Furloughs, Employment and Worker Reallocation

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Abstract

Are furlough schemes useful from the perspective of aggregate employment and productivity under normal business cycle conditions? To address this question, we first analyze administrative data from Finland, where a furlough scheme has been in place long before the COVID-19 pandemic, documenting key patterns in furlough use and their relationship to job creation and destruction. We then incorporate a furlough option into a model of firm dynamics with hiring and layoff costs and frictional unemployment, calibrating it to replicate the observed furlough and broader labor market reallocation patterns. In the model, maximizing aggregate consumption calls for moderately limiting layoffs with a small layoff tax, reflecting a trade-off between higher aggregate employment and the productivity-enhancing reallocation of workers across firms. In contrast, the furlough option consistently reduces aggregate consumption, as furloughs do little to facilitate worker reallocation and do not significantly substitute for layoffs. Consequently, it would be optimal to eliminate the furlough option altogether. We also provide empirical evidence corroborating the model's implication that firms rarely use furloughs as a substitute for layoffs.

Keywords: furloughs, firm dynamics, layoffs, labor market

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1 Introduction

Due to its more stringent employment protection legislation, the European labor markets typically offer less flexibility for employers regarding layoffs compared to the US. In a turbulent environment where firms would frequently like to adjust their scale, the costs of these labor market policies could potentially be high. 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, which were widely seen as effective in preventing a wave of business failures and allowing firms to quickly resume operations without the need for extensive recruitment and retraining.

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 relatively few firms face binding liquidity constraints and aggregate employment is not limited by weak labor demand.

In this paper, we examine how a furlough scheme affects labor productivity and employment under normal business cycle conditions. Our focus is on the Finnish furlough scheme, which has been in place long before the COVID-19 pandemic, providing extensive data on how firms use 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. Furthermore, the administrative process for furloughs is often shorter than that for layoffs.

At the same time, the Finnish unemployment insurance system treats furloughed workers differently from other unemployed individuals. Specifically, furloughed workers are not required to seek new employment during the first three months of their furlough spell to receive unemployment benefits. 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 their relationship to job creation and destruction using administrative data from 2013 to 2019, a period of relative stability for the Finnish economy. During this time, the fraction of furloughed workers consistently hovered around 1% of total employment, while job destruction and job creation rates exceeded 5%. Furloughs are typically used for relatively small workforce adjustments compared to job destruction, and their use correlates positively with firm size. About 11% of all firms furlough at least one worker in a given year, with the share increasing to 30% among firms with more than 500 employees. In these larger firms, furloughed workers typically represent an even smaller share of the total workforce than in smaller firms.

We then incorporate a furlough option into a model of firm dynamics with workforce adjustment costs and frictional unemployment, calibrating it to replicate key patterns of furlough use and broader labor market reallocation dynamics observed in the data. Frictional unemployment implies that laid-off workers do not find new jobs immediately. Meanwhile, wages are rigid, meaning that when a firm experiences a negative productivity shock, the firm and its workers cannot adjust wages downward to preserve valuable employer-employee relationships.

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.

Our main focus is to examine how the furlough option impacts employment and aggregate labor productivity and whether it is beneficial from the perspective of aggregate consumption. To build intuition, we also compare the implications of limiting layoffs versus limiting furloughs. In the model, both layoffs and furloughs result in unemployment. Laid-off workers are temporarily out of work as it takes time for them to find a new job, while furloughed workers wait to be recalled by their former employer. At the same time, both layoffs and furloughs provide firms with a margin of flexibility when facing negative productivity shocks.

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) using a related model. 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 aggregate consumption. 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 fully eliminates their use. While eliminating the furlough option reduces aggregate labor productivity, this effect is very small. This is because furloughed workers typically return to the same firms that furloughed them, meaning that furloughs do little to facilitate the reallocation of workers from low-productivity firms to high-productivity firms. Moreover, the furlough option does not significantly reduce the use of layoffs, implying that furloughs reduce employment or hours worked almost one-for-one.

To assess the robustness of our main results, we explore parameterizations that could make furloughs beneficial from the perspective of aggregate consumption. We find that the furlough option increases aggregate consumption when two conditions are met: (i) productivity shocks are not very persistent, so that firms often view furloughs as a substitute for layoffs, and (ii) labor market frictions are very severe, resulting in long unemployment spells following layoffs. However, such parameterizations appear to be highly unrealistic, producing labor market outcomes that are clearly counterfactual.

As mentioned above, the furlough option does not reduce layoffs much in our model. To assess the credibility of this outcome, we empirically examine the relationship between furloughs and layoffs using firm-level administrative data. Specifically, we exploit variation in layoff costs stemming from statutory notice periods, which increase with worker tenure but do not affect furloughs. If furloughs and layoffs were close substitutes, firms facing higher layoff costs—those with longer-tenured workers—would be expected to rely more heavily on furloughs. However, our empirical results indicate that firms with higher layoff costs do not systematically use furloughs more often, reinforcing the limited substitutability between layoffs and furloughs observed in our model. This suggests that the furlough option does not meaningfully mitigate the employment losses associated with layoffs, supporting our conclusion that furloughs are unlikely to be socially beneficial.

Literature. We build on a body of firm dynamic 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. Some papers have also 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. Our contribution to this literature is to investigate whether, in the presence of high adjustment costs of employment, the increased flexibility given by a furlough scheme is having a positive impact on productivity and employment.

Some recent papers have studied the effects of furloughs or STW policies during deep recessions using search models. Diaz et al. (2025) analyze the effects of the Spanish furlough scheme in a model that accounts for sector-specific human capital and sector-specific productivity shocks. Our paper is also closely related to Cooper et al. (2017), who examine the effects of STW in Germany during the 2008-2009 financial crisis, in the context of heterogeneous multi-worker firms and frictional labor markets. 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 contrast to these studies, we examine the effects of the furlough scheme during relatively normal economic conditions. As a result, key factors that could drive positive employment responses during crises, such as reductions in workers' outside options, financial frictions, and downward wage rigidities, may be less relevant in our context.

Given that in Finland, the furloughed workers are eligible for unemployment benefits but are not required to actively search for new work, the concept of "furlough unemployment" is close to the mismatch unemployment of Shimer (2007) or the rest unemployment of Alvarez and Shimer (2011). A paper close to ours that allows for this type of unemployment while modeling heterogeneous firms is Buera et al. (2021) which considers the ripple effects of temporary lockdown, induced by the COVID-19 shock (an MIT shock), on the aggregate economy. In their model, temporary unemployment caused by close down is close to furloughs in our setup.

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 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 almost 100 percent of 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. 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.

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. The growth rate of the GDP was negative up to the first quarter of 2015 and positive after that. In 2016 and 2017, years in which the GDP growth was around 3%, the difference between job creation and destruction became substantial. There is also a visible decline in furloughs happening at this time.

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.	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: Descriptives

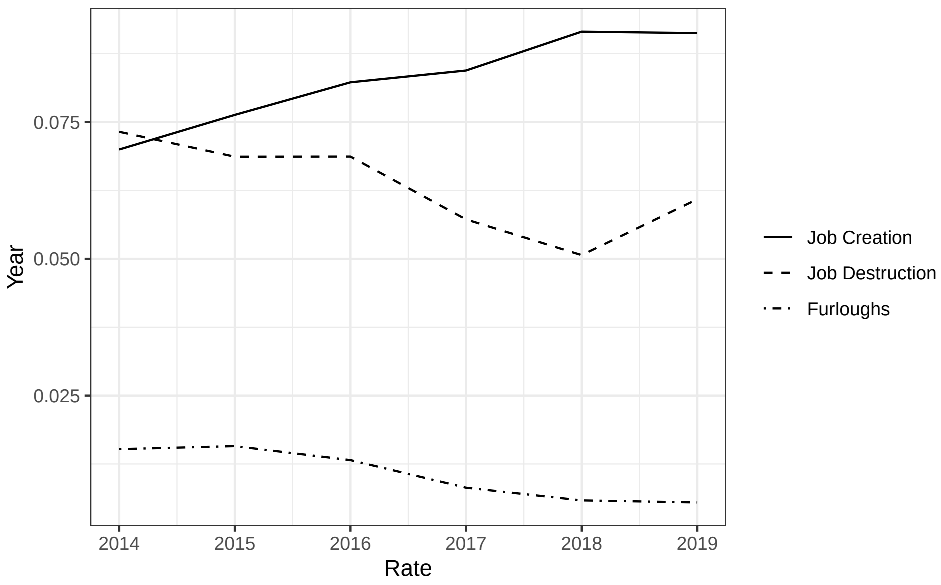

Figure 1: Aggregate reallocation and furloughs

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.

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.

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.

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), with an additional element of frictional labor markets.

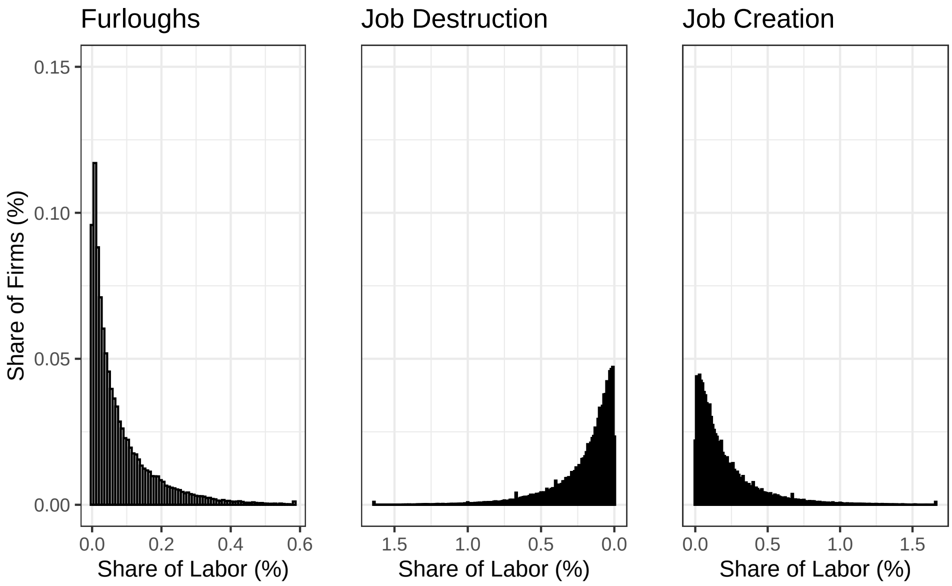

Figure 2: Histograms of reallocation and furloughs

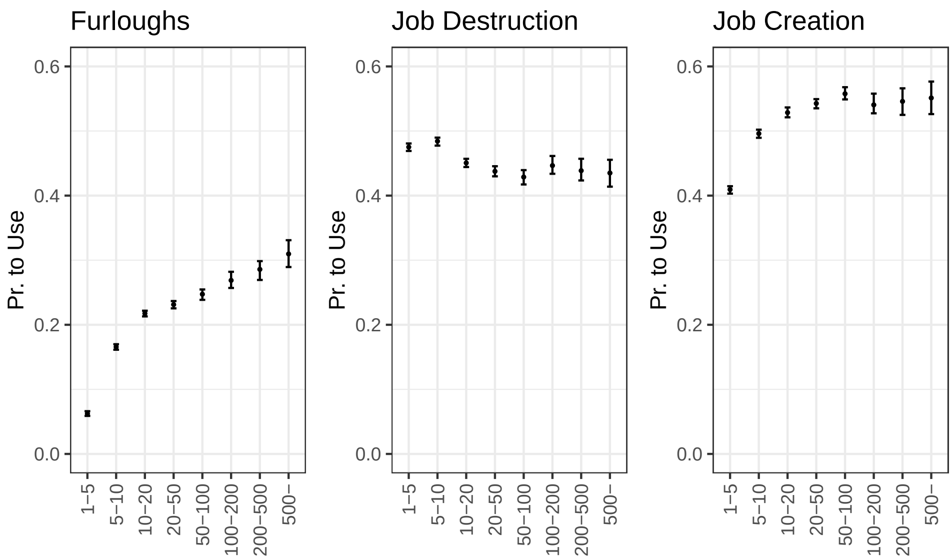

Figure 3: The fraction of firms using furloughs or adjusting their labor condition on the size of the firm

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. The productivity of firms is stochastic, which creates a need for labor reallocation between firms. However, firms face adjustment costs if they want to permanently change their employment levels. We allow these costs to be asymmetric, depending on whether a firm wants to increase or reduce its size.

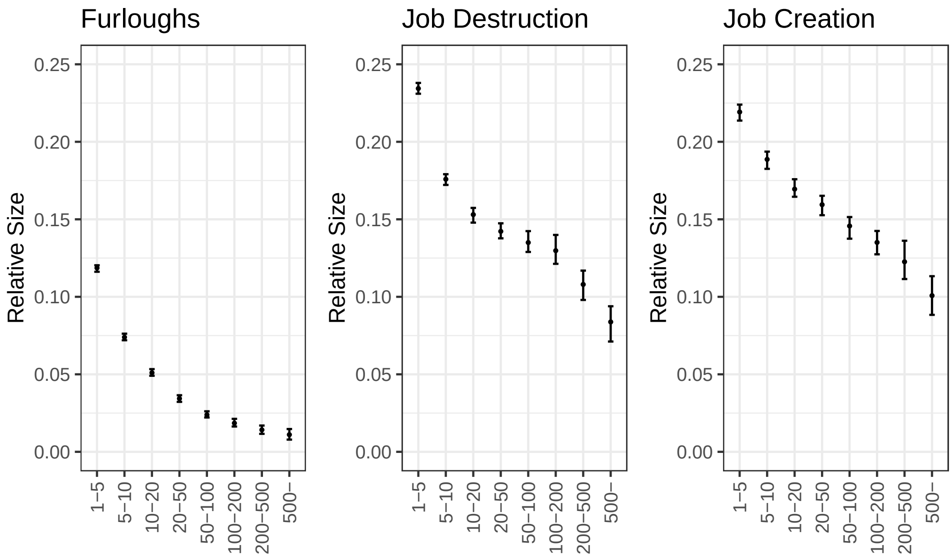

Figure 4: The relative size of adjustment for firms using furloughs, job destruction or job creation conditional on the size of firm

In addition, firms can choose to furlough some of their workers within a period conditional on paying the costs associated with it. This allows firms to temporarily reduce their labor inputs without incurring firing and hiring costs. However, firms are required to take these workers back at the end of the period or pay the firing costs.

Workers. There is a unit mass of infinitely lived risk-neutral workers who differ in their labor market statuses. During the production stage, each worker can be either employed, unemployed or furloughed. Employed agents also differ in their unemployment and furlough risks, which depend on the state of the firm to which they are attached. Unemployed and furloughed workers get flow utility b, while employed workers are paid equilibrium wage rate w. Workers own the firms and thus also use profits, Π, to finance their consumption.

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, unemployed workers' entry to this market is frictional. In line with Alvarez and Veracierto (2001), workers can affect their job finding probability by choosing their search intensity.

Timing. At the beginning of a period, new firm-specific productivities are revealed. Then, in the separation stage, firms that want to reduce their size lay off workers. In the search stage, unemployed workers and those who just lost their jobs choose their search intensity. Next, in the hiring stage, those searchers who were able to enter the competitive labor market are randomly matched with hiring firms. In the production/furlough stage, firms allocate furloughs, workers with a job find out if they are asked to work and production happens. At this stage, wages and profits are paid. Finally, at the end of the period in the exit stage, firms decide if they want to continue in the next period. Workers attached to existing firms start the next period as unemployed.

3.2 Incumbents

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

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

where $0 < \alpha < 1$, n 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 $\varepsilon \sim N(0, \sigma_\varepsilon^2)$.

A firm starts a period with employment level n_- decided in the previous period and it observes its current productivity, z. If the firm wants to change its employment level, it needs to pay a fixed cost, as well as convex adjustment costs. We allow these costs to be different depending on whether employment is increased, in which case the fixed cost is wc_{ph} and the parameter governing the convex costs is wc_{qh}, or decreased, in which case the respective cost parameters are wc_{ps} and wc_{qs}. This allows us to separate between hiring and firing costs in a parsimonious way. In line with Finnish labor market legislation, the firm can also furlough part (or all) of its employees. These employees do not work in the current period and the firm does not have to pay their wages. However, the firm has to take these workers back at the end of the period. The furlough costs are a combination of a fixed cost, wc_{pf}, and convex adjustment costs with cost parameter wc_qf. The firm also needs to pay fixed operation costs, wc_o. Note that, all costs are scaled with the equilibrium wage, w. Finally, at the end of the period, the firm decides whether it wants to exit or stay in the market.

The firm's problem can be summarized by the following Bellman equation:

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

where $\bar{n} = \frac{n+n_-}{2}$. This gives the optimal decision rules for employment $n(z.n_-)$, furloughs $f(z, n_-)$ and exit $x(z, n_-)$, taking value 1 if the firm decides to exit and value 0 if it decides to continue.

3.3 Entrants

There is a continuum of potential entrants that are ex ante identical. If they want to start producing in the next period, they have to pay the entry cost, wc_e. They start the next period as an incumbent firm with $n_- = 1$ and productivity z that is drawn from a stationary distribution associated with the AR(1) process. The mass of entrants is such that the expected value of entry is smaller or equal to the entry costs. We focus on a stationary equilibrium with positive entry, thus

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

3.4 Workers

At the beginning of a period, workers can either be attached to a firm with state $(z\ n_-)$ or unemployed. For workers with a job, unemployment and furlough risks depend on the state of their firm. We also assume that if a firm used furloughs in the previous period, the furloughed workers are the first to be laid off if the firm scales down its size in the current period. This means that the mass of furloughed workers in the previous period (f_-) also affects the unemployment risk for workers at the beginning of the current period.

The beginning of a period value for a worker in a firm (z, n_-, f_-), given that she was not furloughed in the previous period, satisfies the following Bellman equation:

$$\begin{aligned} W_E(z,n_-,f_-) = (1-p_{EU}(z,n_-,f_-))\bigg\{&(1-p_F(z,n_-))\bigg[w+\Pi+\beta\bigg(\mathbb{I}(\text{exit}|z,n_-)U \\ &+(1-\mathbb{I}(\text{exit}|z,n_-))E(W_E(z',n(z,n_-),f(z,n_-))\bigg)\bigg]+p_F(z,n_-)\bigg[b+\Pi \\ &+\beta\bigg(\mathbb{I}(\text{exit}|z,n_-)U+(1-\mathbb{I}(\text{exit}|z,n_-))E(W_F(z',n(z,n_-),f(z,n_-)))\bigg)\bigg\} \\ &+p_{EU}(z,n_-,f_-)W_U, \end{aligned} \tag{5}$$

where W_U denotes the value of unemployment in the search stage and $W_F(\cdot)$ gives the value of employment at the beginning of a period, given that the worker was furloughed in the previous period. The first three lines denote the event in which the worker is not laid off in the separation stage. The probability of this is $1-p_{EU}(z,n_-,f_-)$. In this case, the worker can face a furlough spell in the production/furlough stage with probability $p_F(z,n_-)$. The first square brackets present the case in which the worker is not furloughed, while the second square brackets give the case in which the worker is furloughed. The worker may still end up being unemployed at the beginning of the next period if the firm decides to exit at the end of the period. Finally, the fourth line presents the event in which the worker loses her job due to a layoff in the separation stage.

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

$$p_{EU}(z,n_-,f_-) = \mathbb{I}(n(z,n_-)-n_- < 0)\mathbb{I}(|n(z,n_-)-n_-|-f_- > 0)\frac{|n(z,n_-)-n_-|-f_-}{n_- - f_-}. \tag{6}$$

The probability that the worker faces a furlough spell is

$$p_f(z, n_-) = \frac{f}{n(z, n_-)}. \tag{7}$$

Similarly to Eq. (5), the value of employment at the beginning of a period for a worker who was furloughed in the previous period is given by the following Bellman equation:

$$\begin{aligned} W_F(z, n_-, f_-) = (1 - p_{FU}(z, n_-, f_-)\Big\{(1 - p_F(z, n_-))\Big[w + \Pi + \beta\Big(\mathbb{I}(\text{exit}|z, n_-)U \\ + (1 - \mathbb{I}(\text{exit}|z, n_-))E(W_E(z', n(z, n_-), f(z, n_-))\Big)\Big] + p_F(z, n_-)\Big[b + \Pi \\ + \beta\Big(\mathbb{I}(\text{exit}|z, n_-)U + (1 - \mathbb{I}(\text{exit}|z, n_-))E(W_F(z', n(z, n_-), f(z, n_-)))\Big)\Big\} \\ + p_{FU}(z, n_-, f_-)W_U. \end{aligned} \tag{8}$$

The only difference between the two values of employment, W_E and W_F, comes from the different layoff risks that these two type of agents face. The layoff probability is now given by

$$\begin{aligned} p_{FU}(z, n_-, f_-) = \mathbb{I}(n(z, n_-) - n_- < 0)\Big[\mathbb{I}(|n(z, n_-) - n_-| - f_- > 0) \\ + (1 - \mathbb{I}(|n(z, n_-) - n_-| - f_- > 0))\frac{|n(z, n_-) - n_-|}{f_-}\Big]. \end{aligned} \tag{9}$$

Unemployed agents can affect their probability of finding a job in the current period, s^η, by choosing their search intensity, s. However, search effort causes a linear utility cost given by $-\gamma s$. In line with Alvarez and Veracierto (2001), we assume that the state of a firm is unobservable to an unemployed agent. Moreover, upon entering a firm, the wage rate cannot be renegotiated. These assumptions imply that all firms offer the same equilibrium wage rate (see also Buera et al. (2015), for a similar labor market setup). If an unemployed agent is able to enter the labor market, she gets value $W_E(z, n_-, f_-)$, which depends on the firm that she is matched with. If the worker does not find a job, she gets flow value b and starts the next period as an unemployed worker.

The Bellman equation for an unemployed worker in the search stage is given by

$$\begin{aligned} W_U = \max_s -\gamma s + s^\eta \int \Big\{W_E(z, n_-, f_-)\frac{1}{JC}\mathbb{I}(n(z, n_-) - n_-)(n - n_-)\Psi(dz, dn_-)\Big\} \\ + (1 - s^\eta)(b + \Pi + \beta W_U). \end{aligned} \tag{10}$$

The integral gives the expected value of a new job. It depends on the job creation done by different types of firms over the stationary distribution, $\Psi(\cdot)$, and aggregate job creation, JC. We specify the definitions of these objects in section 3.6 and 3.5, respectively. Note that, we can use $W_E(z, n_-, f_-)$ to describe the value of a new job after separations and hirings, as firms that increase their labor force never layoff workers in the same period. Thus, $p_{EU}(\cdot) = p_{FE} = 0$ for firms that hire new workers.

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 are able to enter this market. The frictional entry is modeled with a reduced form matching function such that only fraction s^{η} of the workers that either were unemployed at the beginning of the period or lost their job during the separation stage are able to enter the labor market.

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

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

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 theprevious equation in a more compact form with the help of aggregate job destruction:

$$M = s^{\eta}(U + JD). \tag{11}$$

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

$$\begin{aligned} JD = &\int \Big[\mathbb{I}(n(z,n_{-}) < n_{-})|n(z,n_{-}) - n_{-}| + \mathbb{I}(\text{exit}(z,n_{-}))n(z,n_{-})\Big]\Phi(dz,dn_{-}) \\ &- M_e \int \mathbb{I}(n(z,n_{-}) < 1)|n(z,n_{-}) - 1|G(dz) \end{aligned} \tag{12}$$

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. $\Phi(dz, dn_{-})$ 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:

$$\begin{aligned} JC = &\int \mathbb{I}(n_{-} < n(z,n_{-}))|n(z,n_{-}) - n_{-}|\Phi(dz,dn_{-}) \\ &+ M_e(1 - \mathbb{I}(n(z,n_{-}) < 1)|n(z,n_{-}) - 1|G(dz). \end{aligned} \tag{13}$$

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 amount of employed, unemployed and furloughed workers during the production/furlough stage. The furlough rate in the economy is given by

$$F = \int f(z,n_{-})\Phi(dz,dn_{-}) \tag{14}$$

and the steady state unemployment rate is

$$U = \frac{1 - s^{\eta}}{s^{\eta}} JD. \tag{15}$$

Taken together, these two equations also pin down the aggregate employment.

3.6 Equilibrium

A stationary equilibrium can be defined with employment, $n(z, n_{-})$, furlough, $f(z, n_{-})$, and exit, $x(z, n_{-})$, policies; unemplyoed workers' search intensity s; a wage rate, w; a mass of entrants, M_e; unemployment, furlough, job creation and destruction rates; and a stationary distribution of firms, $\Psi(dz, dn)$, such that

1. given the equilibrium 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 behaviour, aggregate job creation, the stationary distribution of firms and the values for employment, s solves the problem of the unemployed worker.

3. the stationary distribution of firms is given by:

$$\begin{aligned} \Psi(Z', N) = &\int_{(z,n)|n(z,n_{-}) \in N, z' \in Z'} Q(z, Z')(1 - x(z, n_{-}))\Psi(dz, dn_{-}) \\ &+ M_e \mathbb{I}(n = 1) \int_{z' \in Z'} G(dz'), \end{aligned} \tag{16}$$

   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 is given by (15), job destruction and creation are pinned down by (12) and (13), respectively, and the aggregate amount of the furloughed is in line with (14)

5. the mass of entrants is such that the labor market clears, that is, the unit mass of workers is equal to the amount of employed, furloughed and unemployed workers:

$$1 = \int n(z, n_{-})\Psi(dz, dn_{-}) + U. \tag{17}$$

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 0.65.

We internally calibrate the remaining parameter values to match several empirical targets in the model's equilibrium (shown in Table 2 below). These targets 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 importance of furloughs relative to other methods of adjusting labor input, and the extent of relevant labor market frictions.

Target	Data	Model
Size Distribution: 1-5	0.57	0.54
Size Distribution: 5-10	0.19	0.21
Size Distribution: 10-20	0.12	0.14
Size Distribution: 20-50	0.08	0.09
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	0.44
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 estimated search elasticity and the unemployment rate, are calculated from the same micro-data used in Section 2. By size distribution, we refer to the share of firms in different labor input bins. Our empirical target is based on firms with at least one employee. In the model, the size distribution excludes entrants, defined as firms in their first period in the market. The targeted frequencies and average sizes of hires, furloughs, and layoffs are taken 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 preference parameters (the disutility of search, γ, and the elasticity of job finding probability, η) to match observed unemployment rate and search elasticity exactly.

Fixed adjustment costs (i.e., fixed costs for separation, hiring, and furlough) 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 separation costs reduces the probability that firms

Parameter	Value	Explanation	Rationale
External:			
α	0.660	returns to scale	convention
r	0.050	interest rate	convention
b	0.650	relative value of domestic work	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	1.298	fixed operating costs	exit/entry rate
c_e	9.141	entry costs	size distribution
c_{ph}	0.000	fixed hiring cost	pr. of hiring
c_{qh}	1.022	convex hiring cost	relative size of hiring
c_{ps}	0.000	fixed layoff cost	pr. of layoff
c_{qs}	0.673	convex layoff cost	relative size of layoff
c_{pf}	0.012	fixed furlough cost	pr. of furlough
c_{qf}	1.399	convex furlough cost	relative size of furlough
η	0.314	search elasticity	Uusitalo & Verho (2010)
γ	1.036	search disutility	aggregate unemployment

Table 3: Parameter values

resort to layoffs, while increasing convex separation costs reduces the relative (average) size of layoffs. Additionally, both changes lead to an increased reliance on furloughs.

It may seem surprising that the calibrated fixed costs associated with layoffs are higher than those associated with furloughs, which are close to zero. However, this probably reflects the fact that in reality firms can reduce their workforce in a number of ways, some of which are relatively inexpensive, such as not renewing temporary contracts or not replacing workers who leave voluntarily. In contrast, in the model, reducing the workforce necessarily requires layoffs.

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 simple quadratic cost functions costs related to hiring, layoffs, and furloughs together with the fixed costs are flexible enough to roughly match the frequency and average size of hires, layoffs, and furloughs.

Moment	Data	Model				
Leave After Furlough %	10	5.80				
Aggregate Furlough %	0.78	0.69				
Probability to Use:	Hiring		Layoffs		Furloughs	
Size	Data	Model	Data	Model	Data	Model
1-5	0.41	0.40	0.47	0.54	0.06	0.05
5-10	0.50	0.47	0.48	0.46	0.17	0.17
10-20	0.53	0.50	0.45	0.45	0.22	0.20
20-50	0.54	0.52	0.44	0.44	0.23	0.22
50-	0.55	0.59	0.43	0.38	0.26	0.17
Mean Size of:	Hires		Layoffs		Furloughs	
Size	Data	Model	Data	Model	Data	Model
1-5	0.22	0.20	0.23	0.31	0.12	0.12
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 model's ability to capture non-targeted moments regarding the percentage of furloughed workers, the fraction of furloughed workers who do not return to the same firm after a furlough spell, as well as size-related patterns in the use of furloughs, layoffs, and hirings. The reported fractions of furloughed workers and non-recalled furloughed workers in Finnish data are from Alasalmi et al. (2024).

The model generates the fraction of furloughed workers that is quite close to the data: 0.69% vs 0.78%. The model also produces the fraction of workers returning after the furlough period that is relatively well in line with the data: 94.2% vs 90%. The lower part of Table 4 illustrates that the combination of fixed and convex adjustment costs together with the AR(1) productivity process does a good job in generating size-related furlough, layoff, and hiring patterns even though we did not target these.

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 in a lump-sum fashion. Since the model does not capture the value of leisure or the welfare costs of involuntary unemployment, we consider aggregate consumption to be the most appropriate metric for ranking different tax rates and evaluating optimal policy.

Table 5 illustrates how the equilibrium changes as the layoff tax increases, with the tax expressed as a multiple of the monthly wage per laid-off worker. Restricting layoffs affects employment and productivity differently. On one hand, limiting layoffs reduces productivity-enhancing worker reallocation across firms. This is reflected in the table by a decrease in the average log marginal productivity of labor, an increase in its variance, and a reduction in turnover, entry, and exit rates as the tax rate rises.

On the other hand, layoffs reduce employment because laid-off workers are not immediately matched with new firms, a factor that firms do not account for in their decision-making. This is shown in the table by the increase in the employment rate as the tax rate increases. The share of employed increases by 2.2%-points with a layoff tax equivalent to 12 months' salary compared to the baseline calibration without a layoff tax on top of the resource costs associated with worker adjustments.

These two mechanisms together generate a non-monotone relationship between the layoff tax and aggregate consumption. At low tax rates, a small increase in the layoff tax boosts consumption through higher employment. However, at higher tax rates, the misallocation effect dominates, leading to a decrease in aggregate consumption. As a result, it is optimal to reduce layoffs somewhat by imposing a layoff tax equivalent to a few months' wages per laid-off worker. In this respect, our results are also quantitatively similar to those of Alvarez and Veracierto (2001), despite differences in model structure and calibration. Output always decreases with the layoff tax even though consumption first increases. This is simply because output is measured gross of worker adjustment costs.

The share of furloughed workers increases with the layoff tax. Importantly, however, the effect is very small; the share of furloughed workers rises from 0.7% to just 0.9% with a layoff tax equivalent to 12 months' wages. This suggests that firms rarely view furloughing as a substitute for laying off workers.

Variable	Unit	BM	1 month (w*1/12)	3 months (w*3/12)	6 months (w*6/12)	12 months (w*12/12)
Wage	relative	100.0	99.4	98.3	96.8	94.2
Output	relative	100.0	100.0	99.8	99.2	97.5
Consumption	relative	100.0	100.2	100.3	100.2	99.3
Average log(MPL)	relative	100.0	98.7	96.4	92.8	86.7
Variance of log(MPL)	relative	100.0	104.2	113.4	127.2	156.4
Employed	percent	91.0	91.3	91.9	92.5	93.2
Unemployed (incl. Furlough)	percent	9.0	8.7	8.1	7.5	6.8
Furloughed	percent	0.7	0.7	0.8	0.9	1.1
Turnover	percent	14.6	13.9	12.7	11.4	9.5
Entry and Exit Rate	percent	5.9	5.8	5.8	5.6	5.3
Job-Finding Prob	percent	45.5	45.4	45.4	45.3	45.1

Table 5: The effect of taxing layoffs

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 aggregate consumption. 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 aggregate consumption 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 then examine furlough and layoff taxes jointly, exploring whether the furlough scheme might be more beneficial in a scenario where layoffs are (too) heavily taxed.

In the remaining subsections, we explore additional model variations that could make the furlough scheme useful. Our aim is both to assess the robustness of the baseline model results and to gain a deeper understanding of the key mechanisms driving them. Specifically, we consider adding *i.i.d.* shocks on top of the standard AR(1) productivity process, reducing worker adjustment costs, and increasing the labor market friction present in the model.

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 furloughs. Tax revenues are redistributed to workers in a lump-sum fashion, contributing to aggregate consumption. 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, while the columns to the left of it provide results for different furlough tax levels, ranging from one month's wage to 12 months' wages in the baseline economy per furloughed worker.[1]

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 equilibrium wage rates as furloughing becomes more costly: 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, which balances labor supply and demand, declines. However, these wage reductions are modest, suggesting that the furlough option is not particularly valuable to firms

[1] Since the equilibrium wage rate varies across cases, the furlough tax in the last column, for instance, is not precisely equal to one year's wage in the new equilibrium.

on average. The fact that a furlough tax equivalent to just three months' wages is sufficient to eliminate the use of the furlough option altogether further supports this point.

Taxing furloughs decreases the average marginal productivity of labor, increases its variance, and raises 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, aggregate consumption is maximized at a tax rate that reduces layoffs somewhat but does not come close to eliminating them. In contrast, with a furlough tax, aggregate consumption is maximized when the tax eliminates the use of furloughs altogether.

There are two key reasons for the discrepancy between the optimal policies for layoffs and furloughs. First, when furloughs are restricted, most "furlough unemployment" is converted into employment; as shown in the table, the increase in employment is approximately equal to the decrease in the share of furloughed workers. In other words, furloughs generally do not serve as a substitute for layoffs. Second, unlike layoffs, furloughs only marginally increase labor productivity. This happens because the reallocation channel, which is critical for the positive effects of layoffs, is absent when furloughed workers return to the same firm. As shown in the table, taxing furloughs has virtually no effect on worker turnover or firm entry and exit. Since the productivity channel is weak, the employment channel primarily drives the negative aggregate consumption effects of the furloughs.

Variable	Unit	BM	1 month (w*1/12)	3 months (w*3/12)	6 months (w*6/12)	12 months (w*12/12)
Wage	relative	100.00	99.97	99.96	99.96	99.96
Output	relative	100.00	100.43	100.63	100.64	100.64
Consumption	relative	100.00	100.46	100.66	100.67	100.67
Average log(MPL)	relative	100.00	99.89	99.85	99.85	99.85
Variance of log(MPL)	relative	100.00	101.95	103.50	103.60	103.60
Employed	percent	91.02	91.44	91.65	91.66	91.66
Unemployed (incl. Furlough)	percent	8.98	8.56	8.35	8.34	8.34
Furloughed	percent	0.69	0.23	0.01	0.00	0.00
Turnover	percent	14.59	14.60	14.59	14.59	14.59
Entry and Exit Rate	percent	5.86	5.86	5.87	5.87	5.87
Job-Finding Prob	percent	45.45	45.48	45.49	45.49	45.49

Table 6: The effect of taxing furloughs

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

Table 7 shows the results for layoff tax rates equivalent to 1, 3, 6, and 12 months' wages. Interestingly, the cost of the furlough scheme increases with the layoff tax. With a layoff tax equal to one month's wages, aggregate consumption is 0.7% higher when the furlough option is removed (or when the furlough tax is set so high that firms never use furloughs). This effect increases to about 1.1% when the layoff tax corresponds to 12 months' wages. The reason for this increase is that a higher layoff tax leads to greater use of furloughs, amplifying the negative effect on employment. As shown in the table, the share of furloughed workers increases from

0.71% to 1.11% as the layoff tax increases from one month's wages to 12 months' wages. At the same time, the positive effect of the furlough option on productivity (output per employed worker) increases only marginally.

Variable	Unit	1 month		3 months		6 months		12 months	
		BM	No Furlough	BM	No Furlough	BM	No Furlough	BM	No Furlough
Wage	relative	100.00	99.96	100.00	99.96	100.00	99.95	100.00	99.94
Output	relative	100.00	100.67	100.00	100.71	100.00	100.81	100.00	101.04
Output/Employed	relative	100.00	99.94	100.00	99.91	100.00	99.92	100.00	99.90
Consumption	relative	100.00	100.70	100.00	100.76	100.00	100.87	100.00	101.12
Employed	percent	91.39	92.06	91.93	92.68	92.52	93.35	93.25	94.32
Unemployed (incl. Furlough)	percent	8.61	7.94	8.07	7.32	7.48	6.65	6.75	5.68
Furloughed	percent	0.71	0.00	0.78	0.00	0.87	0.00	1.11	0.00
Turnover	percent	13.90	13.92	12.70	12.70	11.35	11.37	9.47	9.49
Entry and Exit Rate	percent	5.83	5.84	5.76	5.77	5.64	5.64	5.30	5.31
Job-Finding Prob	percent	45.60	45.68	45.59	45.68	45.53	45.62	45.35	45.47

Table 7: Comparison of key variables across four scenarios with different layoff taxes with (BM) and without the furlough option.

6.2 Sensitivity

The baseline results reported above suggest that maximizing aggregate consumption requires completely shutting down 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 utility cost of job search, denoted by γ. Increasing γ 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.

In the baseline model, however, the furlough option does not significantly reduce layoffs. To make furloughs a closer substitute for layoffs, we decrease the persistence of productivity shocks, governed by parameter ρ. Additionally, we experiment with different resource costs of furloughing by varying parameter c_q, which determines the convex component of furlough costs. Lower furlough costs should make firms more inclined to use furloughs as an alternative to laying off workers.

Figure 5 summarizes the results by showing parameter combinations for which removing the furlough option leads to the same relative change in aggregate consumption. The left-hand panel relates to search costs and the persistence parameter, while the right-hand panel pertains to search costs and the furlough cost. Negative (positive) values would indicate that the furlough option increases (decreases) aggregate consumption.

The left-hand panel suggests, as expected, that combinations of higher search costs and lower productivity shock persistence are associated with a reduced cost of the furlough option in terms of aggregate consumption. However, the parameter values in the bottom-right corner of the figure produce a stationary equilibrium that is highly counterfactual. For example, a log search cost of 5 already represents such extreme labor market frictions that it results in an unemployment rate above 60% for all persistence parameter values shown in the figure. At the same time, the lower persistence parameters in this region lead to excessively high turnover rates and a highly counterfactual firm size distribution.

The right-hand panel shows that lowering the resource cost of furloughing does not reduce the cost of the furlough system in terms of aggregate consumption, except when the search cost is extremely high. While a lower resource cost of furloughing reduces the number of costly layoffs, it leads to increased use of furloughs, which dominates in its impact on employment or hours worked. In fact, the furlough option tends to have a smaller negative effect on aggregate consumption when the resource cost of furloughing is higher. This is because a sufficiently high resource cost effectively eliminates the furlough option altogether.

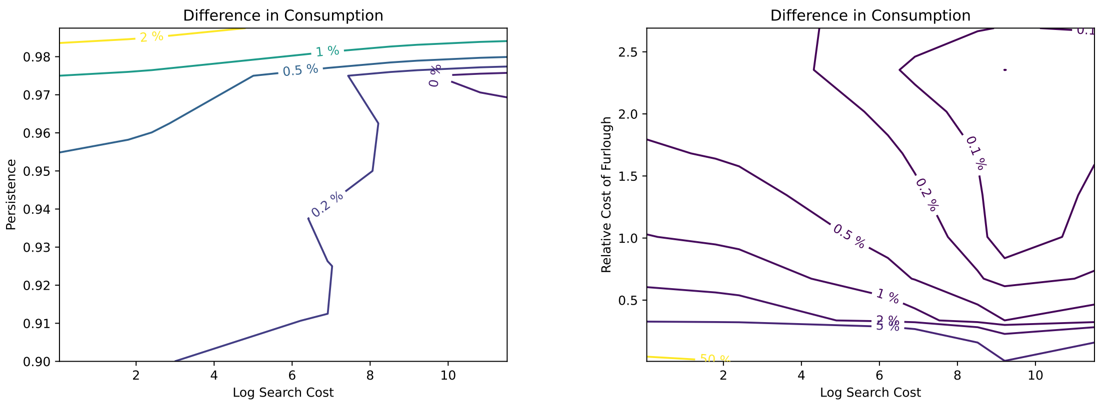

Figure 5: Impact of removing furloughs on aggregate consumption under different parameter combinations. The left panel shows combinations of search cost and productivity shock persistence. The right panel shows combinations of search cost and furlough cost. The curves represent parameter combinations that result in the same change in aggregate consumption following the elimination of the furlough option. Positive values indicate that the furlough option reduces aggregate consumption.

6.3 Temporary shocks

Since furloughing allows firms to temporarily reduce their labor force without incurring hiring costs later, one might expect that temporary productivity shocks would make the furlough option more valuable, at least from the perspective of individual firms. To investigate this, we introduce an *i.i.d.* productivity shock on top of the AR(1) productivity process in the baseline model.

Table 7 shows how taxing furloughs affect the equilibrium with *i.i.d.* shocks; "BM" refers to the new calibration (with the same targets as in Table 2). A comparison with Table 5 reveals that adding an *i.i.d.* shock has very little impact on the key results regarding the effects of the furlough option. This outcome reflects the fact that the *i.i.d.* shock is introduced alongside with higher resource costs for labor adjustment, which reduce the value of the furlough option for firms. We highlighted this point in the sensitivity analysis, where we varied certain parameter values without recalibrating others.

Variable	Unit	BM	1 month (w*1/12)	3 months (w*3/12)	6 months (w*6/12)	12 months (w*12/12)
Wage	relative	100.00	99.97	99.95	99.95	99.95
Output	relative	100.00	100.40	100.62	100.63	100.63
Consumption	relative	100.00	100.44	100.67	100.68	100.68
Average log(MPL)	relative	100.00	99.90	99.82	99.82	99.82
Variance of log(MPL)	relative	100.00	101.71	103.31	103.39	103.39
Employed	percent	90.95	91.37	91.61	91.62	91.62
Unemployed (incl. Furlough)	percent	9.05	8.63	8.39	8.38	8.38
Furloughed	percent	0.73	0.27	0.01	0.00	0.00
Turnover	percent	14.68	14.68	14.68	14.68	14.68
Entry and Exit Rate	percent	5.76	5.77	5.77	5.77	5.77
Profits	relative	100.00	100.40	100.61	100.63	100.63

Table 8: Taxing Furloughs with iid shock

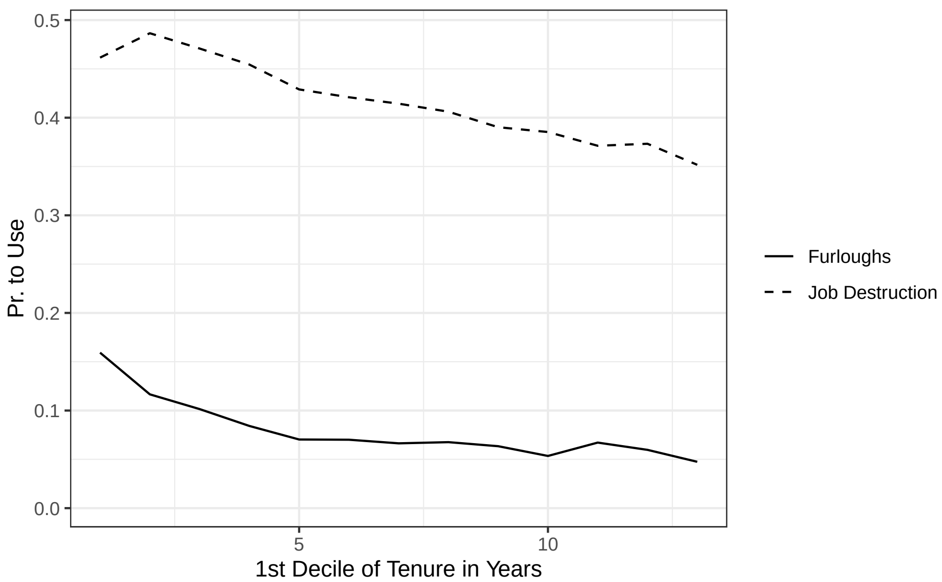

Figure 6: The probability of job destruction and furloughs conditional on the 1st decile of the tenure distribution in a firm

	(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: Statistical models: (1) Pr. Furlough, 0.1%th (2) Pr. Job Destruction, 0.1%th (3) Pr. Furlough, 1%th (4) Pr. Job Destruction, 1%th

7 Substitutability between layoffs and furloughs in the data

A key pattern in our model is that eliminating the furlough option has little effect on layoffs, suggesting that furloughs do not meaningfully reduce layoffs. In other words, furloughs do not significantly alleviate the fundamental problem created by labor market frictions—namely, that laid-off workers take time to find new jobs. As a result, the furlough option is unlikely to be socially beneficial. To explore 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 6 shows the probability of job destruction (a proxy for layoffs) and furloughs for firms with different worker tenure profiles, measured by the first decile of the tenure distribution. Here, as in Section 2, we only count JD 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, 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 firm's 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 analyzed the aggregate implications of furloughs using a general equilibrium model of firm dynamics with labor adjustment costs and frictional unemployment, calibrated to Finnish register data. In the model, firms can reduce their workforce by either furloughing or laying off workers. Unlike layoffs, furloughing allows firms to temporarily reduce their workforce without incurring hiring and training costs in subsequent periods. However, firms must recall furloughed workers in the next period to avoid additional labor adjustment costs for the same workers.

Given the labor market frictions, it may be optimal to restrict layoffs through a layoff tax. Intuitively, firms do not internalize the delays faced by laid-off workers in finding new jobs. However, such a tax should remain moderate, as layoffs are critical for productivity-enhancing labor reallocation. In contrast, our analysis suggests that it would likely be optimal to eliminate the furlough option altogether, as furloughs neither promote reallocation nor significantly reduce layoffs. This conclusion holds even when an excessively high layoff tax is introduced, suggesting that furlough schemes are not an effective tool for mitigating the negative effects of overly stringent employment protection.

In practice, even if the furlough scheme were eliminated, firms would still have the ability to rehire previously laid-off workers. However, removing the formal furlough scheme would eliminate a situation where some unemployed individuals (the furloughed) are not required to actively search for a new job to receive unemployment benefits. This would bring all unemployed workers under the same job search requirements, potentially improving overall job matching. An alternative policy approach could be to impose a fee on firms that furlough workers, making them internalize some of the costs associated with delayed reallocation.

We view our model as reflecting relatively normal business cycle conditions. However, as discussed in the introduction, furloughs may play a more useful role during a recession. There are two main reasons for this. First, during downturns, a significant proportion of firms may face credit constraints. In such situations, the option to furlough could help preserve employer-employee relationships that are valuable to both parties. Our model does not capture this mechanism, as it does not include credit constraints. Second, the employment effects of the furlough system are less concerning in a recession when employment is largely constrained by insufficient demand for labor, rather than by furloughed workers lacking incentives to seek new jobs. While we are skeptical about the usefulness of maintaining a furlough scheme on a permanent basis, such systems may be well-justified during major crises.

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