Endogenous Wage Rigidity and Layoffs

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Abstract

When facing negative productivity shocks, how do firms choose between wage cuts and layoffs? Empirically, those that fire more workers cut wages the least– a pattern often attributed to exogenous wage rigidity. I argue instead that it reflects an active decision by firms: layoffs help firms improve workforce composition, making wage cuts less desirable. I develop an equilibrium search model where firms employ risk-averse workers of varying match productivity on dynamic contracts. To facilitate the role of layoffs, I assume that, between workers on the same contract, the firm is not allowed to wage discriminate, but can fire freely. This constraint induces firms to shed low-productivity matches while smoothing wages of the survivors. The model uniquely predicts that this layoff–wage rigidity relationship arises not only across firms but also within firms, across worker tenure. Using matched employer–employee data from France, I document that, consistent with the theoretical prediction, junior workers face up to five times higher layoff risk than senior workers yet experience virtually no wage pass-through. Policy analysis of the quantified model shows that the minimum wage, a source of exogenous wage rigidity that is particularly prevalent in France, has minimal impact on both job-finding and layoff rates.

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1 Introduction

Firms that lay off the most workers tend to cut wages the least. Why do some firms lay off workers rather than cut wages? In most of the literature, the answer is that firms cannot cut wages for exogenous reasons and therefore resort to layoffs. The assumption of exogenous wage rigidity—potentially justified by minimum wages, morale costs of cuts, or sectoral bargaining—is pervasive in macroeconomics. It is used to amplify employment fluctuations (Hall 2005) and firms' responses to monetary shocks (Keynes 1936; Nekarda and Ramey 2020; Auclert et al. 2021). However, recent survey evidence (Davis and Krolikowski 2025; Bertheau et al. 2025) suggests that firms often have discretion and sometimes actively prefer layoffs to wage cuts when both are feasible.

In this paper, I offer an alternative explanation for why firms lay off workers instead of cutting wages. Rather than lay off because they are restricted in cutting wages, firms *choose* to lay off which then alloows them to avoid cutting survivors' wages. For intuition, consider the following survey question in Bertheau et al. (2025): "Why didn't you lower pay instead of laying off employees?" The modal answer is: "Layoffs give better control over who leaves the firm." I interpret this as firms finding some workers more productive than others and preferring layoffs as a tool to remove lower-productivity matches (whereas wage cuts could induce valuable workers to look for other jobs).

I build a model that generates this intuition as a result of optimal contracting between firms and risk-averse workers of heterogeneous match quality. To facilitate that layoffs are the instrument for culling poor matches, I assume that the firm cannot wage-discriminate between workers on the same contract (equivalently, workers in a same hiring cohort). Layoffs are thus the only tool to affect a cohort's composition. When used, they raise the cohort's average quality and reduce the firm's incentive to cut survivors' wages. I show that this intuition persists across worker tenure and validate this prediction using French administrative data. To directly compare predictions of my model with those of exogenously rigid wages, I quantify the model and evaluate the impact of the main labor market policies in France, including minimum wage and severance pay.

I build an equilibrium model of the labor market with search frictions and one-sided limited commitment on the worker side. Firms employ a continuum of workers, exhibit decreasing returns to scale, and face firm-wide productivity shocks. Search is directed: firms post dynamic contracts to attract workers. While ex-ante homogeneous, all matches receive an initial permanent shock to match quality at the start of employment. Firm-level productivity is common knowledge; the match quality is observed only by the firm. Contracts specify future productivity-history-contingent wages, layoff risk, and severance pay conditional on layoffs. Workers are risk-averse and cannot commit to stay; firms can credibly insure workers against future productivity shocks. Firms thus face a trade-off between insuring workers against future losses and incentivizing workers to stay (leave) when they are most (least) productive.

Because firms have decreasing returns to scale, they manage contracts jointly across employees. In principle, this renders the model intractable: in a recursive formulation, the firm would need to track contracts for a continuum of workers, resulting in an infinite-dimensional state space. Fortunately, with directed search, within a given period a firm hires all workers on the same contract. It is therefore sufficient to track contracts by cohort. This discretizes the state space and makes it finite for firms of finite age: a firm of age ten employs at most ten cohorts. Moreover, up to an approximation, the state space can be bounded: I show theoretically and empirically that cohort wages tend to converge. I use this to justify pooling workers beyond a tenure threshold onto the same contract. Thus, instead of optimizing a continuum of contracts, it suffices to work with a finite set of tenure-specific contracts.

To facilitate that layoffs have a comparative advantage in managing the quality of the workforce, I assume firms cannot wage-discriminate by match quality within a cohort. Layoffs are therefore the only way to affect within-cohort quality. In low-productivity states, layoffs serve two purposes: they shed labor that is overpaid relative to productivity and cleanse the workforce of poor matches. In cohorts that experience layoffs, surviving workers are of higher average quality. The firm is then more inclined to retain survivors and cuts their wages less than in cohorts whose composition did not change. This mechanism is central to the paper's view of layoffs and pay cuts: wherever the firm chooses to fire workers, it has less desire to cut survivors' wages.

A key prediction of my model, unique to this framework, is that the layoff-wage connection exists both between and *within* firms, across worker tenure. When choosing whom to lay off, it is optimal to eliminate the least costly workers to dismiss, often juniors. The model thus generates relatively higher layoff rates among the most junior workers. Individual layoff risk depends on both absolute tenure and relative tenure within the firm: the most junior (and least costly) workers are cut first, consistent with last-in, first-out patterns documented by Buhai et al. (2014). After layoffs, the firm has less incentive to cut the wages of surviving juniors than of seniors, whose average quality has not improved. The model therefore predicts that junior workers are subject to higher layoff risk, but lower wage passthrough, than the more senior workers. I treat this as a testable implication to be validated in the data.

I use French matched employer–employee data merged with firm production data from 2009–2019 to discipline and validate the model. First, I confirm the literature's finding

(Ehrlich and Montes 2024) that firms which lay off the most exhibit the most rigid wages. I document the layoff rate and the pass-through of firm-level productivity shocks to the wages of job stayers. Grouping firms by average layoff rates, I find that after a positive productivity shock normalized to 100%, wages in firms firing the least increase by 1.7%, whereas wages in firms firing the most change by less than 1%.

I then confirm the model's prediction that the connection between layoffs and wage rigidity holds not only across firms but also within firms, across tenure. Workers with tenure below two years face layoff rates of 5–11%, compared with 2% for workers with four to five years of tenure. By contrast, wages of workers with less than one year of tenure essentially do not respond to negative productivity shocks, whereas more senior workers' wages fall by 2.4% in response to a 100% productivity shock. Lastly, I examine relative wage changes between junior and senior workers when a firm begins layoffs. Whenever firms lay off workers, a wage gap opens between senior and junior contracts.

I bring the model to the data to quantify how firms choose between wage changes and layoffs in response to productivity shocks. I quantify the model using moments on labor market flows, firm productivity shocks, and firm size estimated in my matched employer-employee data. I find that the model accounts well for the differential response of wages and layoffs to firm-level productivity shocks across cohorts, which are not targeted by the quantification. The impulse response analysis shows that, upon negative productivity shocks, junior workers are subject to significantly larger spikes in layoff risk, but to almost no wage cuts.

France is a particularly suitable country for my paper because of its strong labor policies, which I leverage to compare the mechanism of my model with the alternative explanations for rigid wages, layoffs, and their heterogeneity. My model incorporates the main labor market policies in place in France, including the minimum wage and severance pay, both of which are substantial compared to the OECD average.

I first consider the impact of a prevalent source of exogenous wage rigidity in France: minimum wage. Standard theories would predict that a minimum wage hike would result is notably more rigid wages and higher layoff rate, as well as lower job-finding-rate. In contract, I find that its impact on both layoffs and the job-finding rate is limited. The intuition is that, unlike in models of exogenously rigid wages, layoffs have value for firms even when wage cuts are available. Moreover, because firms intentionally choose to smooth workers' wages, the minimum wage bound is less likely to be reached and thus binding for firms. I also consider removing the minimum wage so as to evaluate its impact on generating the heterogeneity across worker tenure. Similarly, the impact of removing the minimum wage on the layoffs and wage passthrough across worker tenure is small.

Second, I consider impact of severance pay. In France, although legally severance pay is not high and does not rise much with tenure, in practice, firms make generous agreements with workers or their representatives (Kramarz and Michaud 2010). This may pose a problem for my mechanism as both the legal and de-facto severance pay scale in tenure, providing an alternative explanation for my empirical finding. To alleviate this concern, I introduce firm-chosen, contract-specific severance pay into the model and find that it is optimal for firms to offer significant severance pay. The optimal severance is increasing with tenure and higher than the legal lower bound, consistent with the situation in France. Intuitively, firms use the severance pay as device to smooth worker's utility, thus effectively making it *cheaper* to fire workers, in comparison to having to overcompensate workers for the ex-ante layoff risk. This again comes in contrast with theories of exogenously rigid wages where severance pay would serve to deter firms from firing its workers.

Lastly, I consider the impact of a hiring subsidy. Although it achieves the desired effect of raising job-finding rate, it makes workers cheaper not just to hire, but also to replace. The cost of replacing workers is the core mechanism incentivizing firms to retain workers across time, and, with the cost falling, firms become more free to dispose of their workforce, both via layoffs and wages. This results in both higher layoff rates and larger wage cuts, essentially redistributing income risk from unemployed to employed workers.

The no–within-cohort discrimination assumption is central to this paper. The quoted intuition—"Layoffs give better control over who leaves the firm"—requires that layoffs be more useful than wage cuts for removing undesirable matches. Under complete information about match quality, layoffs would play no special role and the model would not generate meaningful layoffs. I offer several justifications for the assumption. One interpretation is nondiscrimination law: if firms cannot justify why they prefer one worker to another, they cannot selectively change wages. This is distinct from observable differences in worker quality. There is no doubt about productivity differences when Ann publishes significantly more than Bob, and the model need not restrict contracts based on observable quality. It is enough to assume the existence of some firm preferences over workers that are not known to workers themselves.

Related Literature This paper builds on the literature on the roots of wage rigidity. Broadly, two views exist. One treats rigid wages as the endogenous outcome of bilaterally efficient bargaining (Barro (1977), Thomas and Worrall (1988), Balke and Lamadon (2022), Elsby et al. (2024)). The other models rigid wages as the result of exogenously imposed frictions (Christiano, Eichenbaum, and Evans (2005), Nekarda and Ramey (2020), Blanco et al. (2025)). Only the latter can directly connect wage rigidity to layoffs: if firms are restricted from cutting wages, they resort to layoffs. This paper connects wage rigidity and layoffs while taking inspiration from the bilaterally efficient view: firms optimally choose both to fire some workers and to refrain from cutting survivors' wages.

On the empirical side, recent survey evidence builds on Bewley (1999). Bertheau et al. (2025) and Davis and Krolikowski (2025) are closest to this paper, both studying the wage-cut–layoff trade-off. Davis and Krolikowski (2025) survey unemployed workers and find that, while many were open to substantial pay cuts, firms rarely initiated such discussions before resorting to layoffs. Some respondents also conjecture that wage cuts could induce the best workers to leave, suggesting firms do not have complete control over individual wages. On the firm side, Bertheau et al. (2025) merge a large-scale firm survey with administrative data to study incentives to cut wages versus fire workers. They find that wage cuts are often a poor substitute for layoffs because firms want to remove particular workers. This paper provides a theoretical foundation for that intuition.

The model sits at the intersection of dynamic contracts, firm dynamics, and match heterogeneity.

First, it relates to optimal wage contracts in long-term employment. Building on Thomas and Worrall (1988) and Harris and Holmstrom (1982), optimal contracts have been studied in rich search environments by Burdett and Coles (2003), Menzio and Shi (2011), Fukui (2020), Balke and Lamadon (2022), Souchier (2022), Malgieri and Citino (2024), and Elsby et al. (2024), with emphasis on on-the-job search. Closest are Balke and Lamadon (2022), Souchier (2022), and Malgieri and Citino (2024), who study the insurance–incentives trade-off between risk-averse workers and risk-neutral firms. My contribution is to incorporate layoffs into the insurance contract: firms can pass through negative shocks by either cutting wages or firing workers. Within dynamic insurance contracts, this is also the first paper to allow decreasing returns to scale, so firms jointly manage insurance across their workforce. The closest counterpart is Schaal (2017), where firms with DRS production offer dynamic contracts to risk-neutral workers.

Second, it connects to search-and-matching models with firm dynamics, including Acemoglu and Hawkins (2014), Elsby and Michaels (2013), Kaas and Kircher (2015), Schaal (2017), and more recently Gulyas (2020), Bilal et al. (2022), Elsby and Gottfries (2021), McCrary (2022), Rudanko (2023). Beyond Schaal (2017), this paper introduces dynamic contracts with worker–firm risk insurance into this setting. Dynamic contracts are crucial to reconciling within-firm heterogeneity in layoffs and wage pass-through: unlike models with Nash bargaining (McCrary (2022)) or sequential bargaining (Bilal et al. (2022)), workers in the same firm may optimally face different wage paths, layoff risks, and responses to productivity shocks.

Lastly, it relates to models that use match heterogeneity to generate layoffs, such as

Berger (2011), Menzio and Shi (2011), and Gregory, Menzio, and Wiczer (2021). In Menzio and Shi (2011) and Gregory, Menzio, and Wiczer (2021), matches dissolve when they become sufficiently unproductive. Berger (2011) use match heterogeneity to explain countercyclical labor productivity and jobless recoveries. The cycle is similar here: firms grow "fat" in high-productivity states and cleanse their workforce when negative shocks arrive. My contribution adapts this mechanism to the wage–firing trade-off: unlike Berger (2011), firms are free to change workers' wages but choose not to because, after layoffs, remaining workers are sufficiently valuable to retain.

Empirically, this paper relates to a broad set of studies measuring wage pass-through and, separately, layoffs. My average pass-through estimates align with Souchier (2022) and with estimates from other countries (Guvenen et al. (2017), Guiso and Pistaferri (2020)). On layoffs, Buhai et al. (2014) show that last-in workers are typically first out; both my empirical results and my model are consistent with this pattern. Beyond tenure and seniority profiles of wages and layoffs, I document novel differences in pass-through by tenure. The cross-firm link between layoffs and pass-through is consistent with recent structural work by Ehrlich and Montes (2024).

2 Model

I present a model of a frictional labor market in which firms sign workers of varying match productivity to *dynamic* contracts. Layoffs help firms improve workforce composition, making wage cuts less desirable.

2.1 Environment

Time is discrete and indexed by t. The economy is populated by a continuum of firms of measure 1, indexed by $f \in [0,1]$, and a continuum of workers of measure I, indexed by $i \in [0, I]$. Both types of agents are ex ante homogeneous and infinitely lived, with time-separable preferences and discount factor β. Firms are owned by outside investors who diversify firm-specific productivity risk. Thus firms maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \pi_{ft}.$$

Workers are risk-averse and have no access to financial markets. They consume home production b when unemployed and wage w when employed. Their utility is

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}), \qquad u(c) = \frac{c^{1-\sigma}}{1-\sigma}.$$

Production

Firms may pay κ_e to start producing and must pay κ_f each period to remain open. Open firms employ a measure[1] n of workers. Each worker–firm match is either high or low productivity and remains so for the duration of the match. Only the firm observes the quality of an individual match; the proportion of high-quality matches in the firm, z, is common knowledge. Production exhibits decreasing returns to scale in size n and, potentially, in quality z. Production is subject to firm-level shocks $y \in \mathcal{Y}$. Output depends on the numbers of high- and low-productivity matches, n_H and n_L, equivalently on n and z:

$$yF(n_H, n_L) \equiv yF(n, z), \qquad n = n_H + n_L, \quad z = \frac{n_H}{n_H + n_L}.$$

Labor market

Each period, entering firms begin with measure 1 of workers, corresponding to the entrepreneur/owner of the firm; incumbent firms hire $\tilde{n} \geq 0$. Workers—both employed and unemployed—search for jobs. Matching occurs in a frictional labor market with directed search, as in Moen (1997). There is a continuum of submarkets indexed by the promised value v to the worker. Firms choose in which submarket to post vacancies at cost c, and workers choose where to search. Within each submarket, matches are formed according to a constant-returns-to-scale matching function; market tightness θ_v suffices to determine matching probabilities. Let $p(\theta_v)$ and $q(\theta_v) \leq 1$ denote the job-finding and vacancy-filling probabilities.

Firms are not restricted to a discrete number of vacancies and can deterministically hire $\tilde{n}$ workers from submarket v at cost $\tilde{n}\, c/q(\theta_v)$. The probability of a newly hired match having high productivity is $z_0 \in [0, 1]$, constant across agents and time. Upon hiring, the firm commits to deliver expected discounted utility v. The hiring trade-off is between the cost of hiring, $c/q(\theta_v)$, and the (higher) cost of employing a worker as v rises. Firms can downsize by laying off a fraction $s \in [0, 1]$ of their workforce and by incentivizing incumbents to find jobs elsewhere. Lastly, firms can choose to compensate laid off workers by offering perpetual severance pay sev until they find a new job.

Uncertainty

With hiring being deterministic, there are two sources of uncertainty in the model: firm-level productivity, varying over time, and match-specific productivity, constant upon the match forming. Workers are atomic, making the firm-level shocks the only source of uncertainty at

[1] The law of large numbers applies and is used throughout (Sun and Zhang 2009).

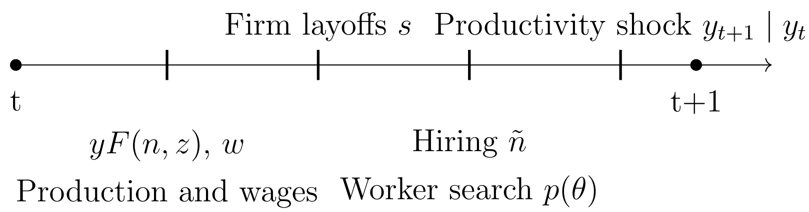

Figure 1: Within-period timeline

the firm level. Because firms hire a continuum of workers, a fixed measure of new highly hired workers, z_0, exhibits high productivity. Firms then need not concern themselves with the outcome of the productivity draw of any particular match. On the workers' side, although workers are ex-post concerned with their own match productivity, ex-ante they are not aware of their draw. Therefore, just like the firm, workers make their decisions keeping in mind only the measure of the high-productivity matches.

On the aggregate, the model is deterministic because firms themselves are also atomic. Each firm-level productivity path is reached by a measure of firms corresponding to the ex-ante probability of reaching said path. Therefore, there is no aggregate uncertainty in the model.

However, during a transition path into the steady-state firms may still need to track the aggregate cross-sectional distribution. To alleviate this, I restrict attention to two versions of the economy: a steady state and, under an additional assumption (Appendix A.5), a block-recursive equilibrium following Menzio and Shi (2011) and Schaal (2017). In either case, firms no longer need to track the aggregate cross-sectional distribution.

Timing

Each period has four stages (Figure 1). First, production occurs: the firm collects output and pays wage w to each worker. Next, the firm lays off a fraction $s \geq 0$ of its workforce. Fired workers become unemployed and cannot search until next period. Then all workers—employed and unemployed—search, and all firms (entrants and incumbents) hire $\tilde{n}$. Hiring and search choices occur before next-period productivity y_{t+1} is realized, so agents take expectations $E_{y_{t+1}|y_t}$.

Information structure and contracts

Upon hiring, the firm commits to deliver expected utility v via a contract. A contract specifies wages and actions for the matched pair for all future firm-productivity histories $y^\tau \equiv (y_1, \ldots, y_\tau) \in \mathcal{Y}^\tau$. Firm productivity histories are common knowledge and therefore fully contractible. By contrast, match-specific productivity z_{if} is private to the firm, and the worker's search decision $\hat{v}$ is private to the worker. The contract is

$$\mathcal{C} = \{w_\tau,\, s_\tau,\, sev_\tau,\, \hat{v}_\tau\}_{\tau=t}^{\infty}. \tag{1}$$

Here w is the wage policy for each future productivity history. The second component, s, is the *expected* layoff probability from the worker's perspective (who does not observe their match quality). These probabilities are history-dependent: in histories where information about match quality is updated, future layoff probabilities reflect the worker's Bayesian update. For example, after multiple negative shocks that force large layoffs, remaining workers rationally assign higher probability to being high productivity, and subsequent layoff probabilities adjust accordingly. The third component is severance pay. Firm can commit to perpetually pay severance *sev* to laid off workers until they find a new job. The last component is the worker's (unobserved) search decision. I focus on contracts in which recommended search is incentive compatible, i.e., the contract specifies workers' search choices subject to the constraint that those choices are optimal for workers.

The contract space allows fully flexible wage and layoff responses to productivity histories. With a continuum of concurrent contracts, the firm can choose how to treat a heterogeneous workforce (by productivity and contract): when a negative shock hits, whom to fire and whose wages to cut. This feature is central and specific to the setting: unlike models with CRS production, these decisions depend on the entire distribution of contracts of match productivities, as well as firm size; unlike dynamic models with Nash bargaining (McCrary (2022)) or sequential bargaining (Bilal et al. (2022)), workers within the same firm may optimally face different wages, layoff risks, and responses to shocks.

Labor Market Policies

I introduce two key labor market policies, prevalent in France: minimum wage and statutory severance pay. Both policies act as lower bounds on the choice variables of the firm: minimum wage restricts the wage that the firms may pay to any worker at any point in time, and severance pay, scaling with tenure [2], similarly restricts the minimum severance that the firm should offer upon layoffs.

Minimum wage is the key source of exogenous wage rigidity, particularly at the bottom of the wage distribution. The key intent of introducing minimum wage is to control for it as it may provide the alternative explanation for both rigid wages and layoffs.

[2] This is the key component of severance pay in France. I provide more details in Section 3.1.

Severance pay is introduced for similar reasons: it is an institutional feature that may offer an alternative explanation for the unique prediction of my model: that junior workers suffer higher layoffs but lower wage passthrough than more senior workers.

2.2 Value functions

The contract and all agents' problems admit a recursive formulation. I begin with workers' problems and then turn to firms managing a continuum of contracts. I show that the firm's problem can be reformulated with a discrete state space.

Worker's problem

Unemployed workers consume b and each period choose the submarket that offers the best trade-off between promised future utility and job-finding probability. In a stationary equilibrium (suppressing time subscripts), the value of unemployment U is

$$U = \max_{v} \; u(b) + \beta\big[(1 - p(\theta_v))U + p(\theta_v)v\big]. \tag{2}$$

Consider an employed worker owed value v. Suppose the firm pays wage w this period, lays off with probability s, and promises future value v' from next period onward. The worker's search problem is

$$v = \max_{\hat{v}} \; u(w) + \beta\Big[sU + (1 - s)\big((1 - p(\theta_{\hat{v}}))v' + p(\theta_{\hat{v}})\hat{v}\big)\Big]. \tag{3}$$

The optimal search target $\hat{v}$ depends only on the promised v'. By raising v', the firm induces search in higher-$\hat{v}$ submarkets, lowering the probability that the worker exits. Equivalently,

$$v = u(w) + \beta\big[sU + (1 - s)R(v')\big],$$

where $R(v') \equiv \max_{\hat{v}} \big[(1-p(\theta_{\hat{v}}))v' + p(\theta_{\hat{v}})\hat{v}\big]$ is the worker's optimal continuation value given promise v' and no layoff.

Firm's problem

A firm employs a measure n of workers. Let $P(v, z)$ denote the joint distribution of promised values owed to incumbents and their productivity. For each v, the firm chooses the wage w_v, layoff rate s_v, and next period's productivity-history–contingent promised values $\{v'_{v,y'}\}$. The firm may also hire $\tilde{n}$ workers at value $\tilde{v}$. Each match can be high or low productivity. I rewrite the joint distribution $P(v, z)$ into two distributions: distribution of values $P(v)$ and the proportion of high-productivity matches for each value $z(v)$. The firm cannot set match productivity-contingent wages; it affects match productivity only through layoffs.Because of this, for each set of workers on some value v, firms also optimally fire the less productive matches first: the only difference between firing more or less productive matches is in the effect on actual production, in which case it is always better to fire poor matches.

The recursive problem is

$$\begin{aligned}
J(y,n,P(v),z(v)) = \max_{\tilde{n},\tilde{v},\{w_v,s_v,sev_v,v'_{v,y'}\}} \; & yF\big(n,\int z(v)dP(v)\big) - n\int w_v\,dP(v) - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f \\
& - \beta n \int s_v \frac{sev_v}{1-\beta\big(1-p(\hat{\theta}_{sev_v})\big)} dP(v) + \beta\, E_{y'|y}\, J\big(y',n',P'_{y'}(v),z'_{y'}(v)\big) \\
\text{s.t.} \quad & u(w_v) + \beta\big[s_v U + (1-s_v)R(v'_v)\big] = v \quad \forall v, \\
& v'_v = E_{y'|y}\, v'_{v,y'} \quad \forall v, \\
& n' = n\int (1-s_v)\big(1-p(v'_v)\big)\,dP_v(v) + \tilde{n}, \\
& n'P'_{y'}(v) = n\int \mathbb{1}\{v'_{v,y'} \le v\}(1-s_v)\big(1-p(v'_v)\big)\,dP(v) + \mathbb{1}\{\tilde{v}\le v\}\tilde{n} \quad \forall v, \\
& n'z'(v) = n\int \mathbb{1}\{v'_{v,y'} \le v\}\min\{\frac{z(v)}{1-s_v},1\}dP(v) + \mathbb{1}\{\tilde{v}\le v\}\tilde{n}z_0 \quad \forall v, \\
& w_v \ge \underline{w} \quad \forall v, \\
& sev_v \ge \underline{sev}_v \quad \forall v
\end{aligned}$$

The firm maximizes the present value of profits subject to honoring each worker's promised value. Because search occurs before the next productivity state is realized, workers care about the expected promised value v'_v rather than particular realizations $v'_{v,y'}$. The last two constraints describe the laws of motion for firm size and the distribution of promises.

Discretizing the problem As written, the state includes a probability distribution—an uncountably infinite-dimensional object. I show that the state space can be discretized, yielding a countably infinite state. First, under directed search, a firm posts in a single submarket and hires at a single value $\tilde{v}$.[3] Hence, all workers hired in the same period by the same firm are owed the same expected utility—both at hiring and, given no quality-contingent wages, thereafter. It is therefore equivalent to work with the CDF $P(v)$ or the PMF $\mathbb{P}(V=v)$, with $P(v)=\sum_{v'\le v}\mathbb{P}(V=v')$. For a firm of age $K<\infty$, there are at most K distinct promised values with positive probability, corresponding to cohorts by tenure $k=t-t_{\text{hired}}\le K$. The state can thus be recast by tenure:

[3] I rule out mixed strategies by an individual firm: if indifferent across submarkets, it posts in one of them.

Lemma 1. *For a firm of age K, the problem $J(y, n, P(v))$ is equivalent to*

$$
\begin{aligned}
J\big(y, \{n_k, v_k, z_k\}_{k\le K}\big) = \max_{\tilde{n}, \tilde{v}, \{w_k, s_k, sev_k, v'_{y',k}\}_{k\le K}} \; & yF\Big(\sum_k n_k, \; \frac{\sum_k n_k z_k}{\sum_k n_k}\Big) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f \\
& - \beta \sum_k n_k s_k \frac{sev_k}{1-\beta\big(1-p(\hat{\theta}_{sev_k})\big)} + \beta \, E_{y'|y} \, J\big(y', \{n'_k, v'_k, z'_k\}_{k\le K+1}\big) \\
s.t. \qquad & u(w_k) + \beta\big[s_k U + (1-s_k)R(v'_{k+1})\big] = v_k \quad \forall k \le K, \\
& v'_{k+1} = E_{y'|y} \, v'_{k+1,y'} \quad \forall k \le K, \\
& n'_{k+1} = n_k(1-s_k)\big(1-p(v'_{k+1})\big) + \tilde{n} \quad \forall k \le K, \\
& z'_{k+1} = \min\Big\{\frac{z_k}{1-s_k}, 1\Big\} \quad \forall k \le K, \\
& n'_0 = \tilde{n}, \quad v'_0 = \tilde{v}, \quad z'_0 = z_0 \\
& w_k \ge \underline{w} \quad \forall k \le K, \\
& sev_k \ge \underline{sev}_k \quad \forall k \le K
\end{aligned}
$$

This representation both discretizes the state space and clarifies how layoffs and wages interact within cohorts. Although workers do not know their own match quality, they know the cohort-level share of high-quality matches. New hires start with z_0, and while z_k may evolve, all workers of the same tenure k share the same probability $z_k \ge z_0$ of being high quality. This probability, common knowledge to the firm and workers, depends on layoffs in the cohort.

Free entry and exit

Firms enter by paying κ_e. Upon entry, a firm draws productivity and starts with a single worker. Free entry pins down expected profits at entry:

$$\kappa_e \ge \max_{v_0} \; \Big(- \frac{c}{q(\theta_{v_0})} + \beta \, E_y \, J\big(y, \{1, 0, \ldots\}, \{v_0, \ldots\}, \{z_0, \ldots\}\big)\Big). \tag{4}$$

Incumbents pay an operating cost κ_f each period to stay open. Although, while open, firms are committed to every contract with their workers, firms are free to exit the market completely. Firms stay open as long as:

$$J\big(y, \{n_k, v_k, z_k\}\big) \ge 0. \tag{5}$$

2.3 Equilibrium

An equilibrium is a sequence of worker policies $\hat{v}$, firm policies $\{w_k, s_k, sev_k, v'_{y'_k}\}_k \tilde{v}, \tilde{n}$, matching rates, and distributions of workers and firms across submarkets v such that, each period:

- Firms solve the problem in Lemma 1.
- Workers solve (2) and (3).
- Free-entry and free-exit conditions (4)–(5) hold.
- Job-finding and vacancy-filling probabilities are consistent with the matching function.
- Tightness θ_v is consistent with firms' posting and workers' search strategies.
- The labor market clears.

Under the assumption in Appendix A.5, the equilibrium may be block recursive—independent of the aggregate distributions. I use that assumption in the quantitative analysis, but not in the theoretical discussion, where I focus on the steady state described above.

2.4 Mechanism

I show how the model generates rigid wages, layoffs, and the connection between the two across worker tenure.

Wage growth I first discuss how the firm chooses to adjust wages of its incumbent employees.

Proposition 1. *For any state $(y, \{n_k, v_k, z_k\})$, wages evolve according to*

$$\frac{1}{u'(w'_{k+1})} - \frac{1}{u'(w_k)} = \eta(v'_{k+1})\, E_{y'|y} \frac{\partial J\big(y', \{n'_k, v'_{y',k}, z'_k\}\big)}{\partial n'_{k+1}},$$

where $\eta(v'_{k+1}) \equiv \frac{\partial \log(1-p(v'))}{\partial v'}\Big|_{v'=v'_{k+1}}$ is the semi-elasticity of the job-finding probability with respect to the promised value.

Proof. See Appendix A.1. □

This relationship captures the insurance–incentives trade-off that the firm faces. When the marginal value of a worker, $E_{y'|y}\big[\partial J/\partial n'_{k+1}\big]$, is positive, the firm prefers to retain workers and backloads wages (setting $w'_{k+1} > w_k$). When the marginal value is negative, the firm lowers wages to encourage quits. The sign of the value of retention depends on current productivity via the expectation operator. Therefore, the wage growth depends on how productive the firm is at the moment.

The model exhibits three sources of endogenous wage rigidity. First, workers are risk-averse and thus, by insuring workers against income risk, firm can pay workers a lower average wage. This tension between providing workers insurance against productivity shocks and incentives via wage backloading is at the core of dynamic contracting models with on-the-job search.

Corollary 1. *For any state $(y, \{n_k, v_k, z_k\})$, future value of retaining cohort k depends on the marginal productivity and future wage of said cohort:*

$$E_{y'|y}\frac{\partial J\big(y', \{n'_k, v'_{y',k}, z'_k\}\big)}{\partial n'_{k+1}} = E_{y'|y}\Big[y'(\underbrace{F'_n}_{\textit{Size effect}} + \underbrace{F'_z\frac{\partial z'}{\partial n'_{k+1}}}_{\textit{Quality effect}}) - w'_{k+1} + \beta E_{y''|y}\frac{\partial J\big(y'', \{n''_k, v''_{y',k}, z''_k\}\big)}{\partial n''_{k+2}}\Big]$$

The other two sources of wage rigidity are unique to my model and show up through the value of worker retention. First, there is an counter-acting impact on any retention incentives via worker *size*: if a firm wants to lose some of its workers, via on-the-job search or layoffs, the firm size will fall, propping up the productivity of a marginal worker. This effect is present in response to both positive shocks, when firms grow in size, and negative shocks, when firms shrink. The size effect on marginal productivity is equal across cohorts as can be seen in Corollary 1.

The last source of endogenous wage rigidity concerns worker *selection* and is cohort-specific. When firm fires bad matches, the average quality in the surviving cohort rises, incentivizing the firm to protect the survivors from poaching. This is a case of heterogeneous downward wage rigidity: cohorts that suffer the most layoffs will also benefit the most from this channel.

Both the size and the selection channels revolve around worker retention incentives. To understand further the impact of the channels on wage growth, I first define a value at which the wage growth would be zero.

Definition 1. *The target wage for cohort k, $w^*_k\big(y, \{n_k, v_k, z_k\}/v_k\big)$, is the wage associated with the promised value $v^*_k\big(y, \{n_k, v_k, z_k\}/v_k\big)$ that solves*

$$M\big(y, \{n_k\}, v_0, \dots, v_k, \dots, \{z_k\}\big) \equiv E_{y'|y}\frac{\partial J\big(y', \{n'_k, v'_k, z'_k\}\big)}{\partial n'_{k+1}} = 0,$$

where $\{n'_k, v'_k, z'_k\}$ are next-period states implied by Lemma 1. The target wage equals

$$w^*_k\big(y, \{n_k, v_k, z_k\}/v_k\big) = u'^{-1}\left(-\frac{n'_{k+1}}{\partial J\big(y', \{n'_k, v'_k, z'_k\}\big)/\partial v'_{y',k+1}}\right).$$

At the target wage, the cohort's marginal profit is zero, making the firm indifferent to poaching (while still preferring to shed low-quality matches within the cohort). The target wage governs within-firm wage movements.

Proposition 2. *For any state* $(y, \{n_k, v_k, z_k\})$ *and cohort* k *there exists a target wage* w_k^* *such that:*

1. *Wages move toward the target:*

$$w_k \leq w_k^* \;\Rightarrow\; w_k \leq w'_{k+1} \leq w_k^*, \qquad w_k \geq w_k^* \;\Rightarrow\; w_k^* \leq w'_{k+1} \leq w_k.$$

2. *The farther from target, the faster the adjustment:*

$$|w_k - w_k^*| \geq |w_{k'} - w_{k'}^*| \;\Rightarrow\; |w'_{k+1} - w_k| \geq |w'_{k'+1} - w'_{k'}|.$$

At any state and for any cohort, wages adjust towards w_k^*. The target wage w_k^* will respond to productivity shocks and thus constantly fluctuate, affecting the movement of actual wages and guiding wage passthrough. To understand how the size and the selection channels lead to wage rigidity, I show how the target wage depends on the size and average productivity of cohorts.

Proposition 3. *For any state* $(y, \{n_k, v_k, z_k\})$ *and cohort* k*:*

1. *Target wage falls in response to any size state:*

$$\frac{\partial w_k^*}{\partial n_{k'}} < 0 \quad \forall k'$$

2. *Target wage rises in response to own quality:*

$$\frac{\partial w_k^*}{\partial z_k} > 0$$

3. *Target wage (weakly) falls in response to other cohorts' quality:*

$$\frac{\partial w_k^*}{\partial z_{k'}} < 0 \quad \forall k' \neq k$$

4. *Target wages between different cohorts respond equally to any size states or any state variables that are not theirs directly*

$$\frac{\partial w_k^*}{\partial n_{\tilde{k}}} = \frac{\partial w_{k'}^*}{\partial n_{\tilde{k}}} \quad \forall k, k', \tilde{k}$$

$$\frac{\partial w_k^*}{\partial z_{\tilde{k}}} = \frac{\partial w_{k'}^*}{\partial z_{\tilde{k}}} \quad \forall k, k',\; \tilde{k} \neq k, k'.$$

Proof. See Appendix A.1. □

Target wage will respond to firm's choices of hiring new workers or actively retaining current ones via the DRS production function: the more workers the firm has, the less productive is the marginal worker, lowering the wage at which the firm would be indifferent about losing such worker. However, the size effect is equal across cohorts, as shown by the last result. The only state variable having a relatively stronger effect on the particular cohort's target wage w_k^* is its own average productivity z_k.

The only way to change productivity of a cohort is layoffs: by firing less productive matches the firm will raise the average productivity of the cohort, thus also raising their target wage. This in turn gives us the connection between layoffs and wage growth: layoffs s_k will trigger a rise in the corresponding target wage w_k^*. Then, to understand the heterogeneity of wage growth across cohorts, we need to understand when and whom do firms fire.

Layoffs Layoffs are the firm's only instrument to alter within-cohort quality; by item 2 of Proposition 3, they are also the only tool differentially moving target wages across cohorts. To understand the impact of layoffs on wage passthrough and its heterogenity, I consider when and whom do firms fire.

Proposition 4. *Consider a state $(y, \{n_k, v_k, z_k\})$ and a cohort k with $z_k < 1$.*

Optimal layoffs satisfy

$$-E_{y'|y}\frac{\partial J'}{\partial n'_{k+1}}\big(1-p(v'_{k+1})\big)+E_{y'|y}\frac{\partial J'}{\partial z'_{k+1}}\frac{\partial z'_{k+1}}{\partial s_k}\frac{1}{n_k}-\frac{R(v'_{k+1})-U}{u'(w_k)} \;\leq\; 0,$$

with $s_k \geq 0$ and complementary slackness.

When does firm fire? *Layoffs are more common in low productivity states. Consider a lower productivity state $(\underline{y}, \{n_k, v_k, z_k\}), \underline{y} < y$:*

$$s_k(\underline{y}, ...) \geq s_k(y, ...) \quad \forall k$$

Who gets fired? *Cohorts with lower promised values are more exposed to layoffs:*

$$v_k \leq v_{k'} \;\Rightarrow\; s_k(1-z_k)n_k \;\geq\; s_{k'}(1-z_{k'})n_{k'} \quad \forall\, k' \leq K,\; z_{k'} < 1.$$

To first order, layoff decisions load equally on quality across cohorts:

$$\frac{\partial s_k}{\partial z_k} = \frac{\partial s_k}{\partial z_{k'}} \quad \forall\, k' \leq K.$$

Proof. See Appendix A.1. □

As with wages, layoffs trade off the marginal value of a worker, $E_{y'|y}[\partial J'/\partial n'_{k+1}]$, against the compensation cost $\big(R(v'_{k+1})-U\big)/u'(w_k)$. The distinctive term is the quality effect,

$E_{y'|y}[\partial J' / \partial z'_{k+1}]\,(\partial z'_{k+1} / \partial s_k)/n_k$, since quality cannot be priced but can be *selected* via layoffs. I will now elaborate on how the layoffs connect to the wage rigidity and, furthermore, why is it the junior workers that get fire.

First, note that layoffs are inversely connected to productivity shocks: the lower is the productivity state y, the more the firm fires. Combined with the result 2 from Proposition 3 that layoffs raise target wage (by raising the average productivity of the cohort), this leads to downward wage rigidity: when a negative shock hits, firms fire bad matches and keep wages (relatively) high to retain the survivors.

Second, the connection between layoffs and rigid wages, while generally applicable through the DRS production function, is especially strong in the cohorts that actually suffer layoffs. The last part of the Proposition 4 shows which cohorts are the first to be fired. The lower-v cohorts are more exposed to layoffs regardless of quality (provided $z < 1$). Furthermore, due to the decreasing returns to scale production, it is not just the absolute promised value v that matters, but the relative one: if there are plenty of lower v bad matches to be fired, the firm will never reach the higher paid matches. This suggests that the lower value cohorts will suffer higher layoffs but, due to the spike in their target wage, lower wage cuts than than the higher paid cohorts.

Finally, to map these results to tenure patterns, note that higher-tenure workers generally have higher promised values than juniors due to two results. First, firms would only hire workers at promised values $\tilde{v}$ where the marginal value of the worker is positive, meaning that the value at hiring is less than the target value:$\tilde{v} < v^*$. Otherwise, the firm would not want to hire at all. Second, due to wage backloading (Proposition 2, item 1), these new hires will experience both wage and value rising over time (main exception being a persistent negative productivity shock right after hiring). Then juniors, being owed less, are therefore more exposed to layoffs than seniors and, via the upward shift in their target wages induced by layoffs, experience smaller wage cuts (if any) than seniors.

2.5 Impact of Policies

I briefly discuss the impact of the two policies introduced into the model: minimum wage and statutory severance pay.

Firms have to offer tenure-specific payments sev_k at least as large as the statutory level $\underline{sev}_k$ that scales with worker tenure. I show that it is in fact optimal for firms to scale their severance pay with worker tenure. Therefore, unless exceptionally high, the statutory severance pay is not binding for firms and thus does not offer the alternative explanation for the high layoff rate of the juniors.

I show that the severance structure involves higher payments for higher paid workers.

Proposition 5. *For any state* $(y, \{n_k, v_k, z_k\})$ *and cohort* k *the severance payments are given by*

$$\frac{u'(b + sev_k)}{u'(w_k)} = 1 - \frac{\beta sev_k \frac{\partial p(\theta_{sev_k})}{\partial sev_k}}{1 - \beta(1 - p(\theta_{sev_k}))}$$
$$\theta_{sev_k} = \theta(arg \max_v [(1 - p(v))U(sev_k) + p(v)v])$$

Proof. See Appendix A.2. □

Note that, besides $u'(w_k)$, all the components of the severance payment are independent of both the firm state and the worker tenure. It is then immediate to notice that higher paid workers will have higher severance payments: as $\frac{1}{u'(w_k)}$ rises, the value to the firm of the severance payment goes up, while costs stay the same. Therefore, the firm will optimally choose to offer higher severance payments to higher paid workers. Lastly, senior workers are generally on higher pay than more junior workers and thus will enjoy higher severance pay upon layoffs. The question of the comparison between the optimal value that the firms might offer and the mandated one is quantitative, not qualitative.

Minimum wage $\underline{w}$ has a direct impact on the downward wage rigidity of lower paid workers, generally juniors. Although my model does not require minimum wage to generate higher layoffs and lower wage passthrough of junior workers, it is crucial to distinguish between the of the two stories as they differ strongly in their implications. I leave the question of the size of the impact of both minimum wage and statutory severance pay to the quantification of the model.

2.6 Assumption discussion

I provide a brief discussion on the main assumptions of my model and their relevance for the mechanism.

On-the-job search On-the-job search is a crucial assumption of this model as it creates incentives for the firm to change workers' wages. If worker's on-the-job search decision was observable and, thus, directly contractible, the firm could offer the worker pay only for the on-path, preferred, search choice, and zero for everywhere else. At its very core, this is a classic moral hazard story where the firm uses prices as a tool to control the worker's unobserved action. The introduction of risk-aversion alongside this unobservable action makes the core mechanism similar to that of Hopenhayn and Nicolini (1997), who design optimal unemployment insurance between a risk-neutral principle and the risk-averse worker with unobservable search effort.

Risk-aversion Risk-aversion is the key reason why the firm is keeping wages smooth. Absent risk-aversion, the moral hazard problem of the firm would become null as, even absent direct contractibility of search, the firm would be able to costlessly backload workers' wages so as to incentivize them to search exactly where the firm wants them to search. This is the case of Schaal (2017), where firm with decreasing returns to scale offers dynamic contracts to risk-neutral workers. Thanks to the risk-neutrality assumption, the firm optimization problem becomes equivalent to maximizing the total surplus of the firm and all its workers. However, in such a model, exactly because wages are so flexible, they are undetermined.

Decreasing returns to scale Absent decreasing returns to scale, there would not be a general degree of downward wage rigidity upon layoffs and leaving workers. Furthermore, decreasing returns to scale provide the model with additional structure for comparison across workers and firms. DRS provide the implications for layoffs and wage passthrough not just across tenure at the firm, but *seniority* – the relative position of the worker at the firm. This is consistent with the last-in-first-out layoff structure (LIFO), documented by Buhai et al. (2014).

Match heterogeneity and the no-wage-discrimination This is a key component for generating meaningful layoffs in this model. Absent the heterogeneity, the firm would only destroy matches if they were inefficient, which is inconsistent with the recent empirical and survey evidence (Jäger, Schoefer, and Zweimüller 2022; Davis and Krolikowski 2025).

The no–within-cohort discrimination assumption is central to this paper. The quoted intuition—"Layoffs give better control over who leaves the firm"—requires that layoffs be more useful than wage cuts for removing undesirable matches. I offer several justifications for the assumption. One interpretation is nondiscrimination law: if firms cannot justify why they prefer one worker to another, they cannot selectively change wages. This is distinct from observable differences in worker quality. There is no doubt about productivity differences when Ann publishes significantly more than Bob, and the model need not restrict contracts based on observable quality. It is enough to assume the existence of some firm preferences over workers that are not known to workers themselves.

3 Empirical evidence

I document the relationship between layoffs and wage cuts using French matched employer–employee data. I examine how layoff rates and the wage pass-through of firm-level productivity shocks vary across firms and across worker tenure, and find substantial heterogeneity along both dimensions. These facts validate the qualitative predictions of my model.

3.1 Institutional Context of the French Labor Market

Relative to other advanced economies, France's labor market combines high coverage of collective agreements with low union density, a statutory minimum wage (SMIC) indexed to inflation, and moderate-to-strong employment protection in international comparison (OECD and AIAS/ICTWSS 2025; OECD 2020). Compared with the United States, France features substantially less decentralized wage setting and stronger wage floors; compared with Denmark, where the survey by Bertheau et al. (2025) was conducted, France relies more on sectoral wage grids and statutory floors, with lower job-to-job mobility and stricter dismissal rules on average (OECD 2025b).

I focus on three French institutions that directly shape firms' trade-off between wage adjustments and layoffs: the high national minimum wage, sectoral bargaining and the extension of wage floors, and legal versus de-facto severance pay.

National minimum wage. France minimum wage is indexed to consumer prices (and, under conditions, to average hourly wages), revalued by government decree.[4] In comparative terms, the minimum wage sits high relative to the wage distribution and, during the 2021–2024 inflation episode, often *caught up* with negotiated or slightly-above-floor wages, expanding the share of workers affected (OECD 2025a; France Stratégie 2024). This makes the minimum wage a binding constraint primarily at the bottom of the distribution.

Implications for empirics. To avoid mechanical truncation of wage changes, I exclude observations less than 5% above the concurrent minimum wage in my specification.

Sectoral bargaining and extended wage floors. Collective bargaining in France is organized mainly at the branche (sector) level. The Ministry of Labour frequently extends sectoral agreements to non-signatory firms, which keeps bargaining coverage very high despite low union density (OECD and AIAS/ICTWSS 2025). Sectoral agreements typically specify wage grids by occupation/qualification. Empirically, the lower rungs of many grids are

[4] Legal basis and indexation details in Eurofound (2024).

anchored by the national minimum wage: when the minimum wage is revalued, the lowest steps can be temporarily overtaken and must be renegotiated to restore compliance (France Stratégie 2024; Langevin 2018). Recent monitoring also noted numerous branches with minima below the updated minimum wage pending revision, underscoring that sectoral floors rarely remain much above the statutory floor for long.[5]

Implications for empirics. Removing observations near minimum wage also attenuates the binding force of sectoral floors in my analytical window. In interpreting wage pass-through, I thus treat sectoral bargaining as setting reference wage structures whose binding power is strongest at the bottom, rather than pervasive hard constraints in the middle of the distribution.

Separation rules and severance pay. Statutory severance for layoffs on open-ended contracts (CDI) follows a tenure-based formula (at least $\frac{1}{4}$ month per year up to 10 years, then $\frac{1}{3}$ per year thereafter), with possible top-ups from collective or firm agreements (Service-Public.fr 2025). In practice, *de-facto* payouts are often higher than the legal minimum due to negotiated arrangements: (i) *Rupture conventionnelle* (mutual termination) has been widely used since its introduction, with median indemnities exceeding the legal minimum and substantial dispersion across tenure and occupational groups (DARES 2022); (ii) *transactional* settlements attached to dismissals (used to reduce litigation risk) further raise realized payouts within tax/social thresholds.[6]

Implications for empirics and mechanism. I interpret this setting as indicative of high endogenous severance pay, initiated by firms. With this in mind, I do not take into account the legal severance pay costs in my empirical setting and instead allow my model to endogenously deliver the de-facto large severance payments.

3.2 Data

I use administrative data from France between 2009 and 2019. The four key variables for the analysis—wages, layoffs, productivity, and tenure—are either directly available or can be constructed given the richness of the data. I combine a worker panel from social-security records covering one-twelfth of the French labor force (providing wages, layoffs, and tenure) with annual firm balance-sheet data (providing productivity). For the sample, I focus on prime-age workers (25–55) in private-sector jobs with wages at least 5% above the national minimum wage at the time. Appendix C.1 provides further details on sample selection. The

[5] See, e.g., union monitoring note (Force Ouvrière 2025).

[6] Administrative and legal syntheses referenced in (DARES 2022).

remaining sample contains 265,000 unique firms and 880,000 unique workers per year. I next describe how I construct the four key variables.

I measure labor productivity using value added per worker, as reported in the balance-sheet data. I model labor productivity y_{fst} at firm f in sector s at time t as

$$\log y_{fst} = \log a_t + \log b_{st} + \log x_{fst},$$

where a_t is the aggregate component, b_{st} is a sectoral component, and x_{fst} is a firm-level component. I residualize $\log y_{fst}$ on time dummies to extract the common time component, measure the sectoral component $\log b_{st}$ as the average productivity within a sector, and compute the firm component $\log x_{fst}$ as the residual. In what follows, I focus on firms' responses to the firm-specific component x_{fst} to abstract from broader general-equilibrium effects.

I measure wages as annual, CPI-adjusted labor earnings divided by days worked. Labor earnings are net of payroll taxes but pre–income tax, and include all forms of compensation (including bonuses and payments in kind) but exclude stock options. I residualize log wages on occupation, firm, and region dummies, as well as a quadratic in worker experience. I focus on job-stayer wage growth $\Delta \log w_{ift}$ for workers continuously employed at firm f in years $t-1$ and t. After computing growth rates for both productivity and wages, I trim the bottom and top 5% of each year's distributions.

I measure layoffs as breaks in employment spells of at least four weeks. The idea is that job-to-job transitions rarely entail long breaks, and given the low job-finding rate in France, recently laid-off workers are unlikely to find employment within a month. There remains a risk of both false positives and false negatives, as well as the risk of misclassifying voluntary transitions into medium-term nonemployment as layoffs. In Appendix C.2 I use the French Labor Force Survey to measure layoffs as quarterly movements from employment into unemployment, as self-reported by workers.

Lastly, workers' tenure at the firm is directly observed in the data. I focus on the first five years of tenure; beyond that, differences across cohorts are small.

3.3 Wages and layoffs across firms

I begin by confirming the existing finding that firms exhibiting the most rigid wages lay off the most workers (see Ehrlich and Montes (2024)). To facilitate comparison, I group firms into terciles $d \in D$ based on their average layoff rates. For each group, I estimate the response of wage growth to firm productivity shocks. Define the growth rate of residualized wages for worker i in firm f between years t and $t-1$ as $\Delta \log w_{ift}$ and the growth rate of

	Layoff rate	Wage change
Low layoff rate	0.05%	0.017***
		(0.0006)
Medium layoff rate	1.5%	0.012**
		(0.0008)
High layoff rate	9.7%	−0.002***
		(0.0006)

Table 1: Wage pass-through across firms. Data: DADS Panel + FARE, 2009–2019.

firm productivity as $\Delta \log(x_{ft})$. I estimate:

$$\Delta \log w_{ift} = \sum_{d \in D} \mathbf{1}\{f \in d\}\big(\alpha^d + \beta^d \, \Delta \log(x_{ft})\big) + \epsilon_{ift}.$$

Average layoff rates and estimated wage pass-throughs across firms are reported in Table 1. Firms in the low-layoff tercile raise wages by 1.7% in response to a 100% productivity shock. Firms in the middle tercile, with an average layoff rate of 1.5%, raise wages by 1.2%. Lastly, high-layoff firms, averaging 9.7% layoffs, reduce wages by 0.2% in response to a positive shock.

These results show that firms laying off the largest share of workers also exhibit the least responsive—and even negatively responsive—wages. This pattern is consistent with both the classical account (firms resort to layoffs when they cannot cut wages) and the mechanism developed here.

3.4 Wages and layoffs across tenure

Beyond cross-firm heterogeneity, the connection between rigid wages and layoffs also appears within firms, across worker tenure. Prior work has documented heterogeneity in layoff rates (e.g., Buhai et al. (2014)). Here I also document heterogeneity in wage pass-through.

Let workers' tenure be $ten \in T$, observed directly in the employer–employee data. Unlike the firm-level analysis, I consider each worker cohort up to five years of tenure. I run two regressions. First, analogous to the across-firm case, I estimate the response of wages to firm-level shocks across tenure:

$$\Delta \log w_{ift} = \sum_{ten \in T} \mathbf{1}\{ift \in ten\}\big(\alpha^{ten} + \beta^{ten} \, \Delta \log(x_{ft})\big) + \epsilon_{ift}. \tag{6}$$

Second, I estimate layoff rates using the individual layoff event EU_{ift} for worker i in firm f

	Layoff rate	Avg. wage pass-through	Response to pos. shock	Response to neg. shock
<1 year	11%***	0.000	0.022***	0.002***
	(0.0002)	(0.004)	(0.004)	(0.003)
1–2 years	5%***	0.004	0.014***	0.020***
	(0.0002)	(0.004)	(0.004)	(0.003)
2–3 years	3%***	0.008**	0.013**	0.020***
	(0.0002)	(0.002)	(0.002)	(0.003)
3–4 years	2%***	0.008*	0.012*	0.015***
	(0.0002)	(0.003)	(0.003)	(0.004)
4–5 years	2%***	0.017***	0.010***	0.024***
	(0.0002)	(0.004)	(0.004)	(0.004)

Table 2: Layoffs and wage pass-through across tenure. Columns 3 and 4 report asymmetric pass-through to positive and negative shocks. Data: DADS Panel + FARE, 2009–2019.

at year t:

$$EU_{ift} = \sum_{ten \in T} \mathbf{1}\{ift \in ten\}\, \alpha^{ten} + \epsilon_{ift}.$$

I also examine asymmetry in pass-through. Negative productivity shocks are when firms are most inclined to use wage cuts and layoffs. Although downward wage rigidity is well established (e.g., Hazell and Taska (2021)), its heterogeneity across tenure is less explored. To estimate it, I modify (6) by interacting productivity growth with an indicator for negative shocks, letting $\Delta \equiv \Delta \log(x_{ft})$:

$$\Delta \log w_{ift} = \sum_{ten \in T} \mathbf{1}\{ift \in ten\} \Big(\alpha^{ten} + \beta^{ten}\, \Delta + \tilde{\beta}^{ten}\, \mathbf{1}\{\Delta < 0\}\, \Delta \Big) + \epsilon_{ift}.$$

Table 2 reports the results. Junior workers exhibit the smallest average pass-through. At the same time, senior workers face layoff rates up to 5.5 times lower than juniors. Regarding downward rigidity, juniors benefit most: their response to positive shocks is largest, whereas their response to negative shocks is near zero. Later cohorts display much less asymmetry in pass-through and are therefore more exposed to pay cuts than juniors.

I interpret these findings as evidence of a cohort-level trade-off between wage cuts and layoffs: whenever and wherever firms lay off workers, they cut survivors' wages less. The heterogeneous treatment of cohorts cannot be explained by standard stories of wage rigidity (minimum wages, sectoral bargaining, morale costs) without additional assumptions. Likewise, as discussed above, statutory severance payments in France rise only slightly with tenure.

	Layoff
Intercept	0.0031***
	(0.0001)
EU	−0.0036***
	(0.0006)

Table 3: Senior–junior wage log change in response to layoffs. Data: DADS Panel + FARE, 2009–2019.

3.5 Senior/junior wage gap response to layoffs

I shift the angle of analysis and examine how the wage gap between senior and junior workers responds to layoffs. Unlike earlier analyses, I neither study the overall cross-section nor condition on productivity shocks. The goal is to examine how layoffs—typically concentrated among juniors—affect within-firm wage inequality.

For each firm–year, I compute the median tenure and take the ratio of wages for workers above and below the median, $\bar{w}_{sen,f,t}/\bar{w}_{jun,f,t}$. I then compute the log change in this ratio over time and regress it on layoffs:

$$\Delta \log\left(\bar{w}_{sen,f,t}/\bar{w}_{jun,f,t}\right) = EU_{ft} + \epsilon_{ft}.$$

Estimates appear in Table 3. On average, the wage ratio rises over time (likely reflecting new hires), but it falls when layoffs occur, suggesting that surviving juniors experience faster wage growth than surviving seniors. These results are consistent with the interpretation that firms lay off junior workers and then cut the wages of surviving juniors by less than those of surviving seniors.

4 Quantitative Analysis

I calibrate the model using administrative data from France and assess whether it reproduces the empirical evidence on wage pass-through and layoffs across firms and tenure. I introduce several policies prevalent in French labor market and use the model to assess their impact.

4.1 Solving the model

The tenure-based formulation yields a discrete—though expanding—state space. To make the problem fully tractable, I note that wages in contracts tend to converge, a result that follows from the propositions above. A corollary of Proposition 2 is that wages for cohorts with the same quality converge because they share the same target wage. I also expect quality across cohorts to converge:

- Lower-quality cohorts (relative to others) have lower target wages;
- Over time, low-quality cohorts become low-value cohorts;
- By Proposition 4, low-value cohorts are laid off first;
- Hence lower-quality cohorts catch up in quality and, consequently, in wages.

Given convergence, the practical question is how quickly it occurs—or, equivalently, how many cohorts to track. Empirically (Appendix C.3), wage growth in France flattens after about ten years of tenure. I therefore restrict attention to a finite and constant $K \leq 10$ for all firms in the quantitative analysis. This is an approximation: as $K \to \infty$, the model converges to the problem in Lemma 1.

A second complication, common in dynamic-contract models, is the large action space because $\{v'_{y',k}\}$ grows with the number of productivity states. Appendix A.4 shows that the problem can be solved in its dual form by choosing future marginal utilities—constant across productivity realizations—instead of promised values.

Lastly, I solve for a block-recursive equilibrium. As shown in Appendix A.5, such an equilibrium exists when all new hires enter at the same promised value v_0; any additional value associated with higher submarkets v is paid as a sign-on wage. I set v_0 equal to the unemployment value U.

4.2 Model specification

I work at annual frequency: contracts in France are rarely updated more than once per year, which facilitates cohort tracking. I set the discount factor to $\beta = 0.96$, consistent with a 4% annual interest rate.

I use logarithmic utility so that the composition $u' \circ u^{-1}(v)$ is strictly increasing; within CRRA preferences, this property holds only for log utility.

Production is a concave function of quality-adjusted quantity:

$$F(n, z) = [n\,(z + \alpha_z(1 - z))]^{\alpha}.$$

I set $\alpha = 0.85$, consistent with recent work on firm dynamics (Schaal (2017); Bilal et al. (2022)). Idiosyncratic firm-level productivity y follows a uniform Markov process as in Balke and Lamadon (2022): with probability λ_y productivity is redrawn uniformly; otherwise it remains unchanged. I normalize the expected value of y to 1.

Moments	Data	Model
Rate of new hires	12.8%	12.2%
Annual separation rate of the bottom prod tercile	3.9%	3.6%
Annual separation rate of the top prod tercile	3.0%	2.8%
Annual job-to-job transition rate	6.3%	5.4%
Tenure profile of wages at 10 years	6.4%	6.2%
s.d. of firm productivity growth	0.39	0.30
Annual persistence of firm productivity	0.79	0.73
Ratio of minimum wage to mean wage	0.45	0.46

Table 4: Targeted moments in data vs. model

Matching follows a CES contact-rate function (as in Menzio and Shi (2011)):

$$p(\theta) = \theta\,[a^\gamma/(a^\gamma + \theta^\gamma]^{1/\gamma}, \qquad q(\theta) = [a^\gamma/(a^\gamma + \theta^\gamma]^{1/\gamma}.$$

I use a common estimate of the curvature $\gamma = 0.8$ and normalize the vacancy posting cost $c = 1$.

Minimum wage

I introduce national minimum wage directly into the baseline of the quantitative model. The intent is to control for the key source of exogenous wage rigidity, which is a potential alternative explanation for both rigid wage and layoffs, in France. In the policy analysis, I will discuss the relevance of the minimum wage for reconciling the data, and its impact, alongside other labor policies, on the economy. This leaves 10 parameters to be estimated with 10 moments in the data.

4.3 Moments of interest

I target four sets of moments: transition probabilities, wage growth, productivity dynamics, and firm dynamics. I proceed with an informal discussion of what moments influence which parameters most.

Transitions. I measure annual job-to-job (E2E) and unemployment-to-employment (U2E) transitions. For the hiring rate, I use the share of newly hired workers among all observations. U2E and E2E map directly to vacancy c and relative search of efficient of job-to-job transitioners, λ_{jj}, respectively. I obtain an E2E rate of 6.3% and a 12.8% share of new hires economy-wide.

Parameters	Value	Parameters	Value
Unemployment production b	0.59	Share of high-quality matches upon hire z_0	0.57
Firm productivity persistence λ_y	0.95	Relative productivity of low-quality matches α_z	0.50
Firm productivity variance σ_y	0.65	Minimum wage w_{min}	0.85
Matching efficiency α	0.72		
On-the-job search efficiency λ_{jj}	0.78		

Table 5: Estimated model parameters

Layoffs across productivity. I track the distribution of employment-to-unemployment (E2U) rates across firms by productivity. I separate firms into productivity terciles, and take average layoff rate from the top and bottom terciles. These moments discipline match-heterogeneity parameters: the lower the relative productivity of low-quality matches α_z, the more even highly productive firms will lay off workers. After sufficiently positive productivity shocks, firms hire; when q_0 (the share of high-quality new matches) is small, subsequent layoffs are more likely.

Wage growth by tenure. I use wage growth over the first ten years of tenure to discipline unemployment production b. Intuitively, wages rise until a cohort's marginal profit reaches zero; the lower the cohort's starting point (which depends on the unemployment outside option), the larger the initial wage growth. I document 6.1% wage growth after five years of tenure.

Productivity dynamics. I measure the standard deviation and persistence of firm-level productivity (net of aggregate and sectoral effects) to discipline productivity parameters λ_y and σ_y. Firm-level productivity is moderately persistent with coefficient 0.79. Its standard deviation is 0.39, the largest among productivity components, consistent with comparable estimates of 0.81 and 0.30 in Souchier (2022).

Firm dynamics. To discipline firm entry cost κ_e, I target a 6% share of jobs created by entering firms. Because fixed cost κ_f affects exit and thus selection, I target an average firm size of 32.5. For comparison, the average establishment size is 17.9, close to 15.6 in the 2002 U.S. Economic Census.

4.4 Model Fit

For the time being, I solve the model with constant returns to scale and estimate it via indirect inference. In this simplified specification, there is no need for firm entry and maintenance costs, and thus, the related moments are also not targeted.

The model fit, as shown in Table 4, can be improved. On the transition probabilities side, both the overall proportion of new hires and the proportion of the job-to-job transitioners fall under their empirical counterparts. On the other hand, the model overestimates the layoff rate occurring in the data, especially at the bottom tercile.

The model currently does not exhibit large enough wage growth, which, alongside the overestimated layoffs, suggests that the unemployment production b could be even lower.

Lastly, the standard deviation of firm productivity growth is notably undervalued. One possible explanation is that the relatively standard parameters values for the volatility of the firm shock that I employ are not large enough to overpower the smoothing effect that the layoffs have on the overall firm productivity.

Parameter Values The corresponding parameter values are presented in Table 5.

The fairly high tenure profile of wages suggests a low value of home production $b = 0.59$. This is above the values used in standard calibrated DMP models like Shimer (2005), but still notably below the calibration of Hagedorn and Manovskii (2008), and well in the range of values (47% to 96%) proposed by Chodorow-Reich and Karabarbounis (2016). This relatively low value also highlights that the model does not need the matches to be inefficient (that is, for match productivity to be below home production) in order to generate layoffs.

The firm productivity parameters are comparable to those in Balke and Lamadon (2022), which is unsurprising given that I am applying the same approach to generate firm productivity shocks. However, my model required a stronger variance in firm productivity, which comes down to two facts: first, unlike in their model, I only have a single source of productivity shocks, at the firm level; second, in my model, firms can endogenously adjust their productivity via layoffs, essentially smoothing the observed firm productivity process.

Both the matching efficiency, relative to the vacancy cost normalized to 1, and the on-the-job search efficiency values are similar to the calibration of Menzio and Shi (2011) for the case where match quality is only observed upon the match being formed, exactly consistent with the story of my model. Crucially, however, my model does not need neither exogenous job destruction nor high unemployment productivity to generate layoffs.

Lastly, the match heterogeneity parameters are closely comparable to those of Gregory, Menzio, and Wiczer (2021), who estimate a Menzio-Shi-like model of directed search with match heterogeneity and calibrate their model to match the proportion and moments (including layoff rates) of three types of workers observed in the data: the alphas, beta, and gammas. Curiously, although my model does not target the specific transition rates across match types, it arrives at extremely similar parameter values: the relative productivity of the low quality match $\alpha_z = 0.50$ falls right inbetween the relative productivities of the less productive types beta, 0.623, and gamma, 0.459. Even more surprisingly, the proportion of

	Data		Model	
	Layoff rate	Avg. wage pass-through	Layoff rate	Avg. wage pass-through
<1 year	11%***	0.000	5.80%***	−0.029***
	(0.0002)	(0.004)		
1–2 years	5%***	0.004	0.70%***	0.013***
	(0.0002)	(0.004)		
2–3 years	3%***	0.008**	0.40%***	0.009***
	(0.0002)	(0.002)		
3–4 years	2%***	0.008*	0.20%***	0.019***
	(0.0002)	(0.003)		
4–5 years	2%***	0.017***	0.10%***	0.019***
	(0.0002)	(0.004)		

Table 6: Layoffs and wage pass-through across tenure in the simulated model.

high quality matches $z_0 = 0.57$ is exactly equal to the proportion of workers of type alpha documented by Gregory, Menzio, and Wiczer (2021).

4.5 Untargeted moments

(a) Plot: average wage and promised value across worker tenure.

	Wages	Value v
Intercept	1.151***	25.897***
	(0.0000)	(0.0001)
Tenure	0.022***	0.121***
	(0.0000)	(0.0000)

(b) Regression: average wage and promised value across tenure

Figure 2: Wage growth and promised value (left) alongside regression summary (right).

I perform two exercises to validate my model.

I first confirm the conjecture that junior workers are on the lower wage and promised value than the more senior workers. This conjecture is important as my theory does not address heterogeneity across worker tenure directly, and instead only through the differences in the promised value and average quality across cohorts.

To test this, I measure the average wage and expected across worker tenure in my simulated panel. Figure 2a shows the wage and value profile and Table 2b shows the estimates of an OLS regression of wages and value on tenure. Both wages and worker promised value rise with worker's tenure at the firm, suggesting that the model's theoretical predictions across cohorts' values can be translated into predictions across worker tenure.

Second, I assess whether the model reproduces the heterogeneity in layoffs and wage passthrough across firms and tenure documented in Section 3. I perform the same regressions on my panel data as in the empirical section, estimating layoff rates and wage passthrough across groups of workers (based on tenure).

The results for heterogeneity across tenure are presented in Table 6. At the current stage, undervalues layoffs in general but overvalues the difference in layoffs across cohorts: juniors suffer a 2.5 times smaller layoff rate than in the data, while more senior workers suffer between 7-30 lower layoff rates.
On the wage passthrough side, the juniors show strongly negatively responsive wages, but wage passthrough of more senior workers is fairly comparable to the data.

4.6 Impulse response analysis

I report the impulse responses in the model to permanent positive and negative innovation shocks to firm productivity y, scaled to generate a 10% output change. In practice, I simulate the histories of a crossection of firms, and compare a treatment group that receives the permanent productivity shock with a control group that does not. Figures 3 and 4 report the differences in variables of interest between the control and treatment groups around the event at time 0. For each case, I simulated firms that existed at the last stage of the simulation that produced the results above. The Figure 3 show the average response across all such cohorts, and Figure 4 focuses on the cohorts the have just recently formed.

After a permanent positive shock to firm productivity, workers are immediately subjected to a fall in layoff risk and, with a delay, a hike in wages. However, the layoff rate change is minimal, as reflected in almost no change to the target wage $\log(w^*)$. Following a rise in wages, the job-to-job transition probability falls as workers are even less incentivized to find jobs elsewhere. The response to a negative shock, while generally the opposite of the response to a positive shock, differs slightly as a firm now has more "opportunity" to lay off poor matches. This is highlighted in the fact that the value of a marginal worker in the cohort changes by a notably smaller amount.

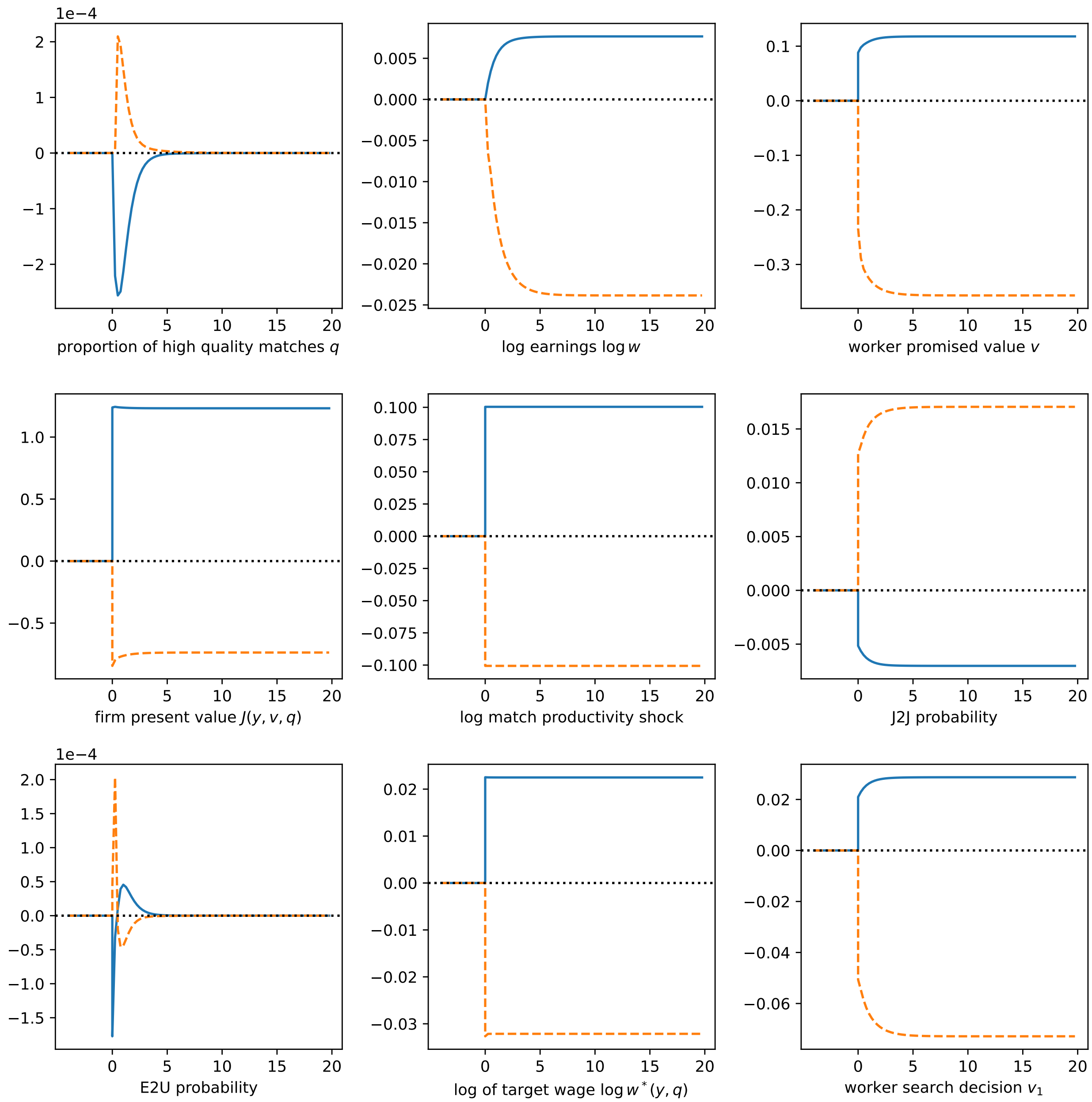

Figure 3: Impulse response to a permanent productivity shock. Blue represents a positive shock, orange – negative shock

The impulse response for junior cohorts, shown in Figure 4, highlight the impact of layoffs much more starkly. Upon a negative productivity shock, the layoff rate spikes sharply enough that the impact is apparent in the target wage and all the related policies: upon layoffs, the wage arrives back to almost the original value, overall a much smaller wage drop than for seniors. This minimal impact on wages is highlighted also in the job-to-job transition probability of the worker that essentially does not change after the negative shock.

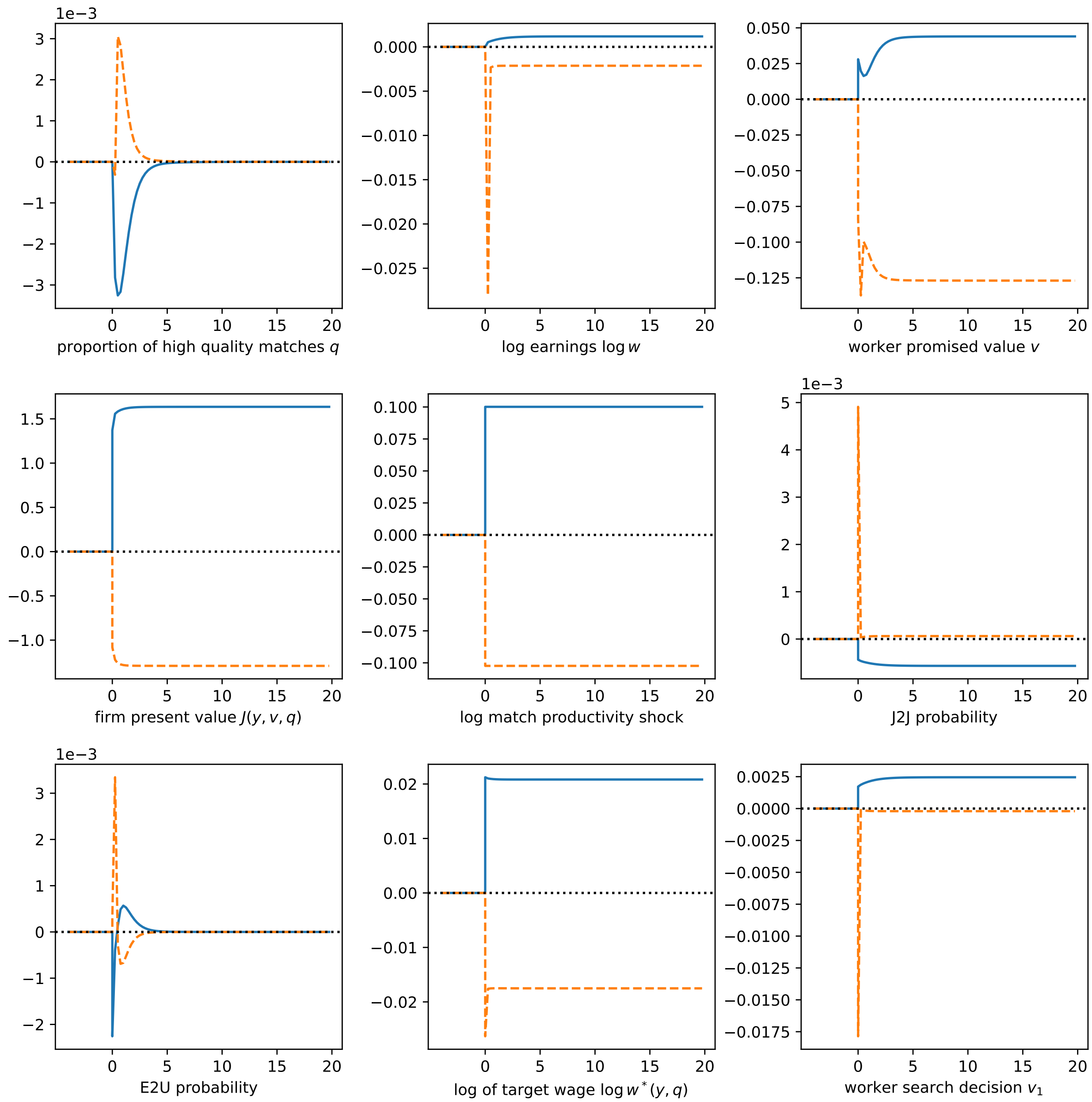

Figure 4: Impulse response to a permanent productivity shock, juniors only. Blue represents a positive shock, orange – negative shock

The effect of the permanent positive shock is similarly muted, due to the fact that quite a few of the low productivity junior matches that would have been fired otherwise, have been retain after the shock. This incentivizes the firm to not raise wages too much, as shown in the sudden fall in worker promised value v'.

4.7 Policy implications

I use my model as a realistic laboratory to evaluate the consequences of varying minimum wage and severance pay policies – two of the most important institutional features of European labor markets. In contrast to earlier models, the key difference in assessing these policies here lies in the endogeneity of wages, which makes it unclear whether the wage rigidity observed in the simulated data comes from the minimum wage or the firms' optimal choice not to cut wages. Similarly for severance pay, firms have incentives to offer their own severance, thus making the ultimate impact of statutory severance unclear.

4.7.1 Minimum Wage

Minimum wage is an important source of exogenous wage rigidity, particularly in France. In this section, I revisit two central questions about the minimum wage. First, using a counterfactual model without a minimum wage, I ask: What are the contributions of the current minimum wage to the wage and layoff ladders? What are its implications for productivity and firing decisions? What are the employment effects? Second, I examine the effects of a 20% increase in the minimum wage to address the question: Starting from an already high level—relative to the OECD average—what are the effects of raising the minimum wage even further? This question is particularly relevant if the minimum wage introduces convexities in the model, whereby additional increases entail disproportionately large costs or gains for the economy.

Table 9 shows the employment transition moments in the economy across the three cases. Overall, the impact of minimum wage is rather muted. Without the minimum wage, the model still delivers almost the same rate of new hires as well as the layoff rate, but slightly underestimates the job-to-job transition rate. As I explain below, this is unsurprising. First, firms hire workers on promised values, not on wages. Although a minimum wage does make it less profitable to employ workers on the values, where this wage would be binding, ultimately the firms can still recoup some of the overdelivered value by not raising workers wages longer-term. This implies that the presence of minimum wage need not strongly affect the value of hiring workers. Second, firms primarily use layoffs to shed less productive matches. Although minimum wage does create cases where the firm may want to fire even more productive matches, those cases are rate Lastly, when the minimum wage binds for a cohort, the firm is forced to frontload the workers' utility. This results in workers being more incentivized to look for other jobs.

The impact of the 20% minimum wage hike is more pronounced, as the minimum wage now reaches even more productive workers and the firms are even further restricted in back-

	No min wage	Baseline	20% hike
Rate of new hires	12.8%	12.2%	11.2%
Annual separation rate of the bottom prod tercile	3.2%	3.6%	3.9%
Annual separation rate of the top prod tercile	2.5%	2.8%	3.0%
Annual job-to-job transition rate	5.2%	5.4%	5.5%

Table 7: Labor transition probabilities for different values of minimum wage.

	No min wage		Baseline		20% hike	
	Layoffs	Wages	Layoffs	Wages	Layoffs	Wages
<1 year	5.4%	0.012	5.80%	−0.029	6.00%	−0.057
1–2 years	0.6%	0.017	0.70%	0.013	0.73%	0.002
2–3 years	0.42%	0.023	0.40%	0.009	0.51%	0.008
3–4 years	0.15%	0.025	0.20%	0.019	0.26%	0.011
4–5 years	0.06%	0.025	0.10%	0.019	0.12%	0.016

Table 8: Layoffs and wage pass-through across tenure for different values of minimum wage.

loading workers wages. Still, the effect is generally muted.

I next consider how the minimum wage affects the heterogeneity in wage passthrough and layoffs across worker tenure. I focus on the comparison between the case of no minimum wage and the baseline as the way to confirm that minimum wage is not essential in reconciling this heterogeneity. Generally, removing minimum wage dampens layoffs and amplifies wage passthrough. Still, the effect are small, suggesting that my model did not rely heavily on minimum wage to generate the heterogeneity.

4.7.2 Severance pay

The severance pay in the model is determined by the firm's endogenous severance pay choice. I discuss the realized severance pay in my model and compare it to the data.

Figure 5 shows the average severance pay across the first 10 years of worker tenure. Severance pay strongly increases in cohort's wage and is only bounded by the exogenous policy for the most senior workers. Even without any requirements, firms choose to provide workers with a significant severance pay in order to compensate workers for layoffs ex-post. Otherwise, absent severance, the ex-ante risk of layoffs would have to be compensated via higher average wage to all the workers.

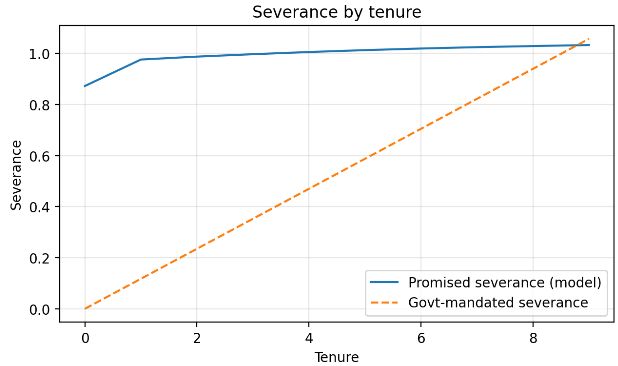

Figure 5: Severance pay across worker tenure.

	Baseline	Hiring subsidy
Rate of new hires	x	x
Annual separation rate of the bottom prod tercile	x	x
Annual separation rate of the top prod tercile	x	x
Annual job-to-job transition rate	x	x

Table 9: Labor transition probabilities from hiring subsidy

The reason for why the optimal severance pay stagnates in tenure is that the optimal severance pay scales with worker wages: the more worker is paid, the more they lose from being laid off, the more the firm wants to compensate them with severance. However, as wage growth stagnates, so do the severance payments. In that sense, my model cannot reconcile the severance pay above legal minima beyond the first ten years of tenure. Further factors beyond the scope of this paper, like human capital accumulation, may induce the firm to keep raising worker's value over the long-term by raising the severance pay.

4.7.3 Hiring subsidies

Lastly, I consider the impact of hiring subsidies on the economy. For this, I consider a drop in cost of posting a vacancy, c, initially normalized to 1.

5 Conclusion

This paper studies the connection between wage cuts and layoffs. I build a model in which firms hire employ workers of various tenure and match quality. Firms use layoffs as a tool to shed poor matches and choose to keep wages of the survivors largely unchanged. This mechanism is pervasive both across firms and across worker tenure. I empirically validate the predictions of the model using matched employer-employee data. The quantitative model accounts well for the documented patterns of wage pass-through and layoffs.

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A Model Appendix

A.1 Proofs

Proof of Proposition 1

The proposition is derived from the first-order conditions of the firm's problem.

Proof. Consider the problem from Lemma 1. The FOC for v'_{k_1} yields (denote ρ_k the shadow cost of PK_k and ω_k the shadow cost of the expectation condition):

$$\rho_k\beta(1-s_k)(1-p(v'_{k+1}))-\omega_k+\beta n_k(1-s_k)\frac{\partial(1-v(v'_{k+1}))}{\partial v'_{k+1}}E_{y'|y}\frac{\partial J(y',\{n'_k,v'_{y',k}\}_{k\leq K+1})}{\partial n'_{k+1}}=0$$

To develop this further, I use the FOC for w_k:

$$-n_k+\rho_k u'(w_k)=0 \iff \rho_k=\frac{n_k}{u'(w_k)}$$

One can similarly develop ω_k by applying the FOC for $v'_{y',k+1}$:

$$\beta Pr_{y'|y}\frac{\partial J(y',\{n'_k,v'_{y',k}\}_{k\leq K+1})}{\partial v'_{y',k+1}}+Pr_{y'|y}\omega_k=0 \iff \omega_k=-\beta\frac{\partial J(y',\{n'_k,v'_{y',k}\}_{k\leq K+1})}{\partial v'_{y',k+1}}\forall y'$$

Applying the envelope theorem one can then note that

$$-\frac{\partial J(y',\{n'_k,v'_{y',k}\}_{k\leq K+1})}{\partial v'_{y',k+1}}=\frac{n'_{k+1}}{u'(w'_{k+1})}$$

Putting all this together, we get

$$\frac{n_k}{u'(w_k)}\beta(1-s_k)(1-p(v'_{k+1}))-\beta\frac{n'_{k+1}}{u'(w'_{k+1})}+\beta n_k(1-s_k)\frac{\partial(1-v(v'_{k+1}))}{\partial v'_{k+1}}E_{y'|y}\frac{\partial J(y',\{n'_k,v'_{y',k}\}_{k\leq K+1})}{\partial n'_{k+1}}=0$$

All that is left is to note that $n'_{k+1} = n_k(1-s_k)(1-p(v'_{k+1}))$, divide by the common terms $(\beta n'_{k+1})$ and rearrange.

$$\frac{1}{u'(w'_{k+1})} - \frac{1}{u'(w_k)} = \eta(v'_{k+1})E_{y'|y}\frac{\partial J(y', \{n'_k, v'_{y',k}\})}{\partial n'_{k+1}}$$

□

Proof of Proposition 2

Proof. □

Proof of Proposition 4

I start by describing the FOC with respect to layoffs s_k:

Proof. Consider the case where $s_k > 0$. Then

$$-\beta n_k(1-p(v'_{k+1}))E_{y'|y}\frac{\partial J(y', \{n'_k, v'_{y',k}, z'_k\})}{\partial n'_{k+1}} + \beta E_{y'|y}\frac{\partial J(y', \{n'_k, v'_{y',k}, z'_k\})}{\partial z'_{k+1}}\frac{\partial z'_{k+1}}{\partial s_k} - \rho_k\beta(U-R(v'_{k+1})) = 0$$

Note that the FOC with respect to w_k yields $\rho_k = \frac{n_k}{u'(w_k)}$ and divide by βn_k to get the FOC in the Propositon.

For the further results, I rewrite the firm state $(y, \{n_k, v_k, z_k\})$ into $(y, \{\underline{n}_k, \bar{n}_k, v_k\})$, where $\bar{n}_k = z_k n_k$ and $\underline{n}_k = (1-z_k)n_k$.

I focus on the case where $\underline{n}_k > 0$ and $s_k(\underline{n}_k + \bar{n}_k) \leq \underline{n}_k$, that is, firm has not yet fired all the bad matches with the cohort (in the previous FOC, this is equivalent to $\frac{\partial z'_{k+1}}{\partial s_k} > 0$). The marginal value of firing a worker is then

$$-\frac{R(v'_{k+1}) - U}{u'(w_k)} - (1-p(v'_{k+1}))E_{y'|y}\frac{\partial J(y', \{\underline{n'}_k, \bar{n'}_k, v'_k\})}{\partial \underline{n}'_{k+1}}$$

To show that cohorts with lower promised values are more subject to layoffs, I take a derivative of this FOC with respect to the promised value v_k.The only component in the FOC directly dependent on v_k is $\frac{1}{u'(w_k)}$, where $w_k = u^{-1}(v_k - \beta[s_k U + (1-s_k)R(v'_{k+1})])$. Due to the $CRRA$ utility function, we find that $\frac{1}{u'(w_k)}$ is increasing in v_k, and, therefore, the marginal profit of firing workers is decreasing in v_k.

Lastly, I show that layoffs are equally dependent on the quality of any cohort (as long as $z_k < 1$). First, I note that quality directly appears only in the marginal value of low quality workers

$$\frac{\partial J(y', \{\underline{n}'_k, \bar{n}'_k, v'_k\})}{\partial \underline{n}'_{k+1}} = y'[F'_1(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k}) - F'_2(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k})\frac{\sum n'_k}{(\sum n'_k z'_k)^2} - w'_{k+1} + \beta E_{y''|y'}\frac{\partial J(y'', ...)}{\partial \underline{n}''_{k+2}}\frac{\partial \underline{n}''_{k+}}{\partial \underline{n}'_{k+}}$$

Next, I note that all the quality states $\{z_k\}$ contribute in the same manner to $\frac{\partial J(y',\{\underline{n}'_k,\bar{n}'_k,v'_k\})}{\partial \underline{n}'_{k+1}}$, no matter the cohort k. Therefore, to first-order, the marginal value of firing a worker is equally dependent on all the quality states.
I don't think I need to assume $s_k(\underline{n}_k + \bar{n}_k) \leq \underline{n}_k$. I can write the proof for both cases, and the results should be there for either one. $\square$

Proof of Proposition ??

Start with the wage growth equation from Proposition 1, extended to the case of heterogeneous matches.

$$\frac{1}{u'(w'_{k+1})} - \frac{1}{u'(w_k)} = \eta(v'_{k+1}) E_{y'|y} \frac{\partial J(y', \{n'_k, v'_{y',k}, z'_k\})}{\partial n'_{k+1}}$$

One can now apply the Envelope Theorem to extend the RHS of the equation:

$$\begin{aligned} E_{y'|y} \frac{\partial J(y', \{n'_k, v'_{y',k}, z'_k\})}{\partial n'_{k+1}} =& E_{y'|y} \Big[y' \frac{\partial F(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k})}{\partial n'_{k+1}} - w'_{k+1} + \\ & \beta(1 - p(v''_{k+2}))(1 - s'_{k+1}) E_{y''|y'} \frac{\partial J(y'', \{n''_k, v''_{y'',k}, z''_k\})}{\partial n''_{k+2}}) \Big] \end{aligned}$$

One can note that the production derivative $\frac{\partial F(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k})}{\partial n'_{k+1}}$ is increasing in z'_{k+1}. And, moreover, that $\frac{\partial^2 F(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k})}{\partial n'_{k+1} \partial z'_{k+1}} > \frac{\partial^2 F(\sum n'_k, \frac{\sum n'_k z'_k}{\sum n'_k})}{\partial n'_{k'} \partial z'_{k+1}}, k' \neq k+1$. This implies that, the workers in steps $k \in K_s$ will experience the largest rise in marginal productivity. This doesn't mean that they are at the highest marginal productivity though! Part of my intuition is predicated on the fact that the other workers, ones not fired, are already quite close to their target wages! Otherwise those guys would still have the best wage growth. Essentially, my intuition is that the fired cohorts receive a spike in marginal productivity, so, if they're on the similar-ish wage path to the other cohorts, they should get the best wage growth. But this needs to be formalized some more.

A.2 Tenure-specific Severance Payments

I allow the firm to offer tenure-specific severance payments sev_k to its workers. The severance is constant over time and paid perpetually upon firing and before finding a new job. I show that the severance structure involves higher payments for longer tenured workers (if those workers are on a higher promised value).

Proof of Proposition 5

Proof. I start by describing the unemployment value of a worker with severance payment sev_k:

$$U(sev_k) = u(b + sev_k) + \beta \max_v[(1 - p(\theta_v))U(sev_k) + p(\theta_v)v]$$

Denote the probability of finding a job with severance payment sev_k as $p(\theta_{sev_k})$. The extra value to the unemployed from the severance payment is then given by

$$\frac{\partial U(sev_k)}{\partial sev_k} = u'(b + sev_k) + \beta(1 - p(\theta_{sev_k}))U'(sev_k) = \frac{u'(b + sev_k)}{1 - \beta(1 - p(\theta_{sev_k}))}$$

Then the total benefit to the firm from raising the severance payment is the slackening of the promised-keeping constraint thanks to this rise in the unemployment value:

$$\lambda_k n_k \beta s_k \frac{\partial U(sev_k)}{\partial sev_k} = \frac{n_k}{u'(w_k)} \beta s_k \frac{u'(b + sev_k)}{1 - \beta(1 - p(\theta_{sev_k}))}$$

On the cost side, the firm internalizes the net present value of the severance payments when firing $n_k s_k$ workers:

$$\frac{\partial}{\partial sev_k}\left[n_k s_k \beta \frac{sev_k}{1 - \beta(1 - p(\theta_{sev_k}))}\right] = n_k s_k \beta \frac{[1 - \beta(1 - p(\theta_{sev_k}))] - \beta sev_k \frac{\partial p(\theta_{sev_k})}{\partial sev_k}}{[1 - \beta(1 - p(\theta_{sev_k}))]^2}$$

The optimal severance payment then follows from the first-order condition:

$$\frac{n_k}{u'(w_k)} \beta s_k \frac{u'(b + sev_k)}{1 - \beta(1 - p(\theta_{sev_k}))} = n_k s_k \beta \frac{[1 - \beta(1 - p(\theta_{sev_k}))] - \beta sev_k \frac{\partial p(\theta_{sev_k})}{\partial sev_k}}{[1 - \beta(1 - p(\theta_{sev_k}))]^2}$$

Rearranging gives the result.

$$\frac{u'(b + sev_k)}{u'(w_k)} = 1 - \frac{\beta sev_k \frac{\partial p(\theta_{sev_k})}{\partial sev_k}}{1 - \beta(1 - p(\theta_{sev_k}))}$$

□

Note that, besides $u'(w_k)$, all the components of the severance payment are independent of both the firm state and the worker tenure. It is immediate to notice then that higher paid workers will have higher severance payments: as $\frac{1}{u'(w_k)}$, the value to the firm of the severance payment goes up, while costs stay the same. Therefore, the firm will optimally choose to offer higher severance payments to higher paid workers.
This equation is also easy to implement numerically: using the formulation in Appendix A.4, where $\rho_k \equiv u'(w_k)$ is a state variable, I can immediately compute the payments for all the firm states, before solving the rest of the firm problem.

A.3 Microfounding the Wage Noncontractability

A version of my model where the firm is allowed to choose quality-specific wage is in fact a signalling game: firm's action of choosing the wage signals the workers their quality. In this section I show that a pooling Perfect Bayesian Equilibrium of such a game exists, and thus it is plausible that no information is conveyed.

As a full infinite-horizon, multiple-receivers, complex sender model is too complicated of a game to solve, I restrict attention to a simplified model.

Consider a 3-period version of the model. The firm starts with measure $n = 2$ of workers, half of them of high quality and the other half of low. I allow the firm to offer quality-contingent wages in whichever way it likes.

I show that, under a sufficiently small elasticity of job search probability with respect to promised value v', $\eta(v') \equiv \frac{\partial(1-p(v'))/\partial v'}{(1-p(v'))}$, the pooling Perfect Bayesian Equilibrium exists. Moreover, under a stronger condition on the elasticity, this PBE survives the Intuitive Criterion (Cho and Kreps (1987)).

A.4 Recursive Lagrangian Approach

The original design of the problem would require solving promised values $v'_{y',k}$ for both each tenure step and each future productivity state. Following Balke and Lamadon (2022), I solve the following Pareto problem:

$$\begin{aligned}
\mathcal{P}(y, \{n_k, \rho_k, z_k\}) = &\inf_{\omega_k} \sup_{\tilde{n}, \tilde{v}, \{w_k, s_k, v'_k\}} yF(n, z) - \sum_k n_k w_k - \kappa_f - \tilde{n}\frac{c}{q(\theta_{\tilde{v}})} \\
&+ \sum_k \rho_k (u(w_k) + \beta[s_k U + (1 - s_k) R(v'_{k+1})] \\
&- \beta \sum_k \omega_k v'_{k+1} + \beta E_{y'|y} \mathcal{P}(y', \{n'_k, \omega_k, z'_k\})
\end{aligned}$$

where

$$\mathcal{P}(y, \{n_k, \rho_k, z_k\}) \equiv \sup_{\{v_k\}} J(y, \{n_k, v_k, z_k\}) + \sum_k \rho_k v_k$$

The following proof (for $K \to \infty$ but the proof extends trivially to finite K) establishes its equivalence with the initial problem. It follows the steps of Balke and Lamadon (2022), extending it to the case of a multi-worker firm.

Proof. We have the following recursive formulation for J:

$$J(y, \{n_k, v_k, z_k\}_{k\leq K}) = \max_{\tilde{n},\tilde{v},\{v'_k, v'_{y',k}, w_k, s_k\}_{k\leq K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y} J(y', \{n'_k, v'_k, z'_k\}_{k\leq K+1})$$
$$(\lambda_k)\ u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1}) = v_k]\ \forall k \leq K$$
$$(\omega_k) v'_{k+1} = E_{y'|y} v'_{k+1,y'}\ \forall k \leq K$$
$$n'_{k+1} = n_k(1-s_k)(1-p(v'_{k+1})) + \tilde{n}\ \forall k \leq K$$
$$z'_{k+1} = min(\frac{z_k}{1-s_k}, 1)\ \forall k \leq K$$
$$n'_0 = \tilde{n}, v'_0 = \tilde{v}, z'_0 = z_0$$

Consider the Pareto problem

$$\mathcal{P}(y, \{n_k, \rho_k, z_k\}) = \sup_{\{v_k\}} J(y, \{n_k, v_k, z_k\}) + \sum_k \rho_k v_k$$

I first substitute the definition of J together with its constraints into $\mathcal{P}$:

$$\mathcal{P}(y, \{n_k, \rho_k, z_k\}) = \sup_{\tilde{n},\tilde{v},\{v_k, v'_k, v'_{y',k}, w_k, s_k\}_{k\leq K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y} J(y', \{n'_k, v'_k, z'_k\}_{k\leq K+1}) + \sum_k \rho_k v_k$$
$$(\lambda_k)\ u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1}) = v_k]\ \forall k \leq K$$
$$(\omega_k)\ v'_{k+1} = E_{y'|y} v'_{k+1,y'}\ \forall k \leq K$$
$$n'_{k+1} = n_k(1-s_k)(1-p(v'_{k+1})) + \tilde{n}\ \forall k \leq K$$
$$z'_{k+1} = min(\frac{z_k}{1-s_k}, 1)\ \forall k \leq K$$
$$n'_0 = \tilde{n}, v'_0 = \tilde{v}, z'_0 = z_0$$

I now substitute in the promise-keeping constraint:

$$\mathcal{P}(y, \{n_k, \rho_k, z_k\}) = \sup_{\tilde{n},\tilde{v},\{v'_k, v'_{y',k}, w_k, s_k\}_{k\leq K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y} J(y', \{n'_k, v'_k, z'_k\}_{k\leq K+1}) + \sum_k \rho_k (u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1})])$$
$$(\omega_k)\ v'_{k+1} = E_{y'|y} v'_{k+1,y'}\ \forall k \leq K$$
$$n'_{k+1} = n_k(1-s_k)(1-p(v'_{k+1})) + \tilde{n}\ \forall k \leq K$$
$$z'_{k+1} = min(\frac{z_k}{1-s_k}, 1)\ \forall k \leq K$$
$$n'_0 = \tilde{n}, v'_0 = \tilde{v}, z'_0 = z_0$$

I introduce the ω_k-constraints with weights β into the problem:

$$\mathcal{P}(y,\{n_k,\rho_k,z_k\}) = \inf_{\{\omega_k\}} \sup_{\tilde{n},\tilde{v},\{v'_k,v'_{y',k},w_k,s_k\}_{k\le K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y} J(y',\{n'_k,v'_k,z'_k\}_{k\le K+1}) + \sum_k \rho_k(u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1})])$$
$$+ \sum_k \beta\omega_k(E_{y'|y}v'_{y',k+1} - v'_{k+1})$$
$$n'_{k+1} = n_k(1-s_k)(1-p(v'_{k+1})) + \tilde{n} \ \forall k \le K$$
$$z'_{k+1} = min(\frac{z_k}{1-s_k},1) \ \forall k \le K$$
$$n'_0 = \tilde{n}, v'_0 = \tilde{v}, z'_0 = z_0$$

I then rearrange the value function by moving $E_{y'|y}\sum_k \beta\omega_k n'_{k+1} v'_{y',k+1}$ (additional constraints are dropped to simplify notation):

$$\mathcal{P}(y,\{n_k,\rho_k,z_k\}) = \inf_{\{\omega_k\}} \sup_{\tilde{n},\tilde{v},\{v_k,v'_{y',k},w_k,s_k\}_{k\le K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y}[J(y',\{n'_k,v'_k,z'_k\}_{k\le K+1}) + \sum_k \omega_k v'_{y',k+1}]$$
$$\sum_k \rho_k(u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1})]) - \sum_k \beta\omega_k v'_{k+1}$$

Lastly, I split the sup:

$$\mathcal{P}(y,\{n_k,\rho_k,z_k\}) = \inf_{\{\omega_k\}} \sup_{\tilde{n},\tilde{v},\{v'_k,w_k,s_k\}_{k\le K}} yF(\sum_k n_k, \frac{\sum n_k z_k}{\sum n_k}) - \sum_k w_k n_k - \tilde{n}\frac{c}{q(\tilde{v})} - \kappa_f$$
$$+ \beta E_{y'|y}[\sup_{v'_{y',k+1}} J(y',\{n'_k,v'_k,z'_k\}_{k\le K+1}) + \sum_k \omega_k v'_{y',k+1}]$$
$$\sum_k \rho_k(u(w_k) + \beta[s_k U + (1-s_k)R(v'_{k+1})]) - \sum_k \beta\omega_k v'_{k+1}$$

From this, one can note that, by definition of $\mathcal{P}$

$$\sup_{v'_{y',k+1}} J(y',\{n'_k,v'_k,z'_k\}_{k\le K+1}) + \sum_k \omega_k v'_{y',k+1} = \mathcal{P}(y',\{n'_k,\omega_k,z'_k\})$$

We thus arrive to the formulationof the problem as described at the beginning, not involving finding future state-specific promised values $v'_{y',k}$. □

A.5 Block Recursivity

I introduce an assumption that would allow for a block recursive eqiulibrium under the same conditions as in Schaal (2017). Block recursivity requires an indifference condition, either on the side of the firms or on the side of the workers. Under two-sided ex-post heterogeneity, that is not immediately achievable.

Schaal (2017) shows that, in a setting similar to mine, but with transferable utility between workers and firms, which he achieves due to the risk-neutral worker utility function, firms all have the same preferences across all the submarkets that they may post vacancies in. Define the minimal hiring cost as

$$k = \min_v [v + \frac{c}{q_v}]$$

Due to transferable utility, the cost of employing the worker from submarket v becomes simply the value v. Thus, the optimal entry of vacancies in Schaal (2017) can be summarized by

$$\theta_v [v + \frac{c}{q_v} - k] = 0$$

Meaning that either a submarket v minimizes the hiring cost or it is closed. This condition is completely independent of the distribution of firms and workers, exactly because the one component where the firm type might come through, the cost of employing a worker from submarket v, is completely independent from the firm's state due to transferable utility.

Utility is not transferable in my model, and thus different firms may face different costs of employing a worker at some value v (for example, fixing y and z, small firms prefer high values v due to their intention to upsize). To get around that, I split the value v that the worker would get upon getting hired into two components, the sign-on wage w_v and the remaining value v_0 such that

$$u(w_v) + \beta v_0 = v$$

This additional wage payment is incurred immediately upon hiring, allowing the remaining value that the firm owes to its worker, v_0, to be completely independent of the submarket v. Essentially, from the firm's perspective, submarkets now differ not in the value that firms would owe to the workers, but in this sign-on wage. The cost minimization problem then becomes

$$k = \min_v [w_v + \frac{c}{q_v}]$$

This problem is now again completely independent of the firm's state, and thus the distribution of firms and workers no longer affects the tightness function q_v.Schaal (2017) shows that, in a setting similar to mine, but with transferable utility between workers and firms, which he achieves due to the risk-neutral worker utility function, firms all have the same preferences across all the submarkets that they may post vacancies in. Then setting θ_v such that

B Quantitative Appendix

B.1 Variables

Endogenous state variables

$$\{n_k\}_{k\leq K}, \{\rho_k, z_k\}_{1\leq k\leq K}$$

Code: `states: size, rho, q`

Exogenous state variables

$$y$$

Code: `z`

Control variables

$$\tilde{n}, \{\rho'_k\}_{1\leq k\leq K}, \{s_k\}_{k\leq K}$$

Code: `hiring, rho_star, sep_star`

Value function

$$\mathcal{P}(y, \{n_k, \rho_k, z_k\})$$

Code: `ERho_star, EJ_star`

B.2 Equations

Equations (1)–(21): Value function in olive (given by value and its gradient guesses from future states), states in green (given), controls in orange (given by policy guess from current states), next period exogenous states in magenta (to be summed over), next period states in blue, parameters in black.

$$0 = \rho'_{k+1} - \rho_k - \eta(E\frac{\partial P(y', \{n'_k, \rho'_k, z'_k\})}{\partial \rho'_{k+1}})E\frac{\partial \mathcal{P}(y', \{n'_k, \rho'_k, z'_k\})}{\partial n'_{k+1}} \tag{7}$$

$$\tag{8}$$

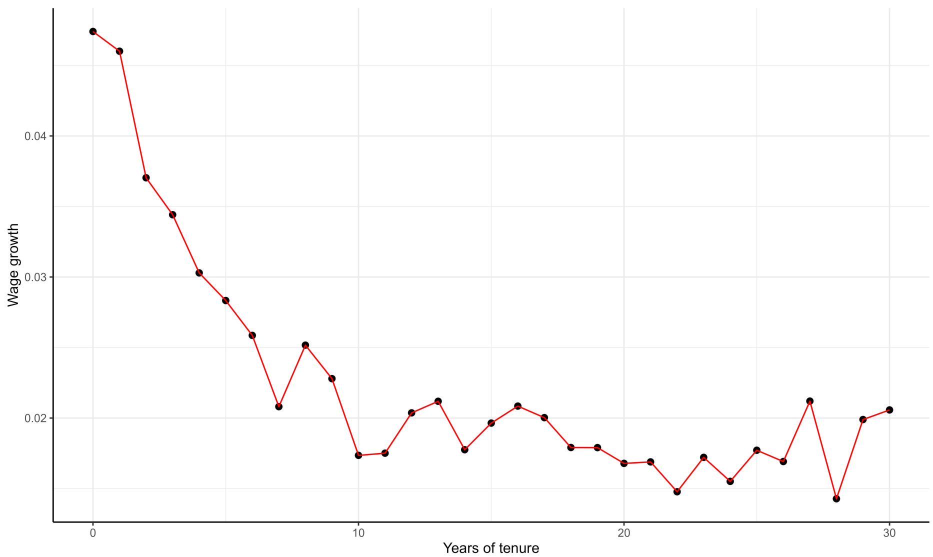
C Data Appendix

C.1 Sample Construction

C.2 Layoffs using Labor Force Survey

C.3 Wage Growth

I use the same sample to plot the log (real) wage growth across first 30 years of tenure.



The wage growth appears to flatten after about 10 years of tenure, suggesting that it is not quantitatively costly to use $K = 10$ as an approximation of the firm problem from Definition 1.