The Value of Preserving Job Matches During a Crisis*

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Abstract

It is generally difficult to measure the importance of preserving worker-firm relationships, particularly for low-wage jobs that involve general skills. The COVID-19 pandemic led to the sudden and seemingly temporary disruption of millions of otherwise productive employment relationships around the world. Using novel administrative and survey data from Denmark, we study a policy where firms paid up to 25% of wages to furlough instead of firing workers. We find firms derive value from maintaining ties to low-wage and blue collar workers and that preserving those matches is beneficial to firms, suggesting policies that preserve job matches may help speed-up recovery.

Keywords: match value, employment subsidies, crisis management, personnel management
JEL Codes: J3, J63, H12, H32, H5, M54

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1 Introduction

The value of a job match depends on how productive a particular employment relationship is relative to the next-best option for the worker and the firm. Labor economists have long recognized that the presence of match value can help explain important empirical facts, including the life-cycle pattern of job mobility (Topel and Ward 1992; Neal 1999), the wage-tenure profile (Jovanovic 1979; Farber and Gibbons 1996), the existence of task- or firm-specific human capital (Gibbons and Waldman 2004) and the costs of job displacement (Lalonde et al. 1993; Lachowska et al. 2020). If match value is a significant feature of the labor market, the end of a job will be damaging for the worker, the employer, or both. As either party can unilaterally destroy a job match notwithstanding potential losses, job destruction can be inefficient when there are barriers to bargaining (Farber 1999). However, it is not clear how many matches are, indeed, worth preserving, and whether – often expensive – policies designed to preserve job matches are worthwhile.

In this paper, we provide evidence that firms derive substantial value from even their lowest-level and lowest-paid jobs, and that preserving those matches is beneficial to their growth and survival. Our analysis is based on novel survey and administrative data from Denmark collected in the context of the sudden and far-reaching labor market disruption caused by the COVID-19 pandemic. Ordinarily when a job match ends, outcomes are endogenous to changes in the value of the match for the worker or the firm. The nature of the COVID-19 induced economic shock — an abrupt and acute risk to public health — was unique in that, unlike most recessions, nothing fundamental seemed to have changed about the economy. Job matches that were valuable just before the pandemic would continue to be just as productive in the absence of the pandemic. However, millions of workers were idled as workplaces closed and social distancing brought economic activity to a halt.

Like many European governments, Denmark focused on policies that would save job matches by heavily subsidizing furloughs. Workers furloughed under the program were barred from working, but the Danish government would pay 75 percent of wages for salaried workers and 90 percent for non-salaried, up to a cap of 30,000 DKK per month. The primary outside option was to fire workers. In Denmark, there are no explicit firing costs, but firms are required to give notice in advance of termination, which has much the same effect as a mandatory severance payment. For white collar workers, mandatory notice periods are determined relative to a worker's tenure and can be several months long. However, for blue collar workers, implied severance costs are quite low. We show that when firms furloughed white collar workers, it would almost always have been much more costly to fire them.

However, for the majority of blue collar workers, firms anticipated furlough costs were higher than the cost of simply firing them and paying their wages through the mandatory notice period. From this set of facts, we infer that firms perceived non-trivial value in preserving those jobs.

We next address the question of whether, or to what extent, furlough aid was necessary to maintain job matches. Given their lengthy notice periods, firms might have chosen to hoard their white collar workers and possibly some portion of their blue collar workers, too. To consider this, we assess the extent to which the program increased furloughs and reduced layoffs. Because Denmark's aid programs were open to all firms and there was no randomization of aid, addressing selection into take-up is challenging. We estimate the average effect of aid on aid-takers using two approaches: a conventional model of selection on observables, and by comparing actual layoffs and furloughs to planned layoffs and furloughs firm managers anticipated making immediately before aid became available. We were able to elicit the latter counterfactual choices because our survey was conducted during the first wave of lockdowns. As such, managers were answering our survey precisely when they were making layoff or furlough decisions and waiting to see what type of aid packages might become available. A growing body of evidence shows that managers are excellent at forecasting changes in the inputs and outputs of their own firms under difficult circumstances (Barrero et al. 2020; Bloom et al. 2019a; Bachmann et al. 2021) and we provide supplementary evidence that Danish managers counterfactual forecasts are reliable using data from administrative records.

Under both models, we find that firms that took aid increased the share of workers they furloughed by about 24 percentage points. The key question is what firms would have done with those workers otherwise. Using our model of selection on observables, we find the policy reduced layoffs by about 3 percentage points. However, this result is largely an artefact of the negative selection into furlough aid. Our survey data show that firms who took labor aid anticipated layoffs that were 16 percentage points higher than firms that did not. With this correction, the program appears to have reduced layoffs by 24 percentage points; nearly identical to the increase in furloughs. While both models have limitations, we argue that the latter model is likely closer to the true estimate and that the majority of workers furloughed would have been laid off otherwise.

By having firms partially responsible for furlough costs, the Danish policy was reasonably cost-effective. The cap on furlough payments nudged firms toward furloughing their lowest-paid workers. Our data show that firms responded to those incentives: the incidence of furlough and the number of furlough days are both decreasing in the worker's monthly

salary. Additionally, the Danish program was relatively well-targeted: most aid was taken up by firms that experienced severe shocks to their revenue and employment. Conversely, we see little change in the revenues of firms that did not take up aid, even among those that were eligible. A back-of-the-envelope calculation suggests that the net additional cost to the Danish government (relative to paying unemployment insurance) was approximately US$15 per furlough day for a part time worker, and US$120 for a full time worker.

We would expect firms to generally only act to preserve job matches through the furlough program if they thought it would benefit the bottom line. We find that this was indeed the case. To address the endogeneity of take-up, we construct instruments based on the incentives built into the program, which make the total cost savings from furlough substantially higher for some workers than for others. In particular, firms that before the pandemic had relatively high fraction of white collar and highly-paid workers will find furlough more attractive than those that can fire their workers at relatively low cost, all else equal. As the composition of the workforce in each firm was chosen prior to and without anticipation of the pandemic, we use the share of workers eligible for the implied two-week severance pay as an instrument for the decision to take up furlough aid. The IV results suggest that regression estimates are biased downward. The decision to take up furlough aid led firms to be more likely to survive by the end of 2020, to have higher employment growth, and higher sales in December 2020 than they would have otherwise.

Our paper contributes to a growing body of evidence suggesting that firms derive considerable value from their low-paying blue collar jobs, and that helping firms preserve those matches can support their recovery from severe, but temporary, shocks to revenue. A job's value to a firm corresponds to what it would lose if a match were suddenly to dissolve without any other changes to the economic environment. Recent work has shown that firms find it difficult to hire replacement workers when their employees suddenly depart due to death (Jäger and Heining 2019) and leave-taking (Schmutte and Skira 2022), and that this is the case even when those workers have less education or are employed in less skill-intensive occupations. Here, we show more directly that firms were willing to pay to hold onto low-paid workers. Our findings thus complement research documenting the difficulty of rebuilding match-specific capital after workers are laid off (Friebel et al. 2019; Lachowska et al. 2020). It is also consistent with the observation of Mercan et al. (2020) that recessions may be prolonged when many unemployed workers are trying to match with many vacant jobs.

Our paper is also relevant for policy. In the early days of the pandemic, some in the United States felt that providing direct payroll support was unnecessary because low-wage jobs could easily be refilled once the crisis passed (e.g. Zwick 2020). At least in Denmark,

firms seem willing to pay to preserve match-specific capital in such jobs. The value in doing so would be to make it easier to recover. Using U.S. data, Gallant et al. (2021) show that the expected speed of recovery depends on the share of workers that were laid off with the expectation of being recalled. While a full assessment is outside the scope of this paper, we compare the performance in 2020 of labor markets in Denmark and the United States. A key difference between the two countries is that the Danish furlough policy focused much more on preserving existing job matches. Both countries experienced similar levels of labor market slack during the shutdown, but the unemployment rate in Denmark recovered more quickly.[1] Our results suggest this was a consequence of firms being able to quickly bring furloughed workers back on the job as economic circumstances improved.[2] We conclude that preserving job matches should be carefully considered as part of the policy response toolkit, especially as disruptive events (including climate and health crises) are expected to intensify (e.g. Jia et al. 2022).

2 The Institutional Environment

In early 2020, businesses across the world were forced to shut down to slow the spread of SARS-Cov-2. There was considerable uncertainty about how long these shutdowns would last. Hoping for a return to normal, managers introduced remote work arrangements where possible (Dingel and Neiman 2020), and otherwise made plans to furlough or lay off other employees. In response, the Danish government allocated nearly 13 percent of GDP in aid. There were three main types of aid: aid to help firms cover fixed costs, relief from tax payments, and aid to offset the cost of allowing employees to miss work. Our focus is on the latter, more specifically the aid directed at putting workers on furlough, and the revealed preference regarding the value Danish firms placed on being able to preserve job matches

[1] Of course by preserving job matches, the Danish government may also have prevented the reallocation of labor away from sectors that declined during the pandemic, and also reduced the incentives for Danish firms to implement work-from-home arrangements (Barrero et al. 2020). We find that furloughs were concentrated in industries and occupations less likely to accommodate remote work.

[2] Analysis of the U.S. policy response to COVID-19 has highlighted the differences in type of unemployment, documenting that temporary-layoff unemployment dissipated relatively quickly while a truly jobless unemployment remained persistent (Hall and Kudlyak 2020; Barrero et al. 2020). Bartik et al. (2020b) find that U.S. states with more generous unemployment insurance and larger share of Paycheck Protection Program (PPP) loans had "milder declines and faster recoveries", though findings on the effectiveness of PPP have been mixed (Hubbard and Strain 2020; Chetty et al. 2020; Granja et al. 2020). In other countries, some wage and furlough subsidy programs were popular and largely seen as successful (Bell et al. 2021; Core and De Marco 2021), though again the evidence is mixed (Kozeniauskas et al. 2020; Cirera et al. 2021). We provide much more direct evidence that allowing firms to hold onto their existing workers was particularly valuable.

through the crisis.[3]

2.1 Furlough Support

The furlough aid program subsidized payroll for furloughed workers as long as they did not work at all – even from home. Workers on furlough received their full regular salary, a portion of which was paid by the government and, crucially, the remainder had to be paid by the firms. It also created incentives for firms to furlough lower-paid workers: firms received a subsidy to cover part of the wages for any furloughed worker: 75 percent for salaried workers (*Funktionaer*) and 90 percent for non-salaried workers. The subsidies were subject to a cap of 30,000 DKK per worker per month. Firms participating in the program were responsible for paying the balance of the worker's regular salary. For example, a salaried worker normally paid 20,000 DKK per month would still receive 20,000 DKK if they were on furlough for a month, with the government paying 15,000 DKK and the firm paying 5,000 DKK. However, a salaried worker paid 40,000 DKK per month would hit the subsidy cap if they were furloughed for a full month, but be under the cap if they were furloughed for only two weeks' worth of work days. In all, over 280,000 unique workers – 9 percent of the Danish labor force – participated in the furlough scheme between March and December 2020.

In practice, most furlough spells were relatively long and were taken by workers with relatively low salaries. Only 25 percent of workers furloughed had a monthly salary above 35,000 DKK (∼5,600 US$).[4] The policy was flexible about how long furlough could last. Furlough support was available for up to 90 days per worker per round, but workers could also be furloughed for as little as one day and multiple times. Therefore, for workers with higher salaries, firms could control the number of furlough days to keep them below the 30,000 DKK monthly cap. Nevertheless, the median furlough lasted 77 days and the 25th percentile furlough was for 62 days.

Furlough support was intended for companies who would otherwise have laid off at least 30 percent of their employees. Determination of eligibility was reliant on self-reports and does not seem to have been binding.[5] The estimated cost of the furlough policy was US$2.6 billion, and overall more expensive to the government than it would have been to support

[3]Furlough is an arrangement where workers are placed on leave from work for a limited period of time. The main difference from a permanent layoff is that the worker maintains their tie to their current employer along with the associated seniority and job title.

[4]Almost 55 percent of furlough days were taken by full-time employees with average monthly pay just under 30,000 DKK (∼4,800 US$). The remaining 45 percent of days were taken by part-time workers with average monthly salary around 12,000 DKK (∼1,900 US$).

[5]For example, we do not observe a discontinuity at 30 percent in the predicted share of employees that would be laid off without aid. See Section 3.

the same number of full-time equivalent workers through the unemployment system.[6]

2.2 Other Types of Aid

Beyond direct payments to support furloughs, the Danish government also provided direct aid for non-salary costs aimed at the hardest-hit firms. Danish firms could take government-backed loans, and were eligible for fixed-cost subsidies if they experienced revenue declines of more than 35 percent (what we call *cost aid*). All firms were eligible for 30 days delay of VAT payments (what we call *fiscal aid*).[7] The different aid programs were not mutually exclusive and any firm meeting the eligibility requirement for a particular program could receive it. In general, we attempt to separate the effects of other programs to help isolate the effect of furlough aid, but the presence of these other programs could have affected which firms took up furlough aid and how that aid was used. Our results indicate that cost aid may have reduced layoffs slightly, but has no relationship with the number of workers a firm put on furlough. The Danish aid programs were similar to those enacted throughout Europe, but with small differences in eligibility thresholds and funding levels.

3 Data Sources

Our analysis is based on linked administrative and survey data. In April 2020, we collected a survey from a representative sample of Danish firms about their experiences with the COVID-19 pandemic and associated public health and economic policies. The survey asked firms about their use of government aid and their decisions to fire and furlough workers to weather the crisis. To help understand the effects of the policy, we also asked firms to report the share of workers they would have laid off and furloughed had aid not been available. We then linked our survey responses to register data on employment, firm accounting information, and job-level administrative records documenting furlough incidence and duration. Using the linked data, we verify the representative nature of our survey, and also show that the survey respondents are accurate by comparing variables that are common in both the survey and administrative data.

[6]Denmark has a "voluntary" unemployment insurance system, where workers can choose to contribute to on a monthly basis. During downturns the government sometimes subsidizes the insurance funds. If workers are not members of an unemployment insurance fund, they may be eligible for government social assistance instead.

[7]The threshold for loans was 50 percent for small firms and 30 percent for large firms.

3.1 Administrative Records

We use the Danish government's register of requests for labor aid support from March to December 2020. The furlough register covers all furlough spells, identifying both the employee that was furloughed, and the firm that employed them through the furlough spell. In all 280,162 unique workers were furloughed and 32,220 firms furloughed at least one worker. The data also report the number of days the worker was furloughed and the total amount that was paid out in furlough aid.

In addition, we have firm accounting data for over 40,000 firms between 2016-2020, including annual revenue and employment. The data are provided by Experian, a private data aggregator that assembles annual reports that all limited liability firms are required to file at the Danish Ministry of Economic and Business Affairs. In these reports, firms must disclose their assets along with various measures of profitability, such as operating revenue and net income.

Finally, we have employment data from Statistics Denmark's eIncome Register (BFL), which is based on income information reported to the Danish tax authority. It includes monthly employment records, including monthly salary, pay period, paid hours, working position, and industry. We have the BFL data from 2019 to 2021, covering 5.6 million worker-firm observations, 3.5 million workers and almost 210,000 firms. We augment the BFL with matched employer-employee data from the Integrated Database for Labor Market Research (IDA) at Statistics Denmark. The IDA provides yearly information on each employment spell that is active in November. We use IDA data to supplement information missing from the BFL, including occupation and tenure in the firm, which we use to calculate potential severance payments.

3.2 Firm Survey

On 23 April 2020 we sent a self-response survey to all private-sector firms with more than 3 employees, of which there are around 45,000 in Denmark. We received 10,642 responses by 1 June 2020 for a response rate of 24 percent. This is an unusually high rate for voluntary online surveys. As a benchmark, Altig et al. (2020); Ben-David et al. (2013); Bloom et al. (2019b) and Bartik et al. (2020a) achieved response rates in firm surveys that ranged from 0.1% to 13%.[8] Using register data, we verify that the respondents are representative of

[8]Participation was voluntary, and no financial compensation was offered to respondents. Our high response rate is likely due to the fact that it was carried out by Epinion, a private survey firm in Denmark that has access to `e-Boks`. `e-Boks` is a secure digital mailbox where individuals and firms can receive mail from the government, their bank, lenders, and so on. Firms expect to receive important government surveys

the population of firms with respect to both firm size and industry (see Section 3.2.1), and construct weights to adjust for any remaining sample selection. All our results are unchanged whether we use weights or not.

The survey included 23 questions, starting with basic firm characteristics and questions about the effect of the pandemic disruption on revenue.[9] We also asked respondents to indicate which of the available aid packages they were eligible for, and if eligible, whether they used them. For all firms, we asked them to report the number of employees they expected to furlough and how many the expected to lay off due to the pandemic. For firms that reported taking aid, we also asked them to report the number of furloughs and layoffs that they had planned to enact if aid was not available.

3.2.1 Survey Validation

We use the data from our survey to measure the effect of taking up labor aid on layoff and furlough decisions. The interpretation of our results depends on their external validity, or the extent to which they apply to the general population of Danish private sector firms. It also depends on the extent to which respondents truthfully report the actual behavior of their firms and their planned behavior in the counterfactual scenario without aid. We find strong support for both criteria.

Sample Selection Because we have access to the population frame from which our sample of firms was drawn, we can assess the extent to which the respondents are representative in terms of the frame variables. Here we focus on industry and firm size.[10] Table 1 reports the distribution of the sampled firms and of the population across firm size bands and major industries. The key contrast is between Columns 4 and 5, which show the share of the sample in each group, and the share of the population in each group. These shares are within a couple of percentage points of one another, indicating that the sample is representative of the population in terms of size and industry. There is a slight bias in the sample toward larger firms, and toward manufacturing firms. We have repeated our analyses after reweighting the data to correct for sample composition and the results are effectively unchanged.

through `e-Boks`.

[9] The full questionnaire is in Appendix C.

[10] Section A in the Appendix provides further evidence of the representative nature of our sample.

Table 1: Distribution of Survey Responses

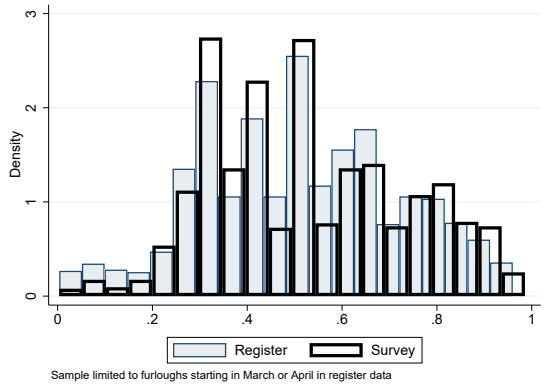
	(1) **Sample size**	(2) **Pop. size**	(3) **Response rate**	(4) **Share in sample**	(5) **Share in pop.**
Firm size					
3-5 emp	3,202	15,768	0.20	0.30	0.36
6-9 emp	2,283	10,488	0.22	0.22	0.24
10-25 emp	2,817	10,860	0.26	0.27	0.24
26-50 emp	1,063	3,801	0.28	0.10	0.09
51+ emp	1,200	3,457	0.35	0.11	0.08
Industry					
Accommodation/Food	472	2,840	0.17	0.04	0.06
Construction	1,477	7,182	0.21	0.14	0.16
Manufacturing	1,561	5,416	0.29	0.15	0.12
Other	2,406	10,497	0.23	0.23	0.24
Professional/Technical	1,116	3,892	0.29	0.11	0.09
Publishing/Broadcasting	788	3,001	0.26	0.07	0.07
Wholesale/Retail	2,745	11,546	0.24	0.26	0.26
Total	10,565	44,374	0.24	1.00	1.00

Notes: Response rates for our firm survey relative to the population frame. The top panel reports response rates by firm size groups, and the bottom panel reports by industry. Column 1 reports the number of survey respondents. Column 2 reports the number of firms in the population frame. Column 3 reports the response rate as the ratio of Columns 1 and 2. Column 4 reports the number of firms in each group as a share of the total sample. Column 5 reports number of firms in each group as a share of the population.

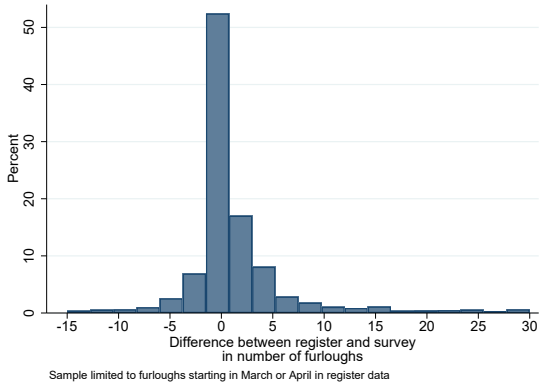
Validity of Survey Responses Another concern is that survey respondents might not provide accurate information. A comparison of survey and administrative data indicates this is not a source of concern. To illustrate, we compare administrative reports on the share of workers furloughed by each firm to the corresponding number reported in the survey. Figure 1a uses histograms to visualize the distributions of both the administrative and the survey measure. The survey reports are not identical, but discrepancies are uniformly small and distributed without any clear pattern. Figure 1b shows the distribution of the difference between the number of registered furloughs and the number implied by the survey response. The survey number is exactly the same for nearly half of the firms and within +/- 5 relative to the register number for approximately 80% of firms. In Appendix A we show that survey responses are also highly accurate for total employment and the take-up of aid. We conclude that there is little evidence of bias and a high degree of precision in the survey reports.

Figure 1: Comparison of Survey and Register Data for Actual Furlough Counts

(a) Distribution of the share of actual furloughed workers



(b) Distribution of the difference in reported furloughs versus registered furloughs

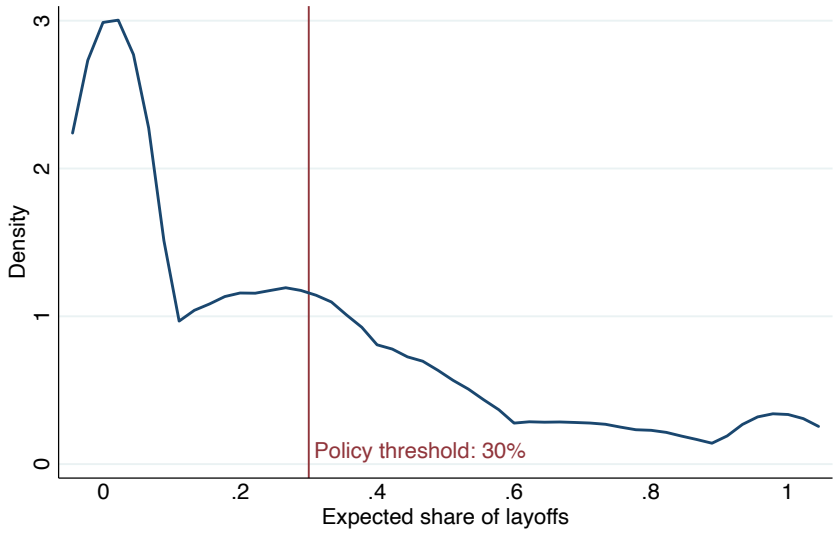


Notes: This graph uses two types of data: (1) data from the Danish government furlough registry (242,126 workers across 29,471 firms) and (2) authors' Danish COVID-19 surve (10,642 responses). Joint sample includes the 3002 firms that have recorded furloughs in the government register and also responded to the COVID-19 survey. Panel (a) plots the distribution of furlough shares at the firm level in both datasets. Panel (b) plots the difference between the number of reported workers furloughed and the number of workers furloughed in the government register for each firm.

Our survey also asks respondents who took up aid to describe the shares of workers they would have laid off and furloughed in the absence of aid. A priori, we expect their responses to these counterfactual scenarios to be accurate on average. Over 90 percent of the respondents were owner-managers or CEOs and thus know — or make — the financial and labor choices in the firm. They are clearly in the best position to make these sorts of

predictions for their firms.[11] Furthermore, at the time of the survey, the manager has very recently considered whether or not it would be beneficial to take up aid, and what they would do if they did not take aid. The salience and recency of those calculations, and the general reliability of the survey answers indicate that the counterfactual information should be accurate.

Figure 2: Distribution of Counterfactual Layoffs if Aid Were Not Taken



Notes: Data from the authors' COVID-19 response survey of Danish firms. Graph includes only aid-taking firms, N=5,868. The variable "expected share of layoffs" is built using the answer to the survey question: "If you had not taken up aid, how many employees would have laid off?", divided by the total number of employees in the firm. The density plot highlights the threshold for aid eligibility (30%).

To add direct empirical evidence that the reported counterfactual furloughs and layoffs are accurate, we check whether respondents defaulted in their reporting of planned layoffs to a clear reference point: the threshold of eligibility for government aid. Furlough aid in Denmark was offered to firms that expected to lay off at least 30 percent of their workforce. If we see bunching of responses around the policy threshold, it would indicate that respondents' answers did not necessarily reflect their true assessment of the number of layoffs they would need to make without aid. We do not find any evidence of this in the data: Figure 2 shows the density of the share of layoffs firms reported they would have made if they did not take aid. Reassuringly, there is no discontinuity at the policy threshold of 30 percent.[12]

[11] The remainder of the respondents were non-managing owners or other administrative staff.

[12] We also conduct the McCrary (2008) test and find the break at the policy threshold is not statistically

4 Selection into Taking Labor Aid

As we will discuss further in Section 5, many Danish firms were willing to pay non-trivial sums to hold onto their production workers. We argue that nature of the COVID-19 shock allows us to interpret furlough decisions as evidence that firms value their ability to preserve matches to specific workers. In support of that interpretaion, we see that the decision to take up furlough aid was not associated with any pre-existing trends in firm-level outcomes. However, the evidence also shows that the firms that took up aid were exactly those firms most affected by the COVID-19 shock, inducing a strong negative selection that we will ultimately need to address.

Figure 3 plots administrative data on employment growth (Figure 3a) and sales growth (Figure 3b) from 2016–2020/21 separately for three groups of firms: those that took aid, those that were eligible, but did not take aid, and those that were ineligible for aid. The levels and trends in both outcomes are nearly identical for all three groups through the end of 2019, suggesting eligibility for aid and the decision to take aid were not associated with pre-pandemic trends in employment or sales.

However, firms that took aid experienced worse outcomes than those that did not. By the end of 2020, firms that took aid experienced a decline in employment growth of almost eight percentage points, falling another 5 percentage points in 2021. Sales growth fell almost 15 percentage points and was around -0.10 by the end of 2020 for aid-takers. For all other firms, employment growth and sales declined steadily, but seem to be following their pre-pandemic trends. Effectively, taking furlough aid is, in the Danish context, a good proxy for whether a firm was actually affected by the disruption from the pandemic. We therefore expect analyses that compare aid-taking firms with firms that did not take aid to be biased by the endogenenity between aid take-up and the effect of the pandemic.

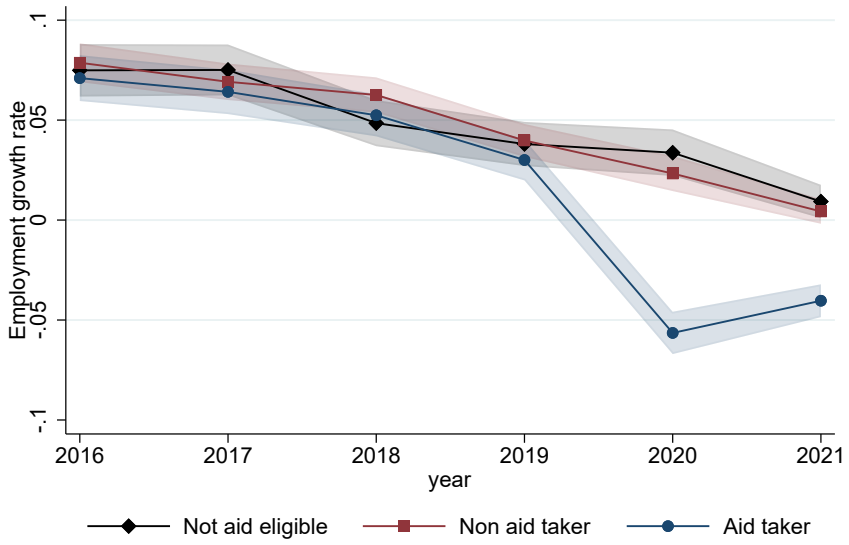
The extreme self-selection observed among Danish firms is not because the disruption was smaller in Denmark than elsewhere, or more narrowly focused. Figure 4a plots the distribution of revenue changes for the population of Danish firms between 2018-2019 in the outlined bars, and for the surveyed firms from January to April 2020 in the shaded bars. While many firms experienced revenue declines in 2019, the shock in April 2020 was substantially larger on average and affected a much larger share of firms. Overall, about one-third more firms experienced declining revenue relative to 2018/2019, and one-quarter more firms faced reductions of revenue above 35 percent (a common threshold for aid).

Approximately 56 percent of firms in our survey reported taking advantage of one or

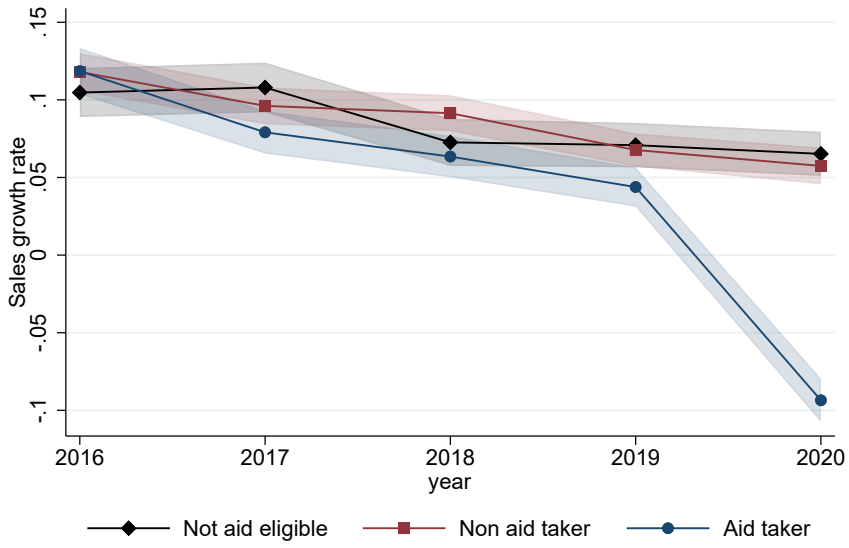
significant. See Figure A.3 in the Appendix.

Figure 3: Comparison of Employment and Sales Growth Across Firms

(a) Employment growth



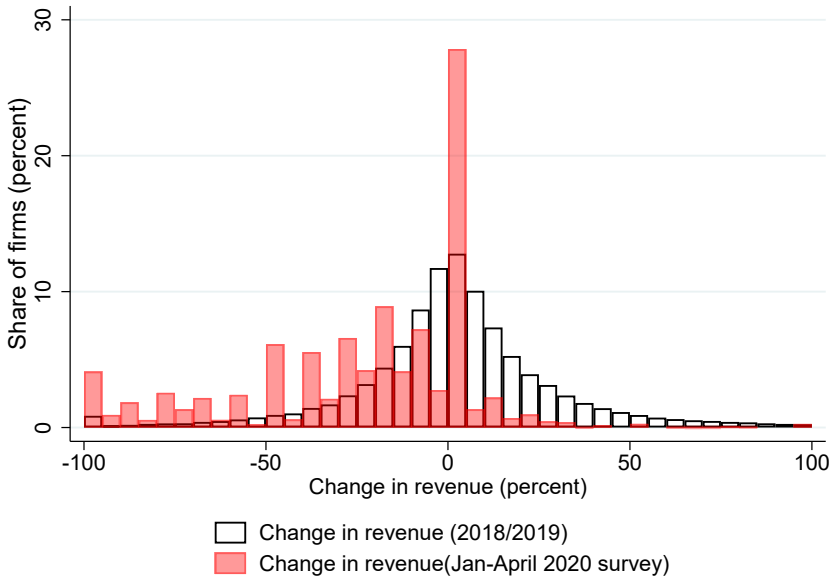
(b) Sales growth



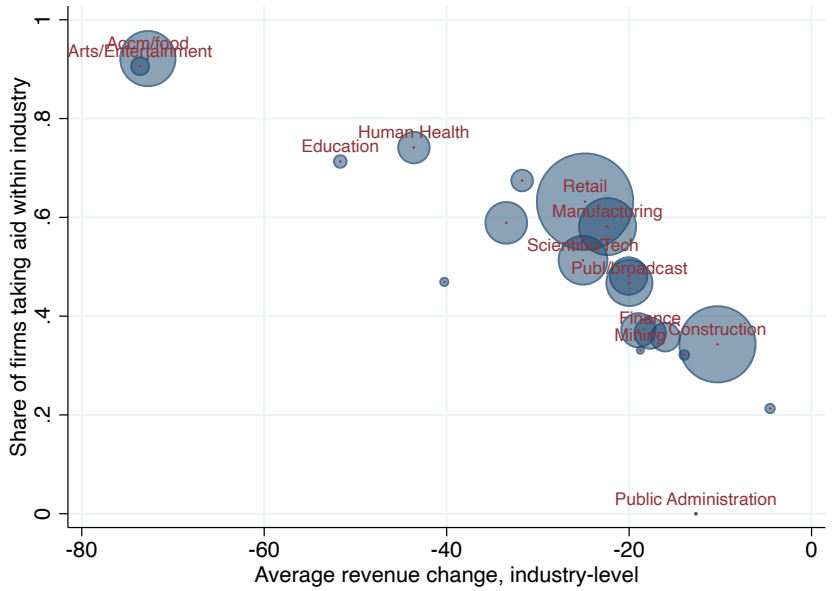
Notes: Graphs include firms in the COVID-19 response survey, matched to administrative employment data from Statistics Denmark in Panel (a) and accounting data from Experian in Panel (b). We plot the time series separately for firms who took aid (blue circles), firms who were eligible, but did not take aid (red squares), and firms that were not eligible for aid (black diamonds). Panel (a) includes firms with more than 3 employees on average and data available for all years between 2015 and 2021. N(not eligible)=1,190, N(non-aid taker)=2,251, N(aid-taker)=1,524. Panel (a) includes firms with more than 3 employees on average and data available for all years between 2015 and 2020. N(not eligible)=1,215, N(non-aid taker)=2,261, N(aid-taker)=1,444.

Figure 4: Revenue Shock and Aid Take-up by Danish Firms

(a) Distribution of revenue change in "normal" and COVID times



(b) Aid take up aid by industry and expected change in revenue



Notes: Figure 4a plots the distribution of the firm level changes in revenue. The outlined black bars represent the change between 2018 and 2019, using Danish register data for the universe of firms with more than 3 employees (N = 40,077). Shaded bars plot the change in revenue reported in the COVID-19 response survey (N = 10,642). Figure 4b reports industry-level average revenue change (x-axis) and the industry-level average aid take-up (y-axis), weighted by industry size. Each circle represents an industry at the 1-digit NACE level, and the size of the circle shows the relative share revenue accounted for by each industry. Observations weighted by the inverse probability of responding to the survey relative to the population of firms.

more government aid programs, and nearly all firms that expected to lose more than half their revenue took some form of aid. Conversely, most firms that report no expected change in revenues also report not being aid recipients.[13] In all industries, more than half of firms expected decreases in revenue from the lockdowns, but some industries were particularly hard hit — notably accommodation and food services, arts and entertainment, and retail. Firms in the hardest-hit industries were the most likely to take up aid (Figure 4b).[14]

5 Firm Responses to Furlough Aid

We are primarily interested in understanding whether the Danish policy was successful in inducing firms to preserve job matches that would have otherwise been severed, and what that reveals about how firms value those matches. First, we study the implied net cost to the firm of each furlough spell. The total cost is what the firm paid out for its share of the worker's salary, but net of any severance cost the firm would have paid if they laid the worker off instead. We then consider what whether workers furloughed under the program would have been laid off instead, using different strategies to address the self-selection of firms into taking up furlough aid.

5.1 Firms Spent Money to Preserve Matches

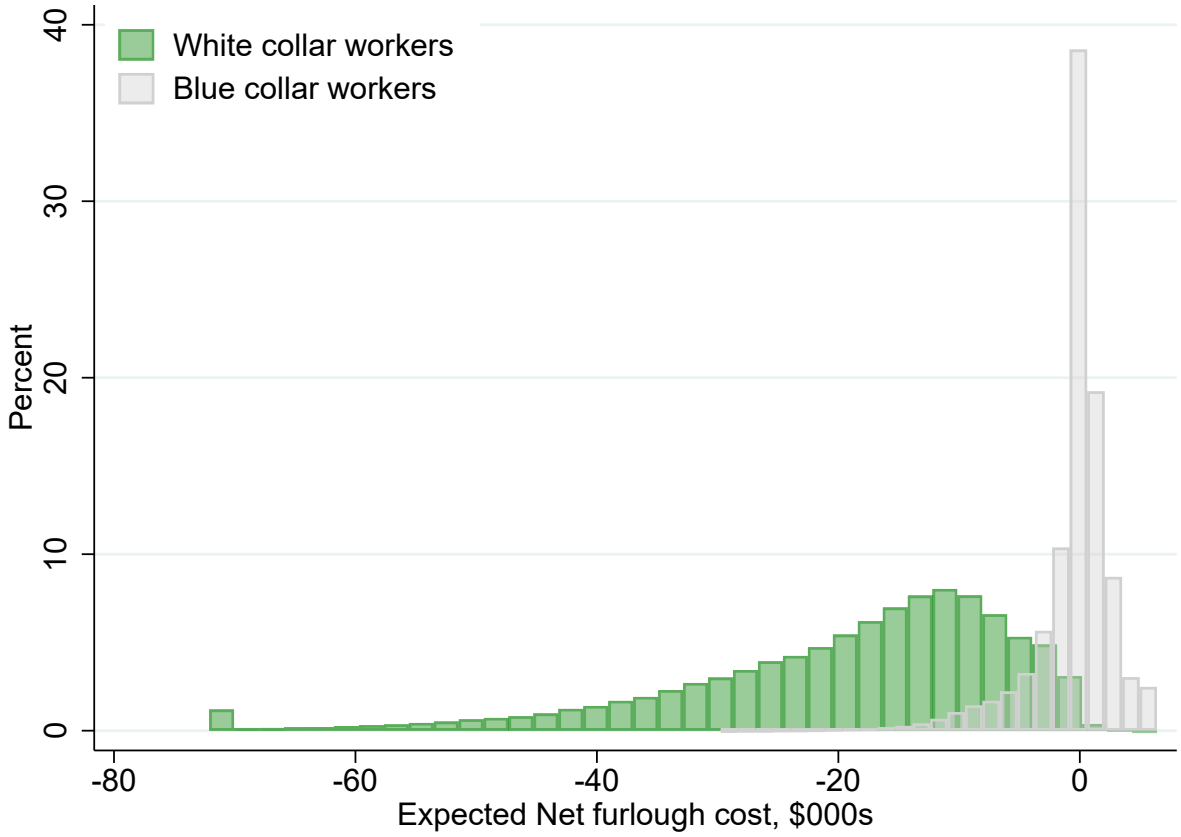
We find clear evidence that firms value matches with their blue-collar workers. Specifically, they were willing to pay higher labor costs (relative to dismissals) to hold onto the employment relationship with those workers. To understand the nature of those costs, we consider both the direct cost of furlough and the alternative cost associated with firing the worker instead. Firms were responsible for paying between 10 and 25 percent of a worker's normal wages during the furlough period, counted as the number of days a worker was furloughed. If they fired a worker instead of furloughing them, a firm would be responsible for payment through the mandatory notice period; effectively a severance payment. Mandatory notice periods range between 2 weeks and six months of full salary depending on tenure and occupation.[15]

[13] The median firm reporting not receiving any aid has an expected revenue change of zero. Note that firms in our survey also report aid take-up with a high degree of accuracy.

[14] The Danish government provided a menu of non-mutually exclusive aid packages: furlough aid, fiscal aid, and cost aid. Table B.2 in the Appendix reports the relationship between firm characteristics and the take-up of different combinations of packages.

[15] For most white-collar and salaried workers employed with less than 6 months of tenure, the notice period 1 month. Between 6-33 months of tenure, it is 2 months, between 34-68 months it is 3 months, between

Figure 5: Furloughs in Denmark: Implicit Net Cost of Furloughs



Notes: Data includes all workers that were furloughed for at least one day, from the Danish government's furlough registry between March to December 2020. The plot shows the distribution of the implicit net firm cost of furlough for all furloughed workers. We calculate the net cost as the firm's predicted furlough payment (25% of the daily salary for each furloughed day for white collar workers – *funktionaer* – or 10% for blue collar workers – *oevrige* or *elev*) minus the estimated amount the firm would be required to pay out over the mandatory notice period if the worker were fired. Darker (green) shade represents the sample of white-collar workers (N=144,880). Lighter (gray) shade represents the sample of blue-collar workers (N=135,550). Bins under -60,000 (for white collar workers) and -35,000 (for blue collar workers) are omitted due to insufficient sample for Danish Statistics clearance

Figure 5 plots the distribution of the anticipated net cost of furlough for all furloughed workers. We calculate this as the difference between the firm's anticipated share of furlough payments and the implied cost of firing the same worker due to mandatory notice laws.[16] There are no pure firing costs in Denmark, but workers have a mandatory period of notice that depends on their occupation, wage rate, and tenure. We treat the worker's pay during the severance period as an implied firing cost.[17]

For about 34 percent of the furloughed workers, the amount the anticipated furlough payments exceeded the implied firing costs. The firm gains no immediate revenue from workers while they are on furlough, so we can conclude that firms put these workers on furlough because they valued the ability to preserve the employment relationship. Presumably, firms expected the pandemic shock to be relatively short. By furloughing workers, they could avoid costs associated with hiring and training a new worker when business conditions improved.

Note that for most white collar workers, the implicit net cost of furlough is negative. This does not imply that firms would not have been willing to pay to preserve those matches as well, but rather simply that firing those workers was strictly dominated by putting them on furlough. This suggests that firms anticipated needing back the labor provided by those workers relatively quickly. If managers thought the pandemic disruption was likely to be long-lasting, they might have been willing to incur the severance cost instead.

Note that our measure of net furlough costs is likely an underestimate, since we assume the firms get no benefit from workers during the mandatory notice period. In practice, some workers likely continue to generate revenue. On the other hand, our anticipated furlough cost, which captures what firms know about furlough costs when making the decision to terminate or furlough, may be an overestimate. If we compute the net cost of furlough using actual furlough payments rather than anticipated furlough payments, the share of workers with positive net cost is smaller, though still economically significant: around 18 percent. We conclude that the true share of workers that firms incurred positive net costs to furlough is somewhere between these two values.

69-103 months of tenure it is 4 months, and for tenure over 103 months (8 years and 7 months) it is 6 months. For blue collar workers, mandatory notice periods are generally around 2 weeks.

[16]The total anticipated payment for a furloughed worker is the number of furlough days multiplied by the implied daily salary, up to the policy cap of DKK30,000. We obtain the implied daily salary from administrative data on the worker's monthly salary in the months before furlough. The firm's share of this predicted furlough bill is 25 percent for salaried workers and 10 percent for non-salaried workers.

[17]For salaried workers, mandatory notice periods are governed by Danish labor law. We get information on mandatory notice periods for non-salaried workers, which are governed only by collective bargaining agreements, from the OECD EPL Database, update 2019 (https://www.oecd.org/els/emp/Denmark.pdf).

5.2 Labor Aid Affected Layoff and Furlough Choices

A key goal of the policy was preserving jobs, and the implicit assumption is that firms would have enacted mass layoffs in the absence of government support. An alternative possibility is that firms would have hoarded that labor anyway, and the furlough program simply defrayed the cost of doing so. While inducing excess furloughs may be desirable from a public health perspective, it is not necessarily so from a labor policy perspective. The evidence in Section 4 suggests that a simple comparison of aid takers and non-takers is problematic, however, since the choice of aid is not random as firms choose to take aid when they anticipate worse conditions.

We take two approaches to identifying the effect of aid-takeup on firms' decisions about layoffs and furloughs. First, we assume that aid take-up is random conditional on observables including the size of the initial revenue shock. Second, we use information elicited from aid-takers about their planned furloughs and layoffs had they not taken up aid. The idea is to estimate the average effect of treatment on the treated by comparing the actions taken by firms when they received aid to the actions they planned to take if they had not received aid.

Panel A of Table 2 is based on comparisons of actual reported outcomes between firms that took aid and firms that did not. These are identified under the assumption that the decision to take aid is independent of the outcome in the absence of aid, conditional on firm size, industry, and the initial shock to revenue.[18] While we have good reason to think this assumption is not satisfied based on the evidence in Section 4 it is a useful benchmark model.

We estimate the model,

$$Y_j = \alpha + \beta_1^L L_j + \beta_1^{NL} NL_j + \boldsymbol{\gamma'} \boldsymbol{X_j} + \varepsilon_j. \tag{1}$$

The variable L_j is a binary indicator equal to 1 if the firm took labor aid, and NL_j is an indicator equal to 1 if it took non-labor aid.[19] The coefficients β^L and β^{NL} measure the difference in observed outcomes associated with labor aid and non-labor aid relative to firms that did not take up such aid.

For this model, the necessary assumption is $E[\varepsilon_j | L_j, NL_j, \boldsymbol{X_j}] = 0$. Our survey necessitates the use of a cross-sectional specification. As our model includes an indicator for whether the firm was eligible for aid, we show that firms that were eligible to take aid but

[18] Since the pandemic was a sudden disruption, these controls are all known prior to the decision to take aid.

[19] Note that aid packages are *not* mutually exclusive.

Table 2: The Effect of Aid Take-up on Furlough and Layoff Decisions

Panel A: All firms	(1)	(2)	(3)	(4)
Total share of workers...	**Furloughs**		**Layoffs**	
Labor aid	0.290***	0.288***	-0.048***	-0.048***
	(0.007)	(0.007)	(0.004)	(0.004)
Non-labor aid	0.005	0.007	0.008***	0.008***
	(0.006)	(0.006)	(0.002)	(0.002)
Aid eligible	-0.022***	-0.024***	0.015***	0.014***
	(0.004)	(0.004)	(0.003)	(0.003)
Avg Wage Growth		-0.002		0.007**
		(0.007)		(0.004)
Industry FE	✓	✓	✓	✓
Revenue shock	✓	✓	✓	✓
Observations	9251	8678	9251	8678
# Firms	9251	8678	9251	8678
Panel B: Aid takers only	(1)	(2)	(3)	(4)
Total share of workers...	**Furloughs**		**Layoffs**	
Actual Outcome				
Labor aid	0.275***	0.274***	-0.083***	-0.083***
	(0.009)	(0.009)	(0.006)	(0.007)
Non-labor aid	-0.008	-0.006	-0.027***	-0.026***
	(0.009)	(0.009)	(0.005)	(0.005)
Counterfactual Outcome				
Labor aid	0.037***	0.036***	0.161***	0.157***
	(0.009)	(0.009)	(0.008)	(0.008)
Non-labor aid	0.013	0.013	0.059***	0.058***
	(0.009)	(0.009)	(0.006)	(0.006)
Avg Wage Growth		-0.011		0.015**
		(0.009)		(0.008)
Controls				
Industry FE	✓	✓	✓	✓
Revenue shock	✓	✓	✓	✓
Observations	10522	9880	10380	9744
# Firms	5261	4940	5190	4872

Notes: Panel A uses data on reported outcomes for all firms. It is possible for firms to take both labor aid and non-labor aid, so it is not necessary to drop one variable for identification. Panel B is restricted to firms that actually took aid. Each such firm has two observations: one with its actual outcomes, and one with the counterfactual outcome in the absence of aid reported in the survey. We report coefficient estimates separately for the actual outcome and for the counterfactual outcome. All models also include controls for revenue loss, log of January employment, and industry (2-digit NACE level). ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels. Standard errors in parentheses.

chose not to had slightly lower furloughs and slightly higher layoffs relative to those that were ineligible. These findings are consistent with Figure 3a, which shows very minimal differences in employment growth between firms that are eligible for aid and those that are not.

The estimates in Column (1) indicate that the share of workers furloughed in firms that took aid was almost 27 percentage points higher than firms that were eligible, but did not take aid, holding the controls fixed. We add a control for pre-2020 wage growth in Column (2), but doing so has little effect. Interpreted as an effect of treatment on the treated, this would suggest the policy had a substantial effect on furloughs. However, as we have already noted, aid-takers were likely negatively selected, so it is possible they would have furloughed a large share of workers regardless of the program, and the estimated effect is simply picking up that selection. Focusing on layoffs, the estimated coefficient in Column (3) indicates that firms that took aid ended up laying off a share of their workforce that was about 3 percentage points lower than firms that were eligible, but did not take aid. If we interpret this as a causal effect, it would suggests labor aid did very little to prevent layoffs. Here, the negative selection could be masking much larger effects if aid takers would have made much larger layoffs than non-takers in the absence of the program, as seems likely.

5.2.1 Analysis Using Reported Counterfactuals

To address self-selection, we take advantage of a novel feature of our survey. In it, we explicitly asked respondents to describe their planned layoffs and furloughs if they did not take up aid. Under the assumption that firms report their counterfactual plans accurately, for which we provide support in Section 3, the contrast between the average actual outcome and the average counterfactual outcome gives an estimate of the average effect of furlough aid on those that took it up.

In Panel B of Table 2 we report estimates from this alternative model. Using data on the 5,261 firms that report taking aid, we create a panel where each firm has two observations: one corresponding to their actual furloughs and layoffs, and one corresponding to their counterfactual furloughs and layoffs. Then we estimate the pooled model

$$Y_{jT} = \alpha + T \times \left(\beta^{L} L_j + \beta^{NL} NL_j\right) + (1 - T)\left(\theta^{L} L_j + \theta^{NL} NL_j\right) + \boldsymbol{\gamma' X_j} + \varepsilon_{jT}. \qquad (2)$$

The variable $T = 1$ for those observations where actual outcomes are reported, and $T = 0$ for observations where counterfactual outcomes are reported. The variables L_j and NL_j are as defined in equation (1). The coefficients β^{L} and β^{NL} measure the difference in observed actual

outcomes associated with taking labor aid and non-labor aid respectively. The coefficients θ^L and θ^{NL} measure the corresponding differences in the counterfactual outcome.

Under the modeling assumptions, the effect of labor aid on aid takers is estimated by $\beta_L - \theta_L$. For furloughs, Panel B shows that the actual furlough share was 27.4 percentage points higher among firms taking furlough aid, but also that firms that took furlough aid expected to have furlough share about 3.6 percentage points higher than those that did not. The implied effect of furlough aid is the difference of 23.8 percentage points, which is nearly identical to the effect of furlough aid using selection on observables in Panel A.

Turning to the effect on layoffs, the difference across the two models is much more stark. Focusing on Column (3), layoffs were about 8.3 percentage points lower among labor aid takers. However, in the absence of aid, firms that took labor aid expected to make layoffs that were 16.1 percentage points higher. Based on this model, the total effect of labor aid on layoffs is -0.244, or a 24.4 percentage point reduction in the share of workers laid off.

5.2.2 Non-Labor Aid

Both models suggest that taking only labor aid had no significant effect on furloughs, but disagree about the effect on layoffs. In Panel A, Column (3), we see evidence that firms taking non-labor aid actually increased layoffs relative to those that did not, but the effect is less than one percentage point. In Panel B Column (3), the coefficient on non-labor aid for actual observations is -0.027, but the coefficient for counterfactual observations is 0.059, taken together, these suggest that firms that took non-labor aid alone actually reduced layoffs by around 8.6 percentage points.

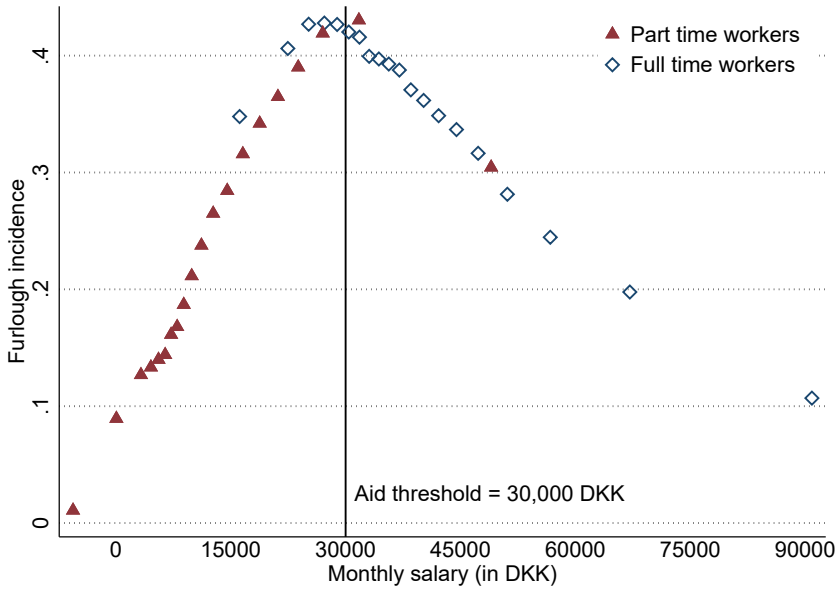
5.3 The Cost of Furlough Influenced Who was Furloughed

The labor aid program preserved strong incentives for firms to retain workers with high potential severance costs. In addition, because the program had a binding cap on monthly payments to any worker of DKK30,000, the program also created incentives for firms to furlough workers on the basis of their monthly earnings. This was particularly effective, since the program allowed firms to furlough workers on a daily basis. This meant managers could choose how to balance the workload across workers, and had flexibility on the intensity of their furlough choices relative to worker salaries.

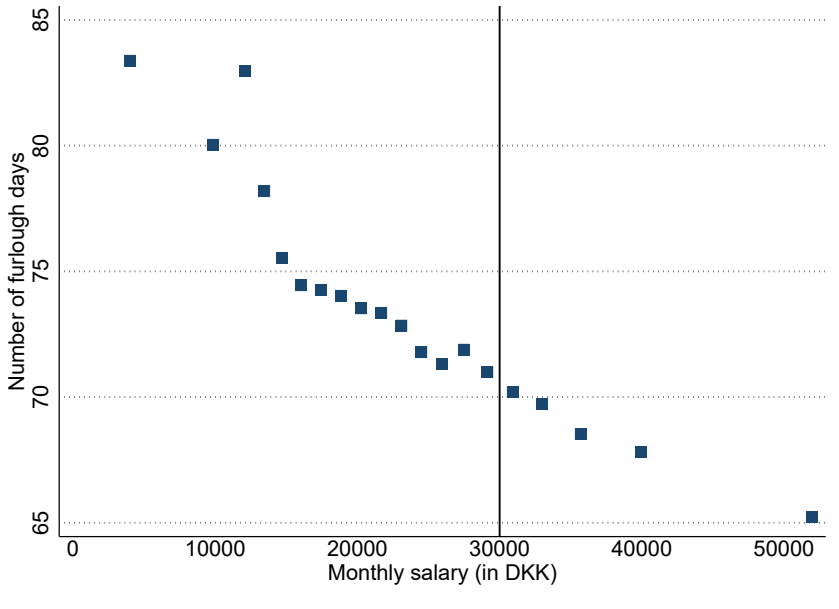
Figure 6a is a binned scatterplot showing the relationship between monthly salary and furlough status for workers employed in firms that furloughed at least one worker. We include a vertical lines at the policy cap on the government's contribution to the worker's wage,

Figure 6: Furlough Incidence and Number of Furlough Days

(a) Furlough incidence by monthly salary



(b) The number of furlough days by monthly salary



Notes: Data from the Danish government's furlough registry between March to December 2020. Binned scatterplots showing the relationship between a worker's monthly salary and an indicator for whether they were furloughed (Figure 6a) or the number of days on furlough (Figure 6b). The plotted values are based on residuals from a regression onto firm size and industry dummies.

DKK30,000 per month. While the vertical axis runs to DKK100,000, over 90 percent of furloughed workers have a monthly salary below DKK60,000.[20] For part-time workers, we find a positive relationship between the likelihood of being furloughed and monthly salary, up to around the maximum government contribution value. For full-time workers the relationship is mostly flat, at least up to DKK60,000 where most of the data are concentrated.

Figure 6b shows the relationship between monthly salary and the number of days a worker is on furlough. The sample is restricted just to workers who were ever on furlough. There is a clear negative relationship between the number of days that any worker is furloughed and their monthly salary, with the longest furlough spells reserved for workers earning below DKK15,000. Both figures include controls for industry and firm size.

In all, the evidence suggests that the flexible furlough policy allowed managers to be judicious in their labor organization choices as they worked to allow for social distancing in the workplace. They were more likely to furlough their more expensive part time workers and their cheaper full-time workers. Conditional on being furloughed at all, however, cheaper workers were more likely to be furloughed for a larger number of days. Together with Figure 5, it seems a large share of managers carefully considered how to optimally furlough workers relative to the constraints of the aid policy.

6 Furlough Aid Positively Affected Firm Outcomes

If firms were using the aid program to invest in preserving valuable matches, we would expect them to benefit by being able to more quickly recover as COVID-19 related disruptions ended. On the other hand, we might also expect a negative impact if the policy led firms to retain unproductive matches that should have been severed.

6.1 A Model of Firm Outcomes

We are interested in estimating the effect of a firm's decision to furlough workers on its medium-term outcomes. In equation (3), $FirmOutcome_i$ is one of the following firm outcomes: whether the firm is still alive in December 2020 (survival), employment growth in 2020 or log of sales in December 2020. The variable of interest $AidTaker_i$ is an indicator for whether the firm took any labor aid to furlough workers. The vector $\boldsymbol{X_i}$ includes predetermined controls that should affect the firm's exposure to the pandemic disruption as

[20] Figure B.5 in the Appendix plots the distribution of monthly salary of full-time and part-time workers for the universe of furloughed workers (Panel A) and all workers (Panel B) in Denmark. The shape of the distributions is fairly similar across the two datasets.

well as its decisions to take up labor aid. The coefficient of interest is β: the effect of taking aid on firm outcomes. However, the identifying assumption $E[\epsilon_i|AidTaker_i, \boldsymbol{X}_i] = 0$ is not likely to hold since firms that took up aid are expect worse outcomes in the absence of aid than those that did not.

$$FirmOutcome_i = \alpha + \beta AidTaker_i + \boldsymbol{\phi'} \boldsymbol{X}_i + \epsilon_i \tag{3}$$

We therefore propose an instrument for $AidTaker_i$: the share of workers in occupations with a two-week mandatory notice period in 2019. This share is calculated from data generated prior to the pandemic, and therefore not related to the pandemic's effect on firm revenue or costs, but still correlated with the cost of adopting the furlough program.[21] Theoretically, firms that have lower shares of blue collar workers and higher shares of well-paid and longer-tenure workers will have higher implicit severance costs and be more likely to furlough workers. For each firm in 2019 (prior to the COVID shock), we measure the share of workers that would be owed two weeks severance, which we expect, and find, to be negatively correlated with a firm's decision to take up labor aid. We estimate the following instrumental variables model:

$$\begin{aligned} AidTaker_i &= \alpha + \rho SeveranceShare_i \quad + \boldsymbol{\eta'} \boldsymbol{X_i} + \nu_i \\ FirmOutcome_i &= \alpha + \beta \widehat{AidTaker}_i \qquad\quad + \boldsymbol{\phi'} \boldsymbol{X_i} + \epsilon_i \end{aligned} \tag{4}$$

where the dependent variable of the first stage is $AidTaker_i$, an indicator that takes a value of 1 when the firm has furloughed at least one worker (i.e. taken labor aid) and 0 otherwise. $\boldsymbol{X_i}$ is the vector of firm controls, including log of employment, share of female employees, share of full time employees, the AKM firm effect, a firm-level average of the AKM worker effects, the standard deviation of AKM worker effects, and 2-digit industry fixed effects.[22]

The dependent variable for the second stage, $FirmOutcome_i$, is one of the following firm outcomes: whether the firm is still alive in December 2020 (survival), employment growth in 2020 or log of sales in December 2020. $\widehat{AidTaker}_i$ is the predicted value from the first stage regression and $\boldsymbol{X_i}$ is the same set of firm-level controls. The coefficient of interest is β: the effect of taking aid on firm outcomes. Table 3 reports the results of this exercise.

[21] We construct the instrument using the same information that we used to measure net furlough costs.

[22] The AKM worker and firm effect are the estimated components of heterogeneity from the two-way decomposition of earnings into components associated with worker and employed heterogeneity first introduced by Abowd et al. (1999).

6.2 Estimation Results

Since aid-takers are expecting worse outcomes (as also seen in Figure 3), the OLS estimates in Panel A Columns (1) to (3) are likely to be biased downward. Adding controls for workforce composition and firm compensation practices has essentially no effect on the estimated relationship between outcomes and taking up labor aid. This is consistent with the pandemic shock being largely random with respect to pre-determined workforce characteristics, though does not imply that the OLS estimates are unbiased since the decision to take aid is still associated with the firm's ability to use aid effectively.

Turning to our IV results, the first stage key coefficients are reported on Panel B of Table 3, Columns (4) to (6). The first stage is strong: the coefficients suggest that doubling the share of blue collar workers in the firm decreases the likelihood a firm would apply for labor aid by about 30 percent. This is consistent with cost-minimizing firm behavior, as low severance entitlement means it is cheaper to fire a worker rather than furlough them. The quality of the IV is further verified by the Kleibergen and Paap (2006) statistics, which are all around 1,500.

The second-stage IV estimates are consistent with our expectations. For the survival outcome in Column (4) of Panel A, the IV estimate is around 3.5 times larger than the OLS estimate. For the employment growth and sales outcomes, the sign actually changes. The OLS estimate indicates that employment growth is 5.8 percentage points lower for aid-takers. The IV estimate suggests it is 32 percentage points higher. Similarly, for sales, the OLS estimate suggests sales are 11 log points lower for aid-takers. The IV estimate is over 1, suggesting that taking up aid causes a nearly 100 percent increase in sales relative to the counterfactual.

While the IV results are consistent with the predicted direction of bias, they are quite large (at least for the sales outcome) leading to some concern about their reliability. The main concern with the IV is that it is based on a firm's workforce composition, which could be correlated with other factors that drive both its decision to take up aid and its broader ability to handle the pandemic disruption. However, our IV results are not sensitive to the inclusion of controls for workforce composition nor the AKM firm effect which is correlated with other productive and management characteristics (Cornwell et al. 2021). We have also re-estimated these models using an IV based on the expected total cost of severance in December 2019 with very similar results. Taken together, these results are at least indicative those firms which were able to keep their workers "matched" were also likely to enjoy survival and performance benefits.

Table 3: The effect of furloughing on firms

Panel A	**OLS**			**IV Second Stage**		
	(1) survival	(2) empl growth	(3) ln(sales)	(4) survival	(5) empl growth	(6) ln(sales)
Labour aid taker	0.0268***	-0.0580***	-0.1158***	0.1020***	0.3242***	1.3815***
	(0.0019)	(0.0029)	(0.0107)	(0.0129)	(0.0207)	(0.0873)
K-P Wald F-stat				1566.6	1485.9	1539.4
Panel B				**IV First Stage**		
Excluded instruments						
Two wk severance %				-0.3050***	-0.3038***	-0.3055***
				(0.0077)	(0.0079)	(0.0078)
# firms	69586	66758	59878	69586	66758	59878
Industry FE	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y

Notes: ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels. Standard errors in parentheses. Panel A reports the second stage coefficients. Panel B reports the first stage coefficients. Outcome variable for columns (1) to (3) is an indicator of whether the firm was still alive in December 2020. Outcome variable for columns (4) to (6) is the employment growth for the firm in 2020. Outcome variable for columns (7) to (9) is the log of sales in December 2020. The first instrument is the share of workers within the firm that would require only two weeks of payment if they were fired (two week severance). The second instrument is the log of the average cost of severance for all workers within the firm (a measure of how expensive it would be to fire their workers).

7 Aggregate Implications

In all, we find that Danish firms chose to furlough workers that they would have otherwise laid off, and that they were willing to pay to do so. Furthermore, participating in the furlough aid program led them to have better business outcomes. To understand whether this might have led to improved macroeconomic outcomes, we document a comparison of the Danish and the United States labor markets over 2020. A key policy debate during the pandemic related to whether it was better to provide direct payroll subsidies to help preserve job matches, or to subsidize the unemployment insurance system and let firms decide how to manage layoffs.[23] While most countries used both policies to varying degrees, the United States focused on expanding unemployment insurance and relatively little on payroll subsidies.

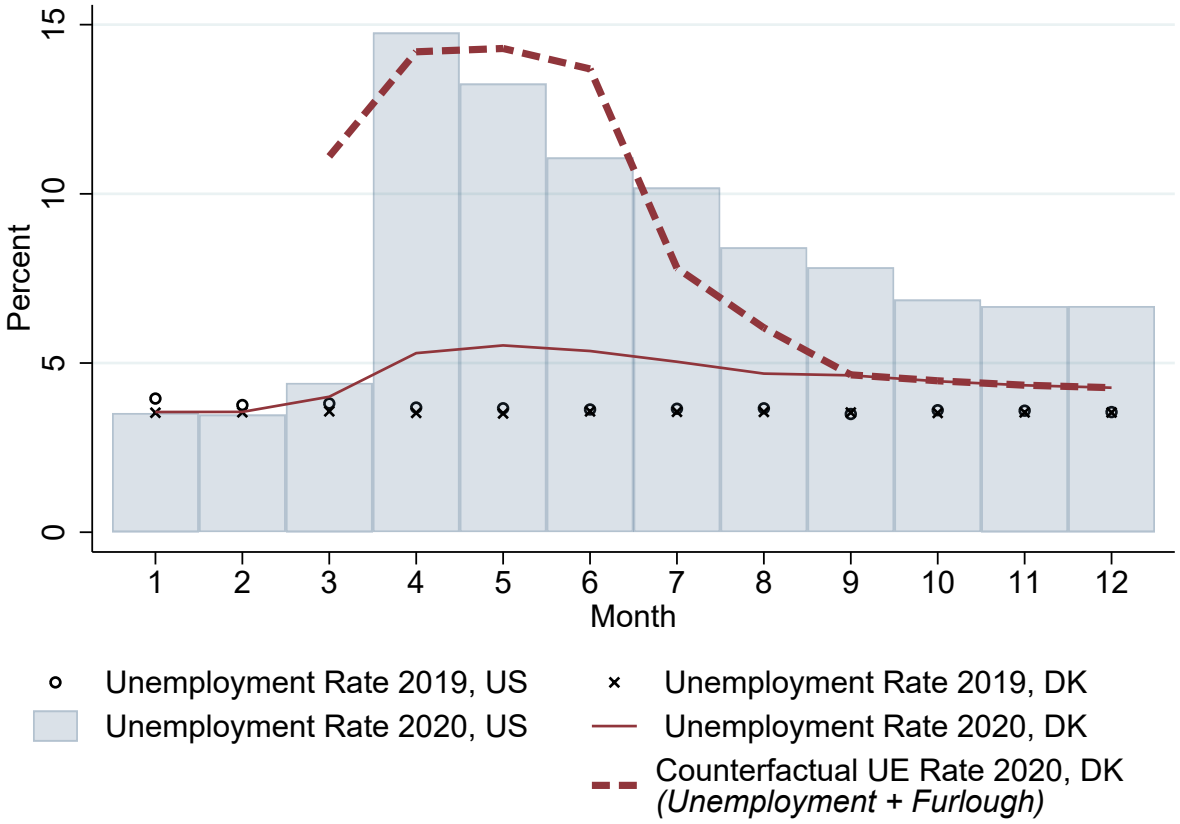
Figure 7 reports the monthly registered unemployment rate for Denmark in 2019 and 2020, along with a "counterfactual unemployment" rate, where we simply add furloughed workers to the unemployed, as would have been the case if all furloughed workers would have otherwise been laid off. The figure also reports the unemployment rate in the United States for each month in 2020 and suggests that, if all furloughed workers had been laid off, Denmark would have experienced unemployment rates very similar to those in the United States.

Gallant et al. (2021) show that much of the rise in U.S. unemployment during the early months of the pandemic was from temporarily unemployed workers who were officially unemployed, but expected to ultimately be recalled by their employers. However, the U.S. policy did not generally tie workers to their pre-pandemic employers as explicitly as the Danish policy. Figure 7 shows that furloughed Danish workers returned to work more quickly than their temporarily unemployed US counterparts, and we also find they mostly returned to their original employers (Figure 8).[24] The US unemployment rate, however, dropped at a slower pace and remained over 2 percentage points higher than in Denmark by December 2020. While these patterns are not conclusive evidence that the Danish policy led to a faster labor market recovery, it is consistent with that view and suggests directions for future research and policy evaluation.

[23] Short-time work policies for managing recession pose similar questions.

[24] Figure 8 shows the monthly "job status" for all workers in Denmark in Panel A and for furloughed workers only in Panel B. The latter panel includes transitions in the categories, for example, into furlough vs out of furlough, out of employment vs staying out of employment.

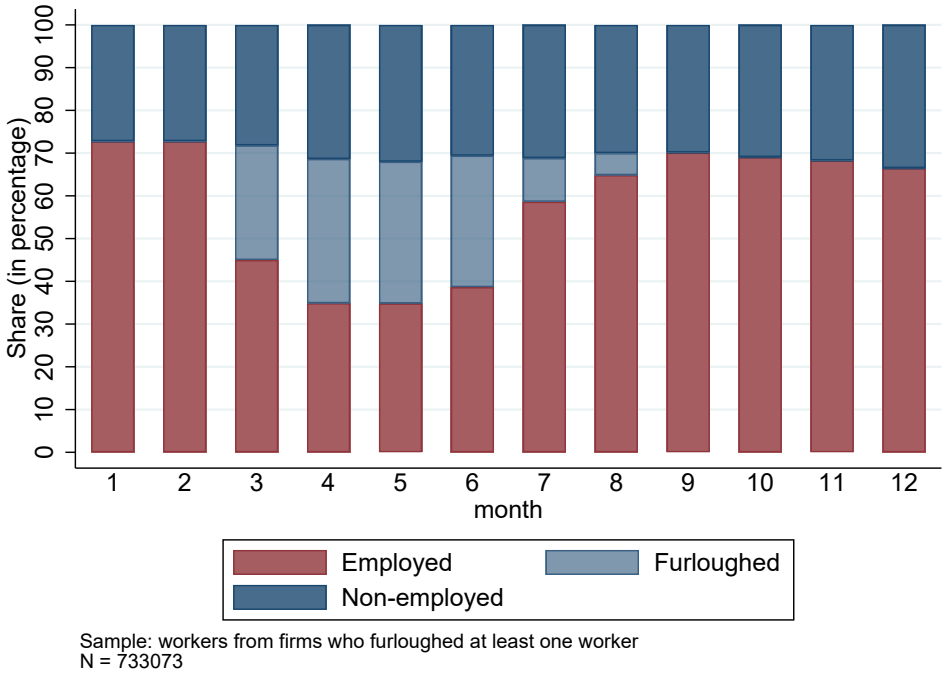
Figure 7: Unemployment rate in Denmark and the United States



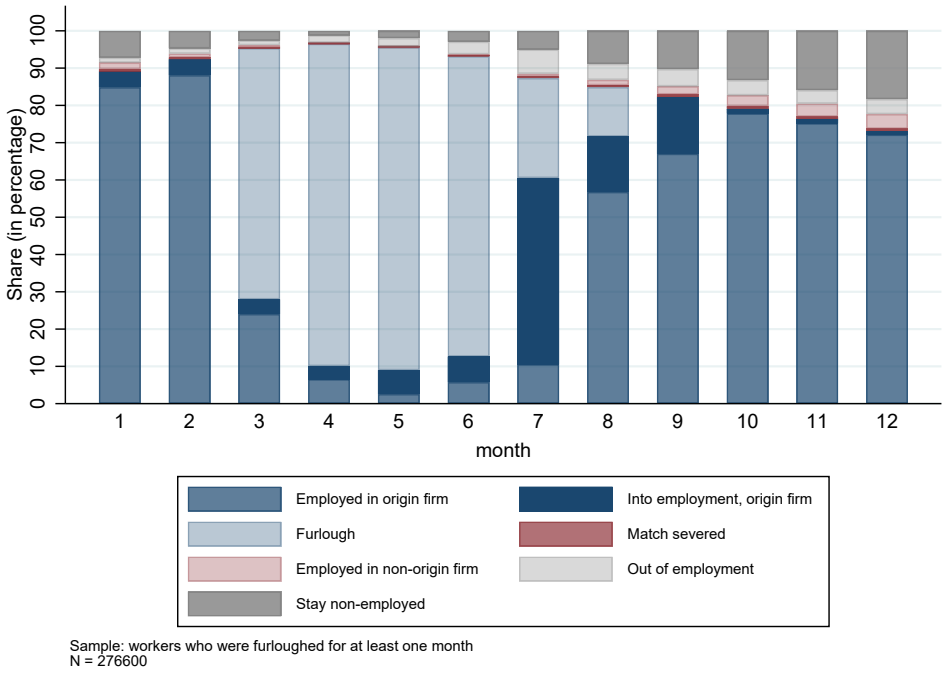
Notes: This figure plots the percentage of workers who were unemployed in 2019 and 2020 in Denmark and the United States. Data for the United States are based on the Bureau of Labor Statistics Employment Situation Summary. Data for Denmark comes from Statistics Denmark. The black hollow circles and crosses mark 2019 unemployment rates. The red solid line plots the official Danish unemployment rate. The red dashed line plots our counterfactual unemployment rate, calculated as the number of unemployed plus the number of furloughed workers that month divided by the size of the labor force (from official records). The navy bars show the monthly unemployment rate in the United States for 2020.

Figure 8: Monthly job status transitions, 2020

(a) All workers in aid-taking firms



(b) Only furloughed workers



Notes: Graphs in this figure include only firms in 2020 that furloughed at least one worker. Each panel depicts the share of workers within that month across each type of job status. Panel (a) includes all workers who work for firms that furloughed at least one worker, even if they were not furloughed themselves. Panel (b) includes only furloughed workers.

8 Conclusion

In this paper we show that, when faced with a sharp, but short-term disruption to productivity, firms may be willing to make small, but non-trivial investments in retaining their workers – even those at the bottom of the wage distribution with "general" skills. Their behavior belies the idea that specific worker-firm relationships have little value to the firm within that class of occupations. While the source of that value is not entirely clear, we find evidence suggesting firms that took furlough aid had better outcomes than they would have had otherwise. Thus, our results provide support for policies that help retain job matches during periods of temporary crisis.

During and after the Great Recession, government programs encouraged firms to find alternative work arrangements rather than lay workers off (Cahuc et al. 2018). While these short-time work policies are effective in preserving employment, they can also prevent workers from being reallocated to more productive jobs (Giupponi and Landais 2018). In a more standard business cycle downturn, such programs may prevent unproductive matches from dissolving and obstruct the reallocation of employment toward more productive uses. Early in the pandemic crisis, misallocation concerns were less relevant, since the economic shock is unrelated to productivity or other market fundamentals. Further, the public health benefits made it optimal to borrow against the future to preserve job matches while maintaining consumption and facilitating social distancing.

Our main contribution is to provide evidence, largely missing to this point, that worker-firm matches do indeed carry value to firms, that this is true across all occupations, and that preserving those matches can be beneficial to firms. Future policy will have to determine how to balance the benefits of preserving this sort of match-specific capital against the possibility of limiting reallocation of resources from less productive to more productive jobs. Unfortunately, with natural disasters likely to be more common (e.g. Jia et al. 2022), we need to think about optimal policies for short-term and sharp interruptions to economic activity that do not necessarily change underlying economic fundamentals. Understanding how and when to protect valuable economic relationships, including employment relationships, should be front of mind.

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ONLINE APPENDIX—NOT FOR PUBLICATION, August 18, 2022

"The Value of Preserving Job Matches During a Crisis,"

A Data Validity

There is an inherent trade-off in using administrative register data and survey data: register data are official and while the reports are verified by the government, data are not timely and are equally susceptible to biased responses.[25] Survey data, on the other hand, are more flexible on timing and can be responsive, though the data relies on truthful reporting with no downside to misreporting. We briefly outline the steps we took to verify our data.

First, over 90 percent of our the respondents were owner-managers or CEOs, and thus know (or make) the financial and labor choices in the firm.[26] Second, the two main concerns regarding the quality of the reporting are truthfulness in reports of actual furloughs and layoffs, and accuracy in the predictions of the counterfactual figures. We can directly test the veracity of the reported actual furloughs against government register data on aid requests. We find that nearly 90% of the reported statuses (having/not having furloughed workers) were accurate (Table A.1).

Table A.1: Number of Firms Reporting Furloughs: survey vs register

		Survey		
		No furloughs	**Furloughs**	**Total**
Register	**No furloughs**	6972	633	7605
	Furloughs	543	2459	3002
	Total	7515	3092	10607

Notes: Register data refers to the data from the Danish government registry of disbursement of wage support for furloughed workers from March 9 to June 9 2020. The data includes 242,126 workers across 29,471 firms. Survey data refers to data from the authors' Danish COVID-19 survey from 23 April 2020 to 1 June 2020. The data includes 10,642 responses, covering approximately one quarter of the Danish economy and forming a representative sample of firms in the country. 7,515 firms reported having no furloughs in the survey, and 6,972 of them indeed had no records of furlough requests with the government. 543 firms that reported no furloughs did have such records. 3,092 firms reported having furloughed workers in the survey, and 2459 of them also had furloughs recorded in the government register while 633 did not. This implies a high level of accuracy of the information reported in the survey relative to government records.

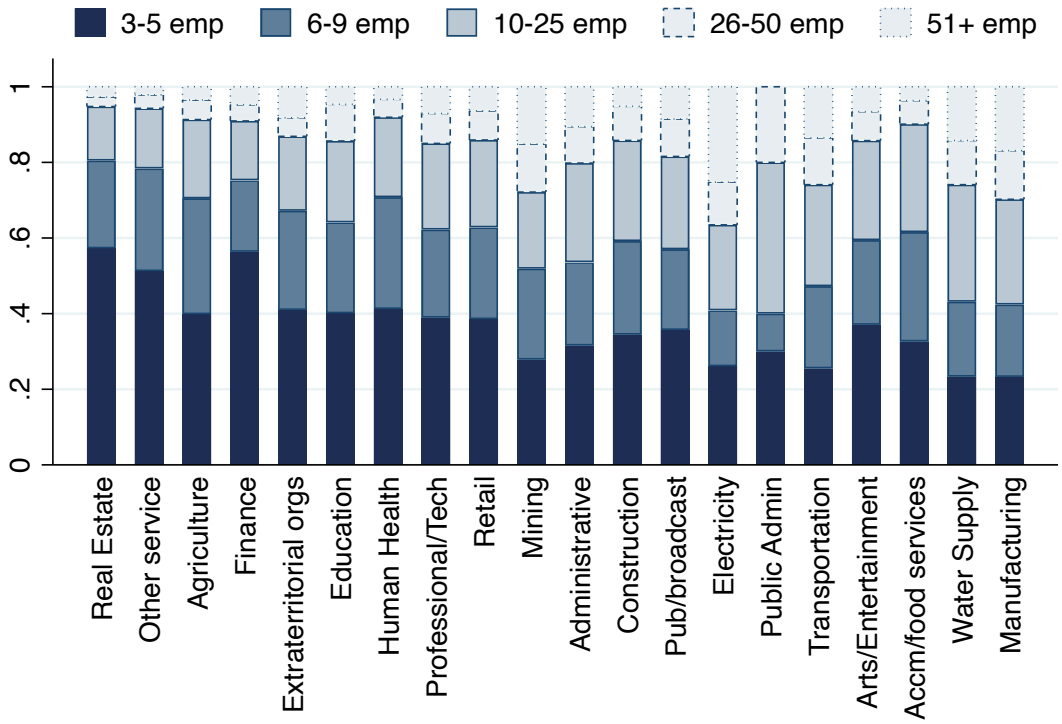
The Danish COVID-19 survey was sent to 44,374 firms; effectively the entire population of firms with more than 3 employees in Denmark. The survey was sent out on 23 April 2020, and by 1 June 2020 we had received 10,642 responses, yielding an overall response rate of 24 percent. This Data Appendix provides details on the sample characteristics and how representative the sample is relative to the Danish population of firms with more than 3 employees. Figure A.2a plots, for each industry, the share of firms in the survey that fall in that industry, and the share of firms in the frame from the industry. Points along the diagonal are industries for which the survey share and frame share are the same. Points above the diagonal are industries that were oversampled in the survey. Points below are industries that were undersampled. Clearly, the sample is generally representative with respect to industry composition, with a small bias toward the Manufacturing and Scientific/Tech industries and against Construction.

[25] For example, when there are thresholds for reporting requirements (Garicano et al. 2016).

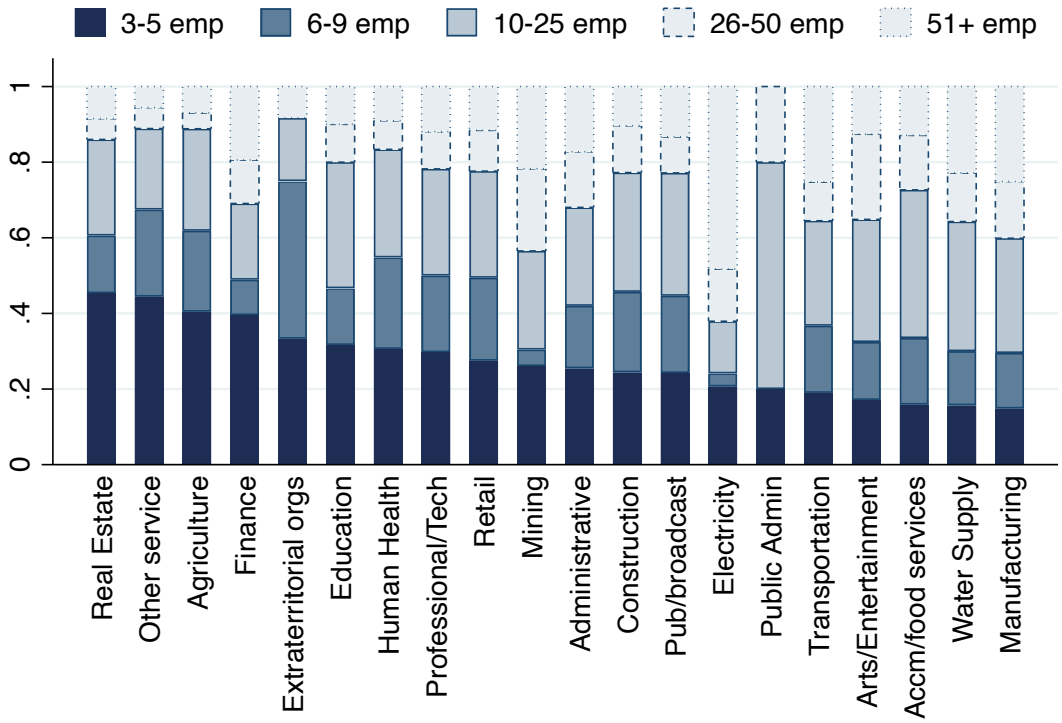
[26] The remainder of the respondents were non-managing owners or other administrative staff.

Figure A.1: Firm Size Distribution Within Industry, Population

(a) Population



(b) Survey Sample

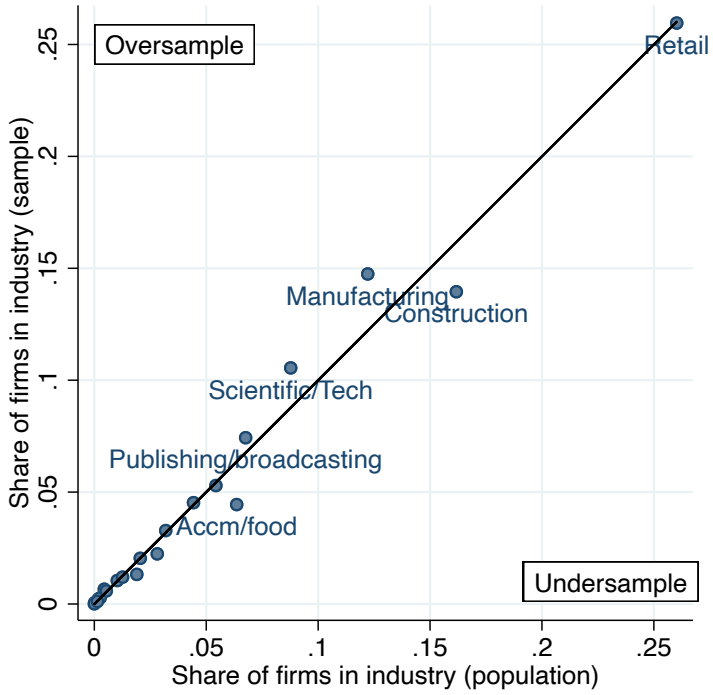


App. 2

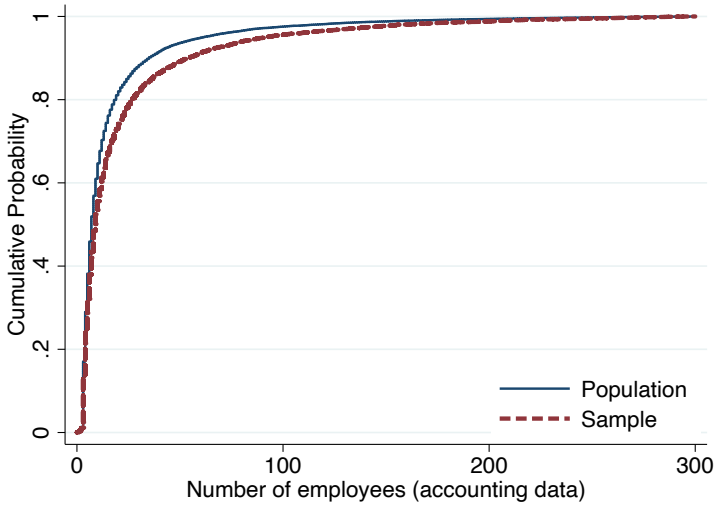
Notes: Population N = 33,513. Sample N = 10,642. Industry defined by 1-digit NACE codes. Graph shows the distribution of firm size (number of employees) in the population and in the sample for each industry.

Figure A.2: Representativeness of Survey Sample

(a) Industry composition

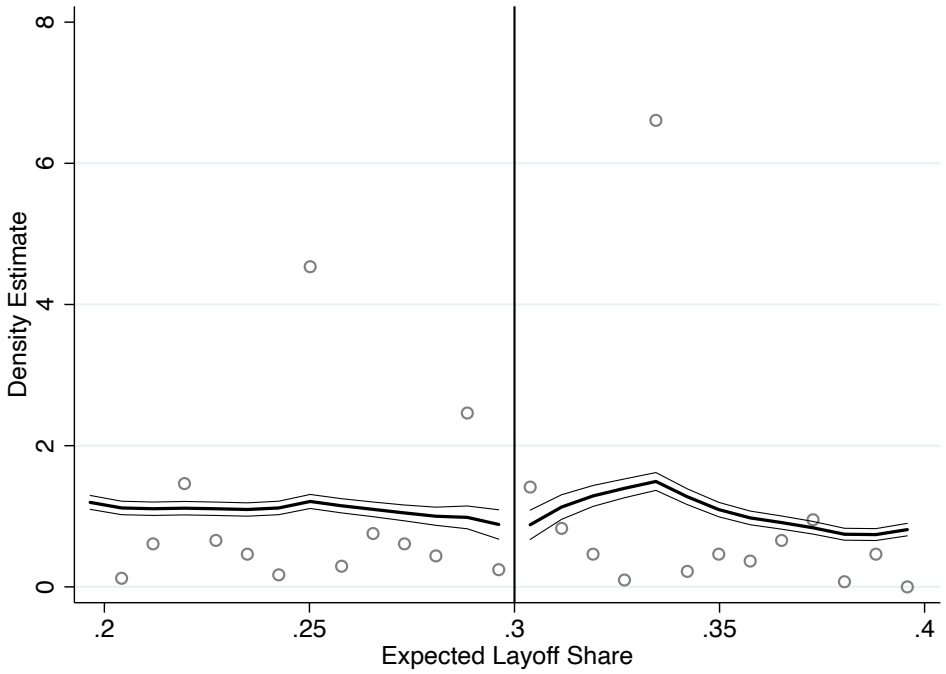


(b) Firm employment



Notes: Figure A.2a shows the share of firms within each industry in the population frame and in the survey sample. Industry markers above the 45-degree line mean an industry is over-sampled. Industry markers below the 45-degree line mean an the industry is under-sampled. Figure A.2b shows the cumulative distribution of firm employment in the population and in the survey sample. The red dashed line represents the cumulative distribution function of firm employment in our survey sample. The blue line represents the cumulative distribution function of the remainder of the population frame that have more than 3 employees. Employment truncated at 99th percentile (300 employees) for exposition. Population N = 33,513. Sample N = 10,642.

Figure A.3: McCrary Test: Discontinuity in Counterfactual Layoffs at the Policy Threshold



Notes: Data from the authors' COVID-19 response survey of Danish firms. Graph includes only aid-taking firms, N=5,868. The variable "expected share of layoffs" is built using the answer to the survey question: "If you had not taken up aid, how many employees would have laid off?", divided by the total number of employees in the firm. The plot highlights the threshold for aid eligibility (30%).

B Further Details on Which Firms Took Aid and How They Used It

The Danish government provided a menu of non-mutually exclusive aid packages: furlough aid, fiscal aid, and cost aid. Table B.2 reports the relationship between firm characteristics and the take-up of different combinations of packages. We report estimates from linear probability models of the take-up of each type of package, starting with general aid take-up, and iterating through the possible package combinations. Column (1) includes all firms in the sample, while the remaining columns include only the firms that took on aid, with the outcome variable taking on a value of one if the firm took on each type of aid bundle. The last rows in the table indicate the share of firms and employment that ended up being covered by each policy package.

Over half of the firms in our representative sample took on some aid, and these firms were more likely to have experienced decreases in revenue (Column 1). Larger firms and firms in harder-hit industries were more likely to take on aid. About 10 percent of all firms (20 percent of aid-taking firms) took on all three aid types (Column 2), and this was again more common for hard-hit sectors. Considering firms that only took on one of the three types of aid, a fifth of aid-takers took labor-aid only or fiscal-aid only, with only 5 percent taking on cost-aid only. Revenue change is not correlated with take-up of labor-only aid when controlling for industry, as the industries experiencing the steepest declines in revenue tended to take on labor aid in conjunction with either cost aid, fiscal aid, or both. Firms that were least affected in terms of revenue decrease and in least-affected industries were most likely to take advantage of the fiscal aid, unless bundled with other aid types.

Table B.2: Characteristics of Firms Choosing Each Aid Package

	All types		**Only one type**			**2 types**		
	(1) Any aid	(2) Labor+Cost + Fiscal	(3) Only Labor	(4) Only Cost	(5) Only Fiscal	(6) Labor + Cost	(7) Labor + Fiscal	(8) Cost + Fiscal
Revenue change								
Increase	-0.466***	-0.180***	0.034	-0.034***	0.341***	-0.137***	0.015	-0.038***
	(0.016)	(0.013)	(0.031)	(0.008)	(0.037)	(0.007)	(0.030)	(0.012)
No change	-0.439***	-0.171***	0.019	-0.047***	0.384***	-0.126***	-0.004	-0.055***
	(0.011)	(0.008)	(0.018)	(0.004)	(0.021)	(0.007)	(0.016)	(0.004)
Characteristics								
Ln(employment)	0.023***	0.009**	0.006	-0.014***	0.006	-0.036***	0.042***	-0.012***
	(0.003)	(0.004)	(0.004)	(0.002)	(0.004)	(0.003)	(0.004)	(0.002)
Industry								
Most affected (top 5)	0.196***	0.227***	-0.094***	0.009	-0.172***	0.147***	-0.115***	-0.002
	(0.011)	(0.019)	(0.012)	(0.009)	(0.007)	(0.017)	(0.010)	(0.010)
Least affected (bottom 5)	-0.116***	-0.084***	0.057***	0.008	0.108***	-0.063***	-0.022	-0.003
	(0.012)	(0.011)	(0.020)	(0.009)	(0.021)	(0.011)	(0.015)	(0.009)
# firms	10504	5868	5868	5868	5868	5868	5868	5868
Share of firms (total)	0.555	0.107	0.106	0.023	0.124	0.077	0.092	0.027
Share of empl (total)	0.569	0.101	0.141	0.006	0.159	0.028	0.127	0.007
Share of firms (aid-takers)	1.000	0.193	0.190	0.041	0.223	0.138	0.165	0.049
Share of empl (aid-takers)	1.000	0.177	0.248	0.010	0.280	0.049	0.223	0.012
Sample	**All firms**	**Aid takers**	**Aid takers**	**Aid takers**	**Aid takers**	**Aid takers**	**Aid takers**	**Aid takers**

Notes: ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels. Robust standard errors in parentheses. Column (1) includes all firms in the sample, while Columns (2) to (8) include only aid-takers. All columns are linear probability models, estimated with OLS. Each outcome variable is an indicator for each type of aid. The omitted category from revenue impact is "experienced a decrease in revenue". Log of employment is calculated based on reported employment in January. Regressions include industry dummies at the 1-digit NACE level, reporting only selected industries based on relevance (share of the economy) and relative impact.

Figure B.4 shows the relationship between the revenue impact of firms that experienced a negative shock and the share of actual share of furloughed or laid off workers. The solid squares represent firms that took at least one type of aid, while hollow squares represent firms that did not take aid. Circles show the relationships for the outcome of actual furloughs. Solid circles represent firms that took at least one type of aid, while hollow circles represent firms that did not take aid. The difference between aid-taking and non-aid taking firms is stark: those that did take aid laid off significantly fewer workers at the higher end of the impact values, and furloughed substantially more workers. Those that did not take aid laid off more workers than they furloughed.

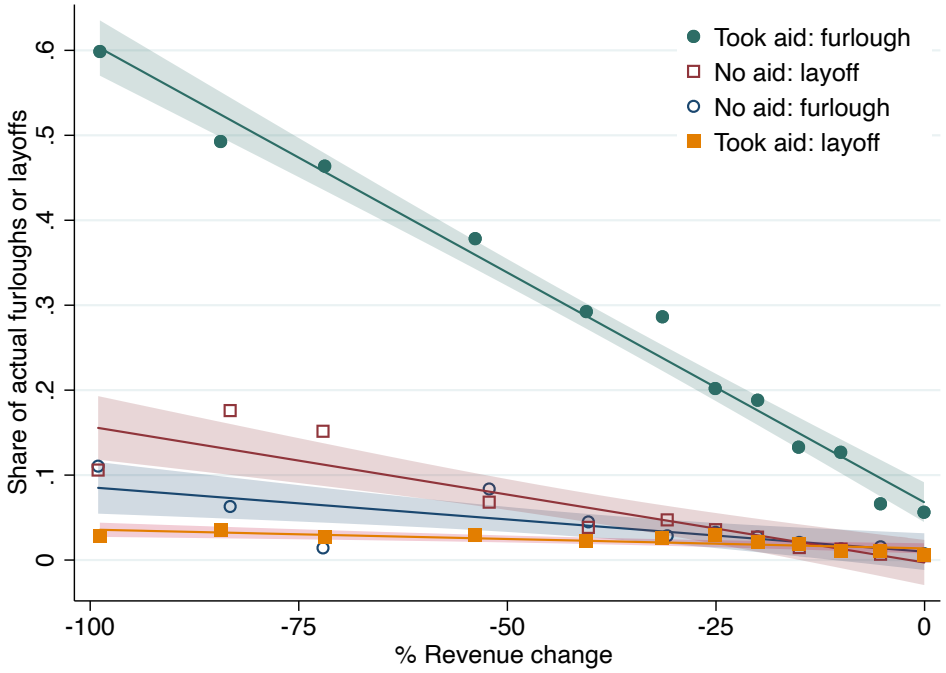
Table B.3: Summary Statistics of Furloughed Workers, First Round

	Mean	**SD**	**25th pctile**	**Median**	**75th pctile**	**N**
Worker-level summary statistics						
Share male	0.50	0.50	0.00	0.00	1.00	242126
Weekly hours worked (pre-COVID)	28.15	12.61	18.00	37.00	37.00	242126
Monthly earnings (000s DKK)	24.90	19.28	9.06	24.82	35.06	242126
Total firm compensation (000s DKr)	37.71	25.55	13.72	37.32	59.40	242126
Share full time	0.58	0.49	0.00	1.00	1.00	242126
# days furloughed	68.27	21.90	62.00	77.00	83.00	242126
# days furloughed (FT workers)	64.67	22.77	52.00	72.00	81.00	140331
# days furloughed (non-FT workers)	73.22	19.59	70.00	79.00	86.00	101795
Firm-level summary statistics						
Share male	0.48	0.40	0.00	0.50	1.00	29471
Weekly hours worked (pre-COVID)	30.56	8.51	26.00	34.75	37.00	29471
Monthly earnings (000s DKK)	24.38	13.33	15.29	24.08	31.86	29471
Total firm compensation (000s DKr)	43.96	20.23	28.41	44.53	58.50	29471
Share full time	0.63	0.40	0.25	0.77	1.00	29471
# days furloughed	73.54	19.14	66.43	80.00	88.00	29471
# employees furloughed	8.22	44.86	1.00	3.00	6.00	29471
# days furloughed (FT workers)	72.54	19.51	64.54	79.00	87.00	23987
# days furloughed (non-FT workers)	73.91	19.22	68.00	81.00	88.00	16907

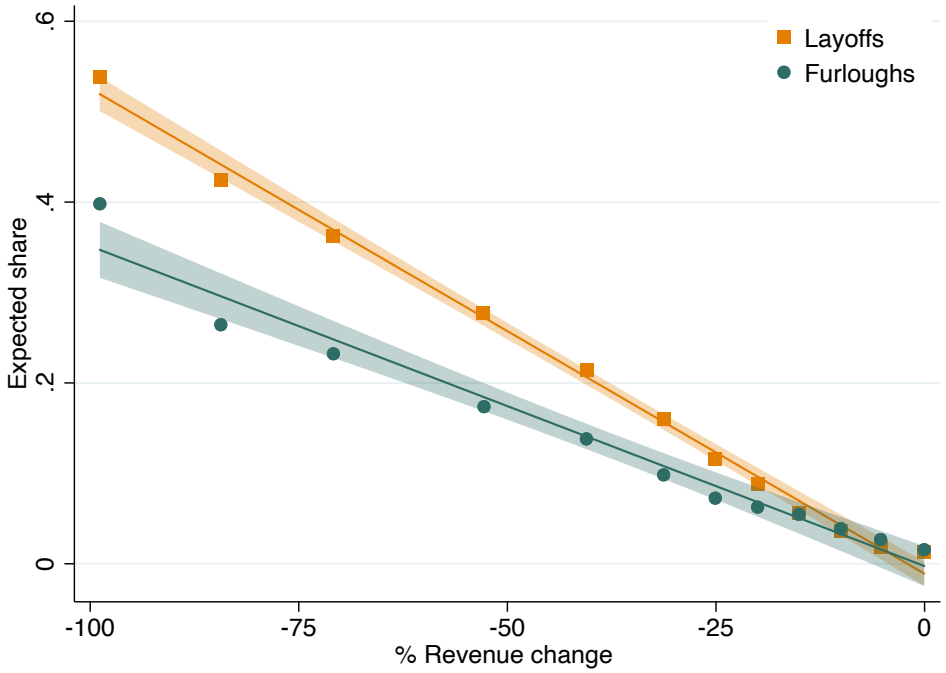
Notes: Data from the Danish government registry of disbursement of wage support for furloughed workers from March 9 to June 9 2020. The data includes 242,126 workers across 29,471 firms. This table reports summary descriptive statistics for workers and firms. Full time refers to workers who were reported to work a 37-hour week pre-pandemic, while part time refers to anyone who works fewer than 37 hours. The lighter shades depict part-time worker data and the darker shade depicts full-time worker data.

Figure B.4: Labor Response to Revenue Change

(a) By aid taker status, actual response



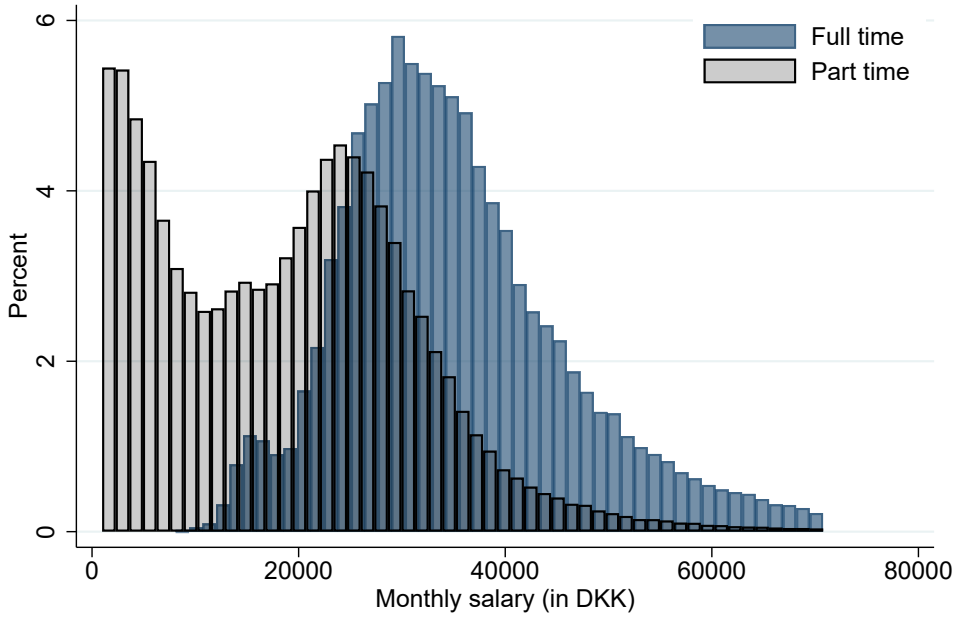
(b) Only aid takers, counterfactual response



Notes: Survey data refers to data from the authors' Danish COVID-19 survey from 23 April 2020 to 1 June 2020. The full dataset includes 10,642, covering approximately one quarter of the Danish economy and forming a representative sample of firms in the country. The number of aid-takers is 5868. These graphs show the binned scatterplot of the simple relationship between the percentage revenue change in firms and the share of employees that they report actually furloughing or laying off. Squares show the relationships for the outcome of actual layoffs. Solid squares represent firms that took at least one type of aid, while hollow squares represent firms that did not take aid. Circles show the relationships for the outcome of actual furloughs. Solid circles represent firms that took at least one type of aid, while hollow circles represent firms that did not take aid.

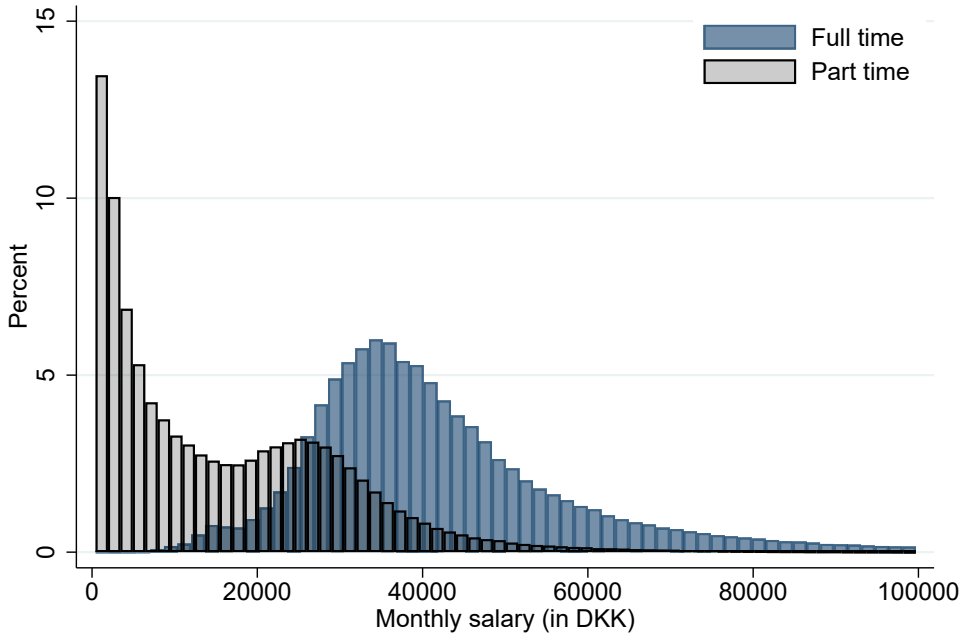
Figure B.5: Distribution of Monthly Salaries of Danish Workers

(a) Furloughed workers only



Salary is trimmed at top and bottom 1%.
Sample limited to furloughed workers only.

(b) All workers



Salary is trimmed at top and bottom 1%

C Survey Questionnaire

Question 1: Respondent role in the firm

Which of the following categories matches your role in the business?

- Owner-manager
- Non-owner director
- Non-director owner
- Other, state: <Open Textbox>

Question 2: Employees

At the end of January, how many employees were there in the company?

- Write the number of employees: <Open Textbox>

Question 3: Effect from COVID-19 economic shock

What was the pandemic effect on the demand for your company's products and services?

- Very negative
- Negative
- Not affected
- Positive
- Very positive

Question 4: Expected revenue change

How do you expect your company's sales revenue to change during the epidemic?

- Sales revenue will *decrease* by <Open Textbox> percent
- Sales revenue will *increase* by <Open Textbox> percent
- Sales revenue will remain *unchanged*

Question 5: Aid packages take-up

Has your company used or is planning to use any of the following aid pacakges?

- Aid Package 1: Compensation for canceled or postponed events
- Aid Package 1: Payment of Compensation up to 80 percent of fixed expenses given a decrease in sales revenue above 40 percent?
- Aid Package 3: State-guaranteed bank loan through the Growth Fund for the drop in sales revenue over 30 percent

- Aid Package 4: No employer-required period for daily sick pay
- Aid Package 5: Pay compensation of 75 to 90 percent of wage payments to employees sent home due to corona triggered financial downturn
- Aid Package 6: Temporary deferral of payment deadlines for tax contributions (VAT, etc.)
- We have not used and do not plan to use any of the above actions [Exclusive]

Question 5A: Reason for no aid take-up

[only asked if respondent selected "no aid taken" in question 5] Is the reason your company has not used or plans to use state aid packages that you do not meet the eligibility requirements?

- Yes
- No

Question 6: Employment Measures

What employment measures has the company introduced?

- Dismissals
- Sent home without wage subsidy (unpaid furlough)
- Sent home with wage subsidy (paid furlough)
- None of the above <Exclusive><Fixed>

Question 6A: Dismissals

How many employees have been laid off in the company?

- Write the number: <Open Textbox>

Question 6B: Furloughs

How many employees were sent home (furloughed) by the company, but are still employed?

- Write the number: <Open Textbox>

Question 6C: Expected dismissals in the absence of aid (counterfactuals)

[only asked if an aid package was selected in Q5] How many employees would have been laid off in your firm if you had not taken up government aid packages?

- Write the number: <Open Textbox>

Question 6D: Expected furloughs in the absence of aid (counterfactuals)

[only asked if an aid package was selected in Q5] How many employees would have been sent home (furloughed) in your firm if you had not taken up government aid packages?

- Write the number: <Open Textbox>