Czech Kurzarbeit: First Evidence from the First Pandemic Wave

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Abstract

We relate the firm-type structure of support from the main Czech kurzarbeit (short-work) program Antivirus B during the spring of 2020 to the structure of the economy and to the structure of demand shocks approximated by declining hours worked. Evidence based on the Structure of Earnings Survey implies large participation gaps in favor of large employers, and disproportionately high intensity of use of the program by manufacturing companies, in particular those exhibiting declining wage bills already prior to the pandemic. Compared to other industries, manufacturing is thus able to 'cover' by kurzarbeit support the largest share of the decline in hours worked between the 2nd quarters of 2019 and 2020, with the exception of the hospitality and culture industries, which were most powerfully affected by pandemic lockdowns. Our analysis illustrates simple statistics available for real-time monitoring of kurzarbeit policies.

1. Introduction

Since the Great recession, *kurzarbeit* (short-time work) programs have been used all over Europe to help employers retain their employees during sharp temporary declines in demand. In April 2020, during the early stages of the Covid-19 pandemic, a kurzarbeit program was activated for the first time in the Czech Republic, under the program title *Antivirus*. The so-called 'regime-A' of the program supported companies primarily in the hospitality industries and in culture that had to shut down their operation due to pandemic lockdowns. The 'regime-B' of the program was the general type of kurzarbeit policy for firms facing declining demand.

In this paper, we present an analysis of the intensity of use of the main Czech kurzarbeit program Antivirus B relative to the structure of the economy and the structure of pandemic demand shocks. Our analysis is based on the Structure of Earnings Survey (SES), which allows us to ask informative descriptive questions related to companies' past performance, as well as to look within companies at the occupational structure of changing hours of work. We establish that the SES provides a representative picture with respect to the participation in this program and focus our analysis on the 2nd quarter of 2020.

We find that large Czech companies, i.e., those with over 1 000 employees, display participation rates in the program close to 40 %, which is about twice the level of participation among companies with fewer than 250 employees. Conditioning on industry and region in a regression analysis does not affect these size-related participation gaps. Even conditional on size and the potentially endogenous firm-specific decline in hours worked between the 2nd quarters of 2020 and 2019, the program's coverage of industries varies widely. The share of firms that participate in the Antivirus program is naturally high in hospitality industries and in culture, but high coverage rates are also found in manufacturing, and several other industries.

We find that manufacturing firms not only use the program with higher probability, but that they use it to cover a higher share of their wage bill than firms from most other industries. As a result, almost two thirds of the overall CZK Antivirus B support ends up in manufacturing firms. Manufacturing firms with over 250 employees represented 13 % of hours worked in the Czech enterprise employment sector in the 2nd quarter of 2019, but they received 60 % of the CZK support provided by the Antivirus B program in the 2nd quarter of 2020. When we express the participation of companies in terms of employee full-time equivalents supported by the program, manufacturing accounts for three quarters of the supported FTE-equivalent employment.

Thanks to this high intensity of program use, manufacturing firms were able to support from the kurzarbeit program the largest share of the pandemic drop in hours, compared to employers from other industries. Hours worked dropped between the 2nd quarters of 2020 and 2019 by over 60 % in hospitality industries and by about 40 % in culture. In manufacturing, administrative and other services industries hours declined by about 20 %. In manufacturing, as well as in hospitality and culture, about a third of the drop in hours was covered by the kurzarbeit program. In all other industries, the share of the drop covered is substantially lower, one-fifth at the most and close to zero in several industries. We also find that firms that experienced a drop in their wage bill during 2019, up until the 1st quarter of 2020, i.e., just before the pandemic hit, also participated in the program more often. And this is again particularly the case for manufacturing companies.

2. Literature Review

The economic rationale behind kurzarbeit policies is that efficient policy response to temporary drops in demand (e.g., financial crises) or temporary suspensions of economic activity (pandemics) should minimize economic behavioral response to a purely transitory phenomenon.[1] More specifically, a large literature (e.g., Davis and von Wachter, 2011) points to significant wage losses of displaced workers and to search frictions in matching workers with firms, and highlights the importance keeping intact employer-employee relationships that are facing a temporary disruption but are viable in the longer term. On the other hand, to the extent that temporary shocks lead to permanent changes in the structure of the global economy, kurzarbeit policies may hinder efficient reallocation and increase the

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[1] Mittag and Pertold (2020) compare kurzarbeit to other available policies and contrast the Czech kurzarbeit policy to those introduced in other developed countries.

overall costs of recessions or pandemics.[2] The key issue in kurzarbeit policy design is therefore to provide incentives for employers and employees to differentiate between temporary and permanent changes and to avoid dis-incentivising responses to permanent changes. Providing a real-time empirical understanding of the structure of the use of such policies ought to be an integral part of kurzarbeit implementation, guiding decisions on kurzarbeit policy extensions.

Recent studies attempt to provide early evidence on the pandemic kurzarbeit programs operating in Europe based on ad hoc surveys.[3] For example, Adams-Prassl et al. (2020) analyze furloughs in the UK using a survey conducted in the spring of 2020, and point out that women were significantly more likely to be furloughed. Similar to most studies in the literature, they do not attempt to answer the question of the impact of furlough policies on preserving employer-employee matches. A fundamental problem with the analysis of the causal effect of kurzarbeit support on employment is that firms facing larger demand shocks are more likely to apply for kurzarbeit support. This issue exists across industries as well as within industries, as firms that do not apply for support are likely to face less of an (unobserved) negative demand shock.

There are two ways how to improve upon a descriptive association analysis. One can directly elicit counterfactual (expected) revenue evolution in absence of the pandemic from employers, as Bennedsen et al. (2020) do in Denmark. Such strategy is based on the strong assumption of limited measurement error in self-reported counter-factual revenue scenarios. Researchers can also look for administrative or geographic sources of exogenous variation in the use of kurzarbeit support. For example, if some of the Czech District Labor Offices (DLOs) awarding kurzarbeit support were less strict in evaluating Antivirus applications, one could compare similar employers applying to different DLOs and receiving different support. Cahuc et al. (2018) represent a rare example of a kurzarbeit study that attempts to estimate causal effects of the policy based on geographical exogenous variation. They study a program operating in France during the financial crisis and find that kurzarbeit support only saved jobs in credit-constrained (typically smaller) firms that were hit by severe demand shocks.[4]

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[2] Cahuc and Carcillo (2011) provide an overview of the kurzarbeit programs used in the great recession and suggest that these may favor insiders and hinder the ability of firms to hire new more productive workers.

[3] In contrast, we rely on a well-established employer survey and on administrative data, which minimizes measurement error and avoids potentially selective participation in surveys conducted during the pandemic.

[4] Most of the literature is unable to use geographical exogenous variation and is thus based on country-level difference-in-differences comparisons (Hijzen and Venn, 2011) or on firm-level matching strategies (Kruppe and Scholz, 2014). There are also macroeconomic studies (Faia et al., 2013).

3. The Czech Kurzarbeit Program and Our Data

According to the Czech Labor Act, employers facing a temporary drop in production due to external conditions can lay off their employees (with severance pay) or can put them on temporary furlough with reduced pay. The Antivirus Program introduced by the government on April 6 2020 allowed employers to receive government compensation equal to 60 % or 80 % of the labor costs associated with pandemic furloughs. The program was administered by District Labor Offices and provided the 80% level of support to employers who were directly affected by pandemic closures or restaurants, cultural events, etc. (Antivirus regime A), and the lower 60% level of support to employers affected indirectly through temporary drops in demand for their output or supply of their inputs (Antivirus regime B). Appendix part 1 details the conditions of each regime. Almost 27 thousand employers (with 84 thousand supported employees) participated in Antivirus A during the 2nd quarter of 2020. During the same quarter, Antivirus B supported a similar number or employers, who were on average larger, and, thus, received support for over 340 thousand employees. Antivirus regime B thus corresponds to about 70 % of the total Antivirus program outlays in the 2nd quarter of 2020.

Our analysis is based on the Czech Structure of Earnings Survey (SES), which collects information on hourly and quarterly wages and hours of work (as well as various types of absences) for all employees of a large well-defined sample of employers. We merge the survey data from the 1st quarter of 2020 (as well as earlier SES data) with the firm identity of the recipients of Antivirus support. Where available, we also add information from balance sheet data (the Czech Albertina database) on 2018 (pre-pandemic) labor productivity (value added per hour of work) and leverage (debt over equity). We study the 4,332 enterprise-sector (non-public) employers with at least 10 employees covered by the SES in 2020. Out of these, 1,351 (31 %) received support from Antivirus B in the 2nd quarter of 2020.

In the first step of our analysis, we confirmed that the industry and employer size structure of recipients within the SES reflects closely that in the rest of the economy.[5] This allows us to interpret our SES-based evidence (with appropriate sampling weights applied) as corresponding to the entire Czech enterprise sector (of firms with over 10 employees).

Table 1 shows publicly available statistics on the number of participating employers by industry and on the industry shares on total Antivirus B CZK outlays in the 2nd quarter of 2020 (which were over 9 billion CZK). Manufacturing drew almost two thirds of the entire support. Below, we ask to what extent this high share corresponds to the share of manufacturing on Czech employment, to what extent it reflects particularly sharp demand shocks in manufacturing, as opposed to higher intensity of program utilization by manufacturing firms.

Comparing the structure of the economy (the SES) with that of the recipients of support in the SES, we find that employers with over 250 employees in culture, in administrative activities, in transportation, and in manufacturing have very high levels of participation: over 70 %. Looking across all industries, employers with over

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[5] See Jurajda and Doleželová (2021) for these comparisons.

1000 employees had participation rates of about 40 %, twice the level of employers with under 250 employees. We quantify these gaps conditionally on multiple firm characteristics in our regression analysis in Section 5.

Table 1 Industry Structure of Support from the Antivirus B Program, 2nd Quarter of 2020

Industry CZ-NACE	Number of firms	Share of total CZK support (%)
A Agriculture, forestry and fishing	263	0,20
B Mining and quarrying	12	0,10
C Manufacturing	5 581	65,04
D Electricity, gas, steam and air conditioning supply	47	0,11
E Water supply; sewerage, waste management	183	0,25
F Construction	1 518	1,35
G Wholesale and retail trade; repair of motor vehicles	6 229	8,41
H Transportation and storage	1 752	7,19
I Accommodation and food service activities	2 646	3,10
J Information and communication	653	1,34
K Financial and insurance activities	180	0,29
L Real estate activities	718	0,58
M Professional, scientific and technical activities	2 297	3,07
N Administrative and support service activities	1 260	4,88
O Public administration and defense; social security	4	0,00
P Education	310	0,37
Q Human health and social work activities	2 310	2,27
R Arts, entertainment and recreation	334	0,83
S Other services activities	575	0,60
Total	26 872	100,00

4. The Structure of Kurzarbeit Use

4.1 Declining Hours of Work

The need for kurzarbeit support (by industry or employer) must be related to the drop in hours worked—the demand shock. Declining hours of work can correspond to layoffs (or part-time reductions), to absences (paid or unpaid), and to paid furloughs compensated by the kurzarbeit programs. It is therefore natural to ask what share of the industry-specific decline in hours of work between the 2nd quarters of 2020 and 2019 is 'covered' by kurzarbeit support.

Table 2 shows such evidence based on the SES data. One would expect supported firms to be under more external pressure to reduce overall hours of paid work. This is indeed the case in most industries. For example, manufacturing firms (NACE category C), which received support from Antivirus B, have cut their hours of work by almost 30 % (28.4 to be precise, i.e., one minus 71,6), while those that did not receive support saw their hours of work drop by under 10 %. However, in industries directly affected by pandemic closures and lockdowns (hospitality and culture, NACE codes I and R), as well as in some other industries, the 2nd quarter declines in hours are strikingly similar among supported and un-supported

employers, suggesting extensive layoffs or contract reductions in unsupported firms. Perhaps these firms did not expect a quick rebound or thought it easy to re-hire laid off workers.

Table 2 Hours Worked in the 2nd Quarter of 2020 Relative to the 2nd Quarter of 2019 (ratio 2020/2019), by Participation in Antivirus A/B

| Industry CZ-NACE	Firms in regime A	Firms in regime B	Firms in regime A and B	Firms with no participation
A	92,3	95,4	94,1	97,5
B	96,2	83,9	97,9	94,9
C	92,8	71,6	77,4	92,2
D	82,8	97,0	85,8	101,0
E	91,0	92,9	90,3	97,0
F	94,7	97,1	89,0	95,8
G	79,7	86,8	75,4	93,9
H	85,7	83,0	87,7	91,0
I	47,2	54,2	43,9	47,5
J	82,7	92,1	60,5	102,7
K	98,6	89,8	86,9	98,4
L	85,4	98,7	81,4	98,1
M	83,1	87,2	74,5	98,0
N	64,1	68,4	59,8	80,7
O	92,9	*	*	97,4
P	100,1	92,6	103,0	98,8
Q	91,5	81,7	71,0	95,3
R	65,5	78,3	52,1	83,2
S	79,2	74,3	85,3	96,6

Notes: For Industry Codes (CZ-NACE), see Table 1. * denotes no participating firms.

Next, Figure 1 shows the industry structure of the decline in total hours worked; it decomposes this overall drop into absences, absences supported by Antivirus A or B, and the rest, i.e., reductions in contracts or layoffs. It is not surprising that the largest drop in hours worked occurred in the hospitality industries (NACE code I). Almost a half of this large drop corresponds to increasing absences, i.e. continued employment without work hours. Under 30 % of the overall decline in hours corresponds to absences supported from Antivirus programs A or B (primarily A in this case). The situation in culture (R) is similar. In manufacturing (C), the overall drop in hours worked is just under 20 % (similar to that in Other services (S) and Administrative services (N)). However, manufacturing was able to support almost a third of its decline in hours worked from Antivirus (primarily regime B). Only culture and hospitality are similarly successful (from Antivirus regime A). The other most successful industries (Transportation (H), Other activities (S)) are able to cover one fifth of their hours decline from kurzarbeit sources. At the other extreme, in Administrative activities (N), hours decline strongly, but Antivirus support is limited, so that layoffs and contract reductions are large.

In the analysis that follows, we ask whether this high program coverage in manufacturing can be explained by a higher share of worker full-time contracts covered by the program in manufacturing (Section 4.2), or by industry firm-size

structure (with larger firms being generally more likely to be supported) and pre-pandemic economic conditions (Section 5).

Figure 1 The Structure of the Drop in Hours Worked Between 2nd Quarters of 2020 and 2019 by Industry (NACE)
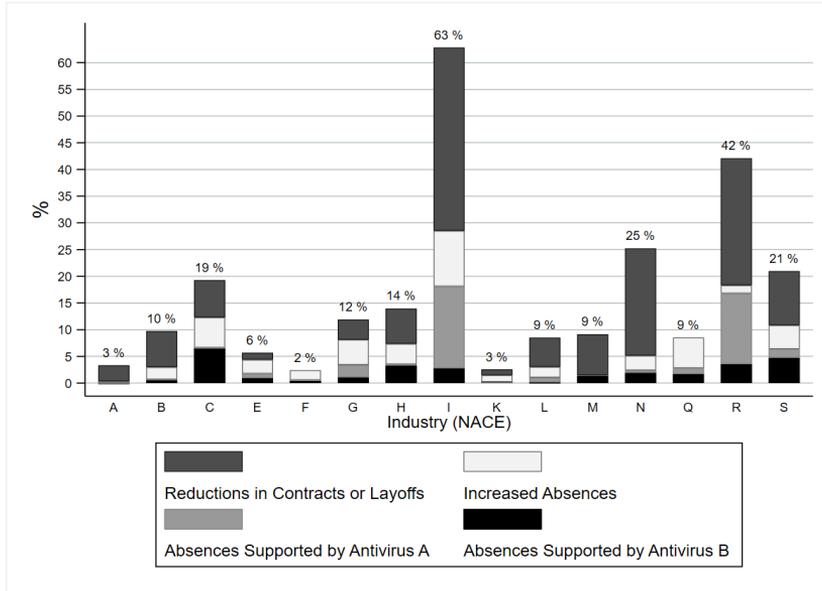
Notes: For Industry Codes (CZ-NACE), see Table 1.

4.2 Part-time Use of Kurzarbeit

In order to understand the extent of program coverage, it is useful to know not only the total number of employees supported, but also the corresponding full-time-equivalent number, i.e. the sum of part-time furlough support expressed in full-time-contract counts. To answer this question, we use the SES data to approximate the employee-specific share of full-time contracts supported by the Antivirus B program.[6] On average, firms got about one-fourth of their employee contracts supported from Antivirus B. And the high coverage of declining hours worked in the manufacturing industry by kurzarbeit support (Figure 1) is in part due to manufacturing firms asking for support for a larger share of employee contracts (higher number of days of support per week) than employers from other industries: the average FTE share supported by Antivirus B is 26 % in manufacturing and 23 % in all other industries.

Next, Table 3 shows the FTE structure of employee support by industry. In total, Antivirus B supported over 340 thousand employees, and this support adds up

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[6] We do not observe worker-level support information. See Jurajda and Doleželová (2021) for details of the approximation procedure, which adds up to near-correct aggregates of support at the firm level.

to a total of about 80 thousand supported full-time employment contracts over the 2nd quarter, a count, which corresponds to the 100 % total in Table 3.

Table 3 The Structure (in %) of Full-Time-Equivalent Counts of Employees Supported by Antivirus B in the 2nd Quarter of 2020, by Industry and Firm Size (Measured by Firm Employment)

Industry CZ-NACE	Employer size according to number of employees				
	10-49 employees	50-249 employees	250-999 employees	over 1000 employees	Total
A	0,006	0,006	*	*	0,012
B	*	*	0,091	0,055	0,146
C	3,263	10,907	25,017	34,820	74,007
D	*	0,035	0,054	0,026	0,115
E	0,108	0,225	0,026	0,083	0,443
F	0,284	0,182	0,060	0,148	0,674
G	2,269	0,842	0,802	0,412	4,326
H	1,772	1,572	1,497	2,973	7,814
I	0,587	0,476	0,688	0,360	2,110
J	0,482	0,265	0,088	0,113	0,949
K	0,030	0,059	0,042	0,034	0,164
L	0,017	0,010	0,002	*	0,030
M	0,304	0,834	0,293	0,016	1,447
N	0,095	1,321	0,832	1,056	3,304
O	*	*	*	*	*
P	0,022	0,017	0,012	0,199	0,252
Q	0,658	0,507	0,781	0,019	1,964
R	0,004	0,149	0,259	0,354	0,766
S	1,323	0,127	0,027	*	1,477
Total	11,224	17,535	30,572	40,669	100

Notes: For Industry Codes (CZ-NACE), see Table 1. * denotes a data cell where there were no additional absences in the 2nd quarter 2020 relative to a year earlier or no recipient of kurzarbeit support. In this analysis, one full-time contract corresponds to 3 months (a quarter) of work.

Table 3 implies that medium-sized and large manufacturing firms received almost 60% of the kurzarbeit support when support is expressed in full-time equivalents. This is close to their overall share on the CZK aggregate Antivirus B outlays. For comparison, these firms corresponded to 13 % of pre-pandemic hours worked in the enterprise sector, so that their support is almost 5 times higher than their employment share. Overall, manufacturing used the program more intensively (for a relatively large share of full-time contracts) and thus it corresponds to nearly three quarters of the total number of supported full-time equivalents.

5. Regression Analysis of Program Participation and Intensity of Use

In this section, we ask whether different firm-size structure, and different firm characteristics in general, help explain the high share of program support received by manufacturing firms. We also relate participation in the program to the firm-specific demand shock approximated by the pandemic decline in total hours worked and to firm-specific pre-pandemic conditions approximated by the pre-pandemic wage bill evolution. To this effect, we simultaneously quantify the association of several firm characteristics with the probability of participating in Antivirus B and with the intensity of use of the program measured as the share of the firm's pre-pandemic wage bill covered by the program.

Our first step is to regress the indicator for program participation (in the 2nd quarter of 2020) on company size (employment), industry, region, share of secondary- and tertiary-educated employees, and on the presence of a collective agreement (at the company or industry level). In our baseline specifications in columns (1) and (3) of Table 4, we also condition on the pre-pandemic evolution of wage bills in companies. These models thus ask whether companies that already experienced declining employment and/or wage rates before the on-set of the pandemic, were more likely to receive support motivated by pandemic relief. We present ordinary least squares regressions, but obtain near-identical findings based on the Logit model. We then additionally control for pre-pandemic leverage and productivity in columns (2) and (4), which are based on the sub-sample where balance-sheet measures are available.

According to the coefficient estimates presented in Table 4, company size has a strong association with program participation and the conditional participation gaps reported in Table 4 are similar to unconditional gaps reported in Section 2. Firms with over 1000 employees have a 40 percentage point higher probability of participating compared to firms with under 50 employees. These are large gaps against the average participation rate of 31 %. Conditional on other firm characteristics, firms in most industries were less likely to draw support than manufacturing firms; the main exceptions are the directly affected hospitality and culture industries. Higher share of college-educated employees is associated with lower probability of participation, as is higher productivity and leverage.[7] Regional location and collective agreements do not predict program participation.

One of the controls in Table 4 (in italics) captures the pre-pandemic evolution of wage bills in companies. The estimated models thus ask whether companies that already experience declining employment and/or wage rates before the on-set of the pandemic, were more likely to receive support motivated by pandemic relief. The answer is that they did. Specifically, we measure the relationship between program participation and the company wage bill evolution between the 1st quarter of 2019 and of 2020 (we obtain near-identical results when using the wage-bill evolution between the first and the last quarter of 2019). About 15 % of firms in the SES reports a drop in wage bills of over 10 % in this period; 25 % of firms reports a rise in wage bills of over 10 %. We obtain a statistically significant coefficient of about -

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[7] This is consistent with Giupponi and Landais (2018) who find that low-productivity firms are more likely to participate in short-time work schemes than high-productivity firms.

0.3, suggesting that a drop in wage bill of 10 % increases the probability of kurzarbeit support by 3 %, i.e., by about a tenth relative to the average support probability of 31 %.

Table 4 Probability of Antivirus B Participation, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Company size (relative to 10-49 employees)				
50-249 employees	0.140***	0.167***	0.140***	0.161***
250-999 employees	0.314***	0.310***	0.313***	0.299***
over 1000 employees	0.400***	0.395***	0.398***	0.379***
CZ-NACE (relative to Manufacturing)				
A Agriculture, forestry and fishing	-0.342***	-0.344***	-0.340***	-0.357***
B Mining and quarrying	-0.198*	-0.165	-0.198*	-0.174
D Electricity, gas, steam and air conditioning supply	-0.274***	-0.258***	-0.275***	-0.266***
E Water supply; sewerage, waste management.	-0.268***	-0.245***	-0.269***	-0.248***
F Construction	-0.201***	-0.177***	-0.199***	-0.188***
G Wholesale and retail trade; repair of motor vehicles	-0.027	-0.050	-0.027	-0.044
H Transportation and storage	0.010	0.028	0.011	0.019
I Accommodation and food service activities	0.388***	0.413***	0.388***	0.419***
J Information and communication	-0.271***	-0.280***	-0.270***	-0.272***
K Financial and insurance activities	-0.320***	-0.244***	-0.320***	-0.236***
L Real estate activities	-0.223**	-0.251***	-0.223**	-0.248**
M Professional, scientific and technical activities	-0.181***	-0.088	-0.181***	-0.085
N Administrative and support service activities	-0.054	-0.079	-0.054	-0.071
O Public administration and defense; social security	-0.360*	-0.016	-0.360*	-0.018
P Education	-0.136*	-0.271***	-0.136*	-0.264***
Q Human health and social work activities	-0.052	0.149**	-0.053	0.146**
R Arts, entertainment and recreation	0.214***	0.270***	0.214***	0.278***
S Other services activities	-0.132**	0.244*	-0.132**	0.249*
Region (relative to Hl. M. Praha)				
Středočeský	-0.047	0.003	-0.047	0.001
Jihočeský	-0.043	-0.027	-0.043	-0.031
Plzeňský	0.002	0.043	0.002	0.042
Karlovarský	0.028	0.070	0.028	0.066
Ústecký	-0.014	0.032	-0.014	0.029
Liberecký	0.049	0.067	0.049	0.065
Královéhradecký	0.016	0.077	0.016	0.074
Pardubický	0.003	0.018	0.003	0.014
Jihomoravský	-0.018	-0.016	-0.018	-0.019
Vysočina	0.039	0.059	0.039	0.055
Olomoucký	0.049	0.072	0.049	0.068
Moravskoslezský	-0.005	0.029	-0.005	0.025
Zlínský	0.044	0.100*	0.044	0.099*

Table 4 Probability of Antivirus B Participation, Least Squares Estimates with Robust Standard Errors Continued

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Share of secondary-educated employees	0.015	-0.042	0.015	-0.048
Share of tertiary-educated employees	-0.246**	-0.298**	-0.246**	-0.302**
Collective agreement (yes)	-0.002	-0.028		
Pre-pandemic evolution of wage bill	-0.290***	-0.277***	-0.290***	-0.276***
Labor productivity 2018		-0.0001**		-0.0001**
Leverage 2018		-0.146**		-0.143**
Higher-level collective agreement			-0.007	0.001
Constant	0.719***	0.748***	0.719***	0.749***
N	3446	2463	3446	2463
Prob > chi^2	0.000	0.000	0.000	0.000
R^2	0.227	0.216	0.227	0.215

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We find similar effects when excluding from analysis those companies that experienced wage-bill growth during 2019. When we estimate these regressions based only on manufacturing firms (Appendix part 1, Table A1), the size effects are similar to those in Table 4, and the automobile industry is the sub-manufacturing group that has the highest program participation rates, conditional on all other controls. Furthermore, the pre-pandemic wage-bill-evolution coefficients based only on manufacturing firms vary between -0.4 and -0.5 across the estimated specifications, i.e., they are substantially larger than those based on all industries.

In sum, we find that manufacturing firms (large automobile producers in particular) are more likely to participate in Antivirus B in comparison to otherwise similar non-manufacturing firms. Is this disproportionate use of the program by manufacturing firms driven by larger demand shocks in these firms? The industry-level evidence in Figure 1 does not support this hypothesis as it shows that the pandemic decline in hours worked in manufacturing is similar to that in several other industries with lower program coverage. We now investigate this issue at the employer level. Specifically, we relate participation in the program to the firm-specific demand shock approximated by the firm-level pandemic decline in total hours worked. We estimate specifications similar to those presented in Table 4, but we additionally condition on the firm-level decline in hours worked (between 2nd quarters of 2020 and 2019).[8] These regressions are possibly affected by endogeneity to the extent that firms may over-use furloughs relative to the size of their true demand shocks, i.e., may ask for support for workers who continue working on home office or who would be laid off in absence of the Antivirus program for reasons not related to the pandemic demand shocks.

As expected, a decline (negative change) in hours worked between the 2nd quarters of 2020 and 2019 is associated with higher program participation in the first row of Table 5. In column (1) of Table 5, we predict program participation using

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[8] Since the inclusion of balance-sheet information did not affect our main results in Table 4, we focus on specifications in Table 5 that are based on the SES data alone.

only the pandemic decline in hours worked and industry indicators. The industry coefficients in this regression represent a simple measure of cross-industry differences in program utilization conditional on firm-specific demand drops. We find that almost all industries have a significantly lower propensity of program participation conditional on our demand-drop proxy. In columns (2) and (3) we additionally control for our standard set of firm characteristics from column (1) and (3) of Table 4. This significantly reduces the industry-level participation gaps against manufacturing and results in industry coefficients similar to those presented in Table 4. Hence, manufacturing appears to be the industry using the Antivirus B program the most even conditioning on a firm demand-drop proxy, which confirms the conclusion from Table 4.[9]

Where could these cross-industry differences in participation come from? Perhaps manufacturing firms are more skilled in relying on government support in general. Perhaps the higher share of retained employer-employee matches in manufacturing reflects higher costs of training relative to services, i.e., a higher option value for these employers of keeping these matches intact. Future research is needed to answer these questions based on a broader perspective, one that goes beyond the scope of our descriptive Antivirus B analysis.

We conclude our main analysis by studying the magnitude of support received by Antivirus B participants. The results again suggest that manufacturing firms were using the program more heavily than comparable firms in many other industries. In Table 6, which is based only on firms receiving support, we study a new outcome variable: the share of pre-pandemic (1st quarter 2020) wage bill that is covered by Antivirus B in the 2nd quarter of 2020. This is a measure of the overall magnitude of support relative to company size. Firms in seven industries draw support that is significantly lower, by 2 to 5 percentage points in terms of wage bill shares, than otherwise comparable firms in manufacturing. Firms with a high share of college-educated workforce draw funding less intensively (again, as expressed in wage bill shares).[10] Finally, the coefficient estimate corresponding to the pre-pandemic wage-bill evolution is again statistically significant and negative. Its value implies that a 10 % decline in pre-pandemic wage bills is associated with one-third of a percentage point lower intensity of use (expressed in 1st quarter 2020 wage bill share covered). These effects are thus much smaller compared to those on participation. However, controlling for pre-pandemic evolution of wage bills eliminates any size-related differences in the intensity of kurzarbeit use.[11] Again, the pre-pandemic wage-bill effects are larger within manufacturing (see Appendix Table A3).

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[9] When we re-estimate the specifications from Table 5 without the three industries that primarily relied on Antivirus A, i.e. without CZ-NACE industries G, I, and R, we obtain qualitatively as well as quantitatively similar conclusions (see Appendix Table A2).

[10] Note that the share of college educated is now not only related to the structure of demand shocks, but also mechanically related to the wage bill regression analysis due to the cap on Antivirus support per worker.

[11] When we exclude the pre-pandemic wage-bill evolution control, we find that companies with over 50 employees draw support that is about 6 % lower than companies with fewer than 50 workers. This implies that the reason why, among recipients, larger companies draw higher magnitudes of support is that larger companies experienced more negative pre-pandemic wage-bill evolution compared to smaller recipients of support.

Our firm-level analysis of Antivirus B participation and magnitude of support points to important cross-industry gaps that are not explained by firm type or demand shocks. To provide further insight into these main findings, we additionally employ worker-level occupation data available in the SES. First, we compare the occupational structure of the pandemic rise in furlough hours between employers that do receive Antivirus B support and those that do not. Second, we similarly contrast the occupational structure of hours of work.

In Appendix Table A4, we estimate regressions at worker level explaining the change (between the 1st half of 2019 and 2020) in hours on paid furlough.[12] In companies receiving Antivirus B support, there are no systematic differences in furlough hours increases (relative to the worker-level pre-pandemic benchmark) across occupations (distinguished at the two-digit ISCO-classification level). In contrast, companies that do not receive support clearly differentiate which occupations end up with high furlough-hours pandemic response. Kurzarbeit support recipients are more likely to increase paid furlough hours for foreign workers. Women experienced a different evolution of furlough hours depending on whether their employer received kurzarbeit support or not. Among support recipients, there are also clear industry differences in terms of the extent of furlough-hours pandemic increase: again, with the exception of culture and hospitality industries, the statistically significant coefficient estimates imply that manufacturing is increasing furlough hours more than other industries. These regressions thus confirm our main analysis at the firm level in that the industry differences we find are preserved when we condition on occupational structure. It is also notable that conditional on firm type and worker occupation, there is no clear industry structure in the pandemic furlough-hours increase among firms that do not draw kurzarbeit support. It could be that conditional on firm-type and occupational structure, there are no industry-level differences in demand shocks among non-recipients.

Next, in Appendix Table A5, we provide a similar occupational comparison of the pandemic response across recipients and non-recipients of kurzarbeit support, but this time the comparison is focused not on furlough hours, but on hours worked. We thus estimate regressions at worker level explaining the change (between the 1st half of 2019 and 2020) in hours worked. Unlike with furlough hours, we find a similar occupational structure of demand shocks (declines in hours worked) across recipients and non-recipients. This suggests that on top of the flat occupational structure of kurzarbeit-supported furloughs, recipients engaged in a similar occupational structure of contract reductions as non-recipients. In both recipient and non-recipient companies, female workers experienced stronger declines in hours of work than men did. Finally, relative to manufacturing, hours of work declined more in most other industries (with the typical exception of culture and hospitality industries). This again suggests that lower kurzarbeit support use was associated with higher contract reductions.

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[12] These regressions are based only on workers who are employed in both periods. About half of SES continuing-employment workers are employed in companies that receive support.

Table 5 Probability of Antivirus B Participation, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model		
	(1)	(2)	(3)
Change in hours (between 2nd quarters of 2020 and 2019)	-0.555***	-0.564***	-0.563***
CZ-NACE (relative to Manufacturing)			
A Agriculture, forestry and fishing	-0.431***	-0.279***	-0.274***
B Mining and quarrying	-0.150	-0.118	-0.119
D Electricity, gas, steam and air conditioning supply	-0.222***	-0.195**	-0.198**
E Water supply; sewerage, waste management.	-0.237***	-0.224**	-0.225**
F Construction	-0.267***	-0.146**	-0.140**
G Wholesale and retail trade; repair of motor vehicles	-0.076**	0.008	0.008
H Transportation and storage	0.012	0.031	0.036
I Accommodation and food service activities	0.075	0.206**	0.206**
J Information and communication	-0.343***	-0.221***	-0.221***
K Financial and insurance activities	-0.396***	-0.282***	-0.282***
L Real estate activities	-0.348***	-0.163*	-0.164*
M Professional, scientific and technical activities	-0.273***	-0.010	0.011
N Administrative and support service activities	-0.097*	-0.058	-0.057
O Public administration and defense; social security	-0.297*	-0.300*	-0.302*
P Education	-0.284***	-0.119*	-0.120*
Q Human health and social work activities	-0.085*	-0.027	-0.028
R Arts, entertainment and recreation	0.033	0.144*	0.144*
S Other services activities	-0.280***	-0.108*	-0.108*
Company size (relative to 10-49 employees)			
50-249 employees		0.163***	0.163***
250-999 employees		0.336***	0.334***
over 1000 employees		0.431***	0.427***
Region (relative to Hl. M. Praha)			
Středočeský		-0.051	-0.051
Jihočeský		-0.024	-0.024
Plzeňský		0.002	0.003
Karlovarský		0.044	0.043
Ústecký		0.014	0.013
Liberecký		0.005	0.004
Královéhradecký		0.008	0.007
Pardubický		0.002	0.002
Jihomoravský		-0.018	-0.018
Vysočina		0.041	0.041
Olomoucký		0.036	0.036
Moravskoslezský		-0.005	-0.006
Zlínský		0.039	0.039

Table 5 Probability of Antivirus B participation, Least Squares Estimates with Robust Standard Errors Continued

Explanatory variable	Model		
	(1)	(2)	(3)
Share of secondary-educated employees		0.119	0.119
Share of tertiary-educated employees		-0.071	-0.071
Collective agreement (yes)		-0.005	
Higher-level collective agreement			-0.016
Constant	1.072***	0.762***	0.762***
N	3 882	3 835	3 835
Prob > chi2	0.000	0.000	0.000
R^2	0.204	0.285	0.285

Notes: * p < 0,05, ** p < 0,01, *** p < 0,001

Table 6 The Share of the Firms' Pre-Pandemic Wage Bill Covered by Antivirus B, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Company size (relative to 10-49 employees)				
50-249 employees	-0.008	-0.006	-0.008	-0.007
250-999 employees	0.000	0.001	-0.001	-0.002
over 1000 employees	0.003	0.005	0.001	0.001
CZ-NACE (relative to Manufacturing)				
A Agriculture, forestry and fishing	-0.041***	-0.041***	-0.040***	-0.040***
B Mining and quarrying	-0.041***	-0.040***	-0.041***	-0.042***
D Electricity, gas, steam and air conditioning supply	-0.028***	-0.025***	-0.030***	-0.027***
E Water supply; sewerage, waste management.	-0.030***	-0.028***	-0.030***	-0.029***
F Construction	-0.029***	-0.024***	-0.026***	-0.022**
G Wholesale and retail trade; repair of motor vehicles	0.002	-0.003	0.003	-0.002
H Transportation and storage	-0.014*	-0.011	-0.012*	-0.010
I Accommodation and food service activities	0.273***	0.297***	0.273***	0.298***
J Information and communication	-0.008	-0.008	-0.007	-0.007
K Financial and insurance activities	-0.026***	-0.023***	-0.025***	-0.022***
L Real estate activities	-0.027*	-0.026	-0.028*	-0.025
M Professional, scientific and technical activities	-0.011*	-0.010	-0.012*	-0.010
N Administrative and support service activities	-0.015*	-0.016	-0.015*	-0.014
O Public administration and defense; social security	-0.026***	-0.025***	-0.027***	-0.026***
P Education	-0.003	-0.017**	-0.003	-0.017*
Q Human health and social work activities	-0.003	0.017	-0.004	0.016
R Arts, entertainment and recreation	0.132***	0.146***	0.132***	0.147***
S Other services activities	0.004	0.074*	0.004	0.075*

Table 6 The Share of the Firms' Pre-Pandemic Wage Bill Covered by Antivirus B, Least Squares Estimates with Robust Standard Errors Continued

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Region (relative to Hl. M. Praha)				
Středočeský	-0.012[*]	-0.006	-0.012[*]	-0.006
Jihočeský	-0.009	-0.001	-0.009	-0.002
Plzeňský	-0.006	-0.003	-0.006	-0.003
Karlovarský	-0.000	-0.004	-0.000	-0.005
Ústecký	-0.010	-0.004	-0.010	-0.004
Liberecký	0.015	0.013	0.015	0.013
Královéhradecký	0.001	0.022	0.001	0.021
Pardubický	-0.012	-0.011	-0.012	-0.011
Jihomoravský	-0.009	-0.011[*]	-0.009	-0.012[*]
Vysočina	-0.003	-0.001	-0.003	-0.002
Olomoucký	-0.011	-0.006	-0.011	-0.007
Moravskoslezský	-0.015[**]	-0.010	-0.015[**]	-0.011
Zlínský	-0.010	0.002	-0.010	0.002
Share of tertiary-educated employees	-0.053[***]	-0.056[***]	-0.054[***]	-0.056[***]
Collective agreement (yes)	-0.003	-0.007		
Pre-pandemic evolution of wage bill	-0.026[**]	-0.023[*]	-0.026[**]	-0.023[*]
Labor productivity 2018		-0.0001[***]		-0.0001[***]
Leverage 2018		-0.0005		-0.0002
Higher-level collective agreement			-0.008	-0.008
Constant	0.092[***]	0.090[***]	0.092[***]	0.089[***]
N	1638	1328	1638	1328
Prob > chi²	0.000	0.000	0.000	0.000
R²	0.310	0.293	0.311	0.294

Notes: * p < 0,05, ** p < 0,01, *** p < 0,001

In sum, while there is a distinct occupational pattern to furloughed hours evolution within firms that do not receive kurzarbeit support, there are (almost) no occupational differences in the evolution of furloughed hours within firms that do receive support. This suggests that recipients spread the kurzarbeit hours evenly across their workers, while non-recipients selectively allocate furlough pay (which they cover on their own) across occupations. Even with kurzarbeit support, the occupational structure of contract reductions may be similar to that observed in companies not receiving support. One explanation for this pattern of findings is that all companies performed contract adjustments that reflected the demand shocks they all faced, but that companies with larger demand shocks, which received kurzarbeit support more often, additionally offered their workers furlough hours that were not selectively allocated with respect to demand shocks. Future research is needed to investigate this hypothesis based on longer-term employment records and/or case studies of individual employers.

6. Employment Effects

Studies of kurzarbeit ideally estimate the causal program effect on employment preservation (see Section 2 for a literature review). We performed two attempts to learn about causal employment effects of Antivirus B, both of which fell short of providing convincing causal evidence. These are reported in brief here, and in detail in Jurajda and Doleželová (2021).

First, we used a subset of about 1 000 SES firms that also answered a survey focusing on new technologies (AI, robotics, automation) in late spring 2020 (see Jurajda and Bělín, 2020, for a description of the survey). Among the recipients of Antivirus support in this SES subsample, about two thirds of firms report that Antivirus support was helpful. Within the entire robotic-survey sub-sample, recipients of support report a 6 % higher probability that they are forced to lay off a part of their workforce, which could be due to facing stronger demand shocks. However, this association is not present when we focus on the two thirds of recipients who report that the program was helpful. While such evidence is based on a potentially selective sub-set of the SES and while it falls short of causal analysis of program effects, it is consistent with the program having positive effects on employment.

Second, we attempted to identify administrative quasi-random sources of variation in program participation that would allow us to study the causal impact of program support on employment. We were not successful. Essentially all applicants receive support. A small subset received support with extensive delays (of about a month), and these delays were disproportionately found in a subset of District Labor Offices, but we could not uncover any significant relationship between the delayed support (instrumented by District Labor Office identity) and economic outcomes of interest. Hence, this study remains entirely descriptive.

7. Conclusions

In this paper, we study the firm-type structure of the use of the main Czech kurzarbeit program called Antivirus B. We find that manufacturing firms, especially large ones, not only use the program with higher probability, but that they use it to cover a higher share of their wage bill, compared to firms from other industries, and use it to support higher shares of full-time contracts of their workers. When we express the participation of companies in terms of employee full-time equivalents supported by the program, manufacturing accounts for three quarters of the supported FTE-equivalent employment. As a result, manufacturing firms were able to support the largest share of the pandemic drop in hours from the kurzarbeit program, compared to employers from other industries. We also find that firms that experienced a drop in their wage bill during 2019, up until the 1st quarter of 2020, i.e., just before the pandemic hit, also participated in the program more often, so that pre-pandemic drops in demand (as reflected in declining wage bills, particularly those of manufacturing firms) are partly compensated by the pandemic relief offered in the Antivirus B program. Why was manufacturing using the program more intensively? Perhaps manufacturing firms are more skilled in relying on government support. Perhaps the higher share of furlough-supported employer-employee matches in manufacturing reflects higher costs of worker training in comparison to service industries. Future research is needed to answer these questions. Our analysis also

implies that the presence of a collective agreement is not related to the structure of kurzarbeit and that women were more affected by declining hours of work in all companies, but experienced a different evolution of furlough hours depending on whether their employer received kurzarbeit support or not.

APPENDIX

1. Additional Regression Evidence

Table A1 Probability of Antivirus B Participation in Manufacturing Companies, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model (1)	(2)	(3)	(4)
Company size (relative to 10-49 employees)				
50-249 employees	0.313***	0.299***	0.309***	0.292***
250-999 employees	0.406***	0.387***	0.390***	0.370***
over 1000 employees	0.510***	0.480***	0.483***	0.451***
CZ-NACE (relative to Manufacture of motor vehicles and other transport equipment)				
Manufacture of food products, beverages, and tobacco products	-0.415***	-0.401***	-0.417***	-0.403***
Manufacture of textiles, wearing apparel, leather, and related products	-0.152*	-0.144*	-0.127*	-0.130
Manufacture of wood, manufacture of paper	-0.330***	-0.362***	-0.327***	-0.360***
Manufacture of coke and refined petroleum products	-0.409	-0.426	-0.418	-0.437
Manufacture of chemicals and chemical products	-0.382***	-0.401***	-0.385***	-0.404***
Manufacture of basic pharmaceutical products	-0.541***	-0.542***	-0.537***	-0.535***
Manufacture of rubber and plastic products	-0.169***	-0.156***	-0.151***	-0.147***
Manufacture of basic metals	-0.252***	-0.226***	-0.253***	-0.227***
Manufacture of computer, electronic and optical products	-0.185*	-0.183*	-0.184*	-0.179*
Manufacture of electrical equipment	-0.153**	-0.149**	-0.152**	-0.147**
Manufacture of machinery and equipment	-0.203***	-0.216***	-0.207***	-0.219***
Manufacture of furniture, other manufacturing	-0.222***	-0.209***	-0.223***	-0.209***
Region (relative to Hl. M. Praha)				
Středočeský	0.012	0.068	0.017	0.072
Jihočeský	0.087	0.106	0.083	0.103
Plzeňský	0.036	0.076	0.041	0.078
Karlovarský	0.110	0.120	0.105	0.119
Ústecký	0.102	0.154*	0.100	0.150*
Liberecký	0.057	0.067	0.054	0.066
Královéhradecký	0.099	0.148*	0.091	0.141
Pardubický	0.013	0.053	0.011	0.051
Jihomoravský	0.075	0.087	0.079	0.087
Vysočina	0.144*	0.189**	0.146*	0.191**
Olomoucký	0.102	0.117	0.101	0.115
Moravskoslezský	0.078	0.126*	0.077	0.122
Zlínský	0.108	0.149*	0.110	0.151*

Table A1 Probability of Antivirus B Participation in Manufacturing Companies, Least Squares Estimates with Robust Standard Errors Continued

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Share of secondary-educated employees	-0.022	-0.001	-0.013	0.008
Share of tertiary-educated employees	-0.203	-0.158	-0.199	-0.156
Collective agreement (yes)	-0.024	-0.030		
Pre-pandemic evolution of wage bill	-0.392***	-0.504***	-0.378***	-0.494***
Leverage 2018		-5.369***		-5.550***
Labor productivity 2018		-0.0001		-0.0001
Higher-level collective agreement			-0.108	-0.074
Constant	0.901***	0.984***	0.882***	0.968***
N	1 196	1 020	1 196	1 020
$Prob > chi^2$	0.000	0.000	0.000	0.000
R^2	0.214	0.215	0.215	0.215

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A2 Probability of Antivirus B Participation Without CZ-NACE G, I, and R, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model		
	(1)	(2)	(3)
Decline in hours (between 2nd quarters of 2020 and 2019)	-0.498***	-0.510***	-0.510***
CZ-NACE (relative to Manufacturing)			
A Agriculture, forestry and fishing	-0.438***	-0.280***	-0.268***
B Mining and quarrying	-0.154	-0.126	-0.123
D Electricity, gas, steam and air conditioning supply	-0.231***	-0.212***	-0.212***
E Water supply; sewerage, waste management.	-0.243***	-0.232***	-0.232***
F Construction	-0.276***	-0.149***	-0.136***
H Transportation and storage	0.010	0.033	0.044
J Information and communication	-0.353***	-0.254***	-0.257***
K Financial and insurance activities	-0.405***	-0.305***	-0.306***
L Real estate activities	-0.354***	-0.162*	-0.164*
M Professional, scientific and technical activities	-0.283***	-0.145**	-0.147**
N Administrative and support service activities	-0.096*	-0.062	-0.064
O Public administration and defense; social security	-0.307*	-0.334*	-0.332*
P Education	-0.291***	-0.161**	-0.163**
Q Human health and social work activities	-0.091*	-0.044	-0.046
S Other services activities	-0.284***	-0.121**	-0.123**
Company size (relative to 10-49 employees)			
50-249 employees		0.178***	0.181***
250-999 employees		0.354***	0.356***
over 1000 employees		0.444***	0.446***
Region (relative to Hl. M. Praha)			
Středočeský		-0.049	-0.048
Jihočeský		-0.016	-0.015
Plzeňský		-0.012	-0.011
Karlovarský		0.061	0.062
Ústecký		0.021	0.021
Liberecký		0.001	0.001
Královéhradecký		0.031	0.031
Pardubický		0.001	0.002
Jihomoravský		-0.026	-0.026
Vysočina		0.048	0.050
Olomoucký		0.026	0.027
Moravskoslezský		0.016	0.017
Zlínský		0.057	0.056
Share of secondary-educated employees		0.045	0.047
Share of tertiary-educated employees		-0.063	-0.061
Collective agreement (yes)		0.005	
Higher-level collective agreement			-0.023
Constant	1.025***	0.754***	0.753***
N	3 240	3 204	3 204
Prob > chi2	0.000	0.000	0.000
R^2	0.198	0.286	0.286

Notes: * p < 0,05, ** p < 0,01, *** p < 0,001

Table A3 The Share of the Firms' Pre-Pandemic Wage Bill Covered by Antivirus B in Manufacturing Companies, Least Squares Estimates with Robust Standard Errors

Explanatory variable	Model			
	(1)	(2)	(3)	(4)
Company size (relative to 10-49 employees)				
50-249 employees	0.009	0.013*	0.008	0.012*
250-999 employees	0.019*	0.027***	0.016*	0.023***
over 1000 employees	0.032**	0.038***	0.027**	0.032***
CZ-NACE (relative to Manufacture of motor vehicles and other transport equipment)				
Manufacture of food products, beverages, and tobacco products	-0.077***	-0.087***	-0.077***	-0.088***
Manufacture of textiles, wearing apparel, leather, and related products	-0.040**	-0.038**	-0.035**	-0.032*
Manufacture of wood, manufacture of paper	-0.069***	-0.073***	-0.068***	-0.073***
Manufacture of coke and refined petroleum products	-0.087***	-0.092***	-0.089***	-0.094***
Manufacture of chemicals and chemical products	-0.077***	-0.078***	-0.078***	-0.078***
Manufacture of basic pharmaceutical products	-0.085***	-0.085***	-0.085***	-0.084***
Manufacture of rubber and plastic products	-0.044***	-0.045***	-0.040***	-0.041***
Manufacture of basic metals	-0.061***	-0.060***	-0.062***	-0.060***
Manufacture of computer, electronic and optical products	-0.070***	-0.073***	-0.069***	-0.072***
Manufacture of electrical equipment	-0.064***	-0.066***	-0.064***	-0.066***
Manufacture of machinery and equipment	-0.056***	-0.055***	-0.057***	-0.056***
Manufacture of furniture, other manufacturing	-0.071***	-0.072***	-0.071***	-0.072***
Region (relative to Hl. M. Praha)				
Středočeský	0.005	0.020*	0.006	0.021*
Jihočeský	0.006	0.020*	0.005	0.019*
Plzeňský	-0.005	0.009	-0.004	0.010
Karlovarský	0.004	0.003	0.003	0.002
Ústecký	0.013	0.029**	0.013	0.028**
Liberecký	0.021	0.030*	0.021	0.029*
Královéhradecký	-0.000	0.016	-0.002	0.014
Pardubický	-0.014	-0.001	-0.014	-0.001
Jihomoravský	-0.016	-0.006	-0.015	-0.005
Vysočina	0.000	0.012	0.001	0.013
Olomoucký	0.001	0.009	0.001	0.009
Moravskoslezský	-0.008	0.001	-0.008	0.000
Zlínský	0.006	0.019*	0.007	0.019*
Share of secondary-educated employees	-0.043	-0.014	-0.042	-0.010
Share of tertiary-educated employees	-0.097*	-0.063**	-0.097*	-0.062**
Collective agreement (yes)	-0.005	-0.006		
Pre-pandemic evolution of wage bill	-0.079*	-0.126***	-0.078*	-0.125***
Labor productivity 2018		-0.000***		-0.000***
Leverage 2018		-0.422***		-0.474***
Higher-level collective agreement			-0.022**	-0.024**
Constant	0.159***	0.144***	0.155***	0.138***
N	763	670	763	670
$Prob > chi^2$	0.000	0.000	0.000	0.000
R^2	0.166	0.223	0.170	0.228

*Notes: * p < 0,05, ** p < 0,01, *** p < 0,001*

Table A4 Change in Worker-Level Hours on Paid Furlough Between the First Half of 2020 And 2019 (Expressed as Ratio) for Antivirus B support recipients (models (1_1) and (2_1)) and non-recipients ((3_0) a (4_0)), Least Squares Estimates, Standard Errors Clustered at Firm Level

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Occupation, code CZ-ISCO (relative to ISCO 52)				
11.czisco2	3.461	3.405	-0.864**	-0.862**
12.czisco2	-0.440	-0.476	-0.923***	-0.928***
13.czisco2	-0.388	-0.427	-0.938***	-0.937***
14.czisco2	0.524	0.471	-0.207	-0.226
21.czisco2	0.402	0.349	-0.676*	-0.688*
22.czisco2	1.201	1.187	-1.013***	-0.968***
23.czisco2	0.158	0.110	-1.161***	-1.162***
24.czisco2	-0.520	-0.567	-1.164**	-1.168**
25.czisco2	-0.697	-0.748	-2.079*	-2.083*
26.czisco2	3.054	2.993	-1.438*	-1.440*
31.czisco2	0.123	0.066	0.074	0.069
32.czisco2	0.979	0.960	-1.139***	-1.099***
33.czisco2	-0.137	-0.169	-0.938**	-0.939**
34.czisco2	0.174	0.112	-0.882	-0.877
35.czisco2	3.940	3.889	0.616	0.615
41.czisco2	-0.091	-0.129	-1.069***	-1.067***
42.czisco2	0.294	0.198	-0.527	-0.532
43.czisco2	-0.115	-0.116	-0.638**	-0.642**
44.czisco2	-0.019	-0.175	-1.006*	-1.011*
51.czisco2	1.182	1.124	0.655	0.658
53.czisco2	0.580	0.540	-1.003***	-0.976***
54.czisco2	0.402	0.343	-0.551*	-0.561*
61.czisco2	-0.475	-0.392	0.058	0.136
62.czisco2	7.550	7.459	-0.352	-0.388
71.czisco2	0.350	0.296	-0.241	-0.233
72.czisco2	0.085	0.028	-0.475*	-0.486*
73.czisco2	-0.370	-0.386	-0.585*	-0.605*
74.czisco2	-0.192	-0.241	-0.404	-0.409
75.czisco2	-0.038	-0.073	-0.432*	-0.435*
81.czisco2	0.227	0.200	-0.309	-0.308
82.czisco2	0.494	0.435	-0.543*	-0.553**
83.czisco2	0.042	0.010	-0.420	-0.413
91.czisco2	0.004	-0.025	-0.503	-0.499
92.czisco2	-0.737	-0.598	-0.652*	-0.622*
93.czisco2	0.039	-0.005	-0.455*	-0.449*
94.czisco2	-0.425	-0.457	3.237	3.249
96.czisco2	0.455	0.406	0.074	0.086

*Notes: p < 0,05, ** p < 0,01, *** p < 0,001. See Appendix B for ISCO occupational codes.*

Table A4 Change in Worker-Level Hours on Paid Furlough Between the First Half of 2020 And 2019 (Expressed as Ratio) for Antivirus B support recipients (models (1_1) and (2_1)) and non-recipients ((3_0) a (4_0)), Least Squares Estimates, Standard Errors Clustered at Firm Level Continued

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Gender: female	-0.138*	-0.145*	0.158	0.159
Citizenship (relative to the Czech Republic)				
Slovakia	-0.089	-0.087	-0.329	-0.330
Poland	0.448	0.438	0.554	0.550
Ukrainian	1.911***	1.892***	0.030	0.032
Bulgaria	1.275***	1.283***	-0.513	-0.516
Romanian	1.473***	1.475***	-0.904	-0.896
Other	0.644*	0.638	-0.584	-0.575
Age	-0.108***	-0.106***	-0.078*	-0.078*
Age*Age	0.001***	0.001***	0.001**	0.001**
Tenure	-0.089***	-0.092***	-0.071**	-0.071**
Tenure* Tenure	0.001**	0.002**	0.001*	0.001*
Company size (relative to 50-249 employees)				
250-999 employees	-0.593	-0.602	-0.262	-0.279
over 1000 employees	-0.549	-0.579	-0.519	-0.541
CZ-NACE (relative to Manufacturing)				
A Agriculture, forestry and fishing	-3.764***	-3.555***	-0.797	-0.746
B Mining and quarrying	-1.118***	-1.081***	0.598*	0.603*
D Electricity, gas, steam and air conditioning supply	-0.352	-0.325	-0.166	-0.170
E Water supply; sewerage, waste management.	-0.581	-0.544	0.458	0.447
F Construction	-0.925***	-0.712***	0.119	0.221
G Wholesale and retail trade; repair of motor vehicles	0.726	0.804	0.357	0.368
H Transportation and storage	-0.577*	-0.439	0.539	0.571*
I Accommodation and food service activities	3.796*	3.802*	0.842	0.821
J Information and communication	1.140	1.121	1.092	1.082
K Financial and insurance activities	-0.210	-0.256	0.204	0.203
L Real estate activities	-1.170**	-1.221**	0.242	0.215
M Professional, scientific and technical activities	0.727	0.625	-0.646	-0.658
N Administrative and support service activities	-0.309	-0.293	0.177	0.161
O Public administration and defense; social security			0.531	0.526
P Education	-0.962	-0.979	-0.897	-0.904
Q Human health and social work activities	-1.267	-1.283	0.171	0.134
R Arts, entertainment and recreation	4.336***	4.276***	3.605***	3.574***
S Other services activities	-0.927*	-0.964*	-0.324	-0.352

Notes: $p < 0,05$, ** $p < 0,01$, *** $p < 0,001$. See Appendix B for ISCO occupational codes.

Table A4 Change in Worker-Level Hours on Paid Furlough Between the First Half of 2020 And 2019 (Expressed as Ratio) for Antivirus B support recipients (models (1_1) and (2_1)) and non-recipients ((3_0) a (4_0)), Least Squares Estimates, Standard Errors Clustered at Firm Level Continued

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Region (relative to Hl. M. Praha)				
Středočeský	1.476***	1.585***	-0.015	-0.001
Jihočeský	0.530	0.643	0.151	0.158
Plzeňský	1.393*	1.479*	0.074	0.085
Karlovarský	2.068	2.133	-0.037	-0.039
Ústecký	1.526***	1.583***	0.297	0.301
Liberecký	0.543	0.617	0.443	0.439
Královéhradecký	0.296	0.355	1.764	1.755
Pardubický	0.021	0.105	0.159	0.166
Jihomoravský	0.478	0.529	0.009	0.022
Vysočina	-0.049	0.035	0.298	0.297
Olomoucký	0.368	0.419	0.196	0.210
Moravskoslezský	0.302	0.344	0.182	0.180
Zlínský	-0.075	-0.019	0.147	0.149
Share of secondary-educated employees	0.124	0.157	-0.237	-0.211
Share of tertiary-educated employees	-0.278	-0.132	2.124*	2.142*
Collective agreement (yes)	0.084		0.007	
Higher-level collective agreement		-0.696		-0.232**
Constant	5.560***	5.571***	4.044***	4.058***
N	537 899	537 899	591 185	591 185
Prob > chi^2	0.000	0.000	0.000	0.000
R^2	0.003	0.003	0.000	0.000

*Notes: p < 0,05, ** p < 0,01, *** p < 0,001. See Appendix B for ISCO occupational codes.*

Table A5 Change (Ratio) in Worker-Level Hours of Work Between the First Half of 2020 and 2019 for Antivirus B Support Recipients (*_1) and Non-Recipients (*_0), Least Squares with Standard Errors Clustered at Firm Level

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Occupation, code CZ-ISCO (relative to ISCO 52)				
11.czisco2	0.074***	0.074***	0.041**	0.039**
12.czisco2	0.068***	0.068***	0.027**	0.025**
13.czisco2	0.058*	0.058*	0.035***	0.034***
14.czisco2	-0.028	-0.029	0.018	0.020
21.czisco2	0.032	0.031	0.034***	0.034***
22.czisco2	0.058*	0.058*	0.025*	0.026*
23.czisco2	0.054*	0.054*	0.053***	0.052***
24.czisco2	0.065**	0.065**	0.025*	0.024*
25.czisco2	0.071**	0.072**	0.026*	0.024*
26.czisco2	0.056**	0.057**	0.041***	0.042***
31.czisco2	0.002	0.002	0.024**	0.023*
32.czisco2	0.045*	0.045*	0.017	0.017
33.czisco2	0.044*	0.044*	0.025**	0.024*
34.czisco2	0.012	0.012	0.000	-0.002
35.czisco2	0.053**	0.052**	0.030*	0.029*
41.czisco2	0.030	0.031	0.022*	0.020
42.czisco2	0.015	0.015	-0.008	-0.010
43.czisco2	0.014	0.015	0.028**	0.027**
44.czisco2	0.057**	0.057**	0.138	0.136
51.czisco2	-0.067*	-0.068*	-0.049**	-0.051**
53.czisco2	0.059*	0.059*	0.021	0.019
54.czisco2	0.044	0.043	0.032**	0.031*
61.czisco2	0.100	0.101	0.026	0.027
62.czisco2	0.006	0.002	0.018	0.017
71.czisco2	-0.016	-0.016	0.027*	0.027*
72.czisco2	-0.010	-0.011	0.006	0.005
73.czisco2	-0.017	-0.016	0.001	0.001
74.czisco2	0.025	0.024	0.013	0.012
75.czisco2	-0.003	-0.003	0.014	0.014
81.czisco2	-0.007	-0.007	0.013	0.013
82.czisco2	-0.036	-0.037	0.005	0.002
83.czisco2	-0.005	-0.006	0.014	0.013
91.czisco2	0.025	0.025	0.024	0.022
92.czisco2	0.128	0.131	0.049	0.047
93.czisco2	0.008	0.008	0.002	0.001
94.czisco2	-0.007	-0.008	-0.024	-0.025
96.czisco2	-0.001	-0.002	0.017	0.014

*Notes: $p < 0{,}05$, ** $p < 0{,}01$, *** $p < 0{,}001$. See Appendix B for ISCO occupational codes.*

Table A5 Change (Ratio) in Worker-Level Hours of Work Between the First Half of 2020 and 2019 for Antivirus B Support Recipients (*_1) and Non-Recipients (*_0), Least Squares with Standard Errors Clustered at Firm Level Continued

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Gender: female	-0.015***	-0.015***	-0.008***	-0.008***
Citizenship (relative to the Czech Republic)				
Slovakia	-0.020***	-0.020***	-0.002	-0.003
Poland	-0.178***	-0.179***	-0.181***	-0.182***
Ukrainian	0.075***	0.075***	0.100***	0.099***
Bulgaria	-0.049***	-0.049***	0.015	0.015
Romanian	0.021	0.020	0.029	0.027
Other	0.058***	0.058***	0.032***	0.030***
Age group (relative to less than 20 years)	.	.	.	.
20-29 years	-0.297***	-0.297***	-0.198	-0.196
30-39 years	-0.317***	-0.317***	-0.223	-0.221
40-49 years	-0.295***	-0.296***	-0.207	-0.205
50-59 years	-0.265***	-0.265***	-0.183	-0.181
60 years and older	-0.314***	-0.315***	-0.233	-0.231
Tenure	-0.005***	-0.005***	-0.008***	-0.007***
Tenure* Tenure	0.000**	0.000**	0.000**	0.000**
Company size (relative to 50-249 employees)				
250-999 employees	0.012	0.011	-0.009	-0.006
over 1000 employees	0.018	0.016	-0.006	-0.001
CZ-NACE (relative to Manufacturing)				
A Agriculture, forestry and fishing	0.110***	0.113**	0.013	0.017*
B Mining and quarrying	0.080***	0.080***	-0.012	-0.010
D Electricity, gas, steam and air conditioning supply	0.104***	0.104***	-0.005	-0.002
E Water supply; sewerage, waste management.	0.090***	0.091***	-0.024*	-0.021
F Construction	0.107***	0.111***	-0.006	-0.002
G Wholesale and retail trade; repair of motor vehicles	0.040	0.044*	-0.003	-0.005
H Transportation and storage	0.083***	0.087***	-0.004	-0.002
I Accommodation and food service activities	-0.105**	-0.103**	-0.176*	-0.176*
J Information and communication	0.045*	0.046*	-0.003	-0.006
K Financial and insurance activities	0.031	0.032	-0.023*	-0.022*
L Real estate activities	0.107**	0.109**	-0.030	-0.033
M Professional, scientific and technical activities	0.020	0.020	-0.011	-0.010
N Administrative and support service activities	0.011	0.014	-0.016	-0.020
O Public administration and defense; social security			-0.029*	-0.025
P Education	0.094*	0.094*	-0.012	-0.008
Q Human health and social work activities	0.017	0.017	-0.005	-0.004
R Arts, entertainment and recreation	-0.142**	-0.141**	-0.198***	-0.199***
S Other services activities	0.065***	0.065***	-0.024	-0.029*

Table A5 Change (Ratio) in Worker-Level Hours of Work Between the First Half of 2020 and 2019 for Antivirus B Support Recipients (*_1) and Non-Recipients (*_0), Least Squares with Standard Errors Clustered at Firm Level Continued

Explanatory variable	Model			
	(1_1)	(2_1)	(3_0)	(4_0)
Region (relative to Hl. M. Praha)				
Středočeský	-0.052**	-0.050**	0.006	0.006
Jihočeský	-0.026	-0.024	0.002	0.004
Plzeňský	-0.030	-0.028	-0.010	-0.010
Karlovarský	-0.059	-0.059	0.001	0.001
Ústecký	-0.053*	-0.052*	0.014	0.014
Liberecký	-0.070**	-0.069**	-0.011	-0.011
Královéhradecký	-0.019	-0.019	-0.008	-0.008
Pardubický	-0.002	-0.001	-0.009	-0.008
Jihomoravský	0.003	0.004	-0.017*	-0.017*
Vysočina	-0.018	-0.016	-0.020	-0.019
Olomoucký	-0.009	-0.008	-0.019	-0.019
Moravskoslezský	-0.007	-0.006	-0.009	-0.007
Zlínský	-0.014	-0.013	-0.011	-0.011
Share of secondary-educated employees	-0.026	-0.027	-0.056	-0.059
Share of tertiary-educated employees	0.049	0.050	-0.002	-0.008
Collective agreement (yes)	-0.003		0.013**	
Higher-level collective agreement		-0.017		0.001
Constant	1.242***	1.242***	1.308***	1.315***
N	557308	557308	617165	617165
Prob > chi²	0.000	0.000	0.000	0.000
R^2	0.040	0.040	0.008	0.008

*Notes: p < 0,05, ** p < 0,01, *** p < 0,001. See Appendix B for ISCO occupational codes.*

2. Occupational Classification (CZ-ISCO)

1 Legislators, senior officials and managers
- 11   Chief executives, senior officials and legislators
- 12   Administrative and commercial managers
- 13   Production and specialised services managers
- 14   Hospitality, retail and other services managers

2 Professionals
- 21   Science and engineering professionals
- 22   Health professionals
- 23   Teaching professionals
- 24   Business and administration professionals
- 25   Information and communications technology professionals
- 26   Legal, social and cultural professionals

3 Technicians and associate professionals
- 31   Science and engineering associate professionals
- 32   Health associate professionals
- 33   Business and administration associate professionals
- 34   Legal, social, cultural and related associate professionals
- 35   Information and communications technicians

4 Clerks
- 41   General and keyboard clerks
- 42   Customer services clerks
- 43   Numerical and material recording clerks
- 44   Other clerical support workers

5 Service workers and shop and market sales workers
- 51   Personal service workers
- 52   Sales workers
- 53   Personal care workers
- 54   Protective services workers

6 Skilled agricultural and forestry workers
- 61   Market-oriented skilled agricultural workers
- 62   Market-oriented skilled forestry, fishery and hunting workers
- 63   Subsistence farmers, fishers, hunters and gatherers

7 Craft and related trades workers
- 71   Building and related trades workers, excluding electricians
- 72   Metal, machinery and related trades workers
- 73   Handicraft and printing workers
- 74   Electrical and electronic trades workers
- 75   Food processing, wood working, garment and other craft and related trades

8 Plant and machine operators and assemblers
- 81   Stationary plant and machine operators
- 82   Assemblers
- 83   Drivers and mobile plant operators

9 Elementary occupations
- 91   Cleaners and helpers
- 92   Agricultural, forestry and fishery labourers
- 93   Labourers in mining, construction, manufacturing and transport
- 94   Food preparation assistants
- 95   Street and related sales and service workers
- 96   Refuse workers and other elementary workers

3. Antivirus Participation Conditions[1]

The formal conditions to be met by participants in the Antivirus program in 2020 were the following:

- Eligible employers comply with the Labor Code and pay social security contributions in full.

- Eligible employees are those with employee contracts, participating in the sickness and pension insurance schemes, currently not within the period of layoff notice.

Antivirus support was provided by the Labor Office of the Czech Republic. The amount and duration of support depended on the reason for the occurrence of an obstacle at work. Employers could apply for compensation in two regimes: Antivirus regime A and Antivirus regime B.

Regime A provided contributions to employers whose operations have been closed down or severely limited as a result of lockdowns and public health measures taken by the government, the Ministry of Health, or regional Public Health Offices. Regime A was also applicable in instances when an employee was unable to work because the employee was in quarantine ordered under legal regulations. The level of contribution under Regime A was equal to 80% of the compensatory (furlough) wage, including any levies, paid by the employer to the employee during the time when obstacles to worked existed. The maximum monthly contribution per employee was 39 000 CZK.

Regime B provided support to employers who were affected through temporary drops in demand for their output or supply of their inputs or who faced a situation where a significant portion of their employees were absent from work due to quarantine, sickness, or childcare (when public child care was not available during lockdowns). Employers were not required to document the relation of the specific obstacle to work to the current epidemic situation. The level of contribution was equal to 60% of the compensatory wage, including any levies, paid by the employer to the employee during the time when obstacles to worked existed. The maximum monthly contribution per employee was 29 000 CZK.

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[1] https://www.mpsv.cz/documents/20142/1443715/Manual_Program_Antivirus_EN.pdf

REFERENCES

Adams-Prassl A, Boneva T, Golin M, Rauh C (2020): Furloughing. *CEPR Discussion Paper* No. 15194.

Bennedsen M, Larsen B, Schmutte I, Scur D (2020): Preserving Job Matches During the COVID-19 Pandemic: Firm-Level Evidence on the Role of Government Aid. , Global Labor Organization, *GLO Discussion Paper Series* 588.

Cahuc P, Carcillo S (2011): Is Short-Time Work a Good Method to Keep Unemployment Down? *Nordic Economic Policy Review,* 1(1): 133–164.

Cahuc P, Kramarz F, Nevoux S (2018): When Short-Time Work Works. *IZA Discussion Paper* No. 11673.

Davis SJ, von Wachter T (2011): Recessions and the Costs of Job Loss. *Brookings Papers on Economic Activity*, 42(2): pp. 1–72.

Faia E, Lechthaler W, Merkl C (2013): Fiscal Stimulus and Labor Market Policies in Europe. *Journal of Economic Dynamics and Control,* 37 (3): pp. 483–499.

Giupponi G, Landais C (2018): Subsidizing Labor Hoarding in Recessions: Employment and Welfare Effects of Short Time Work. *CEP Discussion Paper* 1585, LSE.

Hijzen A, Venn D (2011): The Role of Short-Time Work Schemes during the 2008−09 Recession. *OECD Social, Employment and Migration Working Papers*.

Jurajda Š, Bělín M. (2020): Polarizace českých podniků v důsledku průmyslu 4.0 available at https://www.spcr.cz/images/Studie_320_polarizace_firem_prumysl40.pdf

Jurajda Š, Doleželová P (2021): Antivirus B: Zkušenosti z první vlny epidemie available at https://www.trexima.cz/wp-content/uploads/antivirus-b-vyzkumna-zprava.pdf

Kruppe T, Scholz T (2014): Labour Hoarding in Germany: Employment Effects of Short-Time Work During the Crises. *IAB-Discussion Paper*, No. 17/2014, Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg.

Mittag N, Pertold F (2020): Short-time Work and Related Measures to Mitigate Consequences of a (Partial) Economic Shutdown to Mitigate Consequences of a (Partial) Economic Shutdown, IDEA anti COVID-19 #13 available at
https://idea-en.cerge-ei.cz/images/COVID/IDEA_Short_time_work_COVID19_April2020_13.pdf.