely to make the first offer by posting a wage. In Appendix A.4, I derive the equilibrium surplus shares for any $\mu \in (0, 1)$.

In this more general case, the sign of the relationship between bargaining power and tightness is no longer unambiguous. It depends on the relative responsiveness of workers' and firms' pairing probabilities to market tightness, which is determined by the functional form of the pairing technology. These elasticities govern how the two forces shaping bargaining power, the risk of breakdown and the opportunity cost of delaying agreement, respond to changes in labour market tightness.

To investigate this relationship, I consider Cobb–Douglas and CES pairing functions over a range of matching elasticities. The numerical results show that worker bargaining power increases with tightness for a broad range of parameters, including those consistent with empirical estimates of matching elasticities. I also consider a Leontief pairing technology to illustrate how the relationship can reverse when one side's pairing probability becomes locally unresponsive to tightness. Appendix A.5 presents an analytical example to convey the intuition and numerical exercises in detail. Overall, these results suggest that, although the positive relationship is not guaranteed for every pairing technology, it remains a robust prediction for empirically relevant matching elasticities.

The framework can accommodate different production technologies, vacancy costs, and unemployment values, and can therefore be applied to labour markets with different economic environments. However, the benchmark assumes that firms and workers are homogeneous within each market. While bargaining power can differ across markets as tightness and pairing conditions vary, it is identical across employment relationships within a given market. An important additional source of variation arises when different matches generate different surpluses. I now introduce firm productivity heterogeneity to examine how bargaining power varies within a market, and how these differences interact with labour market tightness.

3 Firm productivity heterogeneity

Let firm productivity p be distributed according to the cumulative distribution function $F(p)$. As in the benchmark, productivity determines the output generated by an employment relationship. I denote the total surplus associated with a firm of productivity p by $S(p)$ and assume that $S'(p) > 0$. All firms generate strictly positive surplus from agreement.

The bargaining protocol and pairing process remain unchanged. In particular, workers and firms continue to be paired with new potential partners while negotiating, the identity of the initial proposer is determined with equal probability, and agents can attend at most one negotiation per period. Pairing probabilities depend on market tightness, but not on firm productivity.

Equilibrium bargaining. The equilibrium is characterised by the same optimality conditions as in the benchmark, laid out in Definition 1. In particular, agents choose which negotiation to attend, which wage to offer, and whether to accept or reject an offer so as to maximise their expected payoffs.

What changes is the information entering these decisions. The state defined in Equation (3) is now augmented by firm productivity. A firm observes its own productivity p , while a worker observes the productivity of the firm in their ongoing negotiation, p , and, when paired with another firm, the productivity p' of the new firm. Attendance decisions therefore depend not only on the bargaining roles and the availability of each partner, but also on the productivity of the firms involved. Equilibrium wage offers and acceptance decisions likewise depend on the productivity of the firm with which the agent is bargaining.

The introduction of firm heterogeneity changes the comparison between an ongoing and new firm for workers. In the homogeneous model, the bargaining role and the availability of the current partner determine which negotiation a worker prefers. With heterogeneous firms, the productivity of the alternative employer also matters. A worker may prefer to

remain in an ongoing negotiation with a highly productive firm even when a new negotiation comes with the role of proposer.

The worker's attendance decisions can therefore be characterised by productivity cutoffs. For each combination of bargaining roles in the ongoing and new negotiations, there is a threshold productivity above which the new firm is sufficiently attractive to induce the worker to leave. These thresholds depend on the productivity of the current firm and are determined jointly with equilibrium wage offers.

Proposition 3 characterises the equilibrium strategies.

Proposition 3 (Equilibrium with heterogeneous firms) *The equilibrium strategies are characterised as follows:*

1. **Bargaining.** *At a firm of productivity p , the firm offers $w_f^*(p)$ when proposing, while the worker offers $w_w^*(p)$. The worker accepts any wage $w \geq w_f^*(p)$, while the firm accepts any wage $w \leq w_w^*(p)$. All equilibrium offers are accepted immediately.*
2. **Attendance.** *A firm follows the same attendance strategy as in (7).*

A worker with only one available negotiation attends it. When both an ongoing and a new negotiation are available, the worker's choice depends on their bargaining roles and the productivities of the two firms.

Let $p^*(p; s_w)$ denote the productivity of a new firm that makes the worker indifferent between the ongoing negotiation with a firm of productivity p and the new negotiation, given the bargaining-role state $s_w = (q_w^o, q_w^n)$ defined in (3).

The worker's optimal attendance strategy, when both negotiations are available, is

$$a_w^*(s_w; p, p') = \begin{cases} n, & p' \geq p^*(p; s_w), \\ o, & p' < p^*(p; s_w), \end{cases} \quad (20)$$

where p' is the productivity of the newly encountered firm. When neither negotiation is available, the worker attends neither.

The equilibrium conditions determining the productivity cutoffs are provided in Appendix A.6.

Productivity cutoffs are key to determine the probability with which worker leaves after a rejection. Naturally, with these equilibrium strategies, this probability will be different for two firms with different productivities. Corollary 1 establishes that productivity cutoff is increasing in firm's own productivity.

Corollary 1 (Productivity and switching cutoffs) *For every state $s_w \in \{P, R\}^2$, the worker's switching cutoff is strictly increasing in the incumbent firm's productivity: for any $p' > p$,*

$$p^*(p'; s_w) > p^*(p; s_w) \quad (21)$$

The proof is provided in Appendix A.6.

Workers bargaining with more productive firms therefore become more selective about alternative employers. Although they encounter new firms at the same rate, a smaller fraction of those firms is sufficiently attractive to induce them to abandon their current negotiation.

Implications for bargaining power. The probability that a firm abandons an ongoing negotiation depends on its bargaining role and market tightness, but not on its productivity. By contrast, the probability that a worker abandons an ongoing negotiation depends on the productivity of the incumbent firm.

For a worker whose role in the ongoing negotiation is $m \in \{P, R\}$, this probability is

$$\Pr(\text{worker leaves} \mid p, m, \theta) = \frac{\lambda_w(\theta)}{2} \sum_{r \in \{P, R\}} \bar{F}(p^*(p; (m, r))), \quad (22)$$

where $\bar{F} = 1 - F$.

By Corollary 1, this probability is decreasing in the incumbent firm's productivity. Workers negotiating with more productive firms are therefore less likely to abandon their ongoing negotiations. This creates a force towards lower worker bargaining power at more productive firms.

The equilibrium expressions for bargaining power, derived in Appendix A.6, are more complex than in the benchmark. Bargaining shares are determined jointly with the endogenous productivity cutoffs and do not generally admit simple closed-form solutions. The effects of firm productivity and market tightness on bargaining power can therefore not be signed analytically in general.

3.1 Numerical analysis

I therefore turn to a numerical analysis to examine how worker bargaining power varies across the firm productivity distribution and how its response to labour market tightness differs between less and more productive firms. I solve the model numerically under the following parameterisation.

Figure 2 plots expected worker bargaining power across the productivity distribution for the two values of market tightness.

Table 1: Parameter choices for the numerical illustration

Parameter	Choice
Pairing function	$\lambda_w(\theta) = \rho\theta^{\frac{1}{2}}, \quad \lambda_f(\theta) = \rho\theta^{-\frac{1}{2}}$
Pairing efficiency	$\rho = 0.25$
Firm productivity distribution	$p = \exp(0.8z), \quad z \sim \text{Beta}(2, 1)$
Discount factor	$\delta = 0.99$
Separation probability	$s = 0.02$
Unemployment payoff	$b = 0.25$
Vacancy cost	$c = 0.05$
Firm first mover probability	$\mu = \frac{1}{2}$
Tightness values compared	$\theta \in \{0.5, 1.5\}$

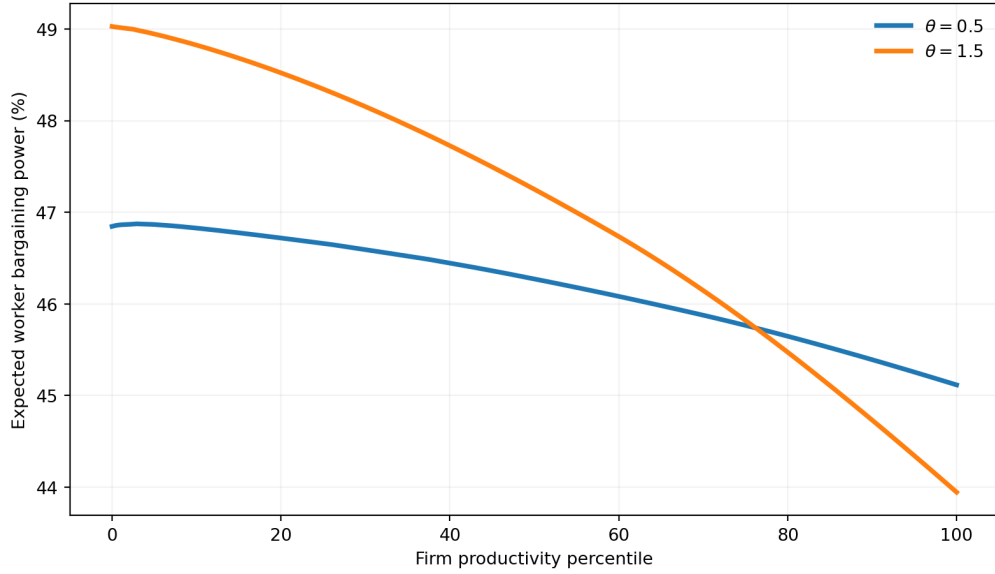


Figure 2: Worker bargaining power across the firm productivity distribution. The horizontal axis reports firm productivity percentiles, while the vertical axis reports average worker bargaining power $\bar{\beta}(p, \theta)$ expressed as a percentage of total match surplus. The blue line corresponds to a labour market with tightness $\theta = 0.5$, and the orange line to a tighter market with $\theta = 1.5$. Both series are obtained from the numerical equilibrium using the parameterisation reported in Table 1.

The figure illustrates two patterns. First, worker bargaining power tends to decline with firm productivity. This is consistent with the mechanism developed above: workers bargaining with more productive firms are less likely to abandon the negotiation, which weakens the role of alternative employers. Second, the effect of tighter labour markets is stronger for less productive firms. Raising market tightness from $\theta = 0.5$ to $\theta = 1.5$ increases worker bargaining power substantially at the lower end of the productivity distribution, but this effect becomes much smaller at higher productivity levels and eventually reverses.

This reversal reflects the two competing channels identified in the benchmark. A tighter labour market reduces the probability that the incumbent firm leaves, increasing the worker's value of continuing negotiations. However, it also raises the value of unemployment by making alternative employers easier to find. At the top of the productivity distribution, few alternative firms are sufficiently attractive to induce the worker to abandon the ongoing negotiation. Consequently, more frequent pairings contribute relatively little to the value of continuing that negotiation, even as they increase the value of unemployment. In the numerical example, this second channel becomes sufficiently important to offset the reduction in breakdown risk, leading worker bargaining power to decline with tightness at the most productive firms.

Empirical counterpart of bargaining power. To take the model to the data, I measure worker bargaining power through the pass-through of firm productivity into wages. Recall from (19) that the expected equilibrium wage in the benchmark is

$$\bar{w} = \bar{\beta}(\theta)p + (1 - \delta) [(1 - \bar{\beta}(\theta))V_w^0 - \bar{\beta}(\theta)V_f^0]. \quad (23)$$

This expression provides a direct empirical counterpart to worker bargaining power: the coefficient on firm productivity captures the share of productivity passed through to wages, while the remaining terms reflect the values of continued search. The wage equation can therefore be taken to the data using a linear regression of wages on firm productivity, provided that the empirical specification adequately controls for differences in search values. I discuss the choice of controls and the corresponding identification strategy in the empirical section.

Productivity pass-through is also a commonly used measure of workers' ability to capture firm surplus in the empirical rent-sharing literature (Card et al., 2018). In particular, Mengano (2022) uses wage pass-through to measure workers' bargaining power within a Nash bargaining framework. I follow this approach, interpreting the estimated pass-through as an empirical measure of worker bargaining power.

The benchmark predicts that bargaining power, and consequently productivity pass-

through, increases with labour market tightness. The heterogeneous firm extension motivates two further questions: how productivity pass-through varies across the firm productivity distribution, and whether its sensitivity to labour market tightness differs between less and more productive firms.

Having established the model’s empirical predictions, I now turn to the data used to test them. I first describe the data sources and construction of the key variables, before presenting the empirical strategy.

4 Data

The empirical analysis combines three sources of French administrative data. Worker wages and employment characteristics come from the employee records in the *Base Tous Salariés* (BTS–Postes). These records are linked to firm balance-sheet information from FARE, which I use to estimate industry-specific production functions using firm-level data. I combine these data with measures of local labour market tightness constructed by the French Ministry of Labour (DARES).

Together, these sources provide the three main objects used in the empirical analysis: workers’ hourly wages, the marginal product of labour at their employer, and the tightness of the labour market in which they search. The firm data also allow me to locate each employer in the productivity distribution of comparable firms, which I use to study the heterogeneous firm implications of the model.

4.1 Matched Employer-Employee data

Worker level information comes from the French administrative database covering the universe of employees in France, the Base Tous Salariés (BTS) Postes. I use annual files for 2011-2023, the years for which the tightness measure described in Section 4.2 is available.

The unit of observation is a job, defined as the employment of a given worker in a given establishment during a calendar year. For each job the data report gross and net annual pay, total hours worked, contract type, a four-digit occupation code, and the worker’s age and gender. Finally, I observe the location and industry of the employing establishment and the identifier of the firm to which it belongs.

Using the firm identifier present in BTS Postes, I link the BTS Postes to firm level balance sheet data, FARE. FARE covers all firms in the private sector, excluding financial enterprises and firms in agriculture. FARE includes detailed information on each firm including main sector of activity, value added, turnover, fixed assets, and materials.

Panel creation. While FARE includes each firm’s identifier and is therefore a panel, the BTS Postes is in the form of repeated cross-section where the identifier assigned to a worker changes every year. Each annual file, however, covers two years: it reports each worker’s jobs in the current year and, if applicable, in the year before. A job held in a given year therefore appears in two consecutive files. Following the strategy developed by Babet et al. (2023), I use this overlap to link workers from one file to the next, matching on the characteristics of the job, such as the employer, gender, hours, and the dates of the employment spell. Chaining these links over time yields a worker panel that follows individuals across years and employers.

Sample. I restrict the attention to the main job held by a worker as flagged in the data. I construct hourly wages for that job using information on gross wages and hours worked. I include open-ended and fixed-term contracts, which excludes apprentices, trainees, temporary agency workers, and subsidised jobs, and I drop records with zero pay or hours. Finally, I keep firms that had the equivalent of two full-time employees on average during the sample period.

4.2 Labour market tightness

I measure labour market tightness using the indicator constructed annually by DARES. The measure varies by occupation, administrative area, and year. I therefore define a local labour market as an occupation–administrative-area pair and denote its tightness in year t by θ_{olt} .

The indicator combines information from vacancy and unemployment registries, flows out of registered unemployment, and employer surveys on recruitment difficulties. Higher values correspond to labour markets in which workers find jobs more easily and firms face greater difficulty filling vacancies. It therefore provides an empirical measure of the relative availability of outside options on the two sides of the market, which is the object captured by tightness in the model. Data is standardised over its sample average over the period 2011-2022.

The administrative areas used in the data correspond to the French *départements*. I refer to them throughout simply as administrative areas.

4.3 Labour productivity

The first empirical exercise measures worker bargaining power through the pass-through of the firm’s marginal product of labour into wages. I construct the marginal product of labour from production functions estimated using the FARE accounts.

For firm j in year t , I assume a Cobb–Douglas value-added production function,

$$y_{jt} = \beta_\ell \ell_{jt} + \beta_k k_{jt} + \omega_{jt} + \varepsilon_{jt}, \quad (24)$$

where y_{jt} denotes log real value added, ℓ_{jt} log labour input, measured using total hours worked, k_{jt} log capital, ω_{jt} firm productivity, and ε_{jt} measurement error. Nominal quantities are deflated using industry-level price indices.

Firms choose their inputs in response to productivity shocks observed by the firm but not by the econometrician, making OLS estimates of the production function inconsistent. I therefore estimate the production function following Levinsohn and Petrin (2003), using intermediate inputs as a proxy for unobserved productivity. The production-function parameters are estimated separately for each two-digit NACE industry, allowing the output elasticities to differ across industries.

Given the estimated labour elasticity for industry s , the hourly marginal product of labour for firm j is

$$\text{MPL}_{jt} = \hat{\beta}_{\ell,s} \frac{Y_{jt}}{L_{jt}}, \quad (25)$$

where L_{jt} denotes total hours worked at the firm. I use this measure to estimate how changes in the productive contribution of labour are transmitted into wages. Productivity pass-through is the empirical measure of worker bargaining power used throughout the analysis.

4.4 Firm productivity

The heterogeneous firm analysis requires a separate measure of the productivity of the firm with which the worker is bargaining. I do not use the level of MPL for this purpose. MPL is the productive margin whose pass-through into wages is used to measure bargaining power, whereas the heterogeneous model asks how this pass-through differs across firms with different underlying productivities.

I recover firm productivity from the same industry-specific Levinsohn–Petrin production-function estimates. In particular, total factor productivity based on revenue (TFPR) is measured from the component of revenue that remains after accounting for the estimated contributions of labour and capital,

$$\hat{\omega}_{jt} = y_{jt} - \hat{\beta}_{\ell,s} \ell_{jt} - \hat{\beta}_{k,s} k_{jt}. \quad (26)$$

Rather than comparing the level of TFPR across industries and local markets, I use a firm’s position in the relevant productivity distribution. Firms are ranked within two-digit

NACE industry, administrative area, and year and assigned to deciles of the corresponding TFPR distribution. Firm productivity in the heterogeneous analysis therefore refers to the firm's relative position among firms operating in the same industry, administrative area, and year.

This distinction between MPL and TFPR rank is central to the empirical design. MPL provides the variation used to estimate wage pass-through, while TFPR rank captures the productivity of the employer relative to comparable firms. I then ask how both productivity pass-through and its sensitivity to labour market tightness vary across this firm productivity distribution.

5 Empirical strategy

The empirical analysis follows the two main implications of the theory. I first ask whether productivity pass-through into wages increases with labour market tightness. In the baseline model, this pass-through is the worker's bargaining power, so the central prediction is that workers capture a larger share of productivity in tighter labour markets.

I then turn to the implications of firm heterogeneity. The model suggests that the relevance of outside opportunities may vary with the productivity of the firm with which the worker is bargaining. I therefore ask whether productivity pass-through itself differs across the firm productivity distribution, and whether its response to labour market tightness is different at less and more productive firms.

5.1 Productivity pass-through and labour market tightness

I begin by estimating the relationship between wages, the firm's marginal product of labour, and local labour market tightness. For worker i employed at firm j , in occupation o , administrative area l , and year t , the baseline specification is

$$w_{ijolt} = \alpha_1 \text{MPL}_{jt} + \alpha_2 \theta_{olt} + \alpha_3 (\text{MPL}_{jt} \times \theta_{olt}) + X'_{it} \gamma + \phi_j + \phi_o + \phi_l + \phi_t + \varepsilon_{ijolt}. \quad (27)$$

The coefficient α_1 captures the pass-through of the firm's marginal product into the worker's wage, while α_3 measures how this pass-through varies with labour market tightness. In particular,

$$\frac{\partial w_{ijolt}}{\partial \text{MPL}_{jt}} = \alpha_1 + \alpha_3 \theta_{olt}. \quad (28)$$

The central prediction of the baseline model is therefore

$$\alpha_3 > 0. \quad (29)$$

In the estimation, MPL is centred around its sample mean before constructing the interaction. This does not affect the estimated productivity pass-through, but makes α_2 the effect of tightness for a firm with average MPL.

The vector X_{it} contains worker age, age squared, and gender. The specification includes occupation, administrative-area, and year fixed effects, as well as firm fixed effects in the preferred specification. Occupation and administrative-area effects absorb persistent differences in wages and outside options across types of work and locations, while year effects absorb aggregate shocks. Firm effects absorb permanent differences across employers, including persistent wage policies, productivity components, and worker sorting that are not explicitly modelled in the theory.

5.2 Identification

There are two main reasons why estimating Equation (27) by OLS need not recover the causal effect of labour market tightness on wage pass-through.

First, tightness is an equilibrium outcome. Wage setting, hiring, and vacancy creation are jointly determined, so variation in local tightness may itself reflect conditions that also affect wages. Second, contemporaneous shocks to a local labour market may move wages and tightness together. A positive occupation-specific demand shock, for example, may simultaneously raise wages and make hiring more difficult.

I therefore instrument local labour market tightness with a leave-one-out measure constructed from the same occupation in other administrative areas. Writing a local labour market as $m = (o, l)$, the instrument is

$$\theta_{mt}^{\text{LOO}} = \frac{\sum_{l' \neq l} E_{ol't} \theta_{ol't}}{\sum_{l' \neq l} E_{ol't}}, \quad (30)$$

where $E_{ol't}$ denotes employment in occupation o and administrative area l' in year t .

The instrument exploits the fact that labour market conditions for the same occupation tend to co-move across locations. National changes in demand, technology, or the supply of occupation-specific skills therefore generate predictive variation in tightness across local markets. At the same time, the worker's own administrative area is excluded from the construction of the instrument, so local wage setting does not mechanically enter θ_{mt}^{LOO} . Similar leave-one-out strategies are used in the literature studying the wage effects of labour

market concentration and tightness (Azar et al., 2022; Bassanini et al., 2026; Börschlein et al., 2024).

The identifying assumption is that, conditional on the controls and fixed effects, labour market tightness for the same occupation elsewhere affects the worker’s wage only through its effect on tightness in the worker’s own local market.

The marginal product of labour may also be endogenous as firms can adjust employment and hours differently as a response to market tightness and wages. This adjustment could affect the marginal productivity of labour. In addition to the problem of endogeneity, there can be measurement error in estimated MPL. I therefore instrument MPL_{jt} with its lagged value, $\text{MPL}_{j,t-1}$. The interaction between MPL and tightness is instrumented with the interaction between the corresponding excluded instruments,

$$\text{MPL}_{j,t-1} \times \theta_{mt}^{\text{LOO}}. \quad (31)$$

The resulting 2SLS specification therefore uses three excluded instruments: lagged MPL, leave-one-out tightness, and their interaction, for the three endogenous regressors MPL, tightness, and MPL interacted with tightness.

5.3 Heterogeneity across firm productivity

I next examine the implications of the heterogeneous-firm model. Recall that firm productivity in this exercise is measured by the firm’s position in the TFPR distribution within its two-digit industry, administrative area, and year. MPL and TFPR therefore play distinct roles in the analysis: MPL is the productive margin whose pass-through into wages is estimated, while TFPR rank determines where the employer lies in the firm productivity distribution.

I proceed in two steps. First, I estimate productivity pass-through separately across TFPR deciles. For each decile d , I estimate

$$w_{ijolt} = \alpha_{1d} \text{MPL}_{jt} + X'_{it} \gamma_d + \phi_{jd} + \phi_{od} + \phi_{ld} + \phi_{td} + \varepsilon_{ijolt}. \quad (32)$$

The coefficients α_{1d} describe how productivity pass-through varies over the firm productivity distribution.

Second, I re-estimate Equation (27) separately within each TFPR decile:

$$w_{ijolt} = \alpha_{1d} \text{MPL}_{jt} + \alpha_{2d} \theta_{olt} + \alpha_{3d} (\text{MPL}_{jt} \times \theta_{olt}) + X'_{it} \gamma_d + \Phi_{jolt,d} + \varepsilon_{ijolt}, \quad (33)$$

where $\Phi_{jolt,d}$ collects the same fixed effects as in the pooled specification.

For a firm in productivity decile d , estimated pass-through is therefore

$$\frac{\partial w}{\partial \text{MPL}} = \alpha_{1d} + \alpha_{3d}\theta. \quad (34)$$

The sequence of α_{1d} coefficients shows how bargaining power, measured through wage pass-through, varies with firm productivity. The sequence of α_{3d} coefficients shows how the sensitivity of bargaining power to labour market tightness varies across the productivity distribution.

These exercises map directly into the mechanisms highlighted by the heterogeneous-firm model. The theory suggests that workers at more productive firms are less likely to encounter outside firms sufficiently attractive to induce them to leave an ongoing negotiation. This creates a force toward lower bargaining power at more productive firms and toward a weaker response of bargaining power to changes in tightness. The theory does not sign either relationship globally, so I treat their shape across the productivity distribution as an empirical question.

6 Results

6.1 Productivity pass-through and labour market tightness

Table 2 presents the baseline estimates for the full sample. Across specifications, firm productivity passes positively into wages. In the level specification without firm fixed effects, an additional unit of hourly MPL raises the hourly wage by about 0.097. In logs, the corresponding elasticity is 0.158. The estimated pass-through becomes smaller once firm fixed effects are included, consistent with part of the cross-sectional relationship between wages and productivity reflecting persistent differences across firms.

The main coefficient of interest is the interaction between productivity and labour market tightness. It is positive in all four specifications and statistically significant throughout. In levels, the interaction is 0.024 without firm fixed effects and 0.022 with firm fixed effects. The corresponding estimates in logs are 0.012 and 0.004. Thus, whether pass-through is measured in levels or elasticities, and whether identification uses variation across and within firms or only within firms, productivity is passed through more strongly to wages in tighter labour markets.

The coefficient on tightness itself shows a different pattern. Without firm fixed effects it is negative in both levels and logs. This coefficient combines the bargaining effect of tighter labour markets with the equilibrium allocation of firms and workers across markets.

Table 2: Productivity pass-through and labour market tightness

	Levels		Logs	
	(1)	(2)	(3)	(4)
	No firm FE	Firm FE	No firm FE	Firm FE
Productivity	0.0968*** (0.0242)	0.0494 (0.1329)	0.1580*** (0.0061)	0.0605*** (0.0067)
Tightness	-0.2108*** (0.0705)	0.0705 (0.0599)	-0.0042* (0.0024)	0.0094*** (0.0012)
Productivity $\times$ Tightness	0.0239* (0.0131)	0.0219*** (0.0068)	0.0125*** (0.0034)	0.0040*** (0.0015)
Worker controls	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes
Administrative-area FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
Observations	11,267,205	11,266,361	11,267,205	11,266,361

Notes. Two-stage least squares estimates. The dependent variable is the hourly wage in columns (1)–(2) and the log hourly wage in columns (3)–(4). Productivity is hourly MPL in columns (1)–(2) and log hourly MPL in columns (3)–(4). Productivity is demeaned before constructing the interaction with tightness. Productivity, tightness, and their interaction are instrumented by lagged productivity, leave-one-out occupation-level tightness, and their interaction, respectively. Worker controls include age, age squared, and gender. Standard errors are two-way clustered by firm and occupation $\times$ administrative area. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

In particular, wages and tightness are jointly determined, and firms with systematically different wage levels may sort into labour markets with different levels of tightness.

Once firm fixed effects are included, this cross-sectional component is removed and identification comes from changes in labour market tightness faced by workers within the same firm over time. The coefficient on tightness then turns positive in both specifications. The level estimate is less precise, while the log estimate is positive and statistically significant. This pattern is consistent with the bargaining mechanism of the model: holding fixed persistent differences across firms, workers receive higher wages when the labour market they face becomes tighter.

Most importantly, the interaction between productivity and tightness remains positive throughout. This is the object directly corresponding to the central prediction of the baseline model: tighter labour markets increase the fraction of productivity that is passed through to workers' wages.

6.2 Productivity pass-through across firms

I next examine how productivity pass-through varies across the firm productivity distribution. Figure 3 reports the estimated coefficient on MPL from separate regressions for each TFPR decile.

The estimates show a clear downward gradient in productivity pass-through across the firm productivity distribution. Pass-through is around 0.3–0.4 over the lower part of the distribution, before declining substantially among the most productive firms. In the ninth decile, the estimated pass-through is about 0.17, and in the top decile it falls to 0.04.

The estimate for the bottom decile is considerably less precise than those for the rest of the distribution. Its point estimate is nevertheless among the largest in the sample, and the broader pattern is not driven by this observation: pass-through remains high in deciles two and three and subsequently falls toward the top of the productivity distribution. The results therefore suggest that workers at more productive firms capture a smaller share of marginal increases in productivity through their wages.

I next ask whether labour market tightness affects productivity pass-through differently across the firm productivity distribution. The heterogeneous-firm model suggests that this may be the case because workers at more productive firms are less likely to encounter alternative firms that are sufficiently attractive to induce them to leave the current negotiation. If so, tighter labour markets should have a smaller effect on wage pass-through at more productive firms.

To examine this, I re-estimate the wage equation separately within each TFPR decile,

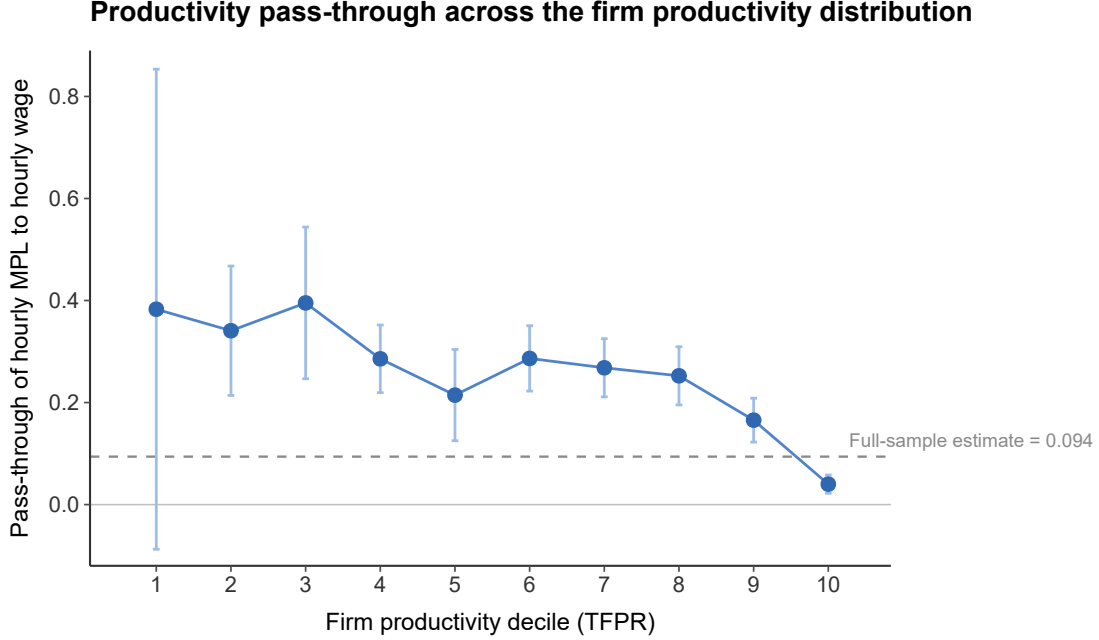


Figure 3: Productivity pass-through across the firm productivity distribution

Notes: Points report 2SLS estimates of the pass-through of hourly MPL to hourly wages, estimated separately by TFPR decile. Vertical bars denote 95% confidence intervals. The dashed line reports the corresponding full-sample estimate.

allowing both the level of pass-through and its interaction with labour market tightness to vary across the productivity distribution. Table 3 reports the results. The first column repeats the decile-specific pass-through estimates shown in Figure 3, while the second reports the coefficient on the interaction between MPL and labour market tightness.

The interaction estimates are generally larger in the lower and middle parts of the productivity distribution, although they are not always estimated precisely within individual deciles. This loss of precision is not surprising, since splitting the sample into ten groups substantially reduces the identifying variation available in each regression while the standard errors continue to allow for correlation within firms and local labour markets.

The point estimates nevertheless reveal a clear contrast with the top of the distribution. Tightness has economically sizeable effects on productivity pass-through in several lower and middle deciles, whereas the estimated effect becomes very small among the most productive firms. In particular, the interaction is close to zero in the eighth and tenth deciles, not only in statistical significance but also in magnitude. The estimates therefore suggest that the effect of labour market tightness on wage pass-through weakens substantially at the top of the firm productivity distribution. While the decile-by-decile estimates are too imprecise to support a strictly monotonic relationship throughout the distribution, the near-zero effects

Table 3: Productivity pass-through and labour market tightness across TFPR deciles

TFPR decile	Productivity pass-through (1)	MPL $\times$ Tightness (2)
1	0.383 (0.240)	0.051 (0.061)
2	0.341*** (0.065)	0.174*** (0.060)
3	0.395*** (0.076)	0.043 (0.053)
4	0.286*** (0.034)	0.025 (0.019)
5	0.215*** (0.046)	0.036 (0.037)
6	0.286*** (0.033)	0.137* (0.079)
7	0.268*** (0.029)	0.041*** (0.014)
8	0.252*** (0.029)	0.001 (0.027)
9	0.165*** (0.022)	0.028 (0.025)
10	0.040*** (0.009)	0.005 (0.005)

Notes: Column (1) reports 2SLS estimates of the pass-through of hourly MPL to hourly wages from separate regressions by TFPR decile, corresponding to Figure 3. Column (2) reports the coefficient on the interaction between hourly MPL and labour market tightness from separate 2SLS regressions by TFPR decile. Location, occupation and year fixed effects are included. Standard errors are reported in parentheses and are two-way clustered by firm and local occupation labour market. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

at the top are consistent with the mechanism in the heterogeneous-firm model.

7 Conclusion

This paper asks what determines worker bargaining power and, in particular, how it depends on labour market conditions. I develop a non-cooperative model of wage bargaining in which workers and firms alternate offers while continuing to search for alternative partners. Following a rejected offer, either party may encounter a new potential partner and decide whether to abandon the ongoing negotiation. These choices make the risk of bargaining breakdown endogenous and dependent on the availability of outside opportunities.

Bargaining power therefore emerges as an equilibrium outcome rather than being imposed through an exogenous bargaining weight.

In the benchmark model, the worker’s share of match surplus is strictly increasing in labour market tightness. Tightness works through two channels that pull in opposite directions. On one side, firms in tighter markets are less likely to find workers and abandon ongoing negotiations, so a worker who rejects an offer is more likely to retain the opportunity to make a counteroffer. This raises the value of rejecting and, through the firm’s offer, the value of agreement. On the other side, tighter markets also raise the value of continued search, since an unemployed worker is paired with firms more often. The surplus from an agreement is what the worker gains over continued search, so a higher value of search leaves less to be gained from any given agreement, and this works against the first channel. In equilibrium, the first channel dominates: the reduction in breakdown risk raises the value of agreement by more than the value of search rises. The model consequently predicts stronger productivity pass-through into wages in tighter labour markets.

The empirical analysis supports this prediction. Using French matched employer–employee data, I measure worker bargaining power as the pass-through of the firm’s marginal product of labour into wages. To address the endogeneity of local labour market conditions, I instrument tightness using the leave-one-out tightness of the same occupation in other locations. In the preferred specification with firm fixed effects, a one-euro increase in the firm’s hourly marginal product of labour raises the worker’s hourly wage by approximately 5.2 cents at average labour market tightness. A one-standard-deviation increase in tightness raises this pass-through to 7.1 cents per euro, an increase of approximately 37%.

I extend the model to allow firms to differ in productivity and, consequently, in the surplus generated by an employment relationship. Workers negotiating with more productive firms require more attractive alternatives before abandoning their current negotiations. This creates a force towards lower worker bargaining power at more productive firms and can weaken the effect of labour market tightness. The empirical results reveal similar patterns. Productivity pass-through declines from approximately 30–40 cents per euro among less productive firms to just 4 cents per euro in the highest TFPR decile. Moreover, the effect of tightness on productivity pass-through becomes very small among the most productive firms.

The model isolates this bargaining mechanism in a simple environment, but the framework can be extended to incorporate multi-worker firms, more general production technologies, on-the-job search, and additional sources of heterogeneity.

More broadly, the results suggest that differences in worker bargaining power across firms and labour markets need not be imposed through an exogenous parameter. They can

emerge from the opportunities available to workers and firms, and from the value of those opportunities relative to the negotiations they are already in. One implication is that rent-sharing elasticities estimated in different markets or periods are not directly comparable without accounting for labour market conditions. Labour market conditions shape wages not only by changing what workers and firms can obtain elsewhere, but also by changing how they divide what they create together.

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A Appendix

A.1 Proof of Proposition 1

A.1.1 Equilibrium characterisation

I write $\lambda_i = \lambda_i(\theta)$ for $i \in \{w, f\}$. We work within the class of Markov strategies defined in Section 2.3, with the convention that an agent attends their only available negotiation when indifferent. Let V_i^0 denote the value of remaining in the search market without an ongoing negotiation. The value of agreement at wage w is $V_i(w)$, as in the main text. Both $V_i(w)$ and V_i^0 are evaluated at the start of a period, consistent with employment beginning in the period after agreement. For any pair of types $i, j \in \{w, f\}$, $j \neq i$, agent i is the proposer when the agreed wage is w_i^* and the responder when it is w_j^* .

Throughout, I take as given that gains from agreement are strictly positive in both roles, $V_i(w_i^*) > V_i^0$ and $V_i(w_j^*) > V_i^0$ for $i \in \{w, f\}$. Section A.1.2 verifies that this holds in the equilibrium constructed there, as a consequence of $p - b + c > 0$.

Lemma 1 (Bargaining strategies) *Conditional on both agents attending, the proposer offers the wage that makes the responder indifferent between accepting and rejecting, and the offer is accepted immediately. Hence the firm offers w_f^* , the worker offers w_w^* , and*

$$r_w^*(w) = \mathbf{1}\{w \geq w_f^*\}, \quad r_f^*(w) = \mathbf{1}\{w \leq w_w^*\}. \quad (35)$$

Proof. Under the Markov restriction, the continuation value following rejection does not depend on the rejected wage. The worker's value of agreement is strictly increasing in w , while the firm's is strictly decreasing. The optimal response rules in (6) are therefore cutoff rules. A proposer prefers the most favourable acceptable wage. An unacceptable offer delays agreement and exposes the negotiation to possible dissolution. The argument of Rubinstein (1982) and Binmore et al. (1986) applies directly, yielding immediate agreement at the responder's cutoff and acceptance at indifference. ■

Corollary 2 (Proposer advantage) *For either agent i , the value of agreement when proposing exceeds the value when responding:*

$$V_i(w_i^*) > V_i(w_j^*), \quad j \neq i. \quad (36)$$

Consequently,

$$w_f^* < w_w^*. \quad (37)$$

Proof.

Note first that $V_i^0 \geq \frac{g_i}{1-\delta}$, since an agent in the search market can attend every negotiation and reject every offer, securing g_i in each period.

Suppose, towards a contradiction, that $V_i(w_j^*) \geq V_i(w_i^*)$. Then $V_i(w_j^*) \geq V_i(w_i^*) > V_i^0$, so $V_i(w_j^*)$ is the largest value agent i can hold at the start of any period. By Lemma 1, the responder is indifferent between accepting w_j^* and rejecting it:

$$V_i(w_j^*) = V_i^{\text{rej}}(R) \leq g_i + \delta V_i(w_j^*), \quad (38)$$

where the inequality holds because, after rejection, the agent receives g_i and then holds one of $V_i(w_i^*)$, $V_i(w_j^*)$ or V_i^0 in the following period, each of which is at most $V_i(w_j^*)$. Rearranging,

$$V_i(w_j^*) \leq \frac{g_i}{1-\delta} \leq V_i^0, \quad (39)$$

which contradicts $V_i(w_j^*) > V_i^0$. Hence $V_w(w_w^*) > V_w(w_f^*)$ and $V_f(w_f^*) > V_f(w_w^*)$. Since the worker's value is increasing and the firm's value decreasing in the wage, both imply $w_f^* < w_w^*$. ■

Lemma 2 (A single negotiation) *An agent with exactly one available negotiation attends it.*

Proof. Attendance has no direct cost and allows the agent to reject an unacceptable offer. Attending therefore weakly dominates attending neither, and is strictly preferable if the partner attends with positive probability. ■

Corollary 3 (New pairings) *Along the equilibrium path, every new pairing proceeds to bargaining and reaches immediate agreement. An agent expects any newly paired partner to attend with probability one.*

Proof. By Lemma 1, all offers are accepted along the equilibrium path, so no ongoing negotiations remain. A newly paired agent therefore has only one available negotiation and attends by Lemma 2. ■

Lemma 3 (Preference for a new negotiation) *An agent with both an ongoing and a new negotiation attends the new one in states (R, P) , (P, P) , and (R, R) .*

Proof. A new partner attends with certainty by Corollary 3.

In state (R, P) , the agent is proposer in the new negotiation and responder in the ongoing one. The new negotiation yields $V_i(w_i^*)$ with certainty, whereas the ongoing one yields at most $V_i(w_j^*)$. By Corollary 2, the new negotiation is strictly preferred.

In state (P, P) , both negotiations yield $V_i(w_i^*)$ if attended by the partner. The ongoing partner is a responder and, by the (R, P) case, leaves whenever newly paired as proposer, an event of probability $\frac{\lambda_j}{2} > 0$. The new partner attends with certainty, so the new negotiation is strictly preferred.

In state (R, R) , both negotiations yield $V_i(w_j^*)$ if attended by the partner. The ongoing partner is now a proposer and, by the (P, P) case, leaves whenever newly paired as proposer, again an event of probability $\frac{\lambda_j}{2} > 0$. The new negotiation is therefore strictly preferred.

Combining the (R, P) and (R, R) cases, a responder in an ongoing negotiation leaves upon any new pairing, an event of probability λ_j . This is the event used in Lemma 4. ■

The remaining state is (P, R) . The ongoing negotiation gives the agent the proposer role but may not be attended by the partner; the new negotiation gives the responder role and takes place with certainty.

Lemma 4 (Preference for an ongoing negotiation) *An agent in state (P, R) attends the ongoing negotiation.*

Proof. Under the candidate strategies, a responder in an ongoing negotiation leaves upon any new pairing by Lemma 3. Thus an agent i who attends the ongoing negotiation as proposer obtains the expected value

$$(1 - \lambda_j)V_i(w_i^*) + \lambda_j V_i^0,$$

where $j \neq i$ is the partner's type. Attending the new negotiation instead gives $V_i(w_j^*)$. We show that the former is larger.

Let $g_w = b$ and $g_f = -c$ denote the period payoffs of remaining in the search market. Under the candidate strategies, the value without an ongoing negotiation satisfies

$$V_i^0 = g_i + \delta \left[(1 - \lambda_i)V_i^0 + \frac{\lambda_i}{2}V_i(w_i^*) + \frac{\lambda_i}{2}V_i(w_j^*) \right]. \quad (40)$$

The responder is indifferent between accepting w_j^* and rejecting it. After rejection they become proposer in the ongoing negotiation. They attend a new negotiation if paired as proposer, an event of probability $\lambda_i/2$; otherwise, they choose the ongoing negotiation, which continues if partner j has not been newly paired. Thus

$$\begin{aligned} V_i(w_j^*) = g_i + \delta & \left[\frac{\lambda_i}{2}V_i(w_i^*) \right. \\ & \left. + \left(1 - \frac{\lambda_i}{2}\right) ((1 - \lambda_j)V_i(w_i^*) + \lambda_j V_i^0) \right]. \end{aligned} \quad (41)$$

Subtracting (40) from (41) gives

$$\left(1 + \frac{\delta\lambda_i}{2}\right) [V_i(w_j^*) - V_i^0] = \delta(1 - \lambda_j) \left(1 - \frac{\lambda_i}{2}\right) [V_i(w_i^*) - V_i^0]. \quad (42)$$

Because $\delta < 1$, $\lambda_i, \lambda_j \in (0, 1)$ and $V_i(w_i^*) > V_i^0$, this implies

$$V_i(w_j^*) - V_i^0 < (1 - \lambda_j) [V_i(w_i^*) - V_i^0]. \quad (43)$$

Therefore

$$V_i(w_j^*) < (1 - \lambda_j)V_i(w_i^*) + \lambda_j V_i^0,$$

so the ongoing negotiation is strictly preferred in state (P, R) . ■

A.1.2 Existence and uniqueness

Existence. We establish existence by constructing the equilibrium values and wage offers.

Since wages are transfers, the joint value of employment is independent of the wage. Define the total surplus relative to continued search as

$$S = V_w(w) + V_f(w) - V_w^0 - V_f^0. \quad (44)$$

Adding the employment value equations gives

$$[1 - \delta(1 - s)]S = p - (1 - \delta)(V_w^0 + V_f^0). \quad (45)$$

We first express the equilibrium bargaining values in terms of S . Evaluating (44) at $w = w_w^*$ and at $w = w_f^*$ gives

$$S = [V_w(w_w^*) - V_w^0] + [V_f(w_w^*) - V_f^0] = [V_w(w_f^*) - V_w^0] + [V_f(w_f^*) - V_f^0].$$

Together with the indifference conditions (42) for workers and for firms, this is a linear system in the four differences $V_i(w_k^*) - V_i^0$, $i, k \in \{w, f\}$, whose unique solution is, for $i \in \{w, f\}$ and $j \neq i$,

$$\begin{aligned} V_i(w_i^*) - V_i^0 &= \frac{2 + \delta\lambda_i}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]} S, \\ V_i(w_j^*) - V_i^0 &= \frac{\delta(1 - \lambda_j)(2 - \lambda_i)}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]} S. \end{aligned} \quad (46)$$

Next, substituting (46) into the search value equation (40) and rearranging yields

$$V_i^0 = \frac{g_i}{1 - \delta} + \frac{\delta \lambda_i [2 + \delta(2 - 2\lambda_j + \lambda_i \lambda_j)]}{2(1 - \delta)[2 + \delta(1 + (1 - \lambda_w)(1 - \lambda_f))]} S. \quad (47)$$

Thus, the outside values are uniquely determined for any given S .

Finally, adding (47) for workers and firms and substituting into (45) gives

$$S = \frac{p - b + c}{1 - \delta(1 - s) + \frac{\delta}{2} \sum_{i \in \{w, f\}} \lambda_i \frac{2 + \delta(2 - 2\lambda_j + \lambda_i \lambda_j)}{2 + \delta[1 + (1 - \lambda_w)(1 - \lambda_f)]}}. \quad (48)$$

The denominator is strictly positive since $\delta \in (0, 1)$, $s \in (0, 1)$, and $\lambda_w, \lambda_f \in (0, 1)$. Under the assumption that there are gains from agreement such that $p - b + c > 0$, equation (48) therefore determines a unique $S > 0$.

Given S , equation (47) uniquely determines V_w^0 and V_f^0 , while (46) determines the employment values associated with each bargaining role. In particular, $S > 0$ implies $V_i(w_i^*) > V_i^0$ and $V_i(w_j^*) > V_i^0$ for both types, which is the condition used in Corollary 2, Lemma 4 and the uniqueness argument below; and since $2 + \delta \lambda_i > \delta(1 - \lambda_j)(2 - \lambda_i)$, (46) delivers (36) directly.

Finally, since $V_w(w)$ is strictly increasing in w , the equilibrium wage offers are uniquely determined from (1):

$$w_i^* = [1 - \delta(1 - s)]V_w(w_i^*) - \delta s V_w^0, \quad i \in \{w, f\}. \quad (49)$$

We have thus established the existence of values S , V_w^0 , V_f^0 , and wages w_f^* and w_w^* consistent with the equilibrium conditions. Together with the strategies characterised in the preceding lemmas, these constitute a Markov perfect equilibrium.

Uniqueness. Given stationary attendance strategies, the continuation value following rejection is independent of the wage offered. The uniqueness of the bargaining strategies therefore follows from the alternating offers argument of Rubinstein (1982) and Binmore et al. (1986).

We next establish uniqueness of attendance strategies. Under the convention that agents attend their only available negotiation, Lemma 2 determines behaviour in states with a single negotiation. By Lemma 3, attending the new negotiation is strictly optimal in states (R, P) , (P, P) , and (R, R) . The only remaining state is (P, R) , where the agent is the proposer in the ongoing negotiation and the responder in the new one.

Lemmas 1 to 3 do not depend on behaviour in state (P, R) : the (R, P) case uses only

Corollaries 2 and 3, the (P, P) case uses the partner's behaviour in (R, P) , and the (R, R) case uses the partner's behaviour in (P, P) . Behaviour in (P, R) can therefore be determined one type at a time, holding the other type's behaviour in (P, R) arbitrary.

Suppose, towards a contradiction, that an agent of type i attends the new negotiation in state (P, R) with probability $\pi \in (0, 1]$. After rejecting an offer, agent i is proposer in the ongoing negotiation. With probability $\lambda_i/2$ they are newly paired as proposer and attend the new negotiation; with probability $\lambda_i/2$ they are newly paired as responder and attend the new negotiation with probability π ; otherwise they attend the ongoing negotiation, which continues if partner j has not been newly paired. The responder's indifference condition therefore becomes

$$V_i(w_j^*) = g_i + \delta \left[\frac{\lambda_i}{2} V_i(w_i^*) + \frac{\lambda_i}{2} \left(\pi V_i(w_j^*) + (1 - \pi) ((1 - \lambda_j) V_i(w_i^*) + \lambda_j V_i^0) \right) + (1 - \lambda_i) ((1 - \lambda_j) V_i(w_i^*) + \lambda_j V_i^0) \right], \quad (50)$$

where $j \neq i$. Subtracting the search value equation (40), we obtain

$$V_i(w_j^*) - V_i^0 = \delta(1 - \lambda_i)(1 - \lambda_j) [V_i(w_i^*) - V_i^0] + \delta \frac{\lambda_i}{2} (1 - \pi) \left((1 - \lambda_j) [V_i(w_i^*) - V_i^0] - [V_i(w_j^*) - V_i^0] \right). \quad (51)$$

Setting $\pi = 0$ recovers (42).

Attending the new negotiation with positive probability in state (P, R) is optimal only if

$$V_i(w_j^*) - V_i^0 \geq (1 - \lambda_j) [V_i(w_i^*) - V_i^0]. \quad (52)$$

Under (52), the last term in (51) is non-positive, so

$$V_i(w_j^*) - V_i^0 \leq \delta(1 - \lambda_i)(1 - \lambda_j) [V_i(w_i^*) - V_i^0] < (1 - \lambda_j) [V_i(w_i^*) - V_i^0], \quad (53)$$

where the strict inequality uses $\delta(1 - \lambda_i) < 1$, $\lambda_j < 1$ and $V_i(w_i^*) > V_i^0$. This contradicts (52). Hence no strategy, pure or mixed, that attends the new negotiation in state (P, R) with positive probability can be part of an equilibrium.

Therefore, an agent must attend the ongoing negotiation in state (P, R) . Together with the preceding lemmas, this uniquely determines the attendance strategies in (7). Given these strategies, the equilibrium value equations uniquely determine the wage offers, as established above. This completes the proof of Proposition 1.

A.2 Proof of Proposition 2

Differentiating the average bargaining power given by Equation (15) with respect to labour market tightness yields

$$\begin{aligned} \frac{\partial \bar{\beta}}{\partial \theta} = & \frac{\delta}{2 [2 + \delta(1 + (1 - \lambda_w)(1 - \lambda_f))]^2} \\ & \times \left[\lambda'_w(\theta) (2 + \delta[1 + (1 - \lambda_f)^2]) \right. \\ & \left. - \lambda'_f(\theta) (2 + \delta[1 + (1 - \lambda_w)^2]) \right]. \end{aligned} \quad (54)$$

The denominator is strictly positive. Since $\lambda'_w(\theta) > 0$, $\lambda'_f(\theta) < 0$, and both expressions multiplying these derivatives are positive, the numerator is also strictly positive. Therefore,

$$\frac{\partial \bar{\beta}}{\partial \theta} > 0$$

for every $\delta \in (0, 1)$. □

A.3 Equilibrium wage expressions

We derive the equilibrium wages after substituting the search values obtained in Appendix A.1.2.

From (47) and the equilibrium bargaining shares, the search values satisfy

$$\begin{aligned} (1 - \delta)V_w^0 &= b + \delta\lambda_w\bar{\beta}S, \\ (1 - \delta)V_f^0 &= -c + \delta\lambda_f(1 - \bar{\beta})S. \end{aligned} \quad (55)$$

Substituting the worker's search value into (18), and using (45), gives

$$\begin{aligned} w_f^* &= b + [\delta\lambda_w\bar{\beta} + (1 - \delta(1 - s))\beta_f] S, \\ w_w^* &= b + [\delta\lambda_w\bar{\beta} + (1 - \delta(1 - s))\beta_w] S. \end{aligned} \quad (56)$$

The denominator of the total surplus expression (48) can equivalently be written as

$$1 - \delta(1 - s) + \delta [\lambda_w\bar{\beta} + \lambda_f(1 - \bar{\beta})].$$

Substituting the equilibrium total surplus, we obtain

$$\begin{aligned} w_f^* &= b + \frac{\delta\lambda_w\bar{\beta} + [1 - \delta(1 - s)]\beta_f}{1 - \delta(1 - s) + \delta[\lambda_w\bar{\beta} + \lambda_f(1 - \bar{\beta})]}(p - b + c), \\ w_w^* &= b + \frac{\delta\lambda_w\bar{\beta} + [1 - \delta(1 - s)]\beta_w}{1 - \delta(1 - s) + \delta[\lambda_w\bar{\beta} + \lambda_f(1 - \bar{\beta})]}(p - b + c). \end{aligned} \quad (57)$$

Finally, taking the average across the two equally likely proposer roles gives

$$\bar{w} = b + \frac{\bar{\beta}[1 - \delta(1 - s) + \delta\lambda_w]}{1 - \delta(1 - s) + \delta[\lambda_w\bar{\beta} + \lambda_f(1 - \bar{\beta})]}(p - b + c). \quad (58)$$

Together with the equilibrium bargaining shares in (14) and (15), these expressions characterise wages entirely in terms of the model's primitives and labour market tightness.

A.4 Asymmetric first mover probabilities

We extend the equilibrium surplus division to the case in which the firm makes the initial offer with probability $\mu \in [0, 1]$ and the worker with probability $1 - \mu$. The equilibrium attendance strategies remain unchanged, but the search values and the responder's continuation values depend on μ .

The search value equations become

$$\begin{aligned} V_w^0 &= b + \delta \left[(1 - \lambda_w)V_w^0 \right. \\ &\quad \left. + \lambda_w(\mu V_w(w_f^*) + (1 - \mu)V_w(w_w^*)) \right], \\ V_f^0 &= -c + \delta \left[(1 - \lambda_f)V_f^0 \right. \\ &\quad \left. + \lambda_f(\mu V_f(w_f^*) + (1 - \mu)V_f(w_w^*)) \right]. \end{aligned} \quad (59)$$

The worker's indifference condition when responding to the firm's offer is

$$\begin{aligned} V_w(w_f^*) &= b + \delta \left[\lambda_w(1 - \mu)V_w(w_w^*) \right. \\ &\quad \left. + (1 - \lambda_w(1 - \mu)) \left((1 - \lambda_f)V_w(w_w^*) + \lambda_f V_w^0 \right) \right]. \end{aligned} \quad (60)$$

Similarly, the firm's indifference condition when responding to the worker's offer is

$$V_f(w_w^*) = -c + \delta \left[\lambda_f \mu V_f(w_f^*) + (1 - \lambda_f \mu) \left((1 - \lambda_w) V_f(w_f^*) + \lambda_w V_f^0 \right) \right]. \quad (61)$$

Subtracting the respective search values (59) and rearranging gives

$$\begin{aligned} S_w(w_f^*) &= \delta \frac{(1 - \lambda_f)(1 - \lambda_w(1 - \mu))}{1 + \delta \lambda_w \mu} S_w(w_w^*), \\ S_f(w_w^*) &= \delta \frac{(1 - \lambda_w)(1 - \lambda_f \mu)}{1 + \delta \lambda_f(1 - \mu)} S_f(w_f^*). \end{aligned} \quad (62)$$

Since total surplus does not depend on the wage, these conditions determine the worker's equilibrium surplus shares for each proposer role. We obtain

$$\begin{aligned} \frac{\beta_f}{1 - \beta_f} &= \delta(1 - \lambda_f) \frac{1 - \lambda_w(1 - \mu)}{1 + \delta \lambda_f(1 - \mu)} \\ &\times \frac{1 - \delta[1 - \lambda_w - \lambda_f(1 - \mu \lambda_w)]}{1 - \delta[1 - \lambda_f - \lambda_w(1 - (1 - \mu) \lambda_f)]}. \end{aligned} \quad (63)$$

Similarly, when the worker makes the initial offer,

$$\begin{aligned} \frac{\beta_w}{1 - \beta_w} &= \frac{1}{\delta(1 - \lambda_w)} \frac{1 + \delta \lambda_w \mu}{1 - \lambda_f \mu} \\ &\times \frac{1 - \delta[1 - \lambda_w - \lambda_f(1 - \mu \lambda_w)]}{1 - \delta[1 - \lambda_f - \lambda_w(1 - (1 - \mu) \lambda_f)]}. \end{aligned} \quad (64)$$

The expressions capture the effects of partner availability, outside opportunities, and the relative costs of delaying agreement. For general μ , these forces need not have the same relative importance for workers and firms.

The worker's expected bargaining power is

$$\bar{\beta}(\theta; \mu) = \mu \beta_f(\theta; \mu) + (1 - \mu) \beta_w(\theta; \mu). \quad (65)$$

Setting $\mu = \frac{1}{2}$ recovers the equilibrium bargaining shares in (14) and (15).

A.5 Bargaining power and market tightness

In the symmetric benchmark, where firms and workers are equally likely to make the first offer, worker bargaining power is strictly increasing in labour market tightness for any pairing technology satisfying the assumptions of the model. When first mover probabilities are asymmetric, however, the relationship is not necessarily monotonic. Its sign depends on how the pairing probabilities of workers and firms respond to changes in market tightness.

To illustrate the role of these responses, consider the limiting case in which firms always make the initial offer, $\mu \rightarrow 1$, and the discount factor approaches one, $\delta \rightarrow 1$. We consider this case simply to make the algebra lighter as the aim is to show the intuition.

Since firms make all initial offers, expected worker bargaining power coincides with the share obtained when the firm proposes, $\bar{\beta} = \beta_f$. Taking the limit of the equilibrium surplus shares and using $\lambda_w = \theta \lambda_f$, we obtain

$$\lim_{\substack{\mu \rightarrow 1 \\ \delta \rightarrow 1}} \bar{\beta}(\theta; \mu) = \frac{(1 - \lambda_f)(1 + \theta - \lambda_w)}{1 + \theta + (1 - \lambda_f)(1 + \theta - \lambda_w)}. \quad (66)$$

The expression illustrates two opposing effects of tighter labour markets. A reduction in the firm's probability of finding another worker lowers the risk that the firm abandons the negotiation, strengthening the worker's bargaining position. At the same time, an increase in the worker's probability of finding another firm raises the opportunity cost of prolonging the negotiation. Whether worker bargaining power increases therefore depends on the relative responsiveness of these probabilities to tightness.

Pairing elasticities and bargaining power. To characterise this relationship, let $P(N_u, N_v)$ denote the aggregate number of pairings generated by unemployed workers and vacancies. The pairing probabilities are given by

$$\lambda_w(\theta) = \frac{P(N_u, N_v)}{N_u}, \quad \lambda_f(\theta) = \frac{P(N_u, N_v)}{N_v}. \quad (67)$$

Define the elasticities of aggregate pairings with respect to unemployment and vacancies as

$$\eta_u = \frac{\partial \log P(N_u, N_v)}{\partial \log N_u}, \quad \eta_v = \frac{\partial \log P(N_u, N_v)}{\partial \log N_v}. \quad (68)$$

Under constant returns to scale, $\eta_u + \eta_v = 1$. Since $\theta = N_v/N_u$, these elasticities determine the responsiveness of the pairing probabilities to market tightness:

$$\frac{\partial \log \lambda_w}{\partial \log \theta} = \eta_v, \quad \frac{\partial \log \lambda_f}{\partial \log \theta} = -\eta_u. \quad (69)$$

Differentiating (66) with respect to market tightness and substituting (69) yields

$$\begin{aligned} \frac{d}{d\theta} \left[\lim_{\substack{\mu \rightarrow 1 \\ \delta \rightarrow 1}} \bar{\beta}(\theta; \mu) \right] &= \frac{\lambda_f(1 - \lambda_f)}{[1 + \theta + (1 - \lambda_f)(1 + \theta - \lambda_w)]^2} \\ &\times \left\{ \eta_u \left[\theta + \frac{(1 + \theta)(1 + \theta - \lambda_w)}{\theta(1 - \lambda_f)} \right] - \eta_v \right\}. \end{aligned} \quad (70)$$

Since the multiplicative term outside the braces is strictly positive, worker bargaining power increases with tightness if and only if

$$\eta_u \left[\theta + \frac{(1 + \theta)(1 + \theta - \lambda_w)}{\theta(1 - \lambda_f)} \right] > \eta_v. \quad (71)$$

The condition highlights the importance of relative pairing elasticities. A higher elasticity with respect to unemployment, η_u , implies that the firm's probability of finding another worker decreases more strongly as the market tightens. This reduces the risk of losing the current negotiation. Conversely, a higher elasticity with respect to vacancies, η_v , implies that the worker's probability of finding another firm increases more strongly, raising the opportunity cost of delay. The first effect must be sufficiently strong relative to the second for worker bargaining power to increase.

An instructive counterexample is a Leontief pairing technology,

$$P(N_u, N_v) = \rho \min\{N_u, N_v\}, \quad 0 < \rho < 1. \quad (72)$$

For $\theta < 1$, the pairing probabilities are $\lambda_f = \rho$ and $\lambda_w = \rho\theta$. Consequently, $\eta_u = 0$ and $\eta_v = 1$. The firm's pairing probability is locally independent of tightness, whereas the worker's pairing probability increases with it. Condition (71) is therefore violated, and worker bargaining power decreases with tightness in this region.

This limiting case establishes that the positive relationship between bargaining power and tightness need not hold under every pairing technology when first mover probabilities are asymmetric. Whether it holds under empirically relevant conditions depends on the elasticities of the pairing function.

Cobb–Douglas and CES pairing functions. We consider two commonly used constant-returns-to-scale pairing technologies. The first is the Cobb–Douglas function,

$$P(N_u, N_v) = \rho N_u^\alpha N_v^{1-\alpha}, \quad (73)$$

where $\rho > 0$ denotes pairing efficiency and $\alpha \in (0, 1)$ is the elasticity with respect to unemployment. It implies

$$\lambda_w(\theta) = \rho\theta^{1-\alpha}, \quad \lambda_f(\theta) = \rho\theta^{-\alpha}, \quad (74)$$

with constant elasticities $\eta_u = \alpha$ and $\eta_v = 1 - \alpha$.

The second is the CES pairing function,

$$P(N_u, N_v) = \rho \left[a N_u^{\frac{\sigma-1}{\sigma}} + (1-a) N_v^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad (75)$$

where $a \in (0, 1)$ and $\sigma > 0$ denotes the elasticity of substitution between unemployed workers and vacancies. For $\sigma \neq 1$, the implied pairing probabilities are

$$\lambda_w(\theta) = \rho \left[a + (1-a)\theta^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad \lambda_f(\theta) = \frac{\lambda_w(\theta)}{\theta}. \quad (76)$$

Unlike Cobb–Douglas, the CES specification allows the pairing elasticities to vary with tightness:

$$\eta_u(\theta) = \frac{a}{a + (1-a)\theta^{\frac{\sigma-1}{\sigma}}}, \quad \eta_v(\theta) = \frac{(1-a)\theta^{\frac{\sigma-1}{\sigma}}}{a + (1-a)\theta^{\frac{\sigma-1}{\sigma}}}. \quad (77)$$

The Cobb–Douglas function is obtained as the limit when $\sigma \rightarrow 1$, with $\alpha = a$.

Both specifications allow us to evaluate the role of matching elasticities in determining bargaining power. We next use empirical estimates from the matching-function literature to select parameter values and examine whether the positive relationship between tightness and bargaining power persists when first mover probabilities are asymmetric.

Empirical evidence on matching elasticities The early empirical literature is surveyed by Petrongolo and Pissarides (2001), who document broad support for CRS Cobb–Douglas matching functions.

To choose empirically relevant parameters, I draw on the comparison of U.S. estimates compiled by Bernstein et al. (2025), together with the studies reported therein. I focus on estimates obtained under CRS and retain both Cobb–Douglas and CES specifications.

Table 4 reports the elasticity with respect to vacancies and its CRS-implied counterpart with respect to unemployment. For CES, it also reports the estimated substitution elasticity σ in the functional-form column.

The Cobb–Douglas estimates span a relatively wide range, while the CES estimates generally place the elasticity of substitution close to one, although these estimates are imprecise. This suggests that Cobb–Douglas is a useful benchmark, while motivating the consideration of CES specifications that allow matching elasticities to vary with tightness.

Table 4: Empirical estimates of matching elasticities

Study	Functional form	η_v	η_u
<i>Cobb–Douglas</i>			
Blanchard and Diamond (1989)	Cobb–Douglas	0.54	0.46
Bleakley and Fuhrer (1997)	Cobb–Douglas	0.31–0.35	0.65–0.69
Shimer (2005)	Cobb–Douglas	0.28	0.72
Hall (2005)	Cobb–Douglas	0.77	0.23
Rogerson and Shimer (2011)	Cobb–Douglas	0.42	0.58
Michaillat and Saez (2021)	Cobb–Douglas	0.51–0.61	0.39–0.49
Borowczyk-Martins et al. (2013)	Cobb–Douglas	0.70	0.30
Sahin et al. (2014)	Cobb–Douglas	0.24–0.66	0.34–0.76
Barnichon and Figura (2015)	Cobb–Douglas	0.34	0.66
Hall and Schulhofer-Wohl (2018)	Cobb–Douglas	0.35	0.65
<i>CES</i>			
Blanchard and Diamond (1989)	CES ($\sigma = 0.74$)	0.54	0.46
Shimer (2005)	CES ($\sigma = 1.06$)	0.28	0.72
Sahin et al. (2014)	CES ($\sigma = 0.9$ –1.2)	0.24–0.66	0.34–0.76

Notes: η_v and η_u denote the elasticities of matches with respect to vacancies and unemployment, respectively. The unemployment elasticities are calculated as $1 - \eta_v$ under constant returns to scale, rather than independently estimated. For CES specifications, σ denotes the elasticity of substitution between unemployment and vacancies, while the matching elasticities refer to the reported reference estimates and need not remain constant across tightness.

Source: Estimates compiled by Bernstein et al. (2025) and the original studies listed in the table.

Numerical analysis under alternative pairing technologies. We now examine how equilibrium worker bargaining power responds to labour market tightness under different pairing technologies and empirically relevant matching elasticities. I use the equilibrium bargaining shares for general first mover probabilities, derived in (63) and (64), to calculate

$$\bar{\beta}(\theta; \mu) = \mu\beta_f(\theta; \mu) + (1 - \mu)\beta_w(\theta; \mu). \quad (78)$$

For each pairing technology, I substitute the implied pairing probabilities $\lambda_w(\theta)$ and $\lambda_f(\theta)$ into these expressions and evaluate worker bargaining power over $\theta \in [0.1, 1.5]$.

Throughout the numerical analysis, I consider three probabilities that the firm makes the initial offer, $\mu \in \{0.1, 0.5, 0.9\}$. I set the discount factor to $\delta = 0.99$ and pairing efficiency to $\rho = 0.15$, holding both constant across specifications. The choice of ρ ensures that pairing probabilities remain strictly between zero and one over the range of tightness considered.

I first consider the Cobb–Douglas pairing function in (73). Guided by the empirical estimates in Table 4, I evaluate three unemployment elasticities, $\eta_u \in \{0.23, 0.5, 0.76\}$. The first and last correspond to the extremes of the estimates reported in the table, while the intermediate value represents a symmetric specification with $\eta_u = \eta_v = 0.5$. Figure 4 presents the results for the two extreme elasticities.

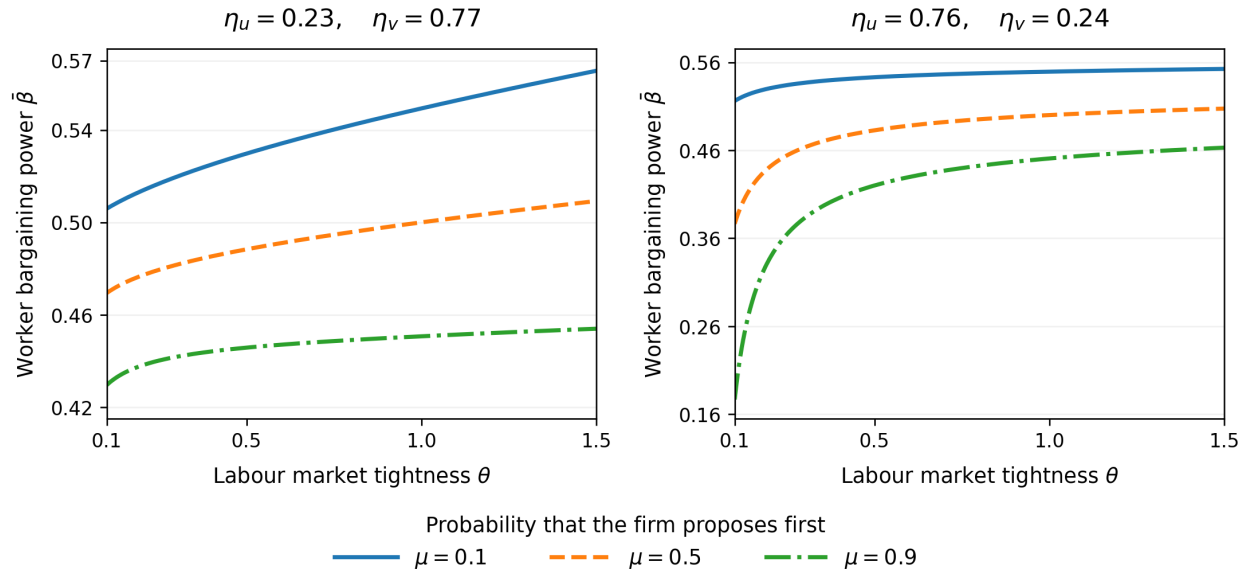


Figure 4: Expected worker bargaining power under Cobb–Douglas pairing. Unemployment elasticity: $\eta_u = 0.23$ (left) and $\eta_u = 0.76$ (right). Panel-specific vertical scales.

I then consider the CES pairing function in (75), allowing the matching elasticities to vary with tightness. Motivated by the empirical estimates in Table 4, I evaluate three elasticities of substitution, $\sigma \in \{0.74, 1.06, 1.2\}$. I set $a = 0.5$, so that the elasticities with respect to

unemployment and vacancies are both equal to 0.5 at $\theta = 1$. All other parameters remain unchanged. Figure 5 presents the results for the two extreme substitution elasticities.

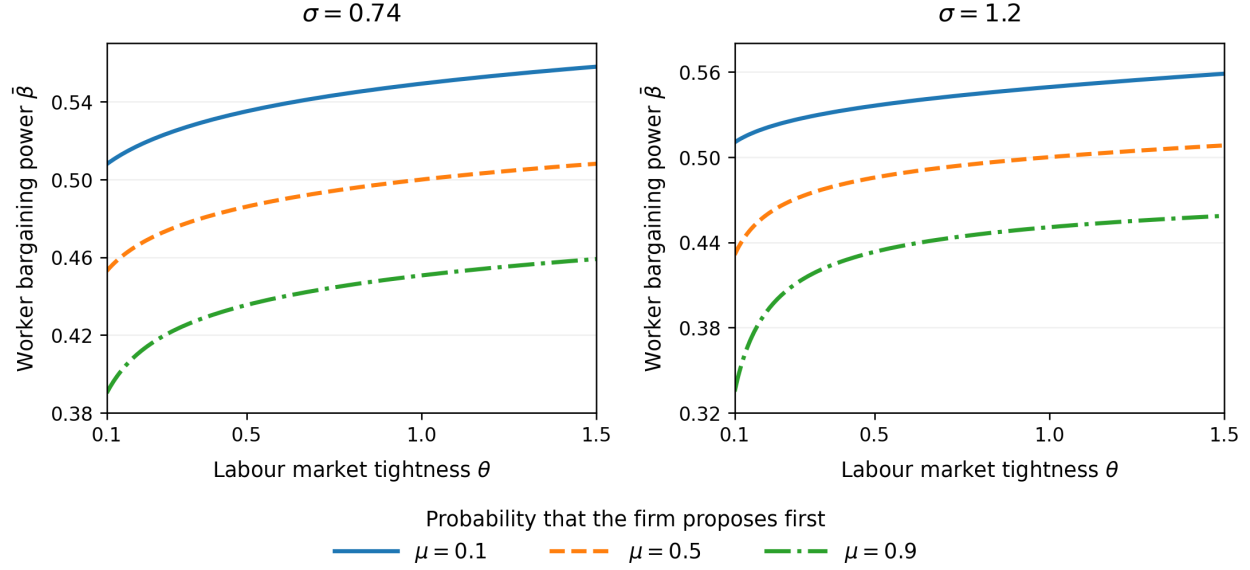


Figure 5: Expected worker bargaining power under CES pairing. Elasticity of substitution: $\sigma = 0.74$ (left) and $\sigma = 1.2$ (right). Panel-specific vertical scales.

A.6 Firm productivity heterogeneity

This appendix characterises equilibrium bargaining with heterogeneous firm productivity and proves the productivity results used in Section 3. As in the benchmark, I set $\mu = \frac{1}{2}$ and take labour market tightness θ as given. Firm productivity is permanent, with distribution F , and the productivity of a newly encountered firm is drawn independently from this distribution. Pairing probabilities do not depend on productivity. Throughout, I assume that employment generates positive total surplus $S(p) > 0$, with $S'(p) > 0$.

The employment value of a worker remains $V_w(w)$, while the firm's value of employment and of maintaining its vacancy now depend on its productivity: $V_f(w; p)$ and $V_f^0(p)$. The value of unemployment V_w^0 is common to all workers. Extending (8), define

$$S_w(w) = V_w(w) - V_w^0, \quad S_f(w; p) = V_f(w; p) - V_f^0(p). \quad (79)$$

Thus, at either equilibrium wage offer,

$$\begin{aligned} S(p) &= S_w(w_f^*(p)) + S_f(w_f^*(p); p) \\ &= S_w(w_w^*(p)) + S_f(w_w^*(p); p). \end{aligned} \quad (80)$$

Search values and optimal bargaining. The optimality conditions in (4)–(6) continue to apply, with firm productivity added to the payoff-relevant state. In an equilibrium with immediate agreement, the values of searching satisfy

$$\begin{aligned} V_w^0 &= b + \delta \left[(1 - \lambda_w) V_w^0 + \frac{\lambda_w}{2} \int (V_w(w_f^*(p')) + V_w(w_w^*(p'))) dF(p') \right], \\ V_f^0(p) &= -c + \delta \left[(1 - \lambda_f) V_f^0(p) + \frac{\lambda_f}{2} (V_f(w_f^*(p); p) + V_f(w_w^*(p); p)) \right]. \end{aligned} \quad (81)$$

The firm's attendance decisions retain the role dependent structure in (7): a new worker does not change the firm's productivity or its payoffs conditional on the bargaining role. The worker, by contrast, compares both the bargaining role and the productivity of the new employer.

Consider first a worker who rejects the firm's offer $w_f^*(p)$. In the following period, the worker is the proposer in the ongoing negotiation. The incumbent firm remains available with probability $1 - \lambda_f$. When a new pairing with a firm of productivity p' arrives, the worker can instead receive $w_w^*(p')$ if selected to propose, or $w_f^*(p')$ if selected to respond. Optimal attendance therefore yields

$$\begin{aligned} V_w(w_f^*(p)) &= b + \delta \left[(1 - \lambda_w) ((1 - \lambda_f) V_w(w_w^*(p)) + \lambda_f V_w^0) \right. \\ &\quad \left. + \frac{\lambda_w}{2} \sum_{j \in \{f, w\}} \int \max\{(1 - \lambda_f) V_w(w_w^*(p)) + \lambda_f V_w^0, V_w(w_j^*(p'))\} dF(p') \right]. \end{aligned} \quad (82)$$

Subtracting the worker's search value in (81) and using (79) gives the surplus form

$$\begin{aligned} S_w(w_f^*(p)) &= \delta \left[(1 - \lambda_f) S_w(w_w^*(p)) \right. \\ &\quad \left. - \frac{\lambda_w}{2} \sum_{j \in \{f, w\}} \int \min\{(1 - \lambda_f) S_w(w_w^*(p)), S_w(w_j^*(p'))\} dF(p') \right]. \end{aligned} \quad (83)$$

The minimum terms reflect the difference between the opportunities available to an unemployed worker and those that improve on the expected value of continuing the incumbent negotiation.

Now consider a firm of productivity p that rejects the worker's offer $w_w^*(p)$. The firm becomes the proposer in the ongoing negotiation. It is paired with another worker with probability λ_f : when it can propose to that worker, it chooses the new negotiation; otherwise,

it continues with the incumbent worker if that worker also attends.

Let $\pi_R(p)$ be the probability that the incumbent worker abandons the negotiation following rejection, when the worker is the responder in the ongoing negotiation. The firm's probability of continuing with the incumbent worker, conditional on choosing the old negotiation, is $1 - \pi_R(p)$. Optimal worker attendance implies

$$\pi_R(p) = \frac{\lambda_w}{2} \sum_{j \in \{f, w\}} \int \mathbf{1} \left\{ S_w(w_j^*(p')) > \left(1 - \frac{\lambda_f}{2}\right) S_w(w_f^*(p)) \right\} dF(p'). \quad (84)$$

Here the factor $1 - \frac{\lambda_f}{2}$ is the probability that the incumbent firm attends when it is the proposer in the ongoing negotiation.

The firm's indifference condition is

$$\begin{aligned} V_f(w_w^*(p); p) = -c + \delta \left[\frac{\lambda_f}{2} V_f(w_f^*(p); p) \right. \\ \left. + \left(1 - \frac{\lambda_f}{2}\right) ((1 - \pi_R(p)) V_f(w_f^*(p); p) + \pi_R(p) V_f^0(p)) \right]. \end{aligned} \quad (85)$$

Subtracting the firm's search value and rearranging yields

$$\left(1 + \frac{\delta \lambda_f}{2}\right) S_f(w_w^*(p); p) = \delta \left(1 - \frac{\lambda_f}{2}\right) (1 - \pi_R(p)) S_f(w_f^*(p); p). \quad (86)$$

These equations also verify the firm's proposed attendance rule. With a single negotiation, the firm attends it. When two negotiations are available, the firm weakly prefers the new one if its role is (P, P) or (R, R) , since its conditional bargaining payoff is the same and the new partner attends with certainty; it prefers the new one in (R, P) because it becomes the proposer. Finally, in (P, R) , (86) implies

$$S_f(w_w^*(p); p) < (1 - \pi_R(p)) S_f(w_f^*(p); p),$$

so the ongoing negotiation is strictly preferred. Thus the firm's attendance strategy coincides with (7).

Equations (81), (80), (83), and (86), together with optimal attendance, characterise equilibrium wages and surplus division across productivity types. We next establish monotonicity of the wage schedules, which justifies representing workers' attendance choices by productivity cutoffs.

Productivity and equilibrium wages.

Lemma 5 (Firm productivity and wages) *Conditional on the identity of the proposer, equilibrium wages are strictly increasing in firm productivity. For any $p' > p$,*

$$w_f^*(p') > w_f^*(p), \quad w_w^*(p') > w_w^*(p). \quad (87)$$

Consequently, their equally weighted average is strictly increasing in firm productivity.

Proof. Fix $p' > p$, so that $S(p') > S(p)$. Suppose, towards a contradiction, that $w_f^*(p') \leq w_f^*(p)$. Since $S_w(w)$ is strictly increasing in the wage, this implies

$$S_w(w_f^*(p')) \leq S_w(w_f^*(p)). \quad (88)$$

The right-hand side of (83) is strictly increasing in the worker's proposer surplus $S_w(w_w^*(p))$. Indeed, the minimum of a fixed number and its continuation-surplus argument is nondecreasing and one-Lipschitz in that argument. Consequently, if the worker's proposer surplus changes by a positive amount, the right-hand side of (83) increases by at least $\delta(1-\lambda_f)(1-\lambda_w)$ times that amount. It increases by no more than $\delta(1-\lambda_f)$ times that amount. Thus the responder and proposer surpluses move strictly in the same direction, and (88) requires

$$S_w(w_w^*(p')) \leq S_w(w_w^*(p)). \quad (89)$$

Furthermore, the upper bound on the change gives

$$\begin{aligned} S_w(w_f^*(p)) - S_w(w_f^*(p')) & \\ & \leq \delta(1-\lambda_f) [S_w(w_w^*(p)) - S_w(w_w^*(p'))] \\ & \leq S_w(w_w^*(p)) - S_w(w_w^*(p')). \end{aligned} \quad (90)$$

By (88), the expected payoff from staying with the incumbent is weakly lower when its productivity is p' than when it is p . Hence every alternative that induces the worker to leave the firm of productivity p also induces departure from the firm of productivity p' . Equation (84) therefore implies

$$\pi_R(p') \geq \pi_R(p). \quad (91)$$

The firm's indifference condition (86) then requires

$$\frac{S_f(w_w^*(p'); p')}{S_f(w_f^*(p'); p')} \leq \frac{S_f(w_w^*(p); p)}{S_f(w_f^*(p); p)}. \quad (92)$$

But the surplus identities in (80) imply

$$\begin{aligned}
& S_f(w_w^*(p'); p') - S_f(w_w^*(p); p) \\
&= S(p') - S(p) + S_w(w_w^*(p)) - S_w(w_w^*(p')), \\
& S_f(w_f^*(p'); p') - S_f(w_f^*(p); p) \\
&= S(p') - S(p) + S_w(w_f^*(p)) - S_w(w_f^*(p')).
\end{aligned} \tag{93}$$

Both increments are strictly positive, and (90) implies that the firm's responder surplus rises by at least as much as its proposer surplus. Since the proposer obtains the larger strictly positive surplus, $S_f(w_f^*(p); p) > S_f(w_w^*(p); p) > 0$, it follows that

$$\frac{S_f(w_w^*(p'); p')}{S_f(w_f^*(p'); p')} > \frac{S_f(w_w^*(p); p)}{S_f(w_f^*(p); p)},$$

contradicting (92). We conclude that $w_f^*(p') > w_f^*(p)$.

Finally, the strictly increasing relation between the worker's two surpluses established from (83) implies $S_w(w_w^*(p')) > S_w(w_w^*(p))$, and hence $w_w^*(p') > w_w^*(p)$. ■

Productivity cutoffs and attendance. By Lemma 5, the worker's payoff from a new negotiation is strictly increasing in the productivity p' of the newly encountered firm. It follows that optimal attendance can be expressed by a cutoff $p^*(p; s_w)$ for each bargaining-role state $s_w = (q_w^o, q_w^n) \in \{P, R\}^2$, as in Proposition 3.

If the worker is the proposer in the ongoing negotiation, the incumbent firm attends with probability $1 - \lambda_f$. When the worker is the responder, that probability is $1 - \frac{\lambda_f}{2}$. The four interior cutoffs are defined by

$$\begin{aligned}
S_w(w_w^*(p^*(p; (P, P)))) &= (1 - \lambda_f) S_w(w_w^*(p)), \\
S_w(w_f^*(p^*(p; (P, R)))) &= (1 - \lambda_f) S_w(w_w^*(p)), \\
S_w(w_w^*(p^*(p; (R, P)))) &= \left(1 - \frac{\lambda_f}{2}\right) S_w(w_f^*(p)), \\
S_w(w_f^*(p^*(p; (R, R)))) &= \left(1 - \frac{\lambda_f}{2}\right) S_w(w_f^*(p)).
\end{aligned} \tag{94}$$

For each state, the worker chooses the new negotiation if $p' > p^*(p; s_w)$ and the ongoing negotiation if $p' < p^*(p; s_w)$. At equality, either choice is optimal; we select the new negotiation. When the indifference point lies outside the support of F , the worker always chooses the same negotiation for that state.

For completeness, the probabilities of abandoning an ongoing negotiation conditional on

the worker's role there are

$$\begin{aligned}\pi_P(p) &= \frac{\lambda_w}{2} [1 - F(p^*(p; (P, P))) + 1 - F(p^*(p; (P, R)))], \\ \pi_R(p) &= \frac{\lambda_w}{2} [1 - F(p^*(p; (R, P))) + 1 - F(p^*(p; (R, R)))].\end{aligned}\tag{95}$$

The second expression agrees with (84). For a continuous productivity distribution, the treatment of exact indifference is immaterial.

Proof of Corollary 1. Proof. Fix a state $s_w \in \{P, R\}^2$ and two incumbent productivities $p' > p$. By Lemma 5, the worker's equilibrium surplus from the incumbent negotiation is strictly higher at p' than at p , whether the worker is proposer or responder. The probability that the incumbent firm attends, equal to $1 - \lambda_f$ or $1 - \frac{\lambda_f}{2}$, depends on the worker's role but not on productivity. The right-hand side of the corresponding cutoff equation in (94) is therefore strictly higher at p' . Its left-hand side is a strictly increasing function of the new firm's productivity. Consequently, for interior cutoffs,

$$p^*(p'; s_w) > p^*(p; s_w).$$

This establishes the claimed monotonicity. If the wage schedules are differentiable with strictly positive derivatives at the relevant productivities, implicit differentiation of (94) also gives $\frac{\partial p^*(p; s_w)}{\partial p} > 0$. ■

Equilibrium division of surplus. Using the same definition as in the benchmark, the worker's conditional bargaining shares are

$$\beta_f(p, \theta) = \frac{S_w(w_f^*(p))}{S(p)}, \quad \beta_w(p, \theta) = \frac{S_w(w_w^*(p))}{S(p)},\tag{96}$$

and expected bargaining power is

$$\bar{\beta}(p, \theta) = \frac{1}{2} [\beta_f(p, \theta) + \beta_w(p, \theta)].\tag{97}$$

In particular, (86) implies

$$1 - \beta_w(p, \theta) = \frac{\delta \left(1 - \frac{\lambda_f}{2}\right) (1 - \pi_R(p))}{1 + \frac{\delta \lambda_f}{2}} [1 - \beta_f(p, \theta)],\tag{98}$$

while (83), divided by $S(p)$, gives

$$\beta_f(p, \theta) = \delta \left[(1 - \lambda_f) \beta_w(p, \theta) - \frac{\lambda_w}{2} \sum_{j \in \{f, w\}} \int \min \left\{ (1 - \lambda_f) \beta_w(p, \theta), \frac{S(p')}{S(p)} \beta_j(p', \theta) \right\} dF(p') \right]. \quad (99)$$

These conditions, together with (94) and (95), determine the productivity-dependent division of surplus. Unlike the homogeneous benchmark, the attractiveness of outside firms depends on the incumbent firm's productivity as well as on the bargaining roles.