Policy Experience and Firm Dynamics

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I ask how the effects of the furlough scheme on output, productivity and welfare change when firms gain experience from previous furloughs. Using comprehensive Finnish employer-employee register data, I document patterns that could align with furlough experience: most firms never furlough workers (64%), and past furlough use predicts future use (an annual furlough probability of 43% vs. 7%). I develop a firm dynamics model with furlough experience and use it to quantify the effects of furlough experience on firm dynamics. I calibrate the model to the Finnish data and find that the experience channel explains the persistence and much of the concentration. Holding the share of furloughing firms fixed, I shut down the furlough experience channel. Making furloughs equally easy to use for all firms would spread them more widely without welfare losses: experience determines which firms furlough, not how much the economy gains from furloughs.

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1 Introduction

Governments design policies that help firms survive temporary shocks, such as wage subsidies, short-time work and furloughs. In a furlough, the firm stops paying wages but preserves the match and later recalls the worker. Hall and Kudlyak (2022) show that recalls avoid the time-consuming search and matching process, so the labor market recovers much faster from an aggregate shock when unemployment comes from furloughs rather than job loss. Because furloughs are voluntary, faster recovery arises only when firms use them, so take-up pins down how effective the policy is. Yet Finnish firms report that the furlough legislation and collective agreements are confusing (Alasalmi et al., 2024). While the effects of furloughs are well documented, less is known about which firms use them and whether they know how to use them.

In this paper I study (i) why furlough use is concentrated across firms and persistent within them; (ii) whether experience from previous furloughs can explain these patterns; and (iii) how this experience changes the effects of the furlough scheme on output per active worker, productivity and welfare. To do so, I first document the concentration and persistence using Finnish employer-employee register data. I then build and calibrate a firm dynamics model with furlough experience based on Hopenhayn and Rogerson (1993).

Most firms (64%) never use furloughs. Firms that furloughed at least once in their first five years have an average annual furlough probability of 43% over the next five years, compared with 7% for firms that did not. Firm fixed effects alone explain 36% of the variation in the annual furlough probability, compared with 10% for three-digit industry and 1.5% for year fixed effects, so furlough use differs mainly across firms, less across industries or over the business cycle. Larger and more volatile firms furlough more; more productive firms furlough less. Financial variables, such as liquidity and leverage, predict the furlough rate weakly.

I model furlough experience as an explanation for these patterns. Firms face idiosyncratic productivity shocks and decide how to adjust their workforce and whether to furlough workers. Furloughs allow a firm facing a temporary negative shock to reduce its wage bill while avoiding the costs of laying off workers and rehiring them later. The more workers a firm furloughs, the more costly it is to reorganize production among the remaining workers, which limits the share of workers it furloughs. Experience enters through an administrative cost: firms that have furloughed before do not pay it, whereas inexperienced firms do. In any year without furloughs, a firm forgets its experience with some probability, which may reflect management turnover. Firm entry and exit are endogenous, and the model is closed in general equilibrium. I calibrate the model to the Finnish data by the simulated method of moments. The calibrated model matches the persistence of furlough use in the data and, although not targeted, generates substantial concentration across firms.

I use the calibrated model for three exercises: I quantify (i) the experience channel and (ii) the value of the furlough option itself, and (iii) I test the robustness of the results to ex-ante heterogeneity in firm volatility. First, I shut down the experience channel so that firms pay the administrative cost every time they furlough, and recalibrate this cost to keep the annual share of furloughing firms at its baseline value. A relatively small fixed administrative cost of 9% of a worker's wage together with the experience channel is able to generate the persistence. In the recalibrated economy the persistence falls: among firms that furloughed in their first five years, the average annual furlough probability over the next five years drops by about 23 percentage points. The same amount of furloughing is spread over more firms, and the share of firms that ever furlough rises by 9 percentage points. Output per active worker and welfare, however, barely change, so the experience channel determines which firms furlough but hardly affects how useful furloughs are for the economy. Second, compared with an economy in which firms cannot furlough, the furlough option raises output per active worker by 0.3% and welfare by 0.17% in consumption-equivalent terms. Output per active worker rises because active labor is better allocated across firms and fewer workers are active. Average productivity, however, falls, because low-productivity firms survive longer. Third, I examine whether ex-ante heterogeneity in firm volatility changes the welfare results. High-volatility firms use furloughs more often than low-volatility firms, but even with two firm types, the experience channel does not raise the value of the furlough option.

My paper is related to several strands of literature. The first studies how regulation affects firms, where regulation typically enters as a compulsory, tax-like wedge. Hopenhayn and Rogerson (1993) show that a firing tax lowers job turnover and productivity in a general equilibrium model of firm dynamics. Restuccia and Rogerson (2008) show that establishment-specific taxes and subsidies misallocate resources and lower aggregate productivity, and Hsieh and Klenow (2009) measure such distortions from firm-level data. I complement this literature with a voluntary policy whose cost of use falls with the firm's own experience.

A second strand studies the take-up of public programs. Low program awareness and informational complexity reduce take-up even among eligible individuals (Bhargava and Manoli, 2015), and providing information and application assistance raises it (Finkelstein and Notowidigdo, 2019). Firms face similar barriers: small businesses were less aware of the Paycheck Protection Program and less likely to apply (Humphries et al., 2020). This literature is mainly empirical and focuses on individuals. I study take-up frictions of firms in a dynamic general equilibrium model.

Beyond macroeconomics, a long theoretical and empirical literature studies temporary layoffs and short-time work. Early theories explain why firms lay off workers temporarily rather than permanently (Feldstein, 1976; Haltiwanger, 1984), and early empirical work studies the cyclicality and seasonality of temporary layoffs, recall expectations, and the role of unemployment insurance (Lilien, 1980; Topel, 1983; Katz and Meyer, 1990; Card and Levine, 1994). More recent work documents facts about temporary layoffs (Nekoei and Weber, 2020) and evaluates the employment and welfare effects of short-time work in recessions (Giupponi and Landais, 2023). This literature mostly studies worker outcomes or the use of these

policies in recessions. I instead study which firms use furloughs and how firms use them in response to idiosyncratic shocks.

Exploring the same theme with a different model family, business cycle literature study temporary layoffs and short-time work.[1] Search and matching models with temporary layoffs study how recalls shape unemployment dynamics (Fujita and Moscarini, 2017; Gregory et al., 2020; Gertler et al., 2026), Cooper et al. (2017) evaluate the employment and output effects of short-time work in Germany, and Buera et al. (forthcoming) study the aggregate effects of a temporary shutdown. These models typically abstract from frictions in policy take-up.

The paper is organized as follows: Section 2 outlines the main features of the Finnish furlough system. Section 3 introduces the dataset. Section 4 presents empirical evidence about concentration and persistence. Section 5 introduces the model and Section 6 the results. Finally, Section 7 concludes. The Appendix contains technical details and extra material.

[1] Temporary layoffs, furloughs and short-time work differ in how formal the employment relationship remains. In the US, a worker on temporary layoff does not work and expects to be recalled by the former employer, but the recall is not guaranteed. A Finnish furlough is formal: the employment contract remains in force, the firm stops paying wages, the worker receives unemployment insurance, and the firm can recall the worker after a short notice period. Short-time work schemes, such as the German *Kurzarbeit*, reduce working hours, and a public subsidy replaces part of the lost earnings. A furlough, in contrast, usually stops the worker's hours completely.

2 Institutional Background

In this section I briefly outline the Finnish institutional setting on furloughs and layoffs. Furloughed workers have an employment contract with the firm but do not work while the firm ceases wage payments. The worker receives earnings-related unemployment insurance varying from 80% to around 50% from low- to high-salary workers. Unemployment insurance is collectively funded by the government, firms, workers, and unions, and there is no experience rating. The workers receive the same amount if they are furloughed or laid off.

Before making any decisions about furloughs or layoffs, a firm must assess the need for employment restructuring with a worker representative in co-operation negotiations.[2] Instead of decreasing the workforce, the negotiations may result, for example, in retraining workers from obsolete to productive positions. Firms may offer a different wage if the job position changes. The negotiations last from two weeks to six weeks depending on the magnitude of layoffs. The law states that furloughs are possible in two cases: i) a firm has a permanent need to lay off workers but decides to furlough instead, or ii) it experiences a sudden and transitory (at most ninety days) decrease in labor demand. If the firm has a sudden and urgent need to furlough, a fourteen-day notice period is sufficient. In addition, the firm must obey collective agreements, for example, about the notice period.

A furlough can be fixed-term or open-ended and full-time or part-time, which resembles short-time work schemes in many European countries. If the furlough has no agreed end date, the worker may resign without a notice period. Moreover, if the furlough has lasted over two hundred days, the worker may resign and receive notice period pay without having to work for the firm for the duration of the notice period. With an open-ended furlough, firms may recall workers with a seven-day notice period. Furloughed workers can work elsewhere while on furlough.

A firm is obliged to recall workers it has laid off up to six months after the layoff, if the worker's skills match the newly opened vacancy. If a firm has furloughed and laid off, it must recall the furloughed workers first. New workers have a four-month (six since 2017) probationary period, during which both parties can terminate the contract without having to provide a reason. If the firm lays off and reopens the same position, it must recall the worker, given that the worker is registered as unemployed.

3 Data

The paper uses linked employer-employee data for 1994–2021. Firm data are based on financial statements and business registers provided by Statistics Finland. The furlough and the employment data are reported by the Ministry of Economic Affairs and Employment and managed by Statistics Finland. The firm

[2] The law was updated in 2021 and took effect in 2022. This section considers the law before these changes took place.

sample focuses on competitive firms. Firms operating in agriculture, the public sector, organizations, households, and unknown sectors are excluded. The financial sector is excluded because of data quality. The sample includes only limited liability companies or partnerships. All monetary variables are deflated to 2023 euros. Firms must have at least €10,000 in annual revenue and must report positive assets, wage bills, value added, and social security payments. Each firm must have at least one full-time employee. The cleaned sample has around 1.9 million observations with 228,000 firms.

Matching firms to furloughs requires employment and furlough data. The employment data contain all employment spells and often have gaps between two consecutive spells with the same employer-employee pair. These consecutive spells are combined into a long one. The furlough must start within the employment spell or within two weeks after the employment has ended. If the two-week rule links a furlough to more than one firm, the furlough is linked to the employment spell that ends within a day of the start of the furlough. After the matching, around 84% of furloughs link to exactly one employer and are kept.

The daily furlough data are accurate for the start of the furlough, as furloughed employees must register with employment services to receive benefits. The end date does not have to be reported to the employment services, so the recorded end date may be too late. That is why furloughs that last over a year are truncated to a maximum duration of one year and then annually winsorized in length at the 99th percentile. The employee-level furlough data are aggregated to the firm-year level. Furloughs are measured in full-time-equivalent (FTE) employees on furlough, and the furlough rate is the fraction of its workforce that the firm furloughs.

A layoff is not observable in the data, but is proxied by a decrease in FTE. However, a decrease in firm size may reflect attrition or furloughs. Furloughed employees are added back into the FTE count so that decreases in firm size do not reflect furloughs. The attrition rate is set at seven percent, and any decrease in the workforce beyond that is considered a layoff. It is based on an annual job-to-job transition rate of five percent for employees aged 15 to 74 in Finland reported by Eurostat and an annual retirement rate of two percent.

4 Empirical Evidence

Before proceeding to the empirical evidence, I provide some background information on furlough use in Finland presented in Alasalmi et al. (2024). The average furlough rate is 1.3%, and during 2020 it went up to 3%. Approximately 10–18% of firms use furloughs during a regular year, and in crisis years the fraction increases, up to 32% in 2020. Some industries use furloughs more than others, but on average the furlough rate varies from close to zero to about 2.5% across industries. Relative to the reduction in the labor force within an industry, furloughs account for 10% to 32%, meaning that up to a third of labor

force reduction is in furloughs. About 17% of furloughing firms furlough less than 1% of their workforce. Nearly 20% of firms that live for at least ten years furlough more than every other year, and 26% furlough at most every ten years. Descriptively, the survival probability over five years for firms that furlough 20% of their workforce is similar to that of firms that do not experience major reductions in workforce.

Empirical Strategy

The empirical evidence is mostly presented in the intensive margin, but the main results about concentration and persistence are in the extensive margin. The rest of the extensive margin results are in Section A.1 in the Appendix. To study the intensive and extensive margins, I estimate the following equation:

$$furlough_{j,t} = \alpha + \mathbf{X}'_{j,t}\boldsymbol{\beta_1} + \mathbf{Z}'_{j,t}\boldsymbol{\beta}_2 + \varepsilon_{j,t}, \tag{1}$$

where $furlough_{j,t}$ is the share of firm j's workforce on furlough in year t expressed in percent (so a value of 1 corresponds to 1% of the firm's workforce being on furlough that year), or a dummy indicating whether a firm has furloughed that year. $\mathbf{X}_{j,t}$ contains firm-level controls described in each subsection, and $\mathbf{Z}_{j,t}$ denotes year, three-digit industry, and firm fixed effects. Standard errors are clustered at the firm level.

4.1 Concentration and Persistence

Figure 1 compares how many times firms furlough in the data with a benchmark in which every firm furloughs with the same annual probability of 16.5%, the sample mean (Table 1). Because a firm that lives longer has more chances to furlough, I compute the benchmark from the observed lifetimes of the firms: it gives the share of firms that would never furlough, furlough once, and so on, shown as the line. The data differ sharply from the benchmark. In the data, 64% of firms never furlough, compared with 40% under a constant probability, and 11% furlough exactly once, compared with nearly 30%. Many firms never furlough, and few furlough only once, so once a firm furloughs, it tends to furlough again.

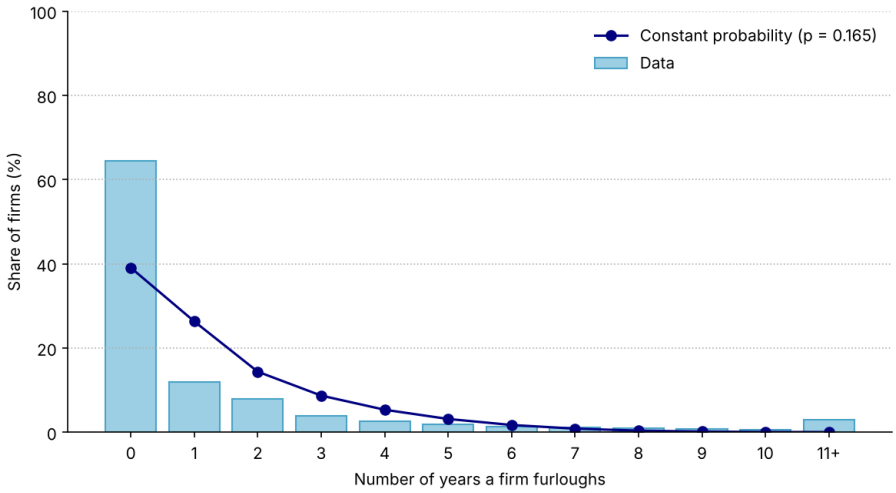


Figure 1: Fraction of firms that furlough over the years 1994–2021. 64% of firms never furlough and around 11% of firms furlough once in their lifetime. The line shows the implied share of firms that furlough if all firms had a 16.5% annual furlough probability.

Table 1: Share of variation in furlough probability and furlough rate explained by year, industry and firm fixed effects

	(1)	(2)	(3)	(4)
Panel A. Furlough probability				
Constant	0.165***	0.165***	0.166***	0.166***
	(0.0039)	(0.0037)	(0.0020)	(0.0018)
Adjusted R^2	0.000	0.015	0.097	0.363
Panel B. Furlough rate (%)				
Constant	1.324***	1.324***	1.324***	1.331***
	(0.0450)	(0.0410)	(0.0300)	(0.0276)
Adjusted R^2	0.000	0.015	0.049	0.282
Observations	1,885,924	1,885,924	1,885,924	1,850,793
Year FE		✓		
Industry FE			✓	
Firm FE				✓

R^2 is adjusted. Years 1994–2021 included. Panel A: linear probability model. Panel B: furlough rate in percent of the workforce. Industry at three-digit level. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 1 reports the adjusted R^2 from regressing furlough probability (Panel A) or furlough rate (Panel B) on a constant alone (column 1), on year fixed effects only (column 2), on three-digit industry fixed effects only (column 3), and on firm fixed effects only (column 4). Each dimension of heterogeneity is

included alone so that the adjusted R^2 can be read as the share of variation in $furlough_{j,t}$ that this dimension alone absorbs. The furlough probability is 16.5%, and the unconditional mean furlough rate is 1.32%. Conditional on the firm furloughing at all in year t, the mean furlough rate is 8.04% (Table 15 in the Appendix). The firm fixed effects explain much more of the variation, 36%, in furlough probability than year (1.5%) or industry (9.7%) fixed effects. For the furlough rate, the corresponding shares are 28%, 1.5%, and 4.9%.

To study persistence, I divide the sample into firms that furlough in the first five years of their life and those that do not. The annual furlough probability in the next five years is then estimated for each group. Table 2 shows that firms that have furloughed in the early years tend to do so in the later years, much more than firms that do not furlough in the early years.[3] The difference is substantial. Firms that have furloughed in early years have an annual furlough probability of 43%, while for other firms it is 7%.

Table 2: Furlough probability in years 6–10 by furlough use in years 1–5

	(1)	(2)	(3)
Panel A. Furloughed in years 1–5			
Constant	0.428***	0.428***	0.428***
	(0.0024)	(0.0023)	(0.0023)
Observations	44,130	44,128	44,128
R^2	0.000	0.016	0.089
Panel B. Did not furlough in years 1–5			
Constant	0.072***	0.072***	0.072***
	(0.0007)	(0.0007)	(0.0007)
Observations	121,600	121,600	121,600
R^2	0.000	0.014	0.034
Year FE		✓	
Industry FE			✓

Dependent variable is the annual furlough probability over the next five years. Panel A: firms that furloughed in their first five years of life. Panel B: firms that did not. Early years refers to the first five years of the firm's lifetime. Firms born in 1995 or later, so that the first years are observed completely. The data end in 2021. The firm must be observed for at least ten years; the estimation sample consists of firm ages 6–10. Results from a linear probability model. Industry at three-digit level. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

[3]Roughly 9% of firms that furlough at some point furlough for the first time in their first operational year. The hazard declines with firm age, falling to around 5% by firm age 10 and remaining roughly flat thereafter (see Figure 3 in the Appendix).

4.2 Larger and Less Productive Firms Furlough More

Larger and less productive firms have a higher furlough rate. Table 3 shows regressions of the furlough rate on log employees and log labor productivity. A 10% increase in firm size is associated with a 0.010 to 0.017 percentage-point increase in the furlough rate, depending on the fixed effects. Relative to the sample mean of 1.32, this is about 0.76–1.3%. The productivity coefficient is negative and larger in absolute terms: a 10% increase in labor productivity is associated with a furlough rate 0.046–0.063 percentage points lower, which is 3.5–4.8% of the mean.

The magnitudes survive the inclusion of firm fixed effects (column 4). The firm size coefficient rises from 0.133 to 0.168 and the productivity coefficient from −0.514 to −0.631. Firms are likely to furlough in years when they are larger or less productive than usual.

Table 3: Furlough rate by firm size and productivity

Furlough rate	(1)	(2)	(3)	(4)
Firm size	0.133***	0.131***	0.100***	0.168***
	(0.0093)	(0.0096)	(0.0113)	(0.0225)
Labor productivity	-0.514***	-0.456***	-0.545***	-0.631***
	(0.0376)	(0.0283)	(0.0281)	(0.0366)
Constant	1.267***	1.255***	1.324***	1.253***
	(0.0450)	(0.0306)	(0.0285)	(0.0419)
Observations	1,885,924	1,885,924	1,885,924	1,850,793
R^2	0.004	0.019	0.053	0.358
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Industry at three-digit level. Includes years 1994–2021. Size, measured in employees, and labor productivity in logs. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

4.3 Revenue Volatility Predicts Furloughs

Firms whose revenue is persistently volatile use furloughs more. Table 4 shows the furlough rate when controlling for a three-year rolling standard deviation of change in log revenue at the firm level. The coefficient is positive throughout but decreases with firm fixed effects: with firm FE (column 4), a 0.1 increase in the rolling volatility is associated with a 0.07 percentage-point increase in the furlough rate, about 5% of the unconditional mean. Once the volatility is controlled for, firm size loses its explanatory power within firms.

Table 4: Furlough rate and persistent revenue volatility

Furlough rate	(1)	(2)	(3)	(4)
SD of Δ log revenue	1.970***	1.991***	1.249***	0.712***
	(0.0874)	(0.0817)	(0.0603)	(0.0535)
Firm size	0.074***	0.062***	0.020**	-0.030
	(0.0083)	(0.0080)	(0.0094)	(0.0270)
Productivity	-0.694***	-0.590***	-0.742***	-0.879***
	(0.0493)	(0.0372)	(0.0375)	(0.0502)
Constant	1.009***	0.997***	1.281***	1.524***
	(0.0424)	(0.0378)	(0.0256)	(0.0530)
Observations	1,368,719	1,368,719	1,368,719	1,349,028
R^2	0.018	0.036	0.066	0.393
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Volatility measured as 3-year rolling standard deviation of Δ log revenue on all years. Volatility is computed over all years, including furlough years, because excluding furlough years would drop most furloughing firms. Firm size, measured in employees, and labor productivity (value added per wage bill) in logs. Industry at three-digit level. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

4.4 Financial Frictions

A natural reason to furlough stems from financial frictions. For example, Giupponi et al. (2022) show that liquidity-constrained firms are more likely to take up short-time-work schemes during downturns. This subsection tests whether standard balance-sheet measures of liquidity and leverage are associated with the furlough rate. Table 5 introduces, one at a time, six financial variables: liquidity, the cashflow-to-assets ratio, the equity ratio (%), log short-term liabilities, log inventories, and the interest rate.

The liquidity, cashflow-to-assets, and equity ratio coefficients are statistically and/or economically not different from zero. The interest rate coefficient (column 6) is similarly tiny in economic terms: with the rate in decimals, even a five-percentage-point ($\Delta = 0.05$) shift in the firm's borrowing rate would move the furlough rate by less than 10^{-3} percentage points within firms. Two coefficients are larger in value: log short-term liabilities (column 4, -0.166) and log inventories (column 5, -0.024). For short-term liabilities, a 10% increase is associated with a 0.017 percentage-point lower furlough rate; for inventories, the corresponding magnitude is 0.002 percentage points. Instead of using furloughs, firms could borrow or increase inventories. Borrowing and inventories are substitutes for furloughs rather than reasons to furlough, so I leave them out of the model.

Table 5: Furlough rate with various liquidity and leverage measures

	Furlough rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	-0.000					
	(0.0000)					
Cashflow		0.000*				
		(0.0001)				
Equity ratio			-0.000			
			(0.0000)			
Short-term liabilities				-0.166***		
				(0.0130)		
Inventories					-0.024**	
					(0.0108)	
Interest rate						0.001**
						(0.0002)
Firm size	0.167***	0.168***	0.168***	0.309***	0.103**	0.161***
	(0.0226)	(0.0225)	(0.0225)	(0.0300)	(0.0390)	(0.0422)
Productivity	-0.633***	-0.631***	-0.631***	-0.636***	-0.729***	-0.839***
	(0.0366)	(0.0366)	(0.0366)	(0.0376)	(0.0519)	(0.0591)
Constant	1.255***	1.253***	1.253***	2.937***	1.689***	1.407***
	(0.0421)	(0.0419)	(0.0419)	(0.1265)	(0.0951)	(0.0714)
Observations	1,843,766	1,850,776	1,850,793	1,794,551	1,081,414	1,115,162
R^2	0.358	0.358	0.358	0.362	0.363	0.394

Regression includes firm fixed effects. Includes years 1994–2021. Firm size, measured in employees, and labor productivity in logs. Short-term liabilities and inventories measured in logs. Liquidity is quick ratio, interest rate is interest payments divided by debt. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

4.5 Furloughing as a Business Plan

A concern is that the firm-level concentration documented above is driven by a small group of firms for which furloughing is part of the regular business model, for example, seasonal sectors that furlough every winter. To check this, I re-estimate the specifications above on a sample that excludes firms that furlough in more than 80% of the years they are observed (Section A.2 in the Appendix)[4]. The exclusion lowers the mean furlough probability and rate, but the main patterns hold. Firm fixed effects explain much more of the variation than year or industry fixed effects (Tables 19 and 20). Furlough use remains persistent: firms that furloughed at least once in their first five years have an average annual furlough probability

[4]I have tried other thresholds, such as 90% and 60%, and the results stay quantitatively the same.

of 34% over the next five years, compared with 7% for firms that did not (Table 21). The furlough rate falls with productivity and rises with revenue volatility (Tables 22 and 25), and financial variables remain weak predictors (Table 26). The exception is firm size, which remains positively associated with the furlough rate within firms after controlling for volatility (Table 25). The patterns are therefore not driven by firms that habitually furlough.

5 Model

The empirical facts are hard to reconcile with a frictionless model in which a firm can furlough costlessly whenever a temporary shock arrives. In such a model, furloughs would be spread more evenly across firms, and past use would predict future use only to the extent that shocks are persistent. Concentration is consistent with a fixed cost of furloughing, and persistence with experience that makes later furloughs cheaper.[5]

The experience channel is also motivated by survey evidence. Alasalmi et al. (2024) surveys Finnish firms on their experience with the furlough scheme. Firms with fewer than five workers in particular report that furloughs are difficult to use and that the legislation is complicated. Such firms account for roughly two thirds of the firm-year observations in the register data, so the difficulty is relevant for a large share of firms. If the difficulty reflects a lack of know-how, it should fall once a firm has used the scheme, which is what the experience channel assumes.

5.1 Environment

The model is built in the tradition of Hopenhayn and Rogerson (1993), featuring a continuum of heterogeneous firms in discrete and infinite time that enter and exit endogenously, face idiosyncratic productivity shocks, and make dynamic employment decisions subject to adjustment frictions. The time period is one year. The framework introduces two key departures from the standard model. First, firms have access to furloughs as an intensive-margin labor adjustment tool. Rather than laying off workers when hit by a negative idiosyncratic productivity shock, a firm can temporarily reduce the fraction of its workforce engaged in production while keeping workers on the payroll. Second, firms get experience when using furloughs, which reduces the administrative costs in future periods. Experience is subject to stochastic forgetting: in any period in which the firm does not furlough, the firm loses its experience with some fixed probability. This captures the idea that organizational knowledge about how to conduct furloughs can be lost when the practice is not regularly used, for instance due to management turnover. The experience is assumed to be binary, so the firm either has experience or does not.

5.1.1 Productivity Shock

Each firm draws an idiosyncratic productivity shock s_t that evolves according to an AR(1) process:

$$\ln(s_t) = a + \rho \ln(s_{t-1}) + \varepsilon_t, \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon^2), \tag{2}$$

[5] Heckman (1978) explores the questions about state-dependence and heterogeneity. An example of an empirical application is provided by Das et al. (2007)

where $\rho \in (0,1)$ governs the persistence of the shock and ε_t is an i.i.d. innovation. Shock persistence ρ plays a central role in the firm's choice between furloughs and layoffs. When a firm is hit by a strong negative shock, the optimal response depends on how long the shock is expected to last, and how likely it is for the firm to experience another large shock. If the shock is highly persistent, the firm expects to remain unproductive for many periods and may prefer to lay off workers permanently rather than pay furlough adjustment costs each period. Conversely, if the shock is expected to be temporary, the firm prefers to furlough, retaining workers who will again be productive once the shock reverts, and avoiding the future hiring and adjustment costs that a layoff would entail.

5.1.2 Attrition

A fraction $1 - \lambda$ of the workforce leaves the firm each period exogenously, through quits or retirements, independent of the firm's decisions. The parameter $\lambda \in (0,1)$ is the survival fraction of the workforce. The state variable n is the workforce chosen last period that enters the current period, before attrition occurs. At the start of each period, attrition reduces this to λn, which becomes the baseline from which the firm makes its new employment choice n'. A firm that neither hires nor fires beyond attrition will therefore carry workforce λn into production.

5.1.3 State Space

The state of an incumbent firm is (s, n, z_f), where s is the current productivity shock and n is the previous-period workforce. The experience state $z_f \in \{0,1\}$ indicates whether the firm has prior experience with furloughs and remembers it. The firm chooses current-period employment $n' \geq 1$ from the post-attrition workforce λn, and the fraction of the workforce engaged in production, i.e. not furloughed, $\gamma \in (0,1]$.

5.2 Technology and Costs

5.2.1 Production

The firm produces output according to:

$$f(s, n', \gamma) = s(\gamma n')^{\alpha}, \qquad \alpha \in (0,1), \tag{3}$$

where $\gamma n'$ is the number of workers actively engaged in production. When $\gamma = 1$ there are no furloughs and all hired workers produce. When $\gamma < 1$, a fraction $1 - \gamma$ of the workforce is on furlough and does not contribute to output. The firm sells output at price p and faces a normalized wage $w = 1$.

5.3 Labor Adjustment and Furlough Costs

The adjustment cost function for a firm is:

$$c(n', \gamma, n) = \frac{\xi_n}{2} \frac{(n' - \lambda n)^2}{(n' + \lambda n)/2} + \frac{\xi_\gamma}{2} (1 - \gamma)^2 n' \tag{4}$$

The components of $c(\cdot)$ capture distinct economic forces. The first term is a quadratic adjustment cost for changing the size of the workforce relative to the attrition-adjusted workforce λn. The cost is scaled by the average firm size across periods. The second term is a convex cost of furloughing, increasing in the share of workers on furlough $(1 - \gamma)$ and scaled by current employment n'. Adjusting the workforce through hiring and laying off becomes increasingly costly per worker the faster the firm grows or shrinks. The convex furlough term captures the idea that as a higher share of the workforce is furloughed, the firm must reorganize tasks and reallocate work among a shrinking active workforce, and these reorganization costs rise with the furlough share. The convex employment cost is symmetrical around λn, which marks the point of inaction for the firm.

5.3.1 Administrative Costs

In addition to the flow costs, a firm incurs an administrative cost if it does not have furlough experience when it furloughs, $\tau_f > 0$. The firm has to pay an administrative cost each year it lays off, $\tau_l > 0$. A layoff is defined as reducing the workforce below the attrition-adjusted level, i.e. $n' < \lambda n$. These administrative costs capture furlough- and layoff-related fixed costs such as understanding how to use furloughs and the six-week co-operation negotiation period for layoffs. Once a firm has incurred the costs of furlough $(z_f = 1)$, it does not pay them again, unless it subsequently forgets — the stochastic forgetting process is described in Section 5.4.1.

Formally:

$$g(z_f, \gamma, n', n) = \begin{cases} \tau_f + \tau_l & \text{if } \gamma < 1,\ z_f = 0,\ n' < \lambda n \\ \tau_f & \text{if } \gamma < 1,\ z_f = 0, \text{ and } n' \geq \lambda n \\ \tau_l & \text{if } (\gamma = 1 \text{ or } z_f = 1),\ n' < \lambda n \\ 0 & \text{if } (\gamma = 1 \text{ or } z_f = 1) \text{ and } n' \geq \lambda n \end{cases} \tag{5}$$

The first case arises when a firm simultaneously furloughs without prior experience and lays off, incurring both administrative costs. The second case covers a firm that furloughs without experience but does not lay off, paying only τ_f. The third case covers a firm that lays off but either does not furlough or already has furlough experience, paying only τ_l. The final case covers all situations in which the firm does not lay off and either does not furlough or has furlough experience, incurring no administrative costs.

An alternative specification would combine the one-time administrative cost with a fixed cost that the firm pays every time it furloughs. I abstract from the recurring component for two reasons. First, under Finnish law small-scale furloughs do not require co-operation negotiations, so furloughing alone carries little recurring administrative burden. Second, firms often furlough and lay off workers in the same period, both in the data and in the model. In those years the firm pays the layoff cost τ_l, which already covers the negotiations. Firms still pay the convex reorganization cost each time they furlough, so furloughing is not free for them.

5.4 Experience Dynamics

5.4.1 Accumulation and Forgetting

Each period a firm can decide to furlough or not. A firm that furloughs immediately acquires experience in it ($z_f = 1$). A firm that does not furlough has a constant forgetting rate. Experience in conducting furloughs can be lost when it is not regularly used, for instance due to management turnover or regulatory changes.

The law of motion for furlough experience is:

$$\Pr(z_f' = 1 | z_f, \gamma) = \begin{cases} 1 & \text{if } \gamma < 1 \\ 1 - \delta_f & \text{if } z_f = 1 \text{ and } \gamma = 1 \\ 0 & \text{if } z_f = 0 \text{ and } \gamma = 1 \end{cases} \tag{6}$$

where (i) the firm furloughs this period ($\gamma < 1$), so it acquires experience with certainty and has it in the next period; (ii) the firm does not furlough ($\gamma = 1$) but enters the period with experience ($z_f = 1$), so it retains experience with probability $1 - \delta_f$ and forgets with probability δ_f; (iii) the firm does not furlough and has no experience ($z_f = 0$), so it remains inexperienced with certainty.

5.5 Firm Value and Optimization

5.5.1 Bellman Equation for Incumbents

An incumbent firm with state (s, n, z_f) solves:

$$W(s, n, z_f; p) = \max_{\gamma \in (0,1],\ n' \geq 0} \Bigg\{ pf(s, n', \gamma) - c(n', \gamma, n) - pc_f - \gamma n' - g(z_f, \gamma, n', n) + \beta \max\Big(\mathbb{E}_{s'|s} \Big[\mathbb{E}_{z_f'} \big[W(s', n', z_f'; p) \big] \Big),\ 0 \Big) \Bigg\}, \tag{7}$$

where c_f is the per-period operating cost and $\beta \in (0,1)$ is the discount factor. The firm pays the wage bill $\gamma n'$ for active workers. The outer expectation integrates over next period's productivity shock s' conditional on s. The inner expectation integrates over the stochastic transitions of the experience states (z_f'), which depend on whether δ_f shocks occur. At the end of the period a firm chooses between continuation and exit. The exit value is zero. Both options pay off next period and are therefore discounted by β via the outer max.

Given (s, n, z_f), the firm weighs current profits net of adjustment and administrative costs against the continuation value, which reflects both the option value of future furlough experience and the risk of forgetting the experience.

5.5.2 Bellman Equation for Entrants

Entrants pay the entry cost c_e before drawing their productivity s, begin with no workforce ($n = 0$) and no furlough experience ($z_f = 0$), and may leave immediately without producing. Their value function is:

$$W^e(s;p) = \max\left\{0,\ \max_{\gamma\in(0,1],\ n'\geq 1}\left\{ pf(s,n',\gamma) - c(n',\gamma,0) - \gamma n' - g(0,\gamma,n',0) \right.\right. \\ \left.\left. + \beta \max\Big(\mathbb{E}_{s'|s}\big[W(s',n',\mathbb{1}\{\gamma<1\};p)\big],\ 0\Big)\right\}\right\}. \tag{8}$$

5.6 General Equilibrium

Because firms are price-takers, closing the model requires only a representative household and free entry: neither adds a state variable to the firm's problem. Free entry pins down p.

Household. A unit mass of identical households supplies labor and consumes the firm sector's output. Following the indivisible-labor preferences of Rogerson (1988), the household's period problem is

$$\max_{C,L}\ \ln C - AL \qquad \text{s.t.} \qquad pC = wL + \Pi, \tag{9}$$

where L is labor supplied to active production, Π is dividend income from the household's ownership of all firms.

Furloughed workers receive a government-administered benefit at replacement rate b, financed lump-sum on the same household; since the household is both the recipient and the taxpayer, the benefit and its financing cancel in (9) and can be omitted without loss.[6] Work disutility falls only on active labor L,

[6] Explicitly, $pC = wL + bwF + \Pi - B$ with $B = bwF$ collapses to (9). Because furlough pay never enters the firm's problem either, b does not affect firm policy or the equilibrium allocation.

since furloughed workers are idle. The static first-order condition is

$$\frac{w}{p} = AC. \tag{10}$$

Stationary equilibrium. Let μ be the invariant measure of incumbents over (s, n, z_f), M the mass of entrants, $G(s)$ the entrant productivity distribution, and normalize $w = 1$. A stationary equilibrium is a price p, quantities (C, L), firm policies $\{n'(\cdot), \gamma(\cdot)\}$, entry mass M, and measure μ such that:

(i) policies solve the incumbent and entrant Bellman equations given p;

(ii) free entry holds, $\int W^e(s; p)\, dG(s) = pc_e$, pinning down p;

(iii) the household satisfies (10);

(iv) the labor market clears, $L = \int \gamma\, n'\, d\mu$;

(v) the goods market clears,

$$\begin{aligned} C = &\int \Big[s(\gamma n')^\alpha - c_f - \tfrac{1}{p}\big(c(n', \gamma, n) + g(z_f, \gamma, n', n)\big) \Big]\, d\mu \\ &+ M \int \Big[s(\gamma_e n'_e)^\alpha - \tfrac{1}{p}\big(c(n'_e, \gamma_e, 0) + g(0, \gamma_e, n'_e, 0)\big) \Big]\, dG(s) - Mc_e; \end{aligned} \tag{11}$$

(vi) μ is invariant under the firm policies and entry at mass M.

Wages and the furlough benefit are transfers within the household and drop out of (11). The adjustment and administrative costs, $c(\cdot)$ and $g(\cdot)$, use up resources: they are measured in wage units ($w = 1$), so dividing by p expresses them in units of output.

5.7 Welfare

Lifetime utility of the representative household, evaluated at a stationary equilibrium, is

$$\mathcal{W} = \sum_{t=0}^{\infty} \beta^t (\ln C - AL) = \frac{\ln C - AL}{1 - \beta}. \tag{12}$$

Consumption-equivalent welfare. Let subscript 0 denote the baseline and 1 a counterfactual (e.g. a lower administrative furlough cost). The consumption-equivalent welfare gain Δ solves

$$\ln[(1+\Delta)C_0] - AL_0 = \ln C_1 - AL_1, \text{so } \Delta = \frac{C_1}{C_0} \exp[-A(L_1 - L_0)] - 1 = \frac{p_0}{p_1} \exp[-A(L_1 - L_0)] - 1, \tag{13}$$

using $C = 1/(Ap)$ for the second equality. A comparison of the equilibria decomposes into consumption and labor-disutility channels:

$$\Delta \approx \underbrace{-(\ln p_1 - \ln p_0)}_{\text{consumption}} - \underbrace{A(L_1 - L_0)}_{\text{labor disutility}}. \tag{14}$$

Furloughed workers, unlike active workers, avoid the disutility of work.

6 Results

I solve for the stationary general equilibrium of the model and calibrate it to Finnish employer-employee data, targeting moments related to furloughs. Some parameters are externally calibrated, some taken from the literature, and the remaining ones are estimated by the simulated method of moments. I then use the calibrated economy to quantify the importance of the experience channel for firm dynamics and welfare.

6.1 Calibration

Table 6 lists the externally set parameters. The discount factor is 0.94, which corresponds to an annual real interest rate of about 6%, and the labor share is 0.64 as in Hopenhayn and Rogerson (1993). The wage is the numeraire. The workforce survival fraction, λ, is the share of workers who stay with the firm from one year to the next, setting attrition to 7% (refer to Section 3 for more details). The labor supply parameter is set to 1.357, to match the average employment rate in Finland in 1994–2021.[7] The fixed operating cost (c_f), the persistence of the AR(1) process (ρ), and the intercept of the AR(1) productivity process (a) are set to values that the full calibration estimated in earlier rounds.

Table 6: Fixed parameters

Parameter	Description	Value
β	Discount factor	0.94
α	Labor share	0.64
w	Wage	1
c_f	Fixed operating cost	10
λ	Workforce survival fraction	0.93
ρ	AR(1) persistence of log productivity	0.93
a	AR(1) intercept	0.076
A	Labor supply parameter	1.357

Table 7 lists the internally calibrated parameters and the empirical counterparts. The administrative furlough cost pins down the annual furlough probability (16.5%), and the convex furlough intensity cost pins down furlough intensity (8%). The furlough forgetting rate pins down the annual furlough probability at ages 6–10, given the firm has or has not furloughed at ages 1–5. The layoff cost and the employment adjustment cost pin down the intensities and the share of firms that lay off and hire. The standard deviation of log employment is pinned down by the AR(1) innovation SD. The entry cost is calculated such that the price is set to one.

[7] Statistics Finland, https://stat.fi/en/statistics/tyokay

Internally calibrated moments, the data moments and the model moments are in Table 7. The simulated moments are calculated using simulated data on incumbent firms, excluding the entry year (and entrants that stay for one year only). The moments describing persistence, furlough probabilities on rows three and four, match the data moments. The annual share of firms that furlough is overestimated, while the furlough intensity is underestimated, meaning that more firms furlough in the simulated data but their furloughs are less intensive. The share of firms ever furloughing is an untargeted moment capturing concentration: a lower value reflects higher concentration. For that moment I draw 28-year windows from the simulated data to match the empirical data length, so that the long simulated lives would not raise the share to one.

Because furloughs and layoffs are both margins of labor force adjustment for the firm, layoff intensity and share are also target moments. I have separate targets for hire share and intensity because the administrative layoff cost is only for layoffs. The layoff share and intensity are underestimated by the model, while the hire intensity and share are overestimated. The standard deviation of log employment is lower than in the data. Mean employment is higher than the data value, and the exit rate is close to the empirical value.

The administrative cost is around 9% of a worker's wage.

6.2 Counterfactual Analysis

To address the importance of the experience channel in explaining persistence and concentration, I analyze two counterfactual economies where the experience channel is shut down (Table 8). By shutting down I mean that the firm must pay the administrative cost every period it furloughs. First I recalibrate the administrative cost of furloughs to keep the furlough share fixed. Second, I keep all parameters as in the baseline model to keep the administrative cost fixed.

The recalibration is in column (2), with the same share of firms using furloughs annually, 21%. The persistence is much lower in this counterfactual economy. The furlough probability in years 6–10 is 20% for firms that furlough in years 1–5 and 9% for firms that do not. The gap is 11.5 percentage points, while in the baseline it is 35.5. The concentration is lower in this economy. Now 55% of firms furlough at some point in their lives, compared with 46% in the baseline. The higher number implies lower concentration because furloughs are spread across more firms.

Column (3) shuts down the experience channel but keeps the administrative cost at its baseline value. Because every furlough year now carries the full administrative cost, furloughs are effectively more expensive for the firm. The share of firm-years with a furlough is much smaller (12% vs. 21%), and furlough intensity is higher (7.2% vs. 5.6%): when the administrative cost is higher, firms use furloughs only for larger adjustments. Persistence is also lower: the gap in the furlough probability in years 6–10

Table 7: Moment fit

Parameter	Value	Moment	Data	Model
Targeted				
Furlough admin. cost τ_f	0.0936	Share of firm-years with a furlough	0.165	0.211
Furlough intensity cost ξ_γ	3.7373	Furlough intensity	0.080	0.056
Furlough forgetting rate δ_f	0.5037	$P(\mathrm{F}_{6\text{–}10} \mid \mathrm{F}_{1\text{–}5})$	0.428	0.428
		$P(\mathrm{F}_{6\text{–}10} \mid \text{no } \mathrm{F}_{1\text{–}5})$	0.072	0.073
Layoff cost τ_l	0.0826	Share of firm-years laying off	0.260	0.162
Employment adj. cost ξ_n	7.4611	Layoff intensity	0.289	0.121
		Hire intensity	0.228	0.263
		Share of firm-years hiring	0.481	0.563
AR(1) innovation SD σ_ε	0.2064	SD of log employment	1.170	0.959
Entry cost c_e [†]	3.753			
Untargeted				
		Share of firms ever furloughing	0.356	0.457
		Mean employment	15.50	26.87
		Exit rate, incumbents	0.087	0.071
		Furlough rate on log firm size[a]	0.148	0.534
		Furlough rate on log labor productivity[a]	−0.534	−5.784
		Furlough rate on revenue volatility[b]	1.970	0.620

Annual probability of a furlough (F) in years 6–10 for firms with or without a furlough in years 1–5. A layoff is $n_t < 0.93\, n_{t-1}$.† Solved from free entry at $p = 1$, not estimated. Parameters are estimated jointly by SMM (9 moments, 6 parameters) with identity weights on percentage deviations; simulated panel of 1,000 firms over 20,000 periods (500 burn-in). Firm-year moments: incumbent firm-years with ≥ 1 FTE in $t-1$ and t. Regression coefficients: pooled OLS, no fixed effects, furlough rate in percent; model regressions on the simulated panel with the data definitions. [a] Separate regressions on log employees and on log labor productivity (value added per wage bill). [b] 3-year rolling SD of Δ log revenue, controlling for log employees and log labor productivity, Table 4, column 1.

between firms that have and have not furloughed in years 1–5 is 11.3 percentage points, compared with 35.5 in the baseline. This gap is almost the same as in column (2) (11.5 percentage points), although the administrative cost is more than four times higher in column (3) (0.094 vs. 0.020). The lower persistence is therefore driven by the experience channel, not by the cost of furloughs.

The fourth column in Table 8 shows a counterfactual economy without the furlough option. When the furlough option is not available, firms lay off more intensively. The exit rate stays the same. The economy without the furlough option is used as a benchmark to study firm dynamics in the counterfactual economies.

Table 8: Counterfactuals – Experience and the Furlough Option

	With furlough option			
	(1)	(2)	(3)	(4)
	Baseline	Experience off, τ_f recalibrated	Experience off, τ_f unchanged	No furlough option
Targeted in the baseline				
Share of firm-years with a furlough	0.211	0.211	0.123	–
Furlough intensity	0.056	0.058	0.072	–
P(furlough yrs 6–10 | furlough yrs 1–5)	0.428	0.202	0.141	–
P(furlough yrs 6–10 | no furlough yrs 1–5)	0.073	0.087	0.028	–
Share of firm-years hiring	0.563	0.563	0.563	0.563
Hire intensity	0.263	0.263	0.263	0.264
Share of firm-years laying off	0.162	0.162	0.164	0.163
Layoff intensity	0.121	0.121	0.121	0.125
SD of log employment	0.959	0.958	0.958	0.955
Untargeted				
Share of firms ever furloughing	0.457	0.546	0.420	–
Exit rate	0.071	0.071	0.071	0.071

(1) Baseline: furlough experience; $p = 1$, $\tau_f = 0.0936$, $\tau_l = 0.0826$, $c_e = 3.753$. (2) and (3) No furlough experience: τ_f is paid in every furlough year; in (2) $\tau_f = 0.0204$ is recalibrated so that the share of firm-years with a furlough equals the baseline value, in (3) $\tau_f = 0.0936$ is unchanged. All other parameters as in the baseline. (4) No furlough option: firms cannot furlough. Removing the furlough option from (1), (2) or (3) gives the same steady state (4), since without furloughs τ_f and the experience channel do not enter. In (2)–(4), c_e is fixed and p is re-solved from free entry. Moments are computed for incumbents with ≥ 1 FTE in $t-1$ and t.

Table 9 compares the baseline and the counterfactual economies with the economy in which firms cannot furlough, which is normalized to 100. The comparison shows how much the furlough option is worth to the economy and whether the experience channel raises or lowers its value. With the furlough option, output per active worker is 0.33% higher, although both average and employment-weighted productivity are lower. Two forces explain this. First, active labor is better allocated: the standard deviation of the log marginal revenue product of labor (MRPL) is 1.5% lower (Hsieh and Klenow, 2009). Second, there are fewer active workers (L), and with decreasing returns to labor, fewer active workers raise output per

worker. Average productivity is lower because low-productivity firms survive longer: with the furlough option, the exit rate is lower and firms live longer. Employment-weighted productivity falls more than unweighted productivity because low-productivity firms keep more workers on their payroll when they can furlough them. Mean employment is therefore 0.9% higher, while active employment is lower. Because firms adjust with furloughs instead of layoffs and rehiring, job creation and job destruction are also lower.

The furlough option raises welfare by 0.17% in consumption-equivalent terms. The gain has two components of similar size. Households consume more (0.08%) because the output price p is lower. Households also work less (0.09%) because fewer workers are active, which reduces the disutility of labor.

To isolate the experience channel, I compare columns (1) and (2). Both economies have the same share of firm-years with a furlough, so differences between them come from which firms furlough. Without the experience channel, active labor is allocated slightly better: the standard deviation of log MRPL is lower (98.47 vs. 98.54). The value of the furlough option is higher (0.176% vs. 0.166%), almost entirely because consumption is higher (0.084% vs. 0.076%); the labor disutility component barely changes. Holding furlough use constant, the experience channel therefore slightly lowers the value of the furlough option. The difference comes from how the friction is distributed: in column (2), every firm that furloughs pays a small cost in every furlough year, whereas in the baseline only firms without experience pay a larger cost.

More generally, welfare is lower when frictions in using furloughs are larger. Without the furlough option, firms cannot adjust labor through furloughs at all, and welfare is lowest. In column (3), firms pay the baseline administrative cost in every furlough year; fewer firms furlough, and the value of the furlough option is 0.120%. The value is higher in the baseline (0.166%), where experience removes the administrative cost for firms that have furloughed before, and highest in column (2) (0.176%).

To assess whether firms differ in their furlough use by productivity, I divide the simulated data into productivity quintiles. Table 10 shows the moments for the first, third and fifth productivity quintiles and reports the baseline for comparison. Firms in the lowest productivity quintile furlough in almost half of their firm-years (48%), whereas firms in the highest quintile furlough in only 1.5%. Firms in the lowest quintile also exit at a high rate of 33% per year, while firms in the upper quintiles rarely exit. This is reflected in the share of firms that ever furlough: only 19% of firm-lives in the lowest quintile ever furlough, compared with 67% in the third and fifth quintiles. Low-productivity firms furlough often while alive, but many exit before they get the chance. Firms that live longer have more time to experience shocks that make them use furloughs.

To study persistence across productivity groups, I divide the simulated data into groups by entry productivity. I include firms that start production and survive for at least ten years. Entrants draw from the lowest 65% of the productivity grid, and only the four highest of these grid points lead to production. Each of these four points forms a group. Table 11 shows persistence by productivity group,

Table 9: Firm dynamics and welfare

	With furlough option			
	(1)	(2)	(3)	(4)
	Baseline	Experience off, τ_f recalibrated	Experience off, τ_f unchanged	No furlough option
A. Productivity				
Output per active worker, Y/L	100.33	100.33	100.26	100
Mean productivity s (unweighted)	99.95	99.93	99.97	100
Employment-weighted productivity	99.72	99.72	99.88	100
SD of log MRPL	98.54	98.47	98.83	100
B. Firm dynamics				
Mean employment	100.90	100.87	100.87	100
Exit rate	99.93	99.97	99.98	100
Mean firm lifetime	100.07	100.04	100.02	100
Job creation rate	99.20	99.15	99.27	100
Job destruction rate	98.06	98.08	98.40	100
C. Output and employment				
Output Y	100.22	100.23	100.18	100
Output price p	99.92	99.92	99.94	100
Employment, active workers L	99.89	99.88	99.92	100
Value of the furlough option: this column relative to (4), consumption equivalent (%)				
Value of the furlough option	+0.166	+0.176	+0.120	–
From higher consumption	+0.076	+0.084	+0.058	–
From lower labor disutility	+0.090	+0.091	+0.062	–

Panels A–C: each measure relative to its value in the economy without the furlough option (4), which is set to 100. Parameters as in the baseline unless otherwise stated; $c_e = 3.753$ fixed and p re-solved from free entry in (2)–(4). Adjustment and fixed costs (ξ_n, ξ_γ, τ_f, τ_l) are resource costs: they are deducted from output in the goods market, as are c_f and c_e. Panels A and B: incumbent firm-years with ≥ 1 FTE in $t-1$ and t; output $y = s(\gamma n)^\alpha$, gross of costs; MRPL of active labor γn, cross-sectional SD of its log averaged over years; lifetime in incumbent years; job flows of incumbents over their employment in $t-1$. **Value of the furlough option**: welfare of the economy k in each column, (1), (2) and (3), relative to the economy without the furlough option (4), $1 + \Delta = (p_4/p_k)\, e^{-A(L_k - L_4)}$, with household utility $\ln C - AL$ and $C = 1/(Ap)$; components $\ln(p_4/p_k)$ (consumption) and $-A(L_k - L_4)$ (labor disutility), which sum to $\ln(1+\Delta)$. A positive value means that households are better off with the furlough option. The labor term equals $-(wL_4/p_4C_4)(L_k/L_4 - 1)$: labor income relative to consumption spending (0.79) times the % change in active labor; it does not depend on the value of A, since $L \propto 1/A$.

with group 1 denoting the least productive. Firms that furloughed in their first five years furlough with an annual probability of 37–44% in years 6–10 in all groups, close to the baseline of 43%. Firms without early furloughs furlough with a probability of 5% in the lowest group and 10% in the highest. Within each group, early experience raises the later furlough probability by a factor of five to eight, whereas entry productivity changes it by at most a factor of two. Experience, rather than productivity, therefore drives the persistence.

Table 10: Baseline by productivity quintile

	Baseline	Q1	Q3	Q5
Share of incumbent firm-years	1.000	0.216	0.237	0.143
Targeted in the baseline (aggregate)				
Share of firm-years with a furlough	0.211	0.479	0.125	0.015
Furlough intensity	0.056	0.072	0.039	0.033
Share of firm-years hiring	0.563	0.210	0.634	0.845
Hire intensity	0.263	0.185	0.300	0.235
Share of firm-years laying off	0.162	0.348	0.105	0.033
Layoff intensity	0.121	0.125	0.118	0.114
SD of log employment	0.959	0.831	0.774	0.707
Untargeted				
Share of firms ever furloughing	0.457	0.187	0.665	0.675
Mean employment	26.87	12.92	21.38	70.17
Exit rate (per year)	0.071	0.328	8×10^{-5}	5×10^{-7}
A. Productivity				
Mean productivity s (unweighted)	5.556	3.246	5.411	9.993
Employment-weighted productivity	7.541	3.264	5.440	11.379
B. Firm dynamics				
Mean firm lifetime (years)	14.11	5.13	17.73	23.21
Job creation rate	0.072	0.008	0.055	0.118
Job destruction rate	0.043	0.091	0.048	0.019

Baseline economy: furlough experience on, $p = 1$. Baseline column: all incumbent firm-years. Q1, Q3, Q5: productivity quintiles at the baseline cutoffs; incumbents with ≥ 1 FTE in $t-1$ and t. Firm-year rows: firm-years with s_t in the quintile. Ever furloughing: firm-lives in 28-year windows, grouped by mean s in the window. Lifetime: completed lives, in incumbent years, grouped by s in the first incumbent year. Job flows: gross employment changes over employment in $t-1$.

Table 11: Persistence by entry productivity

	Baseline	Group 1	Group 2	Group 3	Group 4
Share of surviving cohorts	1.000	0.172	0.227	0.280	0.322
P(furlough yrs 6–10 | furlough yrs 1–5)	0.428	0.390	0.368	0.419	0.441
P(furlough yrs 6–10 | no furlough yrs 1–5)	0.073	0.049	0.059	0.075	0.095

Baseline economy: furlough experience on, $p = 1$. Entry cohorts surviving to age 10, grouped once by their entry draw s_0: entrants draw from the lowest 65% of the productivity grid, and only the four highest of these values lead to production, so the groups are for producing entrants, one grid point each. $P(\cdot)$: average yearly frequency of the event in years 6–10. Events in incumbent years with ≥ 1 FTE in $t-1$ and t.

6.3 Ex-Ante Heterogeneity

To assess the robustness of my results with respect to heterogeneity, I introduce ex-ante volatility differences (Table 12). After paying the entry cost, a firm draws a permanent type: low volatility ($\sigma_L = 0.1664$) or high volatility ($\sigma_H = 0.2464$), that is, the one-type baseline innovation SD of 0.2064 minus or plus 0.04. All other parameters are as in the one-type baseline. I calibrate the share of low-volatility entrants so that the share of firm-years with a furlough equals the one-type baseline value (21%). High-volatility firms are 5.6% of entrants and 20.7% of incumbent firm-years in the stationary equilibrium. They exit less than low-volatility firms (4.7% vs. 11.1%) because higher volatility makes continuing more valuable than exiting.

High-volatility firms furlough more often than low-volatility firms (34% vs. 11% of firm-years) and more intensively (6.5% vs. 4.8%). Furloughs are also more concentrated than in the one-type baseline: 37% of firms ever furlough, compared with 46%. Among high-volatility firms, 66% ever furlough, compared with 23% among low-volatility firms. Persistence is driven by high-volatility firms, because low-volatility firms do not furlough in years 1–5. Among firms that furlough in years 1–5, the furlough probability in years 6–10 is higher than in the one-type baseline (54% vs. 43%). Among firms that do not furlough in years 1–5, the furlough probability in years 6–10 is much higher for high-volatility than for low-volatility firms (17% vs. 2%).

When the ax-ante heterogeneous economy has a calibration to match the baseline furlough share, the volatility differences alone do not fully explain the persistence gap. A high-volatility firm has higher incentives to furlough (evidenced by the higher furlough share), yet the persistence gap deepens with the experience channel. This indicates that the experience channel amplifies the persistence generated by volatility differences.

Table 13 shows three economies with ex-ante types: the ex-ante baseline (1), an economy without the experience channel (2), and an economy without the furlough option (3). As before, column (2) recalibrates the administrative furlough cost so that the share of firm-years with a furlough equals the

Table 12: Baseline and the economy with ex-ante volatility types

	(1)	(2) Ex-ante volatility types		
	Baseline	Pooled	Low σ	High σ
Targeted in the baseline				
Share of firm-years with a furlough	0.211	0.211	0.106	0.335
Furlough intensity	0.056	0.060	0.048	0.065
P(furlough yrs 6–10 | furlough yrs 1–5)	0.428	0.535	–	0.535
P(furlough yrs 6–10 | no furlough yrs 1–5)	0.073	0.081	0.019	0.171
Share of firm-years hiring	0.563	0.577	0.636	0.506
Hire intensity	0.263	0.276	0.298	0.242
Share of firm-years laying off	0.162	0.157	0.093	0.234
Layoff intensity	0.121	0.126	0.108	0.135
SD of log employment	0.959	1.006	0.933	1.035
Untargeted				
Share of firms ever furloughing	0.457	0.369	0.228	0.660
Exit rate	0.071	0.082	0.111	0.047
Parameters				
Innovation SD σ_ε	0.2064		0.1664	0.2464
Share of entrants	1		0.944	0.056
Share of incumbent firm-years	1		0.793	0.207

(1) Baseline (T13). (2) Same parameters, except two permanent volatility types $\sigma_L, \sigma_H = \sigma_\varepsilon \mp 0.04$; the entry share of the low type, $\pi_{low} = 0.944$, is chosen so that the pooled share of firm-years with a furlough equals the value in (1). Both at $p = 1$ with c_e solved from free entry. "Low σ" and "High σ": the same moments computed on each type's firm-years (cohort moments on each type's firm lives). –: no low-type firm in the cohort sample furloughs in years 1–5. Moments for incumbents with ≥ 1 FTE in $t-1$ and t.

ex-ante baseline value (21%); all other parameters are unchanged. Even without the experience channel, high-volatility firms furlough more often (32% vs. 12% of firm-years) and more intensively (6.8% vs. 4.7%) than low-volatility firms. Removing the experience channel halves the persistence gap, from 45.4 to 22.6 percentage points. The reduction comes mainly from high-volatility firms that furlough in years 1–5: their furlough probability in years 6–10 falls from 53.5% to 31.8%. For high-volatility firms, the gap falls from 36.4 to 14.0 percentage points. Without the experience channel, some low-volatility firms furlough in years 1–5, and their gap is 12.5 percentage points. In the economy without ex-ante types, removing the experience channel reduces the persistence gap from 35.5 to 11.5 percentage points, so about a third of the gap remains; with ex-ante types, half of it remains. Furloughs are also less concentrated without the experience channel: 46% of firms ever furlough, compared with 37% in the ex-ante baseline.

Table 14 shows productivity and firm dynamics relative to the economy with ex-ante types but without the furlough option (column 3). With the furlough option, output per active worker (Y/L) is 0.26% higher and labor is better allocated: the SD of log MRPL is 1.2% lower. The improvement in allocation is larger for high-volatility firms, whose SD of log MRPL falls from 0.350 to 0.342, than for low-volatility firms, whose SD falls from 0.315 to 0.313 (Table 13). This indicates that the furlough option is beneficial for high-volatility firms because they can adjust their workforce at a lower cost, which improves allocation. Firms also live longer (0.5%) and exit less (0.5%), and employment-weighted productivity is lower (0.5%). Mean employment is 1.2% higher, while the number of active workers is 0.1% lower. High-volatility firms are almost twice as large as low-volatility firms (37.1 vs. 19.5 workers), and the increase in mean employment comes from them: with the furlough option, high-volatility firms employ 1.4% more workers, while the size of low-volatility firms is almost unchanged (Table 13). Job creation and job destruction are lower, by 1.1% and 1.8%. These changes go in the same direction as in the economy without ex-ante types, but the changes in exit and firm lifetime are larger.

Without the experience channel (column 2), Y/L is higher still (100.39 vs. 100.26), although labor is slightly less well allocated than in the ex-ante baseline (98.86 vs. 98.81). The higher Y/L comes with higher employment-weighted productivity, which is now above the economy without the furlough option (100.76 vs. 99.48 in the ex-ante baseline). High-volatility firms are also larger than in the ex-ante baseline (37.4 vs. 37.1 workers), while low-volatility firms are not (19.5 in both). The exit rate and firm lifetime are close to their values without the furlough option (99.97 and 100.04). Job creation and job destruction are higher than in the ex-ante baseline but still below the economy without the furlough option.

The furlough option raises welfare by 0.18% in consumption-equivalent terms. About half of the gain comes from higher consumption (0.09%) and half from lower labor disutility, because fewer workers are active (0.10%). Welfare is almost the same without the experience channel than in the ex-ante baseline (0.192% vs. 0.184%). The whole difference comes from consumption (0.096% vs. 0.088%), because the output price is lower; the labor disutility component is almost unchanged (0.095% vs. 0.097%). This indicates that having ex-ante heterogeneity does substantially change the welfare results from the baseline

Table 13: Ex-ante volatility types: baseline, experience off and no furlough option

	(1) Baseline with types			(2) Experience off, τ_f recalibrated			(3) No furlough option		
	Pooled	Low σ	High σ	Pooled	Low σ	High σ	Pooled	Low σ	High σ
Targeted in the baseline									
Furlough share	0.211	0.106	0.335	0.211	0.121	0.318	–	–	–
Furlough intensity	0.060	0.048	0.065	0.061	0.047	0.068	–	–	–
$P(\mathrm{F}_{6\text{–}10} \mid \mathrm{F}_{1\text{–}5})$	0.535	–	0.535	0.318	0.160	0.318	–	–	–
$P(\mathrm{F}_{6\text{–}10} \mid \text{no } \mathrm{F}_{1\text{–}5})$	0.081	0.019	0.171	0.092	0.035	0.178	–	–	–
Hiring share	0.577	0.636	0.506	0.577	0.636	0.506	0.576	0.635	0.506
Hire intensity	0.276	0.298	0.242	0.277	0.299	0.243	0.277	0.299	0.244
Layoff share	0.157	0.093	0.234	0.158	0.092	0.236	0.161	0.096	0.239
Layoff intensity	0.126	0.108	0.134	0.126	0.108	0.134	0.129	0.110	0.138
SD of log employment	1.006	0.933	1.035	1.008	0.934	1.038	1.003	0.931	1.035
Untargeted									
Firms ever furloughing	0.369	0.228	0.660	0.464	0.330	0.737	–	–	–
Exit rate	0.082	0.111	0.047	0.082	0.112	0.047	0.082	0.111	0.047
SD of log MRPL	0.343	0.313	0.342	0.343	0.313	0.343	0.347	0.315	0.350
Mean employment	27.58	19.53	37.13	27.68	19.51	37.37	27.25	19.49	36.61
Parameters									
Furlough admin. cost τ_f	0.0936			0.0173			–		
Innovation SD σ_ε		0.1664	0.2464		0.1664	0.2464		0.1664	0.2464
Share of entrants		0.944	0.056		0.944	0.056		0.944	0.056
Share of firm-years		0.793	0.207		0.794	0.206		0.795	0.205

Furlough, hiring and layoff shares: shares of firm-years with a furlough, a hire ($n_t > n_{t-1}$) and a layoff ($n_t < 0.93\, n_{t-1}$). $P(\mathrm{F}_{6\text{–}10} \mid \mathrm{F}_{1\text{–}5})$: annual probability of a furlough in years 6–10 for firms with (without) a furlough in years 1–5. (1) Baseline parameters (T13) with two permanent volatility types $\sigma_L, \sigma_H = \sigma_\varepsilon \mp 0.04$; the entry share of the low type, $\pi_{low} = 0.944$, is chosen so that the pooled share of firm-years with a furlough equals the one-type baseline value (0.211); $p = 1$, $c_e = 0.986$ solved from free entry. (2) Same economy without furlough experience: τ_f is paid in every furlough year and recalibrated to $\tau_f = 0.0173$ so that the pooled share of firm-years with a furlough equals the value in (1); c_e fixed, p re-solved from free entry. (3) Same economy without the furlough option; c_e fixed, p re-solved from free entry. "Low σ" and "High σ": the same moments computed on each type's firm-years (cohort moments on each type's firm lives). –: fewer than 5 of the 143,000 low-type cohorts furlough in years 1–5. Moments for incumbents with ≥ 1 FTE in $t-1$ and t.

results. The experience channel only changes who furloughs, but it barely changes welfare compared to an economy where firms do not face the experience channel.

7 Discussion

This paper asks why a labor market policy is used by few firms, and repeatedly by the same ones. Furloughs are a useful case study because they are easy to identify in register data. Finnish data show that furlough use is concentrated across firms and persistent within them. I build a firm dynamics model in which firms get furlough experience by paying an administrative cost. The model creates less concentration than the data show but matches the targeted persistence.

The main lesson is that the experience channel determines which firms furlough. Removing the channel, while holding the annual share of firms that furlough fixed, spreads furloughs across more firms but leaves welfare almost unchanged. Heterogeneity in firm volatility generates some persistence but not enough to match the data moments, indicating that heterogeneity and experience both explain part of the persistence in furlough use.

The natural extension is an application to an aggregate shock. When a recession hits, inexperienced firms may be unable to furlough in time and lay workers off instead. The experience channel could then matter when the furlough scheme is most needed. Buera et al. (forthcoming) show that the effects of a temporary shutdown on firm dynamics are short-lived if laid-off workers can be recalled without frictions. My results suggest that whether a firm can preserve its matches also depends on its experience.

Table 14: Firm dynamics and welfare: ex-ante volatility types

	With furlough option		
	(1)	(2)	(3)
	Baseline with types	Experience off, τ_f recalibrated	No furlough option
A. Productivity			
Output per active worker, Y/L	100.26	100.39	100
Mean productivity s (unweighted)	99.93	99.92	100
Employment-weighted productivity	99.48	100.76	100
SD of log MRPL	98.81	98.86	100
B. Firm dynamics			
Mean employment	101.21	101.56	100
Exit rate	99.48	99.97	100
Mean firm lifetime	100.54	100.04	100
Job creation rate	98.87	99.18	100
Job destruction rate	98.19	98.51	100
C. Output and employment			
Output Y	100.18	100.19	100
Output price p	99.91	99.90	100
Employment, active workers L	99.88	99.88	100
D. Welfare: relative to (3), consumption equivalent (%)			
Value of the furlough option	+0.184	+0.192	–
From higher consumption	+0.088	+0.096	–
From lower labor disutility	+0.097	+0.095	–

All columns: two permanent volatility types as in Table 13 ($\sigma_L = 0.1664$, $\sigma_H = 0.2464$, $\pi_{low} = 0.944$); pooled over types. Panels A–C: each measure relative to its value in the economy without the furlough option (3), which is set to 100. (1) Baseline parameters with types; $p = 1$, $c_e = 0.986$ solved from free entry. (2) No furlough experience, $\tau_f = 0.0173$ recalibrated so that the share of firm-years with a furlough equals the value in (1). (3) No furlough option. In (2) and (3), $c_e = 0.986$ is fixed and p is re-solved from free entry. Adjustment and fixed costs (ξ_n, ξ_γ, τ_f, τ_l) are resource costs: they are deducted from output in the goods market, as are c_f and c_e. Panels A and B: incumbent firm-years with ≥ 1 FTE in $t-1$ and t; output $y = s(\gamma n)^\alpha$, gross of costs; MRPL of active labor γn, cross-sectional SD of its log averaged over years; lifetime in incumbent years; job flows of incumbents over their employment in $t-1$. **Value of the furlough option**: welfare of the economy k in each column, (1) and (2), relative to the economy without the furlough option (3), $1 + \Delta = (p_3/p_k)\, e^{-A(L_k - L_3)}$, with household utility $\ln C - AL$ and $C = 1/(Ap)$; components $\ln(p_3/p_k)$ (consumption) and $-A(L_k - L_3)$ (labor disutility), which sum to $\ln(1+\Delta)$. A positive value means that households are better off with the furlough option. The labor term equals $-(wL_3/p_3C_3)(L_k/L_3 - 1)$: labor income relative to consumption spending (0.78) times the % change in active labor; it does not depend on the value of A, since $L \propto 1/A$.

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A Appendix

A.1 Empirical

Table 15: Furlough rate conditional on furloughing

	(1)	(2)	(3)	(4)
Constant	8.041***	8.041***	8.041***	8.008***
	(0.1094)	(0.0862)	(0.0848)	(0.0745)
Observations	310,548	310,548	310,546	283,834
R-squared	-0.000	0.021	0.029	0.465
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

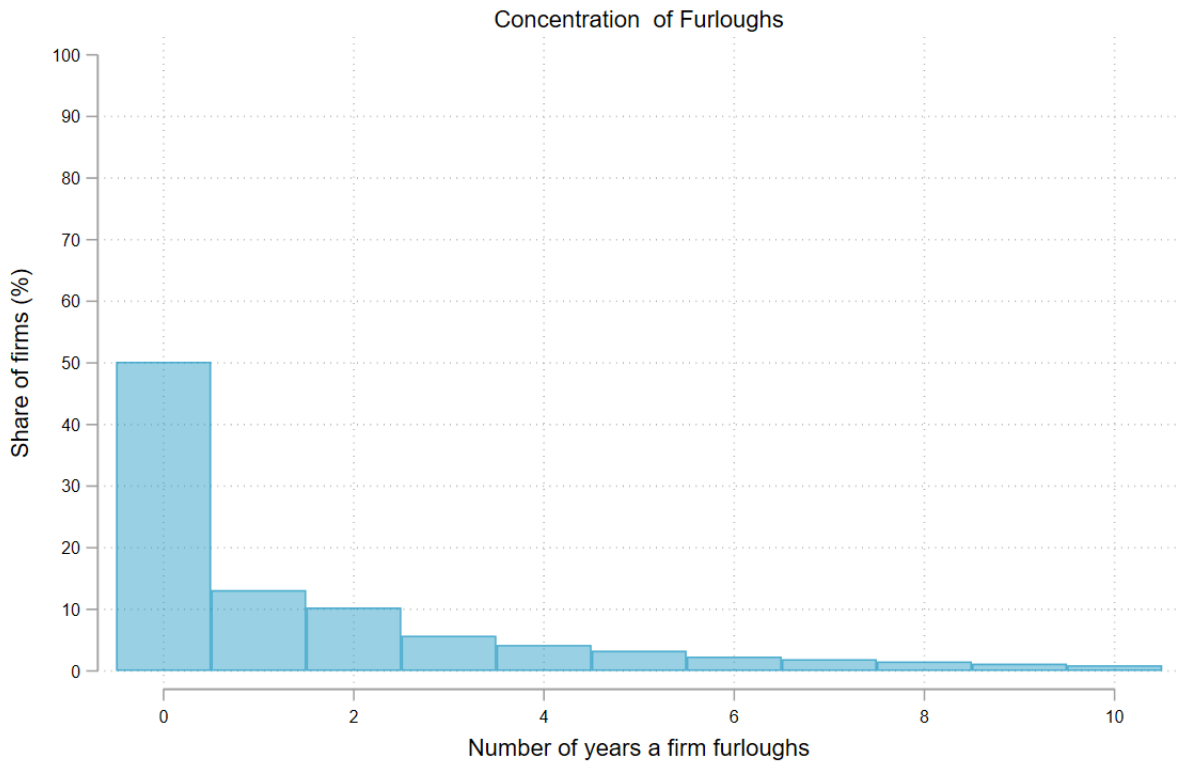


Figure 2: Fraction of firms observed for at least five years that furlough over the years 1994–2021.

Table 16: Furlough probability by size and productivity

Furlough probability	(1)	(2)	(3)	(4)
Employees	0.084***	0.084***	0.081***	0.090***
	(0.0016)	(0.0016)	(0.0019)	(0.0024)
Labor productivity	-0.040***	-0.036***	-0.043***	-0.043***
	(0.0023)	(0.0018)	(0.0016)	(0.0019)
Constant	0.053***	0.052***	0.058***	0.044***
	(0.0026)	(0.0025)	(0.0029)	(0.0033)
Observations	1,885,924	1,885,924	1,885,924	1,850,793
R^2	0.075	0.089	0.161	0.442
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

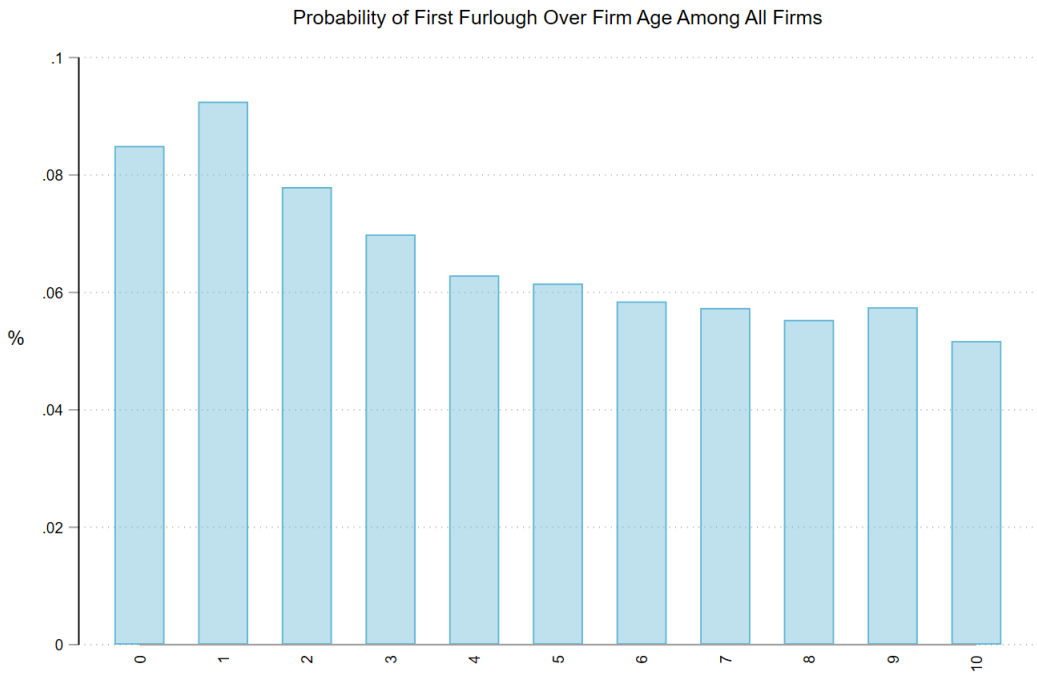


Figure 3: Hazard rate for first furlough over the years 1994–2021

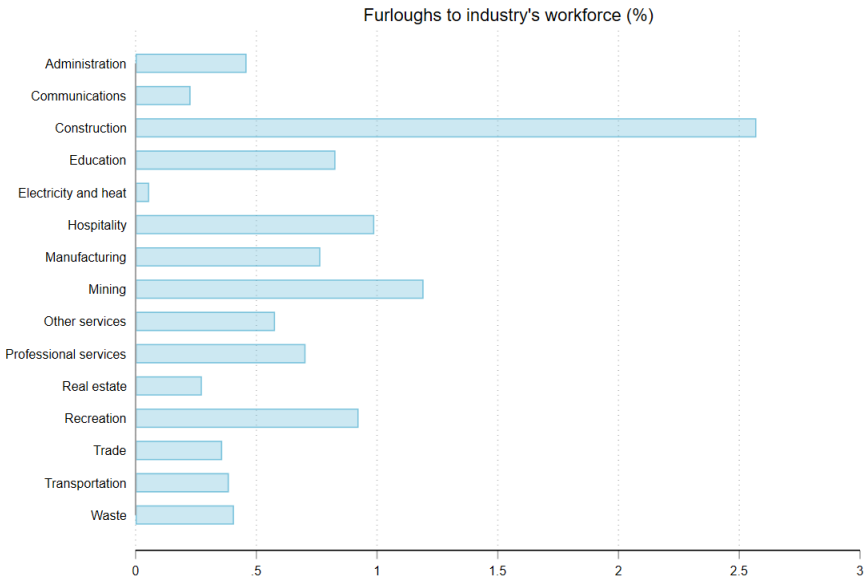


Figure 4: Fraction of furloughed workforce (in full-time equivalent) in each 1-digit industry, over the years 1994–2021

Table 17: Furlough probability with liquidity and leverage measures

	Furlough probability					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	0.000					
	(0.0000)					
Cashflow		-0.000				
		(0.0000)				
Equity ratio			0.000			
			(0.0000)			
Short-term liabilities				-0.005***		
				(0.0007)		
Inventories					0.001	
					(0.0008)	
Interest rate						0.000**
						(0.0001)
Size	0.090***	0.090***	0.090***	0.095***	0.087***	0.092***
	(0.0024)	(0.0024)	(0.0024)	(0.0027)	(0.0031)	(0.0038)
Productivity	-0.043***	-0.043***	-0.043***	-0.044***	-0.052***	-0.053***
	(0.0019)	(0.0019)	(0.0019)	(0.0020)	(0.0028)	(0.0032)
Constant	0.044***	0.044***	0.044***	0.091***	0.052***	0.048***
	(0.0033)	(0.0033)	(0.0033)	(0.0062)	(0.0063)	(0.0053)
Observations	1,843,766	1,850,776	1,850,793	1,794,551	1,081,414	1,115,162
R^2	0.442	0.442	0.442	0.445	0.452	0.469

Extensive margin: dependent variable is an indicator for furloughing in a given period. Regression includes firm fixed effects. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 18: Furlough rate with various liquidity and leverage measures, no fixed effects

	Furlough rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	-0.000					
	(0.0000)					
Cashflow		-0.000*				
		(0.0000)				
Equity ratio			-0.000			
			(0.0000)			
Short-term debt				-0.025***		
				(0.0071)		
Current assets					-0.058***	
					(0.0127)	
Interest rate						-0.000***
						(0.0001)
Constant	1.325***	1.324***	1.324***	1.590***	2.023***	1.443***
	(0.0451)	(0.0450)	(0.0450)	(0.1116)	(0.1688)	(0.0637)
Observations	1,878,848	1,885,907	1,885,924	1,828,709	1,111,498	1,142,366
R^2	0.000	0.000	0.000	0.000	0.001	0.000

No fixed effects. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

A.2 Remove Firms that Furlough More than 80% of the Time

This section repeats the estimations of Section 4 on a sample that excludes firms that furlough in more than 80% of the years they are observed. The exclusion removes about 4% of the firm-years.

Tables 19 and 20 show that the mean furlough probability falls from 16.5% to 13.3% and the mean furlough rate from 1.32 to 1.01. Firm fixed effects still explain much more of the variation than year or industry fixed effects. For the furlough probability, the R^2 is 0.32 with firm fixed effects, compared with 0.06 with industry and 0.02 with year fixed effects. For the furlough rate, the corresponding values are 0.25, 0.03, and 0.02.

Table 21 shows that furlough use remains persistent. Firms that furloughed at least once in their first five years have an average annual furlough probability of 34% over the next five years, compared with 7% for firms that did not. In the full sample, the probabilities are 43% and 7% (Table 2). The exclusion lowers the probability only for firms that furloughed early, since nearly all habitual furloughers are in this group. The 80% share is computed over the firm's whole observed life, including ages 6–10, so the exclusion partly selects on the outcome and mechanically lowers persistence. The remaining gap of 27 percentage points is therefore a conservative estimate.

Tables 22 and 23 show that the furlough rate and probability fall with productivity and rise with firm size. For the furlough rate, the productivity coefficient ranges from -0.42 to -0.58, compared with -0.51 to -0.63 in the full sample (Table 3). The size coefficient is smaller without firm fixed effects (0.07 vs. 0.13) and larger with them (0.25 vs. 0.17).

Tables **??**–25 show that a fall in revenue is associated with a higher furlough probability and rate, and that persistent revenue volatility is associated with more furloughs. For the furlough rate, the volatility coefficient decreases from 1.48 to 0.68 when firm fixed effects are added, compared with 1.97 to 0.71 in the full sample (Table 4). Unlike in the full sample, firm size remains positively associated with the furlough rate within firms after controlling for volatility (0.095, compared with an insignificant -0.030).

Tables 26 and 27 show that financial variables remain weak predictors. Short-term liabilities are negatively associated with the furlough rate, and the interest rate coefficient is positive but economically negligible. Unlike in the full sample, the inventory and cash-flow coefficients are not statistically significant.

Table 19: Furlough probability in firms that furlough less than 80% of the time

Furlough probability	(1)	(2)	(3)	(4)
Constant	0.133***	0.133***	0.133***	0.135***
	(0.0030)	(0.0027)	(0.0019)	(0.0019)
Observations	1,809,705	1,809,705	1,809,705	1,777,532
R^2	0	0.0176	0.0607	0.3194
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Extensive margin: dependent variable is an indicator for furloughing in a given period. Sample consists of firms that furlough less than 80% of the time. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 20: Furlough rate in firms that furlough less than 80% of the time

Furlough rate	(1)	(2)	(3)	(4)
Constant	1.005***	1.005***	1.005***	1.023***
	(0.0343)	(0.0301)	(0.0271)	(0.0262)
Observations	1,809,705	1,809,705	1,809,705	1,777,532
R^2	0	0.0172	0.0271	0.2507
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Intensive margin: dependent variable is the furlough rate. Sample consists of firms that furlough less than 80% of the time. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 21: Furlough probability in years 6–10 by furlough use in years 1–5 in firms that furlough less than 80% of the time

	(1)	(2)	(3)
Panel A. Furloughed in years 1–5			
Constant	0.343***	0.343***	0.343***
	(0.0024)	(0.0024)	(0.0024)
Observations	37,819	37,817	37,817
R^2	0	0.020	0.057
Panel B. Did not furlough in years 1–5			
Constant	0.072***	0.072***	0.072***
	(0.0007)	(0.0007)	(0.0007)
Observations	121,538	121,538	121,538
R^2	0	0.014	0.033
Year FE		✓	
Industry FE			✓

Dependent variable is the annual furlough probability over the next five years. Panel A: firms that furloughed in their first five years of life. Panel B: firms that did not. Sample excludes firms that furlough in more than 80% of the years they are observed. Early years refers to the first five years of the firm's lifetime. Firms born in 1995 or later, so that the first years are observed completely. The data end in 2021. The firm must be observed for at least ten years; the estimation sample consists of firm ages 6–10. Results from a linear probability model. Industry at three-digit level. Standard errors are clustered at the firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 22: Furlough rate in firms that furlough less than 80% of the time

Furlough rate	(1)	(2)	(3)	(4)
Employees	0.071***	0.068***	0.065***	0.253***
	(0.0082)	(0.0083)	(0.0098)	(0.0226)
Labor productivity	-0.420***	-0.367***	-0.452***	-0.577***
	(0.0342)	(0.0259)	(0.0259)	(0.0363)
Constant	1.019***	1.008***	1.036***	0.817***
	(0.0355)	(0.0316)	(0.0241)	(0.0394)
Observations	1,809,705	1,809,705	1,809,705	1,777,532
R^2	0.003	0.020	0.031	0.254
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Intensive margin: dependent variable is the furlough rate. Sample consists of firms that furlough less than 80% of the time. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 23: Furlough probability in firms that furlough less than 80% of the time

Furlough probability	(1)	(2)	(3)	(4)
Employees	0.066***	0.065***	0.065***	0.088***
	(0.0013)	(0.0013)	(0.0015)	(0.0024)
Labor productivity	-0.034***	-0.030***	-0.038***	-0.043***
	(0.0021)	(0.0016)	(0.0014)	(0.0020)
Constant	0.049***	0.048***	0.050***	0.020***
	(0.0022)	(0.0022)	(0.0021)	(0.0032)
Observations	1,809,705	1,809,705	1,809,705	1,777,532
R^2	0.052	0.069	0.108	0.335
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Extensive margin: dependent variable is an indicator for furloughing in a given period. Sample consists of firms that furlough less than 80% of the time. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 24: Furlough probability and persistent revenue volatility in firms that furlough less than 80% of the time

Furlough probability	(1)	(2)	(3)	(4)
SD of Δ log revenue	0.126***	0.126***	0.071***	0.037***
	(0.0051)	(0.0049)	(0.0030)	(0.0028)
Size	0.064***	0.063***	0.063***	0.083***
	(0.0013)	(0.0012)	(0.0015)	(0.0025)
Productivity	-0.050***	-0.043***	-0.055***	-0.061***
	(0.0029)	(0.0022)	(0.0020)	(0.0028)
Constant	0.032***	0.032***	0.049***	0.025***
	(0.0025)	(0.0023)	(0.0024)	(0.0039)
Observations	1,312,370	1,312,370	1,312,370	1,293,378
R^2	0.054	0.076	0.114	0.363
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Extensive margin: dependent variable is an indicator for furloughing in a given period. Sample consists of firms that furlough less than 80% of the time. Volatility measured as 3-year rolling standard deviation of Δ log revenue. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 25: Furlough rate and persistent revenue volatility in firms that furlough less than 80% of the time

Furlough rate	(1)	(2)	(3)	(4)
SD of Δ log revenue	1.475***	1.491***	1.031***	0.679***
	(0.0716)	(0.0661)	(0.0574)	(0.0537)
Size	0.013*	-0.001	-0.008	0.095***
	(0.0076)	(0.0067)	(0.0086)	(0.0265)
Productivity	-0.603***	-0.507***	-0.648***	-0.809***
	(0.0487)	(0.0367)	(0.0369)	(0.0504)
Constant	0.899***	0.893***	1.048***	1.005***
	(0.0377)	(0.0334)	(0.0228)	(0.0505)
Observations	1,312,370	1,312,370	1,312,370	1,293,378
R^2	0.014	0.036	0.041	0.296
Year FE		✓		
Industry FE			✓	
Firm FE				✓

Intensive margin: dependent variable is the furlough rate. Sample consists of firms that furlough less than 80% of the time. Volatility measured as 3-year rolling standard deviation of Δ log revenue. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 26: Furlough rate with various liquidity and leverage measures in firms that furlough less than 80% of the time

	Furlough rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	0.000					
	(0.0000)					
Cashflow		-0.000				
		(0.0002)				
Equity ratio			-0.000			
			(0.0000)			
Short-term liabilities				-0.131***		
				(0.0115)		
Inventories					-0.016	
					(0.0107)	
Interest rate						0.000**
						(0.0002)
Size	0.253***	0.253***	0.253***	0.361***	0.209***	0.257***
	(0.0226)	(0.0226)	(0.0226)	(0.0301)	(0.0394)	(0.0427)
Productivity	-0.579***	-0.577***	-0.577***	-0.583***	-0.668***	-0.773***
	(0.0363)	(0.0363)	(0.0363)	(0.0374)	(0.0520)	(0.0592)
Constant	0.819***	0.817***	0.817***	2.160***	1.101***	0.950***
	(0.0395)	(0.0394)	(0.0394)	(0.1069)	(0.0872)	(0.0701)
Observations	1,770,718	1,777,515	1,777,532	1,724,164	1,031,679	1,072,110
R^2	0.254	0.254	0.254	0.259	0.264	0.301

Intensive margin: dependent variable is the furlough rate. Sample consists of firms that furlough less than 80% of the time. Regression includes firm fixed effects. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 27: Furlough probability with various liquidity and leverage measures in firms that furlough less than 80% of the time

	Furlough probability					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	0.000					
	(0.0000)					
Cashflow		-0.000				
		(0.0000)				
Equity ratio			0.000			
			(0.0000)			
Short-term liabilities				-0.004***		
				(0.0007)		
Inventories					0.001	
					(0.0008)	
Interest rate						0.000**
						(0.0001)
Size	0.088***	0.088***	0.088***	0.093***	0.086***	0.091***
	(0.0024)	(0.0024)	(0.0024)	(0.0028)	(0.0032)	(0.0039)
Productivity	-0.043***	-0.043***	-0.043***	-0.044***	-0.053***	-0.054***
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0028)	(0.0032)
Constant	0.020***	0.020***	0.020***	0.063***	0.021**	0.024***
	(0.0032)	(0.0032)	(0.0032)	(0.0062)	(0.0066)	(0.0052)
Observations	1,770,718	1,777,515	1,777,532	1,724,164	1,031,679	1,072,110
R^2	0.335	0.335	0.335	0.338	0.345	0.375

Extensive margin: dependent variable is an indicator for furloughing in a given period. Sample consists of firms that furlough less than 80% of the time. Regression includes firm fixed effects. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

A.3 Furlough Probability Persistence

Table 28: Furlough probability given that the firm has not furloughed in the first five years: additional controls

Furlough probability	(1)	(2)	(3)
Employees	0.045***	0.045***	0.048***
	(0.0006)	(0.0006)	(0.0006)
Labor productivity	-0.017***	-0.020***	-0.021***
	(0.0011)	(0.0011)	(0.0012)
Constant	0.037***	0.038***	0.034***
	(0.0010)	(0.0010)	(0.0010)
Observations	248,493	248,493	248,492
R^2	0.028	0.048	0.083
Year FE		✓	
Industry FE			✓

Dependent variable is the furlough probability over the next five years, given that the firm has not furloughed in its first five years of life. Early years refers to the first five years of the firm's lifetime. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.

Table 29: Furlough probability given that the firm has furloughed in the first five years: additional controls

Furlough probability	(1)	(2)	(3)
Employees	0.075***	0.075***	0.085***
	(0.0015)	(0.0015)	(0.0016)
Labor productivity	-0.059***	-0.053***	-0.071***
	(0.0049)	(0.0049)	(0.0048)
Constant	0.283***	0.281***	0.266***
	(0.0040)	(0.0040)	(0.0040)
Observations	62,678	62,678	62,678
R^2	0.041	0.053	0.134
Year FE		✓	
Industry FE			✓

Dependent variable is the furlough probability over the next five years, given that the firm has furloughed in its first five years of life. Early years refers to the first five years of the firm's lifetime. Industry at 3-digit level. Standard errors are clustered at firm level. *p<0.10, **p<0.05, ***p<0.01.