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Furloughs, Employment, and Worker Reallocation in Normal Times

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Abstract

Are furlough schemes useful under normal business cycle conditions? We address this question using administrative data from Finland, where such a scheme has long existed, and a model of firm dynamics with hiring and layoff costs, frictional unemployment, and firm-level wage rigidity. Furloughs provide firms with flexibility by allowing temporary workforce reductions at a lower cost than layoffs followed by rehiring. Yet in the model, it is optimal to eliminate the furlough option, as it does little to facilitate reallocation from low productivity to high productivity firms and does not reduce layoffs much. In contrast, a small layoff tax improves welfare by balancing employment gains against reduced productivity.

Keywords: furloughs, firm dynamics, layoffs, labor market

JEL Codes: E24, J63, J64, J65

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1 Introduction

European labor markets typically offer employers less flexibility for layoffs due to their more stringent employment protection legislation compared to the US. In environments where firms frequently need to adjust their scale due to idiosyncratic productivity shocks or changing market conditions, such labor market regulations may impose significant costs. On the other hand, some European countries have furlough or short time work (STW) schemes in place. These schemes are designed to help companies reduce labor costs during temporary challenges, while maintaining the employer-employee relationship and supporting workers' income.

During the COVID-19 crisis, several countries introduced or expanded furlough schemes. These policies were widely viewed as effective in preventing a wave of business failures and enabling firms to quickly resume operations without the need for costly recruitment and re-training.

However, while these schemes may help firms navigate temporary disruptions, they can also have negative consequences. Rather than preserving valuable employer-employee relationships, furloughs may hinder productivity-enhancing worker reallocation. They may also reduce employment or hours worked by incentivizing firms to furlough workers instead of keeping them employed. These adverse effects may dominate in normal times, when aggregate employment is not limited by weak labor demand and relatively few firms face binding liquidity constraints.

In this paper, we examine how a furlough scheme affects labor productivity and employment under normal business cycle conditions. We focus on the Finnish furlough scheme, which has been in place since well before the COVID-19 pandemic and for which we have rich data on how firms make use of it.

In Finland, both layoffs and furloughs are regulated by labor market legislation and involve various administrative tasks such as communication and negotiations with all the firm's workers. However, the criteria for furloughs are less stringent. A temporary reduction in the employer's ability to provide work, defined as a period of up to 90 days, is sufficient to justify a furlough. By contrast, layoffs require a more permanent reduction in the employers ability to provide work. Furthermore, the administrative process for furloughs is often shorter than that for layoffs.

At the same time, Finnish unemployment insurance system treats furloughed workers differently from other unemployed workers. While unemployed and furloughed workers receive the same unemployment benefit, furloughed workers are not required to seek new employment during the first three months of their furlough spell. In practice, the monitoring of job searching is also likely to be less strict for other furloughed workers. Over 90 percent of furlough spells end with the furloughed worker returning to the company that furloughed them.

The furlough scheme used in Finland is closely related to various short time work arrangements applied in many European countries. The key difference between furloughs and STW schemes is that, while the furloughs typically reduce workers' hours to zero, STW schemes aim for more moderate work time reductions though in many countries zero hours are also allowed (see Cahuc (2024) for discussion on STW schemes).

We first document key patterns in furlough use and its relationship to job creation and destruction using administrative data from 2013 to 2019–a period of relative stability in the Finnish economy. During this time, the share of furloughed workers consistently hovered around

1% of employment, while annual job destruction and job creation rates ranged from 5% to 8%. Furloughs are typically used for relatively small workforce adjustments compared to job destruction and correlate positively with firm size. Furloughing is fairly common: about 11% of all firms furlough at least one worker in a given year, with the share rising to 30% among firms with more than 500 employees. In these larger firms, on the other hand, furloughed workers typically make up an even smaller share of the workforce than in smaller firms.

We then incorporate a furlough option into a model of firm dynamics with workforce adjustment costs and frictional unemployment. Frictional unemployment is modeled following Alvarez and Veracierto (2001), where laid-off workers must search to enter a competitive hiring market.[1] Wages are rigid at the firm level, so when a firm experiences a negative productivity shock, it cannot reduce wages to preserve valuable employer-employee relationships. The model features a fairly flexible adjustment cost function that allows us to capture key asymmetries in hiring, firing, and furloughing behavior. This flexibility is important for replicating the empirical patterns in job destruction, job creation, and the use of furloughs. We calibrate the model to match these patterns along with broader labor market reallocation dynamics observed in the data.

In the model, firms can reduce their workforce through layoffs or furloughs, both of which involve costs. Furloughing allows firms to temporarily reduce their workforce without incurring hiring and training costs in the next period. However, if a firm does not recall furloughed workers in the next period, it must either lay them off or furlough them again, both of which generate additional costs. In the baseline model, these costs take the form of resource costs. Additionally, we introduce furlough and layoff taxes, which allow us to regulate the use of these workforce adjustment margins. The revenues from these taxes are redistributed to workers in a lump-sum fashion.

We first show that in the model economy, it is optimal to limit layoffs moderately through a layoff tax. This reflects a trade-off between aggregate employment and productivity similar to that identified in Alvarez and Veracierto (2001). On the one hand, layoffs reduce employment because it takes time for laid-off workers to find new jobs, a factor that firms do not internalize. On the other hand, limiting layoffs restricts the productivity-enhancing reallocation of workers across firms. Starting from a zero layoff tax, the employment effect dominates, so that imposing a small tax on layoffs increases both aggregate consumption and welfare, the latter also accounting for the search effort exerted by unemployed workers. As the tax rate increases, the productivity effect eventually becomes dominant.

In the case of furloughs, the trade-off disappears in the sense that it is optimal to tax furloughs at a rate that eliminates their use entirely. This reflects two key mechanisms. First, furloughed workers typically return to the same firms that furloughed them, so furloughs do little to facilitate the reallocation of labor from low- to high-productivity firms.

Second, furloughs do not significantly reduce unemployment (measured excluding furlough

[1] In Buera et al. (2015) and Buera et al. (2021), a similar friction limits the number of unemployed workers who can access the hiring market in each period, but those models do not include endogenous search effort. We allow unemployed workers to choose their search intensity because this margin is potentially important for our welfare analysis of the furlough system. Furloughed workers are re-employed without having to search, while unemployed workers must exert costly search effort.

spells), implying that they lower employment or hours worked almost one-for-one. This mainly reflects the fact that the option to furlough does not reduce layoffs much. Intuitively, due to the structure of labor adjustment costs, firms use furloughs primarily to manage temporary reductions in workforce, while layoffs are reserved for more permanent downsizing. In other words, furloughs are not a valuable substitute in the situations where firms would otherwise lay off workers. Moreover, even when furloughs do replace layoffs, the resulting gains in employment or hours worked remain modest unless the labor market friction is very significant.

To assess the robustness of our main results, we first consider whether a layoff tax higher than the welfare-maximizing level might create a role for the furlough option. However, even when layoffs are made excessively costly, we find that the furlough option does not generate a welfare gain. We also explore parameterizations that could make furloughs socially beneficial. We find that the furlough option may slightly increase welfare when two conditions are met: (i) productivity shocks are not very persistent and (ii) the labor market friction is very severe, resulting in long unemployment spells following layoffs. However, in the light of our model, such parameterizations appear highly unrealistic, as they imply clearly counterfactual labor market and firm dynamics.

That said, we also show that firms experiencing large but temporary (one-period) negative productivity shocks do, to a significant extent, use furloughs instead of layoffs when the option is available. This suggests that while furloughs have little impact on layoffs under normal conditions, they can substantially reduce layoffs–and thereby frictional unemployment–when a large share of firms faces temporary disruptions, such as during a lockdown or other widespread but short-lived shocks. In such situations, the furlough option is likely to improve employment outcomes, especially if alternative job opportunities for laid-off workers are scarce, as is typically the case during lockdowns or in deep recessions when labor demand is weak. Buera et al. (2021) (discussed below) provide a comprehensive analysis of such a situation and reach a similar conclusion.

Literature. We build on a body of firm dynamics research that has explored the consequences of high layoff costs when firms face idiosyncratic productivity (or demand) shocks, and thus have the need to adjust their size. A partial equilibrium analysis by Bentolila and Bertola (1990) concludes that severance payments can increase employment. The seminal paper of Hopenhayn and Rogerson (1993) finds that layoff taxes could have severe consequences on total factor productivity. In their framework, this also leads to a reduction in employment as households decrease their labor supply in response to declining productivity. Alvarez and Veracierto (2001) extend the Hopenhayn-Rogerson framework to include frictional labor markets. In line with Hopenhayn and Rogerson (1993), they conclude that severance payments increase misallocation and thus decrease aggregate productivity. Employment, however, increases with the tax and a moderate layoff tax increases welfare compared to no tax. Our contribution to this literature is to examine whether, in the presence of high employment adjustment costs and frictional unemployment, the additional flexibility offered by a furlough scheme can increase welfare.

Other papers have explored the effects of adjustment costs in the search and matching framework: in Saint-Paul (1995), firing costs increase unemployment, while in Mortensen and

Pissarides (1999), firing costs have the opposite effect. As highlighted by Ljungqvist (2002), specific assumptions about the bargaining process are the key to these varying results.

In contrast to these models, we assume that firms take wages as given, meaning they cannot lower wages in response to firm-level shocks. This reflects institutional wage-setting constraints in the Finnish labor market and implies that furloughs may help preserve valuable firm-worker relationships that might otherwise be lost due to wage rigidity. Our model also features richer firm dynamics, including endogenous entry and exit. These elements make our framework well-suited for analyzing how the furlough option affects aggregate productivity through worker reallocation across firms.

Other papers that analyze the effects of STW during downturns using quantitative search models with single-worker firms include Tilly and Niedermayer (2017) and Albertini et al. (2022), both of whom develop models with rich worker-level heterogeneity, as well as Balleer et al. (2016), who differentiate between rule-based and discretionary STW policies. Cahuc et al. (2021) illustrate the heterogeneous effects of STW policies using a theoretical partial equilibrium model that incorporates both within-firm and between-firm heterogeneity. Generally, these papers find that STW policies help stabilize employment over the business cycle. However, this often comes at a cost: hours worked are reduced for some workers who would not have been laid off in the absence of the STW policy.

There is also a small but growing body of empirical research analyzing the effects of STW schemes during recessions using firm-level data and quasi-experimental variation in STW rules (see Giupponi and Landais (2022), Cahuc et al. (2021) and Kopp and Siegenthaler (2021)). Typically, this literature finds that, at least in the short term, these job retention programs are effective in preserving jobs. A notable exception is Brinkmann et al. (2024), who study the effects of STW in Germany. They compare the employment outcomes of cohorts above retirement age, who are ineligible for STW, to slightly younger cohorts who are still eligible, and find no difference in job retention between the two groups during the COVID period.

In Finland, furloughed workers are eligible for unemployment benefits but are not required to actively search for new work. As a result, the concept of 'furlough unemployment' resembles the mismatch unemployment described in Shimer (2007) or the rest unemployment in Alvarez and Shimer (2011).

A related framework that incorporates this type of unemployment while also modeling heterogeneous firms is Buera et al. (2021), which examines the ripple effects of temporary lockdowns induced by the COVID-19 shock on the aggregate economy. Their model features both financial and labor market frictions and predicts that the effects of lockdowns on output, employment, and firm dynamics are not persistent, provided that workers on temporary layoff can be recalled by their previous employers, and the government provides employment subsidies to support firms during the lockdown. This result highlights the potential role of furlough schemes, or similar arrangements, in ensuring that temporary reductions in labor demand during crises do not lead to prolonged job losses afterwards. However, unlike their study, we examine furloughs under relatively normal economic conditions, where employment is not constrained by insufficient labor demand and laid-off workers are much more likely to find new employment than during deep recessions or lockdowns. In this environment, the potential benefit of furloughs in preserving employer–employee matches is naturally smaller. In addition, we map our model to detailed Finnish data on furlough use in normal times, whereas Buera et al. (2021) do not conduct a comparable exercise outside of lockdown scenarios. In the concluding section, we discuss how the Finnish furlough system might be reformed to retain its crisis-mitigation role without imposing welfare costs in normal times.

Another type of unemployment, common in the US and similar to furlough unemployment, is recall unemployment, which arises from temporary layoffs. This type of unemployment has been recently analyzed by Fujita and Moscarini (2017), Gertler et al. (2022) and Albertini et al. (2023). The main difference between furloughs and recall unemployment is that in the case of furloughs the recalls are much more likely as the employment contract has not been terminated.

2 Furloughs and job reallocation in Finland

In this section, we report some key empirical regularities regarding the firms' use of furloughs, as well as the labor reallocation patterns in Finland. Following Davis et al. (1998), we measure reallocation by gross job destruction (JD) and gross job creation (JC).

2.1 Data

We use register data provided by Statistics Finland (FOLK data and Financial Statement Statistics) and the Ministry of Economic Affairs and Employment (URA database). We identify the furlough periods from URA data, which contains all furlough spells for which the worker was receiving unemployment compensation payments. In order to link these workers to firms, we utilize FOLK period data on employment relationships. This gives us access to employment periods for the whole population. From this data, we take the employment period that is still ongoing at the end of a year and the three longest employment periods for all worker-year pairs. A furlough is linked to an employment spell when the starting day of the furlough coincides with the employment period. In the case of overlapping employment periods, we attach the furlough to the employment period that is ongoing at the end of the year if possible. For other overlapping employment spells, we assign the furlough to the employment period with the longest duration. This process enables us to associate firms for nearly all furloughs spells. Finally, we match the firm IDs to Financial Statement Statistics, which gives us annual balance sheet information, including employment, for nearly all Finnish firms.

We focus on the period 2013-2019 and restrict our attention to industries 10-63, 68-82 and 85-93 with NACE rev 2 codes.[2] That is, we do not consider the agricultural and mining sectors (0-9) nor industries that are mainly dominated by the public sector, such as education and public administration (84-85). We also omit finance and insurance activities (64-67), for which the data coverage on the Financial Statement Panel is somewhat weaker than for other industries. We restrict our sample to limited liability companies with more than one worker and a value added of over 10 000 in euros in 2014 currency.

[2]For a descriptive analysis of Finnish firms' furlough use over a longer timespan, see Korpela (2024). Korpela documents, among other things, a very large increase in the use of furloughs during both the deep recession of 2009 and the recent Covid-19 crisis.

We use full-time equivalent (FTE) employees to measure annual employment, job creation, job destruction and furloughs in firms. We only report JC, JD and furlough events that amount to at least 0.1% of the firm's labor force. For reallocation measures, we consider relative changes in potential employment available to firms including furloughed workers. In practice, we calculate the change in (potential) employment between years t and t-1 (or the absolute value of employment change in the case of destruction) and divide it by the average (potential) employment in these years. To keep our furlough measure comparable with these job reallocation measures, we also divide the FTE measure of furloughed employees in year t by the average employment in years t and t-1. Thus, the values of our job creation/destruction and furlough measures vary between 0 and 2 for all firms. For the economy-wide aggregate measures,we use current average total employment between years t and t-1 as a scaling variable.

2.2 Descriptive patterns

Figure 1 depicts the aggregate annual job creation, job destruction and furlough rates measured for 2014-2019. There is a substantial difference in the level of furloughs compared to job creation and destruction: the fraction of furloughed workers hovers around 1% of employment, while job creation and destruction rates are always over 5%. The business cycle conditions are visible for all time series. GDP growth was slightly negative up to the first quarter of 2015 and positive thereafter. In 2016 and 2017, when GDP growth reached around 3%, job creation began to exceed destruction more markedly, and furlough use declined visibly.

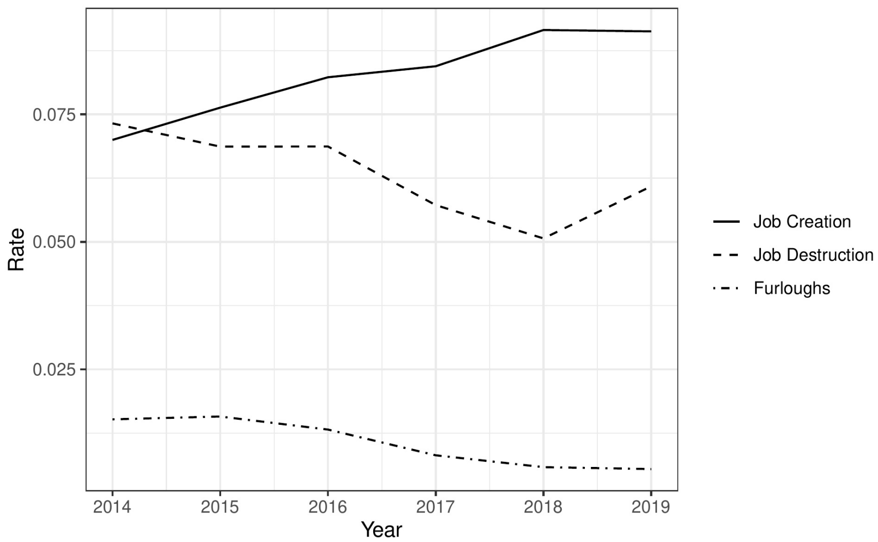

Figure 1: Aggregate reallocation and furloughs

Notes: job creation (destruction) is the total potential employment increase (decrease) in firms that increased (decreased) their employment, divided by the total average potential employment between years t and t-1. Furlough rate is the amount of furloughed workers in a year scaled with total average potential employment.

Table 1 presents the basic descriptive statistics for firms' use of furloughs, job creation, and job destruction for the pooled data. An entry in the first row shows the probability of a random firm in a given year using one of the margins of adjustment. We use linear probability models when controlling for year and industry effects. From the first line, we see that about 11% of the firms are using furloughs to adjust their employment. This is substantially less than the fraction of firms adjusting their size downwards, which is around 46%. In our dataset, job creation is slightly more common than job destruction.

	Furlough		Job destruction		Job creation	
Industry & Year controls	No	Yes	No	Yes	No	Yes
Pr. to Use	0.106	0.114	0.452	0.465	0.473	0.469
Mean adj. (rel. to workforce)	0.078	0.068	0.207	0.193	0.212	0.190
Variance adj.	0.009	0.008	0.050	0.049	0.054	0.051

Table 1: Descriptive statistics on furloughs and job destruction

The second row in Table 1 reports the mean relative size of an adjustment when the corresponding margin of adjustment is used. Again, the size adjustments using furloughs are substantially smaller than with the other margins: the mean size of furloughs is 7-8% of FTE (potential) employment, while job destruction is, on average, around 20% of FTE employment. The average size of job creation is similar to that of job destruction. The variances of adjustment sizes are given in the third row of the table. From this, we can see that the dispersion of furloughs is substantially smaller than the dispersion of the other two margins. Another observation is that the variances of job creation and job destruction are quite close to each other. Figure 2 shows the histograms of relative adjustments. It further corroborates the conclusion that furloughs are typically used for relatively small adjustments compared to job destruction. Note also that the histograms of job creation and job destruction look quite similar.

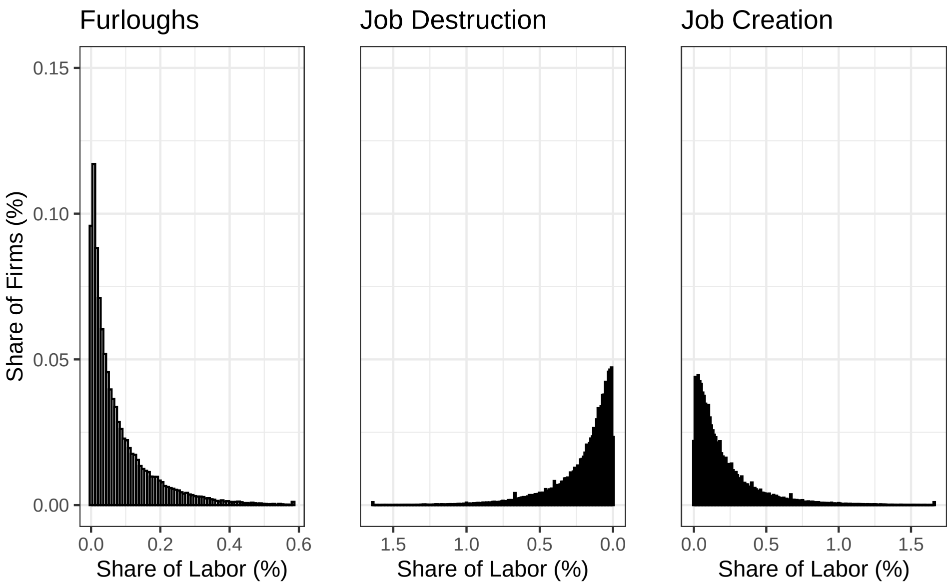

Figure 2: Histograms of reallocation and furloughs

Figures 3 and 4 extend the exercise of Table 1, focusing on how firm size affects the use of furloughs, job creation, and job destruction. In all cases, we control for industry and year fixed effects. Figure 3 shows that small firms are much less likely to use furloughs than larger firms; for example, less than 10% of firms with fewer than 5 workers use furloughs, while over

30% of firms with more than 500 workers do. Additionally, job creation is more likely in larger firms. Interestingly, the probability of job destruction does not appear to depend on firm size. Figure 4 illustrates the opposing pattern for the relative size of adjustments, with all margins decreasing as firm size increases.

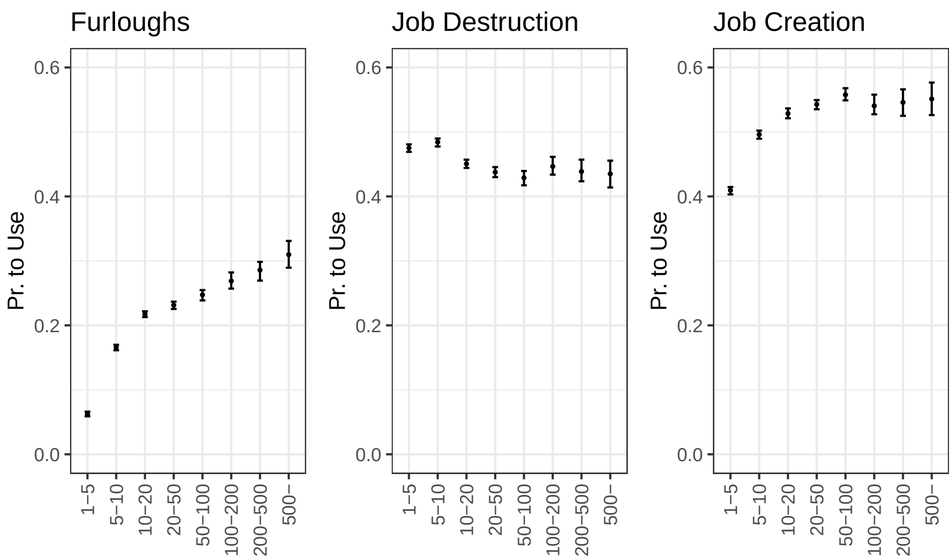

Figure 3: Fraction of firms using furloughs or adjusting their labor conditional on the firm size

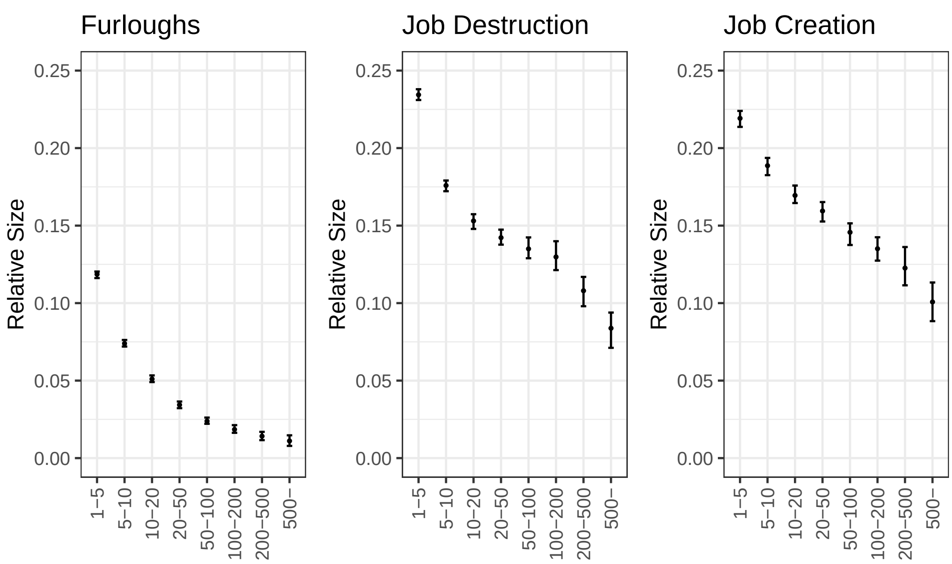

Figure 4: Relative size of adjustment for firms using furloughs, job destruction or job creation conditional on firm size

3 Model

We explore the aggregate effects of furloughs with the help of a firm dynamic model in the spirit of Hopenhayn and Rogerson (1993), augmented with a labor market friction.

3.1 Environment

We consider a stationary equilibrium with heterogeneous firms and workers with varying labor market statuses.

Firms. There is an endogenous measure of heterogeneous firms, each producing a homogeneous good using a decreasing returns to scale production function in labor. Firm productivity is stochastic, which creates a need for labor reallocation between firms. However, firms face adjustment costs if they want to change their employment levels. We allow these costs to be asymmetric, depending on whether a firm wants to increase or reduce its size. A firm seeking to reduce its workforce in the current period can either layoff or furlough some of its workers, both of which involve costs. The key difference is that furloughing allows firms to temporarily reduce labor input without incurring rehiring costs later. However, furloughed workers must be reinstated at the end of the period or laid off, in which case layoff costs apply.

Workers. There is a unit mass of infinitely lived, risk-neutral workers who differ in their labor market status. At any point in time, each worker is either attached to a firm–meaning they have an ongoing job contract with it–or unemployed. For brevity, we refer to workers attached to a firm as *attached workers*. These workers may either be working in production or furloughed. The probabilities that an attached worker becomes unemployed, is furloughed, or works in production depend on the state of the firm they are attached to. In contrast, the probability that an unemployed worker finds a job and becomes attached to a firm depends only on their search effort.

Workers collectively own the firms and receive profit income Π. In addition to profits, workers in production earn the equilibrium wage w, while furloughed and unemployed workers receive unemployment benefits b, which are financed through a lump-sum tax, T, paid by all individuals. The flow utility is linear in consumption and disutility from search effort. Specifically, the flow utilities are $w + \Pi - T$ for workers in production, $b + \Pi - T$ for furloughed workers (who do not search), and $b + \Pi - T - \gamma s$ for unemployed workers who choose search intensity s, where $\gamma > 0$ governs the disutility from search.

Labor markets. In modelling labor markets and unemployment, we follow Alvarez and Veracierto (2001) and Buera et al. (2015). There is a centralized labor market from which firms can hire new workers with identical wage contracts. However, the entry of unemployed workers into this market is frictional. In line with Alvarez and Veracierto (2001), workers can affect their job finding probability by choosing their search intensity. This probability is s^η, where $\eta > 0$.

Timing. At the beginning of a period, firms have a given number of attached workers, determined by their decisions in the previous period, and they observe their new productivity shock. Workers, in turn, are either attached to a firm or unemployed. The period begins with the separation stage, where firms that want to reduce their number of attached workers lay off some of them. This is followed by the search stage, during which unemployed workers–both those unemployed at the beginning of the period and those just laid off–choose their search intensity. Search effort determines the probability of entering the competitive labor market.

In the hiring stage, unemployed workers who enter the labor market are randomly matched with firms that are hiring, i.e., firms that want to increase their number of attached workers. Unemployed workers who do not enter the labor market remain unemployed and start the next period in that state. In the production stage, firms decide whether to furlough some of their attached workers (if the option is available); the remaining attached workers participate in production. Wages and profits are then paid. Finally, in the exit stage, firms decide whether to continue operating in the next period. Workers who were either working for or furloughed by firms that remain in the market are attached to the same firm at the beginning of the next period. In contrast, workers attached to firms that exit are unemployed at the beginning of the next period.

3.2 Incumbent firm's problem

There is an endogenous mass of incumbent firms, denoted by Ω. Each firm produces a homogeneous good using the following production technology:

$$y = e^z l^\alpha, \tag{1}$$

where $0 < \alpha < 1$, l is the amount of employed workers in a firm, and e^z is the firm-specific productivity. We assume that z follows an AR(1) process:

$$z' = \rho z + \varepsilon, \tag{2}$$

where $0 < \rho < 1$ and the innovation term ε is distributed according to $\varepsilon \sim N(0, \sigma_\varepsilon^2)$.

As described in the timing section, each firm begins the period by observing its current productivity z and taking as given the number (more precisely, the mass) of workers attached to it based on past decisions. We denote this number by n_-. If the firm wants to change the number of attached workers, it must pay both a fixed cost and a convex adjustment cost modeled with a quadratic function. These costs differ depending on the direction of adjustment: when increasing workforce size, the fixed and convex cost parameters are c_{ph} and c_{qh}, respectively; when decreasing workforce size, the corresponding parameters are c_{ps} and c_{qs}. This flexible formulation allows us to parsimoniously capture asymmetries between hiring and firing costs. We assume convex costs to reflect the notion that major expansions or reductions are likely to require costly reorganizations. Mass layoffs may also involve increased legal risks compared to smaller adjustments.

Firms may also furlough part of their attached workers. Furloughed workers do not participate in production and are not paid wages, but must be reinstated at the end of the period or incur layoff (or furlough) costs. The furlough cost structure mirrors that of layoffs: a fixed cost c_{pf} and a convex component governed by parameter c_{qf}. Firms also pay fixed operating costs c_o and decide at the end of the period whether to exit or continue.

All these adjustment costs, as well as the fixed operating cost, are resource costs: they do not generate revenue that could be redistributed or used to finance consumption. Denoting the decision variables, namely the number of current period attached workers and furloughed workers by n and f, respectively, the firm's problem can be summarized by the following Bellman equation:

$$
\begin{aligned}
V(z,n_-) = \max_{n\in[0,\infty),f\in[0,n_-]} \; & e^z \underbrace{(n-f)}_{\equiv l}{}^{\alpha} - w(n-f) - c_o \\
& - \mathbb{I}(f>0)\left[c_{pf} + c_{qf}\left(\frac{f}{\bar{n}}\right)^2 \bar{n}\right] \\
& - \mathbb{I}(n>n_-)\left[c_{ph} + c_{qh}\left(\frac{n-n_-}{\bar{n}}\right)^2 \bar{n}\right] \\
& - \mathbb{I}(n<n_-)\left[c_{ps} + c_{qs}\left(\frac{n-n_-}{\bar{n}}\right)^2 \bar{n}\right] \\
& + \frac{1}{1+r}\max\{EV(z',n), -c_{ps} + c_{qs}2n_-\},
\end{aligned}
\tag{3}
$$

where $\bar{n} = \frac{n+n_-}{2}$. The last max-operator refers to the exit decision. Exiting implies adjustment related to setting $n = 0$. The solution gives the optimal decision rules for attached workers $n(z,n_-)$, furloughs $f(z,n_-)$, and exit $x(z,n_-)$, equal to 1 if the firm exits and 0 otherwise.

3.3 Entrants

There is a continuum of ex ante identical potential entrants. If they want to start producing in the next period, they have to pay an entry cost, c_e. They start the next period as an incumbent firm with one attached worker $n_- = 1$ and productivity z that is drawn from the stationary distribution associated with the AR(1) process. We focus on a stationary equilibrium with positive entry, in which the expected value of entry equals the entry cost:

$$
\int V(z,1)G(dz) = c_e. \tag{4}
$$

3.4 Worker's problem

At the beginning of each period, workers are either attached to a firm with state (z,n_-) or unemployed. For attached workers, both the risk of unemployment and the risk of being furloughed depend on the firms state. We assume that if a firm reduces its workforce, workers furloughed in the previous period are laid off first. This assumption gives the model a chance to replicate the empirical observation that roughly 10% of furlough spells end in separation. As a result, a worker's beginning-of-period value depends on whether they were furloughed in the previous period, as well as on the previous-period number of workers furloughed by the firm, f_-, even though f_- is not a relevant state variable for the firm's own problem. We denote the value for a worker who was not furloughed in the previous period by $W_E(z,n_-,f_-)$, and for one who was furloughed by $W_F(z,n_-,f_-)$. These value functions are defined formally below.

However, we do not need to keep track of the distribution of firms with respect to their previous-period furlough decisions. Attached workers–whether employed or furloughed–make no active choices, so the only decision problem lies with the unemployed, who choose search effort. While the separation probability for attached workers depends on the firm's previous-period furloughs f_-, this history is irrelevant for unemployed workers: firms that hire do not immediately lay off, so past furlough decisions of hiring firms have no bearing on their prospects. This allows us to formulate the unemployed worker's problem using value functions defined after the separation stage, conditional on whether the worker is employed or furloughed in the current period, together with furlough probabilities.

We denote these conditional value functions by $\tilde{W}_E(z, n_-)$ for a worker who remains employed and $\tilde{W}_F(z, n_-)$ for a worker who is furloughed. They represent the value of an attached worker once the current separation outcome has been resolved. $\tilde{W}_E$ and $\tilde{W}_F$ reflect firms' furlough decisions only through the next-period W_E and W_F, which depend on the number of furloughed workers in the current period. That number, in turn, is determined by the firms current-period state.

Formally, the conditional value functions $\tilde{W}_E$ and $\tilde{W}_F$, defined in the production stage after furlough decisions, are given by:

$$\begin{aligned}\tilde{W}_E(z, n_-) =& w + \Pi - T + \beta\Big[x(z, n_-)W_U \\ &+ (1 - x(z, n_-))EW_E(z', n(z, n_-), f(z, n_-))\Big], \end{aligned} \tag{5}$$

$$\begin{aligned}\tilde{W}_F(z, n_-) =& b + \Pi - T + \beta\Big[x(z, n_-)W_U \\ &+ (1 - x(z, n_-))EW_F(z', n(z, n_-), f(z, n_-))\Big]. \end{aligned} \tag{6}$$

where W_U denotes the value of being unemployed in the search stage. The first terms on the right-hand sides give the flow utility from wage or unemployment benefit and profit income, net of tax. The continuation value depends on the firm's decisions today, including whether it exits or not, and on its future productivity.

The beginning-of-period value for an attached worker who was not furloughed in the previous period is then:

$$\begin{aligned}W_E(z, n_-, f_-) = & (1 - p_{EU}(z, n_-, f_-))(1 - p_F(z, n_-))\tilde{W}_E(z, n_-) \\ &+ (1 - p_{EU}(z, n_-, f_-))p_F(z, n_-)\tilde{W}_F(z, n_-) \\ &+ p_{EU}(z, n_-, f_-)W_U. \end{aligned} \tag{7}$$

The probability of a layoff at the beginning of the period for a worker without a furlough spell in the previous period, $p_{EU}(\cdot)$, is given by

$$p_{EU}(z, n_-, f_-) = \mathbb{I}(n(z, n_-) - n_- < 0)\mathbb{I}(|n(z, n_-) - n_-| - f_- > 0)\frac{|n(z, n_-) - n_-| - f_-}{n_- - f_-}.$$

The probability of a furlough spell is

$$p_F(z, n_-) = \frac{f(z, n_-)}{n(z, n_-)}.$$

Similarly, the value at the beginning of a period for an attached worker who was furloughed in the previous period is:

$$
\begin{aligned}
W_F(z, n_-, f_-) = &(1 - p_{FU}(z, n_-, f_-))(1 - p_F(z, n_-))\tilde{W}_E(z, n_-) \\
&+ (1 - p_{FU}(z, n_-, f_-))p_F(z, n_-)\tilde{W}_F(z, n_-) \\
&+ p_{FU}(z, n_-, f_-)W_U.
\end{aligned}
\tag{8}
$$

The only difference between W_E and W_F lies in the separation probability, which depends on whether the worker was furloughed in the previous period. The layoff probability is now given by

$$
\begin{aligned}
p_{FU}(z, n_-, f_-) = \mathbb{I}(n(z, n_-) - n_- < 0)\Bigg[&\mathbb{I}(|n(z, n_-) - n_-| - f_- > 0) \\
&+ (1 - \mathbb{I}(|n(z, n_-) - n_-| - f_- > 0))\frac{|n(z, n_-) - n_-|}{f_-}\Bigg].
\end{aligned}
$$

Notice that we could define $\tilde{W}_E$ and $\tilde{W}_F$ without referring to W_E and W_F by replacing the latter in (5) and (6) by the right-hand side of (7) and (8). We introduce W_E and W_F only to keep the Bellman equations more compact and transparent.

Unemployed workers choose their search effort s to maximize expected utility. Upon finding a job, they are matched with a hiring firm (z, n_-) according to the distribution of job creation across firms. The expected value of entering a job is given by:

$$
\begin{aligned}
EW_E^{\text{entry}} = \int &\left[(1 - p_F(z, n_-))\tilde{W}_E(z, n_-) + p_F(z, n_-)\tilde{W}_F(z, n_-)\right] \\
&\times \frac{1}{JC}\,\mathbb{I}(n(z, n_-) > n_-)\,(n(z, n_-) - n_-)\,\Psi(dz, dn_-).
\end{aligned}
$$

Finally, we can write the Bellman equation for an unemployed worker, which characterizes the only optimization problem on the worker side:

$$
W_U = \max_s \left\{-\gamma s + s^\eta EW_E^{\text{entry}} + (1 - s^\eta)(b + \Pi - T + \beta W_U)\right\}. \tag{9}
$$

The first term on the right-hand side is the flow utility cost of search. With probability s^η the unemployed worker enters the competitive market. If the worker does not enter, their flow utility is determined by the unemployment benefit and profits, net of tax.

3.5 Labor markets

Firms and workers meet in a centralized labor market where all workers are paid the same equilibrium wage. However, as stated earlier, not all unemployed workers can access this market. Given search effort s, only a fraction s^η of those who were unemployed at the beginning of the period or became unemployed during the separation stage access the labor market in the current period.

Taken together, the amount of workers entering the labor market, M, is given by

$$M = s^{\eta}(U_{-} + JD^{s} + JD^{e}_{-}),$$

where U_{-} is the amount of unemployment workers in the previous period production stage, JD^{s} is job destruction in the current separation stage and JD^{e}_{-} is job destruction through firms' exits at the end of the previous period. Since we focus on a stationary equilibrium, we can write the previous equation in a more compact form with the help of aggregate job destruction:

$$M = s^{\eta}(U + JD). \tag{10}$$

Aggregate job destruction is the sum of job destructions in the separation and exit stages:

$$\begin{aligned} JD = &\int \Big[\mathbb{I}(n(z,n_{-}) < n_{-})|n(z,n_{-}) - n_{-}| + \mathbb{I}(\text{exit}(z,n_{-}))n(z,n_{-})\Big]\Psi(dz,dn_{-}) \\ &- M_{e}\int \mathbb{I}(n(z,n_{-}) < 1)|n(z,n_{-}) - 1|G(dz) \end{aligned} \tag{11}$$

where the first indicator function takes the value of one if a firm does reduce its size in the separation stage and the second indicator function does the same if a firm decides to exit at the end of the period. $\Psi(dz, dn_{-})$ gives the measure of firms over different productivity and employment levels at the beginning of a period, while M_{e} gives the measure of new firms. New firms behave as if they had one worker in the previous period even though they did not produce anything. The last component makes sure that we don't count the actions of these firms as part of the job destruction.

Aggregate job creation was needed in defining the value of unemployment. It can be defined as:

$$\begin{aligned} JC = &\int \mathbb{I}(n_{-} < n(z,n_{-}))|n(z,n_{-}) - n_{-}|\Psi(dz,dn_{-}) \\ &+ M_{e}(1 - \mathbb{I}(n(z,n_{-}) < 1)|n(z,n_{-}) - 1|G(dz). \end{aligned} \tag{12}$$

The second line counts the job creation of new firms up to one worker (the rest of new firms' job creation is counted in the first term).

Finally, we can define the shares of furloughed and unemployed workers (recall that we have a unit mass of workers). The furlough rate in the economy is given by

$$F = \int f(z,n_{-})\Psi(dz,dn_{-}) \tag{13}$$

and the steady state unemployment rate is

$$U = \frac{1 - s^{\eta}}{s^{\eta}}JD. \tag{14}$$

These two equations also pin down the share of workers in production.

3.6 Equilibrium

A stationary equilibrium consists of employment, $n(z, n_-)$, furlough, $f(z, n_-)$, and exit, $x(z, n_-)$, policies; unemployed workers' search intensity s; a wage rate w; a mass of entrants M_e; unemployment, furlough, job creation, and destruction rates; a lump-sum tax T and a stationary distribution of firms, $\Psi(dz, dn_-)$, such that:

1. given the wage rate, the policy rules $n(z, n_-)$, $f(z, n_-)$ and $x(z, n_-)$ solve the firm problem

2. given the wage rate, firms behavior, job creation, the stationary distribution of firms, s solves the problem of the unemployed worker

3. the stationary distribution of firms is given by:

$$\begin{aligned}\Psi(Z', N) = \int_{(z,n)|n(z,n_-)\in N, z'\in Z'} & Q(z, Z')(1 - x(z, n_-))\Psi(dz, dn_-) \\ + M_e\mathbb{I}(n = 1) \int_{z'\in Z'} & G(dz'),\end{aligned} \tag{15}$$

   where $Q(z, Z')$ is the transition function giving the probability of moving from z to Z', each (z, n_-) is such that $n(z, n_-) \in N$ and the last term gives the measure of entrants with $z' \in Z'$ given that $1 \in N$

4. unemployment, U, is determined by (14), job destruction, JD, and creation, JC, are pinned down by (11) and (12), respectively, and the aggregate amount of the furloughed, F, is in line with (13)

5. the labor market clears:

$$1 = \int n(z, n_-)\Psi(dz, dn_-) + U \tag{16}$$

6. The government's spending on unemployment benefits is financed by its tax revenue

$$T = b(U + F). \tag{17}$$

4 Calibration

We set the model period to one year. We also set the real interest rate r to 5%, the returns to scale parameter α to 0.66 and the replacement rate, b, to 0.60.

The remaining parameters are calibrated internally to match several empirical targets in the model's stationary equilibrium. These targets are shown in Table 2. They include the size distribution of firms, the autocorrelation of employment at the firm level, firm entry rate, the probability and average size of hires, furloughs, and layoffs relative to firms' labor force, an empirical estimate of the search elasticity of unemployed workers, and the unemployment rate. By targeting these benchmarks, we seek to ensure that the model is quantitatively realistic with respect to firm dynamics, the role of furloughs in overall labor adjustments, and the extent of labor market frictions.

Target	Data	Model
Size Distribution: 1-5	0.57	0.55
Size Distribution: 5-10	0.19	0.21
Size Distribution: 10-20	0.12	0.14
Size Distribution: 20-50	0.08	0.08
Size Distribution: 50-	0.05	0.03
Entry/Exit Rate	0.10	0.06
Autocorrelation of Employment	0.98	0.98
Aggregate Unemployment	0.08	0.08
Response to 15% Increase in Replacement Rate in $1/s^{\eta}$	1.12	1.12
Average Size of Hire	0.19	0.18
Pr. to Use Hiring	0.47	0.45
Average Size of Layoff	0.19	0.24
Pr. to Use Layoff	0.47	0.50
Average Size of Furlough	0.07	0.07
Pr. to Use Furlough	0.11	0.11

Table 2: Model fit

All calibration targets, except for the search elasticity and the unemployment rate, are constructed from the same micro-data used in Section 2. The firm size distribution refers to the share of firms in different labor input bins, based on firms with at least one employee. In the model, we exclude entrants (i.e., firms in their first period) from this distribution. The targeted frequencies and average sizes of hires, furloughs, and layoffs are taken directly from Table 1.

The targeted search elasticity is based on Uusitalo and Verho (2010). Using a change in the Finnish unemployment benefit system, they estimate that a 15% increase in the replacement rate extended the average unemployment spell by about 12%. The targeted unemployment rate is the average unemployment rate for 2014–2019, as reported by Statistics Finland.

Table 3 lists the parameter values for our preferred calibration. The last column links each parameter value to an empirical target. For the internally calibrated parameters, a change in parameter value typically affects multiple target moments. The table highlights the target that is likely to be most sensitive to changes in that parameter.

The model is block recursive in the sense that workers' behavior does not affect the firms. This means that given the rest of the parametrization we can adjust the disutility of search, γ, and the elasticity of job finding probability, η, to match the observed unemployment rate and the estimated search elasticity exactly.

Fixed adjustment costs (i.e., fixed costs for layoffs, hiring, and furloughs) primarily affect the likelihood that firms will utilize the corresponding margin of adjustment. Similarly, convex adjustment costs have the greatest impact on the relative average size of the associated adjustment margin. For instance, increasing fixed layoff costs reduces the probability that firms resort to layoffs, while increasing convex layoff costs reduces the relative (average) size of layoffs. Both changes also increase firms' reliance on furloughs.

It may seem surprising that the calibrated fixed cost for layoffs is lower, and very close to zero, than the fixed cost for furloughs. However, this reflects the fact that in reality, firms

Parameter	Value	Explanation	Rationale
External:			
α	0.660	returns to scale	convention
r	0.050	interest rate	convention
b	0.600	replacement rate	replacement rate from OECD
Internal:			
σ_ε	0.156	std of productivity shock	size distribution
ρ	0.966	autocorrelation of productivity	autocorrelation of employment
c_o	1.280	fixed operating costs	exit/entry rate
c_e	8.930	entry costs	size distribution
c_{ph}	0.000	fixed hiring cost	pr. of hiring
c_{qh}	1.063	convex hiring cost	relative size of hiring
c_{ps}	0.000	fixed layoff cost	pr. of layoff
c_{qs}	0.674	convex layoff cost	relative size of layoff
c_{pf}	0.012	fixed furlough cost	pr. of furlough
c_{qf}	1.411	convex furlough cost	relative size of furlough
η	0.313	search elasticity	Uusitalo & Verho (2010)
γ	1.214	search disutility	aggregate unemployment

Table 3: Parameter values

can often slightly reduce their workforce at low cost by letting temporary contracts expire or by not replacing workers who leave voluntarily. In the model, we do not distinguish between separations due to formal layoffs and those resulting from such low-cost exits. The calibration therefore assigns a low fixed layoff cost to roughly match the observed frequency and size of workforce reductions. The higher fixed cost for furloughs in turn reflects the more deliberate and administratively burdensome nature of using the furlough option, even for very small-scale adjustments.

Higher fixed operating costs directly increase the exit rate of firms, which, in stationary equilibrium, also increases the entry rate and shifts the size distribution toward larger firms. Entry costs significantly affect the size distribution, as higher entry barriers reduce competition and increase prices, enabling firms to grow larger. While fixed and entry costs have qualitatively similar effects on the size distribution, they have opposing effects on the entry rate.

Increasing the variance of innovations in the productivity process shifts the firm size distribution toward the tails, creating a greater need for both furloughs and hires. Higher persistence in productivity influences the size distribution in a manner similar to an increase in fixed costs, while also altering all margins of adjustment. However, it is the only parameter that substantially affects the persistence of employment, making it the most critical parameter for this target.

Table 2 compares the targeted moments in the data and the model. The largest relative discrepancy between the model and the data is in the entry (or exit) rate, which is 10% in the data and 6% in the model. Matching this target more closely without sacrificing other targets may require a more detailed consideration of how the size and growth rate of very young firms are determined. We match all other targets fairly closely. In particular, the combination of fixed and quadratic costs for hiring, layoffs, and furloughs provides enough flexibility to closely match the frequency and average size of these adjustments.

Moment	Data	Model				
Leave After Furlough %	10	5.78				
Aggregate Furlough %	0.78	0.68				
Probability to Use:	Hiring		Layoffs		Furloughs	
Size	Data	Model	Data	Model	Data	Model
1-5	0.41	0.41	0.47	0.53	0.06	0.05
5-10	0.50	0.47	0.48	0.46	0.17	0.16
10-20	0.53	0.51	0.45	0.44	0.22	0.20
20-50	0.54	0.52	0.44	0.44	0.23	0.23
50-	0.55	0.59	0.43	0.37	0.26	0.16
Mean Size of:	Hires		Layoffs		Furloughs	
Size	Data	Model	Data	Model	Data	Model
1-5	0.22	0.19	0.23	0.31	0.12	0.11
5-10	0.19	0.18	0.18	0.15	0.07	0.06
10-20	0.17	0.16	0.15	0.15	0.05	0.05
20-50	0.16	0.16	0.14	0.14	0.03	0.04
50-	0.14	0.12	0.13	0.12	0.02	0.03

Table 4: External validity

Table 4 illustrates the models ability to match non-targeted moments, including the average (point in time) share of furloughed workers, the fraction of furloughed workers who eventually resume work with the same firm, and size-related patterns in the use of furloughs, layoffs, and hirings. The empirical figures for the share of furloughed workers and recall rates are from Alasalmi et al. (2024).

The model matches the overall furlough share fairly well (0.68% vs. 0.78% in the data) and produces a recall rate (94.2%) that is reasonably close to the observed rate (90%). The lower panel of Table 4 shows that the combination of fixed and convex adjustment costs with an AR(1) productivity process also roughly replicates the observed size-related adjustment patterns, even though these were not directly targeted.

5 Layoffs: employment vs. productivity

Before evaluating whether the furlough scheme is beneficial, it is useful to highlight the trade-off between productivity and employment that arises from layoffs in the model. To this end, we introduce a linear tax on layoffs, which firms pay in addition to the labor adjustment costs specified in the baseline calibration. The tax revenues are redistributed to all workers as lump-sum transfers. Our main welfare metric is aggregate consumption net of the search costs incurred by unemployed workers, consistent with the model's linear utility specification. Additionally, we report changes in consumption, corresponding to firms' output net of all adjustment costs that are resource costs, rather than taxes.

Table 5 illustrates how the stationary equilibrium changes as the layoff tax increases, with the tax expressed as a multiple of the monthly wage per laid-off worker. A higher layoff tax reduces firm profits and labor demand at a given wage, so the equilibrium wage must fall to balance labor demand and supply in general equilibrium via firm entry. With a layoff tax equivalent to six months wages, the wage rate declines by about 3.2%.[3]

More importantly, restricting layoffs also affects employment and productivity very differently. On the one hand, limiting layoffs hampers productivity-enhancing worker reallocation across firms. This is reflected in a decrease in aggregate labor productivity ('Output/Employed'), an increase in the variance of log marginal productivity, and a reduction in turnover, entry, and exit rates as the tax rate rises. On the other hand, it increases employment, since laid-off workers do not immediately find new jobs–a margin that firms do not internalize. With a layoff tax equal to six months wages, the employment rate is about 1.3 percentage points higher than in the baseline without a layoff tax. (In Table 5, and similar tables below, both the employment and unemployment rates are calculated excluding furloughed workers from the numerator.) The job-finding probability declines modestly due to reduced search effort among unemployed workers. This occurs because the value of the unemployment benefit (held fixed) increases relative to the wage, reducing the incentive to search.

Together, these two mechanisms create a non-monotonic relationship between the layoff tax and welfare. A tax rate equal to one month's salary boosts consumption through higher employment and the fact that firms incur less adjustment costs net of the layoff tax. Welfare ('Consumption net of disutility from search') increases even more because of decreased aggregate search effort by the unemployed. However, at higher tax rates, the misallocation effect dominates, leading to a decrease in both consumption and welfare through low average labor productivity. As a result, it is optimal to reduce layoffs somewhat by imposing a small layoff tax.[4] In this respect, our results are similar to those of Alvarez and Veracierto (2001), despite differences in model structure and calibration.

In contrast to consumption, output always decreases with the layoff tax. This is because output is measured gross of worker adjustment costs. The share of furloughed workers increases with the layoff tax. However, the effect is fairly small; the share of furloughed workers rises from 0.68% to just 0.87% with a layoff tax equivalent to 6 months' wages. This indicates that, within the model, furloughing is rarely a substitute for laying off workers.

[3]We define the layoff tax, and the furlough tax in the next section, relative to the wage rate in the baseline economy without either tax. Since the equilibrium wage varies across cases, the layoff tax in the last column of Table 5 is not exactly six months' wage in the new equilibrium.

[4]As discussed above, layoff and furlough costs in the model are treated as (unavoidable) resource costs, with taxes introduced on top of them. In reality, some of these resource costs–particularly administrative burdens–stem from labor market regulation. This matters for interpreting the result that a modest layoff tax improves welfare. It does not imply that layoffs should simply be made more costly for firms relative to the status quo; it may well be desirable to ease regulatory hurdles while using taxes to make firms internalize some of the broader costs of layoffs.

Variable	Unit	BM	1 months (w*1/12)	3 months (w*3/12)	6 months (w*6/12)
Wage	relative	100.00	99.41	98.31	96.81
Output	relative	100.00	99.94	99.67	99.01
Output/employed	relative	100.00	99.61	98.83	97.65
Consumption	relative	100.00	100.15	100.24	100.04
Variance of log(MPL)	relative	100.00	104.54	113.47	127.41
Employed	percent	91.02	91.32	91.79	92.29
Unemployed (excl. furloughed)	percent	8.30	7.97	7.44	6.84
Furloughed	percent	0.68	0.71	0.77	0.87
Turnover	percent	14.55	13.82	12.66	11.32
Entry and exit rate	percent	5.87	5.84	5.78	5.66
Job-finding prob	percent	45.40	45.27	44.99	44.55
Consumption net of disutility from search	relative	100.00	100.20	100.38	100.28

Table 5: Effects of imposing a layoff tax equal to 1, 3, or 6 months wage

6 Aggregate effects of furloughs

In this section, we present our main results. Our primary focus is on assessing whether the furlough scheme is beneficial in terms of welfare. We also aim to identify the factors and mechanisms that shape its impact. To this end, we introduce a linear furlough tax, similar to the layoff tax discussed in the previous section, and compare the equilibrium under different tax rates, including rates high enough to effectively eliminate the use of furloughs altogether.

We first analyze the effect of the furlough scheme in the baseline model. We show that while the furlough option decreases employment (or hours worked) and increases average labor productivity, the employment effect dominates in the sense that welfare is maximized when the furlough option is completely shut down. In other words, the trade-off between productivity and employment is very different in the case of furloughs than with layoffs. We also consider furlough and layoff taxes jointly to explore whether the furlough scheme might prove more beneficial in scenarios where layoffs are heavily taxed. In the remaining subsections, we explore model variations that could make the furlough scheme socially useful.

6.1 Baseline results

In this subsection, we consider the equilibrium effects of the furlough scheme by introducing a tax on furloughs to the baseline model. By varying the tax rate, we observe how changes in firms' incentives to use furloughs influence aggregate outcomes and compare these effects with those of a layoff tax. We consider tax rates high enough to effectively eliminate the use of the furlough option; the resulting equilibrium mirrors that of an economy without the option. Again, tax revenues are redistributed to workers in a lump-sum fashion. Apart from the tax, the model aligns with the baseline calibration described in Section 4. In particular, firms continue to incur the same resource costs associated with workforce adjustments.

Table 6 summarizes the results. The third column shows the equilibrium associated with the baseline calibration, with some of the measures normalized to 100, while the columns to the right of it provide results for different furlough tax levels, ranging from one months wage to 6 months wages per furloughed worker.

The option to furlough is, of course, beneficial from the perspective of an individual firm. This is reflected in the table by the evolution of the equilibrium wage rate as furloughing becomes more costly for firms: for a given wage level, taxing furloughs reduces firms' expected profits, which decreases the number (or mass) of firms in the market, thereby reducing labor demand. As a result, the equilibrium wage rate declines. However, these wage reductions are very small, suggesting that the furlough option is not particularly valuable to firms on average. This conclusion is also in line with the finding that a furlough tax equal to just one months wage reduces the use of furloughs by about two thirds.

Taxing furloughs decreases output per employed worker, increases the variance of the log marginal productivity of labor, and increases employment. In these respects, taxing furloughs has qualitatively similar effects to taxing layoffs. However, the trade-off between productivity-enhancing worker reallocation and employment differs significantly. With a layoff tax, consumption and welfare are maximized at a tax rate that reduces layoffs somewhat but does not come close to eliminating them. In contrast, with a furlough tax, consumption and welfare are maximized when the tax eliminates the use of furloughs altogether.

There are two main reasons why the optimal policies for layoffs and furloughs differ. First, when furloughs are restricted, most furloughs are converted into employment. As shown in the table, the increase in the employment rate, which in the table excludes furloughed workers and thus corresponds to the share of workers in production, closely matches the decline in the share of furloughed workers, indicating that furloughs are rarely used as a substitute for layoffs. Second, furloughs contribute little to productivity gains. Unlike layoffs, which facilitate the reallocation of workers across firms, furloughs typically involve workers returning to the same employer. Consequently, taxing furloughs has virtually no effect on worker turnover, firm entry and exit, or the job-finding rate. With the reallocation channel muted, the employment effect dominates, causing furloughs to lower aggregate output.

Limiting furloughs increases the job-finding probability by raising the search effort of unemployed workers. This occurs because the value of employment rises when the risk of being furloughed diminishes. However, the effect is very small. The very small increase in search effort, combined with the fact that restricting furloughs does little to reduce unemployment, also explains why limiting their use increases consumption and welfare almost one-to-one.

Variable	Unit	BM	1 month (w*1/12)	3 months (w*3/12)	6 months (w*6/12)
Wage	relative	100.00	99.97	99.96	99.96
Output	relative	100.00	100.45	100.66	100.67
Output/employed	relative	100.00	99.97	99.96	99.96
Consumption	relative	100.00	100.48	100.69	100.69
Variance of log(MPL)	relative	100.00	102.05	103.56	103.66
Employed	percent	91.02	91.46	91.67	91.67
Unemployed (excl. furloughed)	percent	8.30	8.32	8.32	8.33
Furloughed	percent	0.68	0.22	0.01	0.00
Turnover	percent	14.55	14.53	14.54	14.54
Entry and exit rate	percent	5.87	5.87	5.87	5.87
Job-finding prob	percent	45.40	45.45	45.47	45.47
Consumption net of disutility from search	relative	100.00	100.48	100.68	100.69

Table 6: Effects of imposing a furlough tax equal to 1, 3, or 6 months' wage

Figure 5 helps explain why the furlough option does not substantially reduce layoffs. It shows the firm's optimal employment and furlough policy for different realizations of the productivity shock z, assuming the number of firm's previous period attached workers corresponds to the number of attached workers the firm would like to maintain if it faces a zero productivity shock in the current period. All values are shown relative to this benchmark workforce level. The blue and green curves display the optimal number of attached workers with and without the furlough option, respectively. The yellow curve shows the optimal number of furloughed workers when the option is available. The blue dotted line shows the number of workers in production (employment) with the furlough option. Without the option, the number of attached workers (shown by the green line) is also the number of workers in production.

As expected, the optimal number of attached workers increases with current productivity. For small negative shocks, the firm relies exclusively on layoffs, even when the furlough option is available. This reflects the fact (discussed in Section 4), that the fixed cost associated with layoffs is smaller (and close to zero) compared to the fixed cost of using furloughs. Importantly, however, there is a range of productivity shocks (from about 0.3 to 0.2) where the firm chooses to furlough workers, yet furloughs have no visible effect on layoffs (the blue and green curves overlap). So in this range, furloughs are used in addition to layoffs, with virtually no substitution between the two margins.

This limited impact of the furlough option on layoffs reflects the firms incentive to make long-term adjustments in response to a persistent negative productivity shock. Since furloughs are inherently temporary and involve costs, they are relatively unattractive when the firm expects to operate at a lower scale for an extended period. Layoffs, which permanently reduce the workforce, are the natural response in this setting. When furloughs are used, it is only to fine-tune labor input at the margin. Removing the furlough option does not lead to significantly more layoffs, as the marginal benefit of further layoffs is offset by the convex structure of layoff costs.

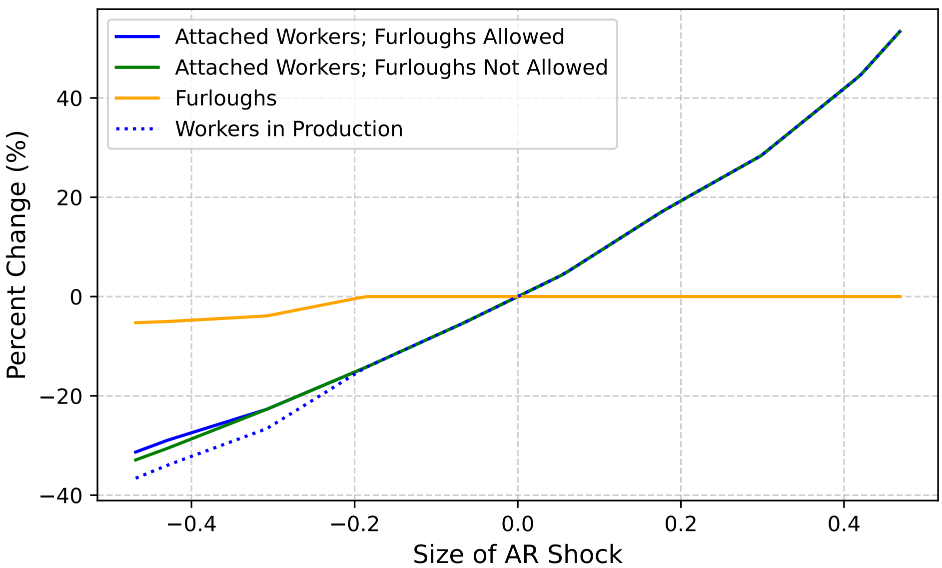

Figure 5: Firm's employment and furlough policies, relative to optimal employment with $z = 0$

One might expect the added flexibility provided by the furlough scheme to be socially more beneficial, or at least less harmful, in a context where layoffs are heavily restricted. To explore this possibility, we compare the model equilibrium with and without the furlough option, while also varying the layoff tax.

Table 7 reports results for layoff tax rates equivalent to 1, 3, and 6 months' wages. The layoff tax has little effect on the welfare gain from eliminating the furlough option. If anything, the cost of the furlough option increases slightly with the layoff tax, from 0.69% with a layoff tax equivalent to one month's wage to 0.76% with a layoff tax equivalent to 6 months' wage. This small increase reflects greater use of furloughs as layoffs become more expensive, which amplifies their negative effect on employment. The share of furloughed workers rises from 0.68% to 0.77% as the layoff tax increases from one to six months wages.

Variable	Unit	1 month		3 months		6 months	
		BM	No Furlough	BM	No Furlough	BM	No Furlough
Wage	relative	100.00	99.96	100.00	99.96	100.00	99.96
Output	relative	100.00	100.67	100.00	100.65	100.00	100.71
Output/employed	relative	100.00	99.96	100.00	99.92	100.00	99.91
Consumption	relative	100.00	100.69	100.00	100.69	100.00	100.76
Variance of log(MPL)	relative	100.00	103.66	100.00	103.48	100.00	103.63
Employed	percent	91.02	91.67	91.32	92.00	91.79	92.53
Unemployed (excl. furloughed)	percent	8.30	8.33	7.97	8.00	7.44	7.47
Furloughed	percent	0.68	0.00	0.71	0.00	0.77	0.00
Turnover	percent	14.55	14.54	13.82	13.83	12.66	12.64
Entry and exit rate	percent	5.87	5.87	5.84	5.85	5.78	5.79
Job-finding prob	percent	45.40	45.47	45.27	45.35	44.99	45.07
Consumption net of disutility from search	relative	100.00	100.69	100.00	100.69	100.00	100.76

Table 7: Key variables across scenarios with layoff taxes (equal to 1, 3, and 6 months' wage) in the baseline model (BM) with the furlough option and without it.

6.2 Sensitivity

The baseline results reported above suggest that maximizing welfare requires completely removing the furlough option. To assess the robustness of this conclusion, we explore parameterizations that could make the furlough option beneficial. A natural parameter to consider is the one that governs the utility cost of the job search, denoted by γ. Increasing γ effectively amplifies matching frictions in the labor market, resulting in longer unemployment spells following layoffs. These frictions do not directly affect furloughed workers. Therefore, if the matching friction is severe enough, the furlough option may increase employment, provided that at least some firms choose to furlough workers instead of laying them off.

To give a high labor market friction a chance to make the furlough option socially beneficial, we also modify the environment to increase the substitutability between furloughs and layoffs. Specifically, we reduce the persistence of productivity shocks by lowering the parameter ρ. This makes furloughs a more natural response to adverse shocks.

Figure 6 summarizes the results by showing parameter combinations for which removing the furlough option leads to the same relative change in welfare (consumption net of search costs). Negative (positive) values would indicate that the furlough option increases (decreases) welfare.

As expected, higher search costs and lower productivity shock persistence reduce the welfare cost of the furlough option. However, only the bottom-right region–characterized by both a high labour market friction and low persistence of the productivity shock–yields a (very small) welfare gain from the furlough option. This parameter region implies highly counterfactual outcomes: unemployment exceeds 50%, worker turnover is far above observed levels, and the firm size distribution is much more compressed than in the data. This suggest that the result that the furlough option reduces welfare in our baseline model is robust to reasonable changes in parameter values.

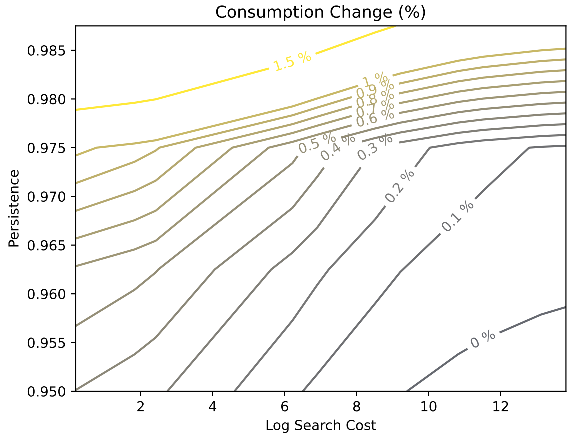

Figure 6: Impact of removing furloughs on welfare under different combinations of search cost and productivity shock persistence. *Note*: The curves represent parameter combinations that result in the same change in welfare following the elimination of the furlough option. Positive values indicate that the furlough option reduces welfare.

6.3 Temporary shocks

Since furloughing allows firms to temporarily reduce their labor force without incurring rehiring costs, one might expect that fully temporary productivity shocks could make the furlough option more valuable. To examine this, we augment the baseline model by adding an *i.i.d.* productivity shock to the existing AR(1) process. The variance of the *i.i.d.* shock is set to half that of the AR(1) innovation term in the baseline calibration. We then recalibrate the endogenously chosen parameters to match the same empirical targets as in the baseline calibration.

Table 8 reports how taxing furloughs affects the model economy with *i.i.d.* shocks. Without a furlough tax, the shares of employed, unemployed, and furloughed workers–as well as the job-finding rate and firm dynamics–are very close to those in the baseline model (Table 6). The effects of taxing furloughs on these statistics are likewise similar: taxing furloughs still increases output, employment, and welfare, although it raises unemployment slightly more than in Table 6. Hence, our main conclusion–that the furlough option reduces welfare under normal business cycle conditions–appears robust to the inclusion of fully temporary shocks.

Although the average impact of the furlough option on layoffs remains limited in the stationary equilibrium of the model with temporary shocks, the outcome can be very different for individual firms in specific situations. Figure 7 illustrates firms optimal employment and furlough decisions in response to temporary productivity shocks. As before, all values are expressed relative to the firms workforce under a zero shock.

Variable	Unit	BM	1 month (w*1/12)	3 months (w*3/12)	6 months (w*6/12)
Wage	relative	100.00	99.97	99.95	99.95
Output	relative	100.00	100.40	100.61	100.62
Output/employed	relative	100.00	99.94	99.90	99.90
Consumption	relative	100.00	100.44	100.66	100.67
Variance of log(MPL)	relative	100.00	101.71	103.31	103.39
Employed	percent	90.97	91.39	91.62	91.64
Unemployed (excl. furloughed)	percent	8.30	8.34	8.37	8.36
Furloughed	percent	0.73	0.27	0.01	0.00
Turnover	percent	14.68	14.68	14.68	14.68
Entry and exit rate	percent	5.76	5.77	5.77	5.77
Job-finding prob	percent	45.55	45.55	45.54	45.54
Consumption net of disutility from search	relative	100.00	100.44	100.66	100.67

Table 8: Effects of imposing a layoff tax equal to 1, 3, or 6 months' wage with i.i.d. shocks

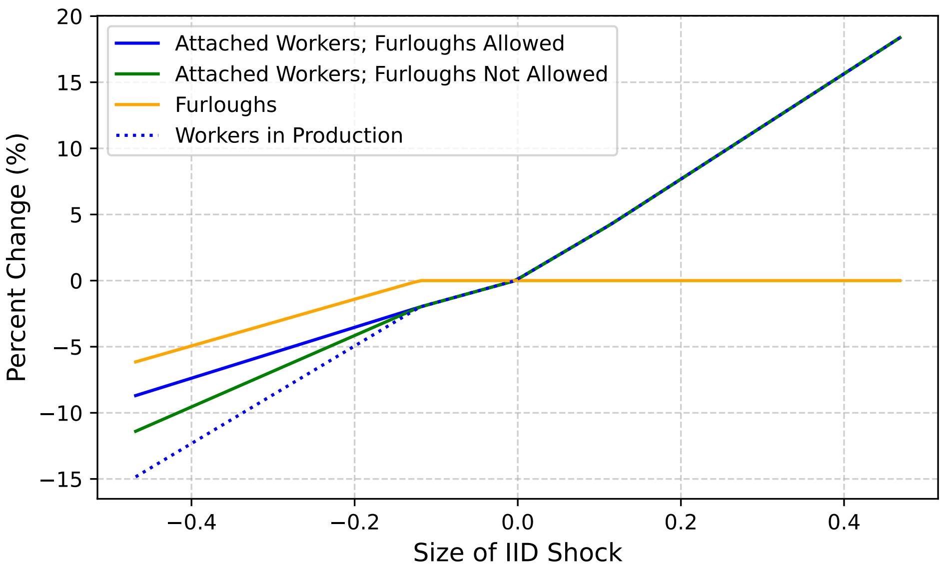

Figure 7: Firm's employment and furlough policies, relative to optimal employment with $z = 0$, *i.i.d.* shock

To generate the figure, we assume that the firm begins the period with a number of attached workers corresponding to its optimal workforce when both the temporary and persistent productivity shocks are zero. We then examine optimal policy responses across a range of temporary shocks, holding the persistent shock fixed at zero. The green line shows the optimal number of attached workers without the furlough option, the blue line shows the optimal number of attached workers when the furlough option is available, the yellow line shows the optimal number of furloughed workers, and the dotted blue line shows the optimal number of workers in production.

Compared with the persistent-shock case in Figure 5, allowing furloughs now leads to a much larger reduction in layoffs–relative to an economy without the furlough option–following large negative shocks, as shown by the widening gap between the green and blue lines. This reflects stronger substitution between furloughs and layoffs when shocks are temporary.

The intuition lies in the interaction between the nature of the shock and firms labor adjustment costs. For a temporary shock, the firm ideally wants to reduce labor input for only one period. Furloughs are well suited for this purpose, because they allow for temporary reductions in labor input without triggering rehiring costs in the next period. Layoffs, by contrast, are a permanent adjustment tool and less appropriate when disruptions are expected to be temporary and short-lived. If furloughs are not available, firms must rely on layoffs even if they would prefer to avoid the associated costs of separation and rehiring. Given convex adjustment costs, the marginal cost of layoffs and rehiring is relatively low starting from the adjustment levels that would be optimal with furloughs. This explains the sharp rise in layoffs following large negative shocks when the furlough option is removed.

The contrast between the strong firm-level substitution in Figure 7 and the limited aggregate effects in Table 8 is explained by the rarity of very large *i.i.d.* shocks. However, Figure 7 also suggests that if a large share of firms were to face such shocks simultaneously–for example, due to a lockdown–the furlough option could substantially reduce layoffs, leading to a significant aggregate impact. In this case, there is also little reason to worry about reduced worker reallocation, as workers do not need to move to other firms when the shock is fully temporary. This aligns with existing literature emphasizing the usefulness of furlough and short-time work schemes during widespread but temporary disruptions. Our model therefore supports the view that, while the furlough option offers limited benefits under normal business cycle conditions, it may be socially valuable in the face of rare but severe temporary disruptions.

7 Substitutability between layoffs and furloughs in the data

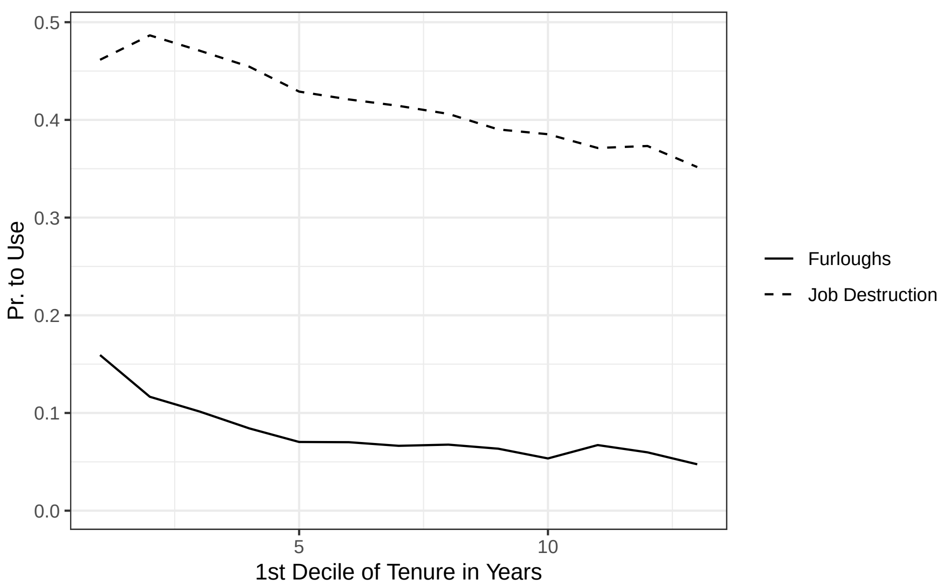

Figure 8: Probability of job destruction and furloughs conditional on the 1st decile of the tenure distribution

	(1)	(2)	(3)	(4)
Tenure at p10	-0.0021	-0.0091	-0.0026	-0.0097
	(0.0001)	(0.0002)	(0.0001)	(0.0002)
Size & VA controls	YES	YES	YES	YES
Num. obs.	365225	365225	365225	365225
R^2	0.1471	0.0257	0.1213	0.0273
Num. groups: Industry	658	658	658	658
Num. groups: Year	6	6	6	6

Robust standard errors in parentheses.

Table 9: Regression results. Dependent variable: (1) Probability of furlough, threshold level 0.1% of workforce; (2) Prob. of job destruction, 0.1% threshold level; (3) Prob. of furlough, 1% threshold level; (4) Prob. of job destruction, 1% threshold level

As discussed above, a key feature of our model is the limited substitutability between layoffs and furloughs. Because the furlough option does not meaningfully reduce layoffs, it fails to mitigate the core friction in the labor market–namely, that laid-off workers take time to find new jobs. To assess the credibility of this model-based result, we empirically examine the relationship between furloughs and layoffs in our data.

Ideally, we would exploit exogenous variation in the cost of furloughs across firms. However, we are not aware of such variation in our data. In the absence of a quasi-experimental setup, we provide correlative evidence by exploiting the fact that statutory layoff regulations in Finland vary with worker tenure. Specifically, the minimum notice period for layoffs increases from two weeks for workers with less than one year of tenure to six months for those with more than 12 years. We interpret this as an increase in effective layoff costs for firms with a more senior workforce. In contrast, the notice period for furloughs does not vary with worker tenure. If furloughs and layoffs were close substitutes, we would expect firms with longer-tenured workers (and thus higher layoff costs) to rely more heavily on furloughs.

Figure 8 shows the probability of job destruction (a proxy for layoffs) and furloughs for firms with different tenure profiles, measured by the first decile of the tenure distribution. Here, as in Section 2, we only count job destruction and furlough events that amount to at least 0.1% of the firm's labor force. We focus on the first decile to capture the "marginal" workers whom firms might lay off first, as they have the shortest notice periods. The figure shows that the probability of job destruction decreases as the first decile of a firm's tenure distribution increases, likely reflecting longer notice periods. However, a lower probability of layoffs is not associated with a higher probability of furloughs. This pattern suggests that firms facing higher layoff costs do not systematically resort to furloughs more often. In other words, in line with our model economy (in particular with Table 5), there appears to be little substitutability between layoffs and furloughs.

Table 9 presents regression results that corroborates this pattern. The probability of layoffs decreases with the first decile of a firm's tenure distribution, even after controlling for firm size, value added, and industry and year fixed effects. The probability of furloughs also declines with the first decile of the tenure distribution, but the relationship is much weaker. The table reports results using two different minimum thresholds for counting job destruction and furlough events–0.1% and 1% of the firms workforce. The choice of threshold has little effect on the overall results, indicating that the observed patterns are not driven by small employment adjustments.

8 Conclusions

We used a general equilibrium model of firm dynamics with labor adjustment costs and frictional unemployment–calibrated to Finnish register data–to assess the aggregate effects of furloughs. In the model, firms can downsize either by layoffs or by furloughing workers. Furloughs allow a temporary reduction in workforce without rehiring or retraining costs, but to avoid further adjustment costs, furloughed workers must be recalled in the next period.

In stationary equilibrium, the furlough option has only a negligible effect on layoffs and thus fails to address the main labor market friction: that laid-off workers take time to find new jobs. In addition, furloughs do little to improve the allocation of workers across firms. Consequently, the furlough option reduces output, employment, and welfare. These results hold even with excessively high layoff taxes, indicating that furloughs are not an effective instrument for mitigating the distortions caused by overly stringent employment protection.

While our focus is on the use of furloughs under relatively normal business cycle conditions, we also show that firms experiencing large but fully temporary negative productivity shocks do use furloughs instead of layoffs when the option is available. This suggests that the furlough option is likely to be socially beneficial during widespread but short-lived disruptions, especially if job opportunities are scarce. Ideally, furlough schemes should perhaps be designed as contingent tools, activated in response to exceptional shocks rather than maintained as a permanent arrangement. Our results, however, also indicate that even a rather small tax on furloughs substantially reduces their use in normal times, while still leaving the option available in exceptional situations. Such a tax could therefore serve as a practical alternative, ensuring that furloughs are mainly used only during temporary aggregate disruptions such as lockdowns or deep recessions.

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