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Flexible Use of the Large-Scale Short-Time Work Scheme in Germany during the Pandemic: Dynamic Labour Demand Models Estimation with High-Frequency Establishment Data

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Abstract: Our study uses 24 waves of the survey Establishments in the COVID-19 crisis (BeCOVID), a high-frequency dataset collected at monthly intervals by the Institute for Employment Research during the COVID-19 pandemic, to investigate the behaviour of establishments with respect to the dynamics of their employment, in particular their use of short-time work. Due to the high-frequency intervals, the present data are considerably better suited than annual panel surveys to investigate adjustment processes. This is especially true for the role of short-time work, which is seen as a particularly fast adjustment option and thus reduces adjustment costs rapidly. Our estimations reveal a much faster overall workforce adjustment process compared with previous studies, which rely on annual panel surveys. In addition, our empirical results show that the employment adjustment in establishments using short-time work during the COVID-19 crisis occurred almost immediately within one month.

Keywords: short-time work; COVID-19; dynamic labour demand; panel analysis; high-frequency establishment data

JEL Classification: C23; C26; J23; J39

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1. Introduction

During the COVID-19 pandemic, many countries used income and job-preserving measures, including short-time work (STW) schemes, in supporting workers' income and ensuring that employment rapidly rebounded as COVID-19 'crisis-related' shutdowns were erased (OECD 2020). The adoption of job retention schemes reached an all-time high in the OECD countries in the pandemic, with 60 million jobs preserved—more than 10 times as many as during the Great Recession 2008/2009 (OECD 2021, 2022). As the use of STW is expensive, needs appropriate agencies and can provide wrong incentives, measures adopted in other countries were wage subsidies, subsidies for periods of leave and bans on dismissals in times of crisis, as well as income transfers to employees and business aid programmes (Fitzenberger and Walwei 2023). However, international observers argue that STW programmes are effective in preserving existing jobs, but they may not be efficient in the reallocation of workers from unviable jobs to industries and firms with better prospects (International Monetary Fund 2020; OECD 2020). Furthermore, despite the experiences with the instrument of STW gained during the Great Recession 2008/2009, the massive programme has reached its administrative limits, particularly concerning the flexibility in the amount of work compensated for and the multi-stage application procedure (Fitzenberger and Walwei 2023). The pandemic provides an excellent example for this conflict. On the one hand, exceptional STW measures in response to the COVID-19

crisis in Germany, such as the increase of the eligibility threshold of affected workers and the coverage of 100% of social security contributions for the lost hours starting from the first month, made the STW scheme more attractive for both employers and employees. On the other hand, these adjustments of regulations provided additional incentives to lock-in employees in their current jobs and decrease their willingness to switch jobs. Although a huge bulk of the literature has been devoted to studying the effects of large-scale STW programmes on employment and unemployment (e.g., Mosley and Kruppe 1996; Hijzen and Venn 2011; Boeri and Bruecker 2011; Bellmann et al. 2013; Cahuc et al. 2018, 2021), analyses of the entries into and exits from firms and employees from this scheme are missing, especially applying microdata.

As the adoption of STW schemes varied over the course of the pandemic, annual employer and employee surveys cannot be used to investigate the entries and exits because establishments' representatives and employees are not able to remember the exact timing of the events and answer the questions reliably. As administrative data from, e.g., the Federal Employment Agency, do not include the complete relevant variables, surveys among the establishment representatives must be conducted. Using a unique establishment survey Establishments in the COVID-19 crisis (BeCOVID), which was launched by the Institute for Employment Research (Institut für Arbeitsmarkt-und Berufsforschung, IAB)—partially in cooperation with the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, BAuA) and the excellence cluster ECONtribute of the universities Cologne and Bonn—we study the impact of the pandemic on German establishments (Bellmann et al. 2022).

This paper contributes to the literature, firstly by investigating the effects of STW on the dynamics of employment during the pandemic, a time when STW schemes were adopted at an unprecedented level, not only in Germany. Secondly, we use 24 waves of Germany high-frequency establishment panel data in order to estimate, thirdly, a dynamic labour demand model using a two-stage general method of moments system estimator (Arellano and Bond 1991; Blundell and Bond 1998).

The remainder of the paper is structured as follows. Section 2 presents the institutional background related to the German STW scheme and the previous literature. Section 3 describes the dataset. In Section 4, our theoretical model and empirical strategy are outlined. Section 5 shows some descriptive statistics and the empirical model, and Section 6 presents the econometric results. Section 7 discusses the results and Section 8 briefly concludes.

2. Institutional Background and Previous Literature

The COVID-19 crisis severely affected the German economy from March 2020 onwards. In the second quarter of 2020, real GDP decreased by more than 10 percent and 5 percent over 2020, respectively; and, in the third quarter of 2021, real GDP increased by more than 8 percent (Destatis 2022). In February 2022, the Germany economy was hit by the war of aggression against Ukraine. GDP increased by 1.9 percent in 2022. In the light of Germany's successful reaction to the Great Recession, with a very limited increase of unemployment and decrease of employment but a subsequent growth in productivity and employment (Bellmann et al. 2016), STW became the blueprint for many countries during the COVID-19 crisis.

STW aims to reduce the labour costs of establishments facing a major drop in activity for economic reasons due to extraordinary events, if the drop is regarded as temporary and unavoidable (Konle-Seidl 2020; Fitzenberger and Walwei 2023). In normal times, the labour agency reimburses 60 percent of the last net earnings for a childless worker and 67 percent for a worker with children. Social security contributions for lost working hours usually have to be fully covered by the employer. Special regulations are valid for employees with a temporary contract and apprentices. So-called mini-jobbers, solo self-employed and new entrants to the labour market are not covered. STW can be paid for a maximum of 12 months. During the pandemic, some extensions of the STW scheme were enacted, including the following:

(1) The entitlement period was prolonged, so that the STW allowances could be paid for a maximum of 24 months.
(2) Social security contributions for the lost working hours were covered by the labour agency from the first month.
(3) The replacement rate was raised to 70 percent for employees without children and 77 percent for employees with children beginning in the fourth month of STW, and to 80 percent and 87 percent, respectively, from the seventh month.
(4) Employees with temporary contracts became eligible.

As several lockdowns were imposed, the incidence of STW varied considerably over time. In April 2020, the number of workers for whom their employers notified a shortage of work to the labour agency was approximately 10 million. However, the actual number of employees on STW schemes was approximately 6 million, i.e., 14% of the labour force. The relative number of employees with STW was highest in the accommodation and food services (Federal Employment Services 2022). Thus, due to the severity of the crisis, the attractiveness of STW was improved. To avoid the lock-in of employees, incentives were created to end individual STW episodes (Bellmann and Jenckel 2020; Fitzenberger and Walwei 2023):

(1) The extension of the period during which the STW allowance could be paid was from 12 months to up to 24 months ending 31 December 2021 at the latest only for those establishments that had introduced STW by 31 December 2020.
(2) Full reimbursement of social insurance contributions was possible until June 2021, followed by reimbursement of half of the amount until 31 December 2021.
(3) Increased STW allowance after the fourth and the seventh month, if the loss of work was at least 50 percent and STW had been introduced by 31 March 2021.
(4) Possibility of supplementary earnings, e.g., through part-time work, up to the normal pay level until 31 December 2021 (Bellmann et al. 2020).
(5) Skills development during STW was made more attractive for the employers.

These adjustments of the STW programme design helped to limit and decrease the number of participants, e.g., the BeCOVID survey reveals that in manufacturing the proportion of establishments using STW decreased from 40 percent in March–August to 34 percent in October, in trade and repair from 43 to 21 percent, and in hotels and restaurants from 63 to 35 percent (Bellmann and Jenckel 2020). Noteworthy, the OECD (2021) wrote in the executive summary of its Employment Outlook that job retention schemes helped to limit rises in unemployment while there is no indication that they had a significant adverse impact on job creation. As a number of countries started scaling back the level of STW, the burden of the COVID-19 crisis fell disproportionally on already vulnerable groups with the need to upskill and reskill the workforce (OECD 2022).

STW was used for the first time in the tobacco crisis in Baden in 1909, more intensively during the Great Depression and after World War II (Schmid 2022). A dramatic increase of unemployment after the German reunification was avoided by STW (Mosley et al. 1995). As already mentioned, the instrument was used on the initiative of the then minister of labour and social affairs, Olaf Scholz, during the Great Recession 2008/2009. Studies conducted by Boeri and Bruecker (2011), Scholz et al. (2011), Crimmann et al. (2012) and Bellmann et al. (2013) reveal that STW was successful in reducing job losses during the Great Recession, and was highly dynamic and well targeted. However, favourable pre-crisis conditions after government interventions, such as bailout packages, and pacts for employment and competitiveness, aided the positive employment development (Bellmann et al. 2016). Macroeconomic evaluation studies demonstrated that the existence of STW reduced fluctuations of both employment and output (Balleer et al. 2016).

3. Data

For our analyses, we use data from the survey "Establishments in the COVID-19 Crisis" (BeCOVID) (Backhaus et al. 2021; Fitzenbeger et al. 2021; Bellmann et al. 2022), a high-frequency rotating panel survey that started in August 2020 and ended in August

2022. It was conducted on behalf of the Institute for Employment Research (IAB) in order to monitor establishments during the COVID-19 crisis. The survey comprises twenty-four waves, each including between 1500 and 2000 establishments, representative for private sector establishments with at least one employer subject to social security contributions. The sampling frame was the establishment file of the Federal Employment Agency, which contains all establishments that have to submit employee notifications to the social security system. In the questionnaire, the respondents were asked to report not only socially insured employees but also civil servants, family workers and owners or proprietors. The sample was drawn via disproportionate sampling, stratified by establishments size (1–9, 10–49, 50–249 and 250+ employees) interacted with five broad economic sectors. Data collection was performed by Kantar Public and was carried out by computer-assisted telephone interviews (CATI). The definition and the measurement of variables of interest are provided in Table 1.

Table 1. Descriptive statistics of dependent and independent variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
Number of workers (log.)	45,852	3.289081	1.548164	0	11.35041
Average daily wage 2020 (log.)	39,670	4.531232	0.3603016	2.152924	6.67605
Share of unskilled workers	43,996	0.1448739	0.2092642	0	1
Number of short-time workers	42,463	4.585333	29.10596	0	2000
Short-time work (=1)	7382	0.172917	0.3781799	0	1
Supply of goods and services					
Exclusively or mainly within Germany	39,761	0.8807008	0.3241438	0	1
Mainly outside Germany	1360	0.0301238	0.1709299	0	1
In equal parts within and outside Germany	4026	0.0891754	0.2849999	0	1
Foreign ownership (=1)	2692	0.0591752	0.235955	0	1
Works council (=1)	9986	0.2179921	0.4128865	0	1
Liquidity (duration until insolvency)					
1 to 2 weeks	530	0.0130071	0.1133059	0	1
up to 4 weeks	1761	0.0432179	0.2033498	0	1
up to 2 months	5068	0.1243773	0.3300155	0	1
up to 6 months	7821	0.1919405	0.3938314	0	1
up to 12 months	3879	0.0951972	0.2934907	0	1
sufficient reserve	21,688	0.53226	0.4989643	0	1
Industry					
Agriculture, forestry and fishing	672	0.0136393	0.1159896	0	1
Mining and quarrying	56	0.0012182	0.0348816	0	1
Manufacturing industries	7881	0.1714379	0.3768953	0	1
Energy supply	124	0.0026974	0.0518671	0	1
Water supply	257	0.0055906	0.0745618	0	1
Construction	3718	0.0808788	0.2726519	0	1
Trade and maintenance	8671	0.188623	0.3912131	0	1
Transportation and storage	1733	0.0376985	0.1904681	0	1
Hospitality industry	2165	0.0470959	0.2118464	0	1
Information and communication	1373	0.0298673	0.170223	0	1
Financial and insurance services	1001	0.0217751	0.1459499	0	1
Real estate activities	441	0.0095932	0.0974751	0	1
Professional, scientific and technical serv.	4171	0.0907331	0.2872323	0	1
Other scientific services	3373	0.0733739	0.2607521	0	1
Education	1508	0.032804	0.1781252	0	1
Health and social work	6484	0.1410485	0.3480754	0	1
Arts, entertainment and recreation	513	0.0111595	0.1050484	0	1
Other services	1874	0.0407657	0.1977491	0	1
Impact of COVID-19 on business activities					

Table 1. *Cont.*

Variable	Obs	Mean	Std. Dev.	Min	Max
Very strongly negative −5	3696	0.0842163	0.2777151	0	1
−4	5074	0.1156151	0.3197664	0	1
−3	6006	0.1368515	0.3436944	0	1
−2	2892	0.0658965	0.2481039	0	1
−1	907	0.0206667	0.1422676	0	1
Balanced/neither nor 0	22,180	0.5053888	0.4999767	0	1
1	175	0.0039875	0.0630215	0	1
2	409	0.0093194	0.0960872	0	1
3	1076	0.0245175	0.1546511	0	1
4	992	0.0226035	0.1486374	0	1
Very strongly positive 5	480	0.0109372	0.1040087	0	1
Establishment size					
1 to 9 employees	13,503	0.293735	0.455477	0	1
10 to 49 employees	14,107	0.306874	0.4612017	0	1
50 to 249 employees	14,665	0.3190124	0.4660989	0	1
250+ employees	3695	0.0803785	0.2718812	0	1

Data source: BeCOVID, own calculations.

4. Theory

The following estimates are based on a dynamic labour demand model (Hamermesh 1993). Here, it is traditionally assumed that firms adjust their employment continuously over several periods, as the associated adjustment costs increase disproportionately. However, the seminal work of Hamermesh (1989) and subsequently Caballero et al. (1997), Abowd and Kramarz (2003), Varejão and Portugal (2007), Nilsen et al. (2007) and Kramarz and Michaud (2010), respectively, have shown that this assumption is not tenable if microdata are used. According to their results, labour demand in competitive markets adjusts disruptively and without further lags, i.e., longer periods in which firm employment is held constant alternate with short periods of rapid labour demand adjustment. Such behaviour indicates either lump-sum or largely linear cost structures (Addison et al. 2014). Under such cost structures, a firm will adjust whenever the additional profits from adjustment, $\Delta\pi(\Delta L)$, are greater than the cost of adjustment, $C(\Delta L)$, with π as profits, L as labour and C as a function of adjustment costs. This results in the following model:

$$L_t = \begin{cases} L^* & if\ \Delta\pi > C \\ L_{t-1} & if\ \Delta\pi < C \end{cases} \quad (1)$$

or

$$L_t = \beta L_{t-1} + (1 - \beta)L^* \quad (2)$$

with t indicating the period and * indicating the profit maximizing level of labour demand. Then, β is the share of firms that do not adjust employment to its optimal value. Based on Equation (2), it is also clear that using panel data with short time intervals is much more informative than, for example, a dataset with annual survey intervals. The larger the adjustment costs are, the smaller should be the proportion of establishments that adjust their employment over a single period of time. However, if the survey interval is very large, then almost all establishments will have adjusted their employment without inferring differences in costs. Therefore, data should be available for estimation at least quarterly (Addison et al. 2014). Previous estimates have shown that an adjustment was often completed within one to two quarters (Hamermesh 1993, p. 261). STW can also be interpreted as a way of changing contractually agreed working hours at short notice and without major bureaucratic effort. In this context, it should also be noted that it is often assumed that an adjustment of working hours occurs faster than an adjustment of the number of employees in a recession. In addition to dismissal protection regulations as a cause for such behaviour, labour hoarding due to STW can also preserve specific

human capital (Cahuc et al. 2014, p. 137). If rational agents are assumed, then firms also consider all future firing costs when hiring, and vice versa. Therefore, there should then be approximately symmetric behaviour, even if direct hiring and firing costs differ.

Manning (2006), on the other hand, takes a different approach to derive a dynamic model of labour demand when the labour market corresponds to a monopsony (or an oligopsony). Starting from the determinant supply function in the monopsony, employers must raise wages to attract more workers. This implies two things. First, if more workers are to be hired, higher wages must be paid to each additional worker. Second, hiring costs for larger firms are ceteris paribus higher. Thus, hiring costs not only increase disproportionately, but also depend on the previous level of employment. Conversely, firing costs should be much lower for firms on a monopsony, since they can save costs on high wages. Thus, the adjustment costs are probably asymmetric. However, employees also acquire company-specific human capital, which can lead to labour hoarding (Crimmann et al. 2012; Bellmann et al. 2013). Moreover, rationally acting employers should also include future adjustment costs in their decision here, so that it is hardly possible to make statements about differences in the adjustment speed between hiring and firing.

The situation is similar in the case of a shortage of skilled labour with wage competition. If different firms compete for a limited number of applicants, they have to pay higher wages in order to attract new employees or to prevent the workforce from leaving (Cahuc et al. 2006). However, all firms present in a market then compete with each other regardless of their size, so that costs are incurred equally by small and large firms. The size of a firm is then only a sign of higher productivity and the associated ability to attract more employees through higher wages (Cahuc et al. 2006).

Moreover, the adoption of STW has further implications. Experience from Germany and France shows that companies that suffered severely from the economic downturn in the Great Recession of 2008/2009 used STW as a flexible and less-costly solution to protect their core workforce from unemployment, and were able to put these workers back to work immediately when the economy began to recover (Crimmann et al. 2012; Cooper et al. 2017; Cahuc et al. 2018). This should indicate a much faster adjustment process of STW compared with changes of employment through external hiring and dismissals. Nevertheless, there are also studies revealing inefficiencies in the use of STW. Cooper et al. (2017) point to an extended filling time for vacancies. Cahuc and Nevoux (2019) use French data to show that firms may use STW too intensively, leading to significant production losses. This would then indicate a slowdown in adjustment processes.

Hence, we are able to formulate the following hypotheses:

H1: *If STW increase firms' ability to preserve existing jobs in the short-run, the use of STW should speed up the employment adjustment for the personnel actually working in the respective establishments.*

H2: *If STW decrease firms' ability to adjust employment, the use of STW should prolong the adjustment time of firms' total workforce.*

The implications regarding the asymmetry of costs and differences in adjustment behaviour can be tested using the econometric methods applied.

5. Descriptive Analysis and Empirical Model

5.1. Descriptive Analysis

Based on data from the Federal Employment Agency, Figure 1 shows the development of the number of short-time workers over time at the macroeconomic level. Immediately after the beginning of the pandemic, the number of short-time workers strongly increased and reached the peak in April and May 2020, with approximately 6 million people being on STW. After the peak, the number declined quickly, increased again until February 2021 and then declined again. This development of the number of short-time workers is supporting the assumption that STW was used as a quite flexible labour market scheme in Germany during the pandemic.

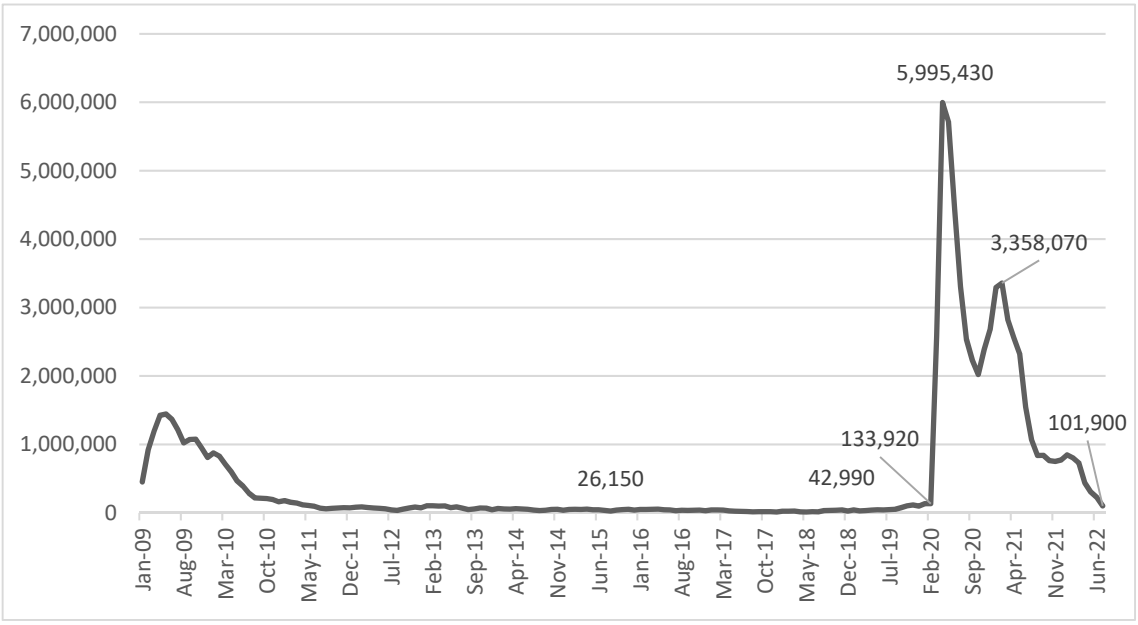

Figure 1. Total number of short-time workers. Data source: Statistic of the Federal Employment Agency, 21 February 2023.

However, as Figure 2 shows, there were large differences in the use of STW across different industries. The industries adopting STW most intensively in April 2020 were manufacturing, trade and food services.

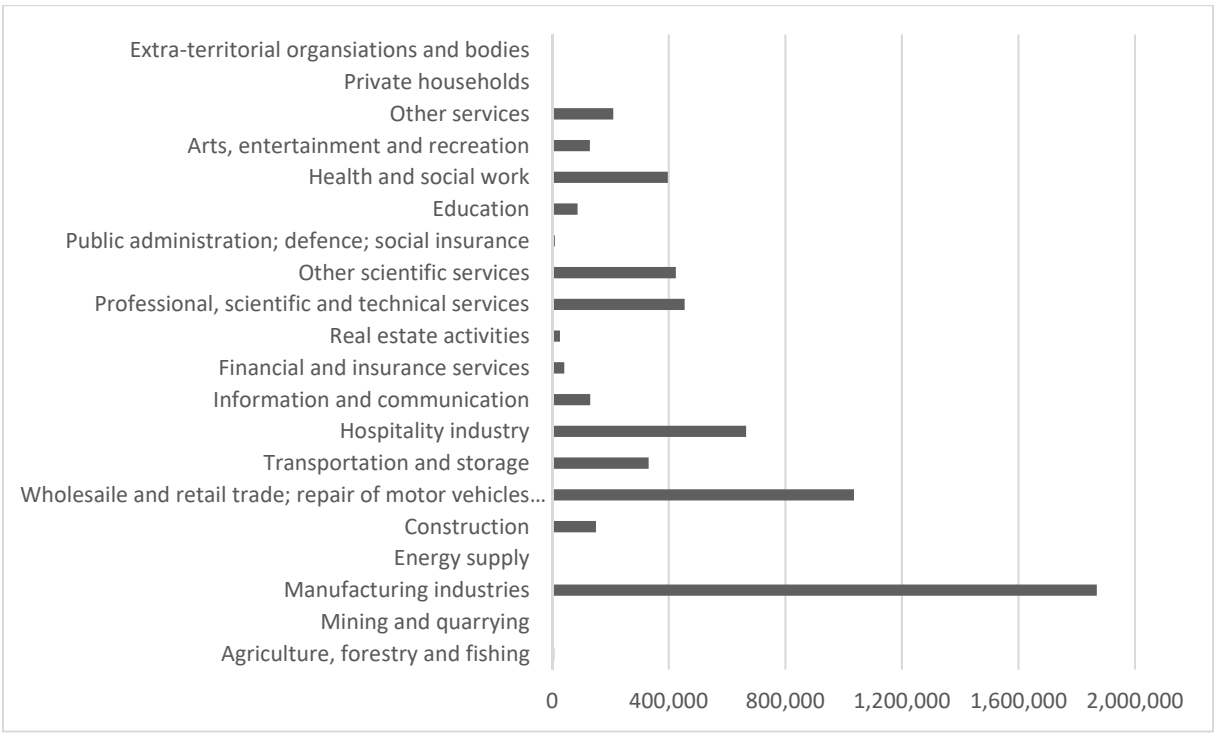

Figure 2. Number of short-time workers by industry, April 2020. Data source: Statistic of the Federal Employment Agency, 20 February 2023.

Moreover, it is evident there are differences not only across industries but also on an establishment level. As the data from the Federal Employment Agency does not provide

information at the establishment level, we ran descriptive analyses based on data from the BeCOVID survey. Figure 3 shows the development of the usage of STW during the survey period, starting in August 2020 and ending in August 2022. The *y*-axis shows the mean number of short-time workers by establishment, aggregated by wave, while the solid line shows the amount and the dashed line the development from wave to wave. These descriptive results also support the idea that STW was used quite flexibly, with quick adjustments from month to month during the pandemic.

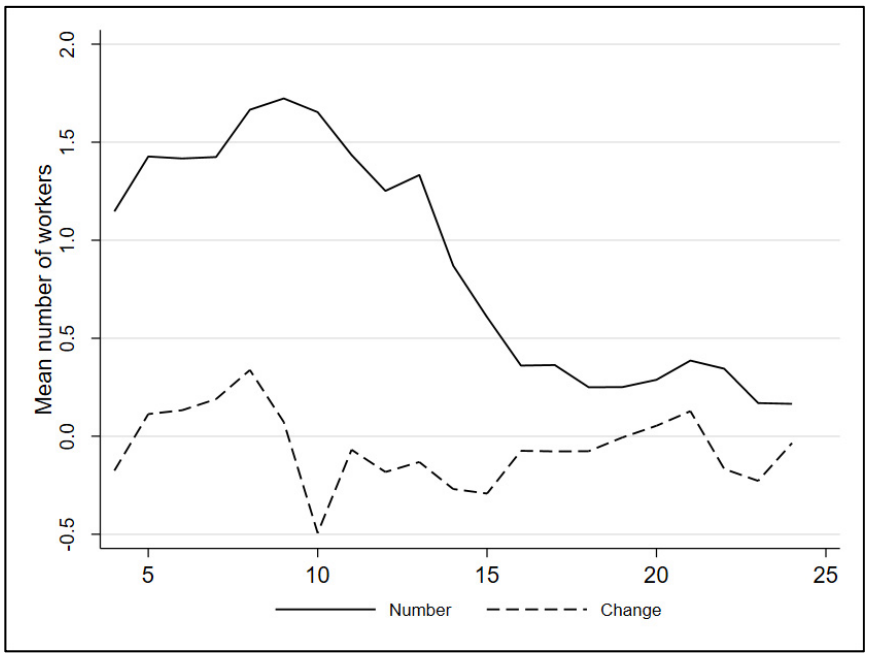

Figure 3. Number of short-time workers and change in the number of short-time workers (mean by wave). Data source: BeCOVID, own calculations with weighted data.

Figure 4 presents the weighted mean number of short-time workers by establishment size. The results provide descriptive evidence that there are huge differences in the adoption of STW between firm size categories. Regarding the number of short-time workers, the largest adoption of STW was by large establishments with more than 50 employees, while small- and medium-size establishments played only a minor role for the total number of workers being on STW. During the first months of the pandemic, large establishments had on average between 10 and 15 workers who were on STW, with only between two and four workers at medium-size establishments (with 10–49 employees) and between zero and one at small establishments (with 1 to 9 employees).

Similarly, we examine the share of short-time workers at establishment level instead of the total amount. Figure 5 exhibits the share of short-time workers to all employees in percent, aggregated by wave. The Figure show quite similar curves for all three establishment size categories, while the curve for the large establishments is slightly flatter: at the peak, small- and medium-size establishments had a share of about 15 percent of all employees being on STW, while large establishments had approximately 10 percent. The curves for small- and medium-size enterprises also record a second small peak in February 2022 (wave 21/22), which cannot be found for large establishments. Overall, from a descriptive point of view, we demonstrate that STW played an important role for establishments of all sizes during the pandemic, even though the total amount of STW at the macroeconomic level was driven by large establishments.

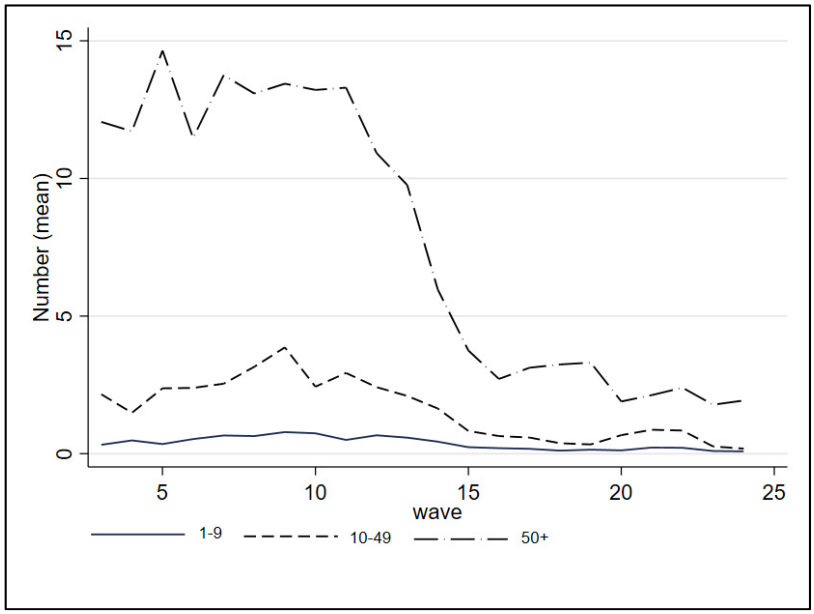

Figure 4. Mean number of short-time workers by establishment size class. Data source: BeCOVID, own calculations with weighted data.

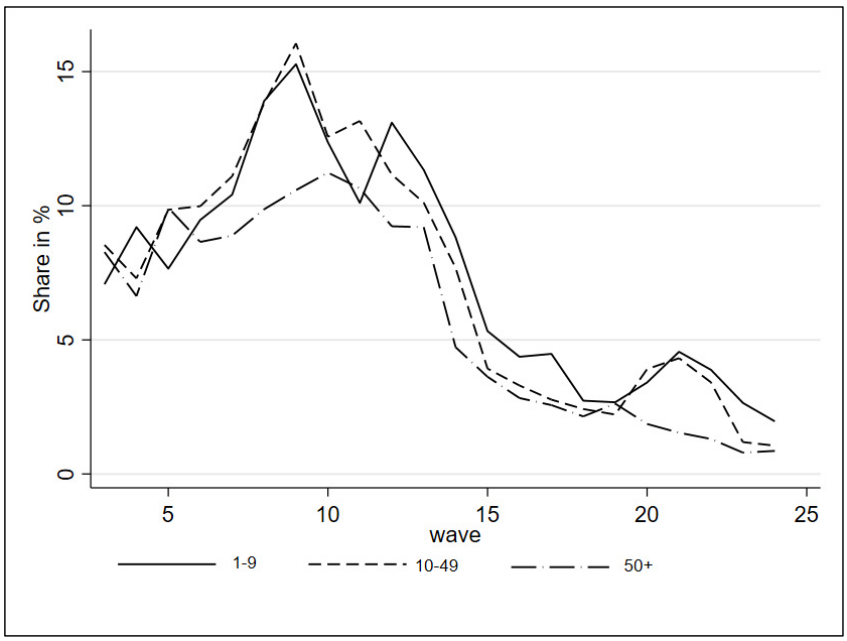

Figure 5. Share of short-time workers to all employees (in percent) by establishment size class. Data source: BeCOVID, own calculations with weighted data.

5.2. Empirical Model

The results below are based on a dynamic labour demand model and are obtained using a two-stage generalized method of moment (GMM) system estimator that uses both lagged differences of the exogenous variables and their levels as instruments (Arellano and Bover 1995; Blundell and Bond 1998). Equation (2) yields the empirical model to be estimated:

$$L_t = \beta L_{t-1} + \gamma X_{it} + \mu_i + \varepsilon_{it}, \quad (3)$$

with X_{it} as the additional covariates determining labour demand, L^*, μ_i as establishment-specific heterogeneities, and ε_{it} as the error term. Such a model cannot be estimated consistently with a panel estimator because the errors, ε_{it}, are autocorrelated due to the

lagged endogenous variable L_{t-1}. Arellano and Bond (1991) therefore propose an instrumental variables approach, which is then estimated using GMM. As a first step, we take first differences of both sides of Equation (2) to eliminate establishment-specific heterogeneities:

$$\Delta L_t = \beta \Delta L_{t-1} + \gamma \Delta X_{it} + \Delta \varepsilon_{it}. \quad (4)$$

To eliminate the correlation between ΔL_{t-1} and $\Delta \varepsilon_{it}$, valid instruments are required. All data of L, which are older than 2 periods, are suitable for this purpose. The errors $\Delta \varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1}$ are correlated with $\Delta L_{t-1} = L_{t-1} - L_{t-2}$, but not with L_{t-3}. This is also true for all periods, *t-n*, further back, for both the lagged endogenous variable and the other exogenous covariates. This leads to a set of instrumental variables that are on the one hand larger than the number of parameters to be estimated and on the other hand do not have to be the same in each period. Therefore, GMM is a suitable estimation method.

The empirical model used in our study is an extension of the original Arellano–Bond GMM estimator, which is particularly suitable for datasets with many observed units and few time points of observation. This is called the GMM system estimator (Arellano and Bover 1995; Blundell and Bond 1998). One condition to apply this model is, on the one hand, that autocorrelation with the errors is not present and, on the other hand, that the firm-specific effects are not correlated with the first difference of the dependent variables. Since, based on the modelling, the first difference of the errors will be autocorrelated, the rejection of a test for autocorrelation does not mean that the model is misspecified. However, rejection of the null hypothesis at higher orders means that the moment conditions are not valid. Then, it is also possible to determine parameters for time-invariant exogenous variables in two-step GMM models (Kripfganz and Schwarz 2019). Moreover, we used a Windmeijer bias-corrected (WC) estimator to calculate robust standard errors (Windmeijer 2005). The BeCOVID data is a rotating panel. After a maximum of six participations, an establishment was rotated out of the sample. Therefore, the number of possible instruments is limited and we did not test the sensitivity to a large number of instruments (cf. Roodman 2009).

The endogenous variable is defined as the logarithm of the actual number employed by the firm. This number does not include short-time workers, although they are still formally tied to the firm. Since a dynamic model is estimated here, the endogenous variable lagged by one period is also one of the covariates. In addition, a dummy for whether the establishment uses STW or the log number of short-time workers is used. Since STW is not an economic explanation for determining optimal employment, this information is used only as an interaction variable with the lagged number of employees to describe differences in the speed of adjustment. Other exogenous variables include establishment assessments of economic development (11-digit ordinal categories) and liquidity, the existence of a works council, whether the establishment exports or is foreign-owned, the average wage in June 2020, and time, industry and establishment size dummies. Instruments used are levels as well as first differences. Additional instruments are the levels and first differences of the endogenous variables lagged by more than one period.

Implicitly, we use here a model with two factors of production, labour and capital. Therefore, we need to add the cost of capital of firms to our empirical model. We assume that these are a combination of general market conditions, i.e., the average interest rates businesses have to pay for a loan, and establishment-specific factors such as the liquidity of the firms. While the first factor is time-specific and does not vary across firms, it is deleted to consider time-specific heterogeneities. However, we still control for firm-specific factors of the cost of capital such as liquidity.

6. Results

Table 2 contains the results of the basic model, in which only the influence of the STW on the demand for labour plays a role. The results for the Arellano–Bond autocorrelation test show the expected results, so that the estimates can be considered as valid. The outcome is calculated using robust standard errors proposed by Windmeijer (2005). Column (a) contains the simplest model. The dependent variable is defined as the entire workforce

including short-time workers. In addition to the lagged endogenous variable, the estimate also includes the covariates described above. The estimated parameter for the lagged endogenous variable is 0.775. Assuming, as Addison et al. (2014) do, that adjustment costs do not rise disproportionately, the value suggests that about 22.5% of establishments adjust their permanent employment completely within two survey waves, which is approximately one month. This would be significantly faster than estimates for Germany based on annually repeated surveys (e.g., Jung 2014) and in line with results that can be obtained for the duration of the staffing process in Germany from the IAB Job Vacancy Survey (Carbonero and Gartner 2022). In addition to the lagged endogenous variable, several dummy variables are also statistically significant. This is also true for prior pay in 2020, the share of unskilled workers, establishments that also sell their products and services abroad, and establishments that have a works council. All variables appear to be characteristic of larger establishments. Since the results for these covariates do not change for the other estimates, they are not considered further below.

Table 2. Arellano–Bover/Blundell–Bond two-step GMM system estimator of a dynamic labour demand model.

	(a) Employment Incl. STW	**(b) Employment Incl. STW**	**(c) Employment Incl. STW**	**(d) Employment Excl. STW**	**(e) Employment Excl. STW**
Log. of lagged endogenous variable ($t-1$)	0.775 ** (0.062)	0.741 ** (0.069)	0.768 ** (0.056)	0.228 * (0.090)	0.260 ** (0.099)
Interaction variable: Log. of lagged endogenous variable ($t-1$) × (use of STW, no. of STW)		0.002 (0.001)		−0.009 * (0.004)	
Interaction variable: Log. of lagged endogenous variable ($t-1$) × (use of STW, yes = 1, no = 0)			0.008 (0.008)		−0.250 * (0.113)
Log. of average daily remuneration in 2020	0.053 ** (0.017)	0.065 ** (0.020)	0.055 ** (0.016)	0.187 ** (0.056)	0.181 ** (0.067)
Share of unskilled workers	0.107 ** (0.034)	0.122 ** (0.037)	0.109 ** (0.031)	0.367 ** (0.110)	0.253 * (0.125)
Supply of goods and services … (base: exclusively or predominantly within Germany)					
Predominantly outside Germany	0.015 (0.014)	0.011 (0.015)	0.016 (0.015)	0.065 (0.050)	0.090 (0.059)
In roughly equal parts within and outside Germany	0.029 ** (0.011)	0.029 * (0.012)	0.028 * (0.011)	0.044 (0.046)	0.089 (0.057)
Predominantly in foreign ownership	−0.026 (0.016)	−0.027 (0.018)	−0.026 (0.017)	−0.071 (0.066)	−0.114 (0.076)

Table 2. *Cont.*

	(a) Employment Incl. STW	(b) Employment Incl. STW	(c) Employment Incl. STW	(d) Employment Excl. STW	(e) Employment Excl. STW
Works council	0.054 ** (0.017)	0.060 ** (0.018)	0.054 ** (0.015)	0.134 ** (0.040)	0.135 ** (0.046)
Impact of the Corona pandemic on business activities (10 dummies) #	yes *	yes	yes	yes **	yes **
Liquidity (5 dummies) ##	yes	yes	yes	yes	yes
Dummies indicating industries (18 dummies)	yes	yes	yes	yes **	yes **
Dummies indicating firm size (3 dummies)	Yes **	Yes **	Yes **	yes **	yes **
No. of observations (firms; instruments)	16,169 (6547; 188)	14,882 (6148; 271)	14,951 (6167; 267)	14,832 (6133; 271)	14,832 (6133; 267)
Wald test χ^2 (df.)	256,740.53 ** (64)	226,025.24 ** (63)	227,057.01 ** (63)	14,810.92 ** (63)	11,454.93 ** (63)
First order (z-value)	−3.8511 **	−3.3483 **	−3.553 **	3.3222 **	2.5863 **
Second order (z-value)	1.2632	1.3527	1.3893	−0.0745	−0.4514

Note: BeCOVID panel waves 1 to 24, Windmeijer (2005) WC-robust standard errors. ** and * denote significance at the 0.01, and 0.05-level, respectively. # 10 dummies from very strong negative impact to very strong positive impact, base: no impact, ## 5 dummies from "1 to 2 weeks" to "generally sufficient reserves", base: "1 to 2 weeks". The regressions contain additional dummies indicating the different waves and a constant.

Columns (b) and (c) contain estimates with the same endogenous variable supplemented by a STW variable as an additional covariate. Since larger firms (may) use STW both more frequently and more intensively, the number of short-time workers or a corresponding dummy variable would have no further information. Instead, these variables are interacted with the lagged endogenous variable so that the impact on the speed of adjustment can be measured. Although both parameters are positive, indicating a slower adjustment process, they are rather small and insignificant. Hence, there is only little support for hypothesis 2.[1]

The estimates in columns (d) and (e) are derived from a different endogenous variable. Here, STW is excluded from the number of workers. In column (d), the lagged endogenous variable is interacted with the number of STW, and, in (e), a dummy indicating the use of STW is applied instead. This has serious implications for the estimated parameters for the lagged endogenous variable. The estimated values are now 0.228 and 0.260, respectively, indicating that on average about three-quarters of establishments adjust their employment within one month. Since the estimated interaction variables are both negative and statistically significant, this suggests an even faster adjustment when STW is used by the firms. In the case of column (e), the values cancel out almost entirely, so that, according to this estimate, the use of STW leads to an adjustment of employment within one month

only. Due to the facilitated conditions regarding the use of STW in Germany during the pandemic, this result seems quite reasonable.

Table 3 contains the results of estimates of differences in adjustment costs between firms that lay off employees and other entities. It seems that the speed of adjustment is slower in establishments that reduce total employment (column a). However, this is probably not due to the use of STW as the results in column (b) are not significant. When the number of short-time workers is subtracted from the number of employees, the picture is somewhat different. Not surprisingly, the use of STW seems to accelerate the reduction of employment actually needed in the workplace (column d).

Table 3. Arellano–Bover/Blundell–Bond two-step GMM system estimator of a dynamic labour demand model (change in employment).

	(a) Employment Incl. STW	**(b) Employment Incl. STW**	**(c) Employment Excl. STW**	**(d) Employment Excl. STW**
Log. of lagged endogenous variable $(t-1)$	0.816 ** (0.056)	0.804 ** (0.053)	0.260 ** (0.063)	0.337 ** (0.118)
Interaction variable: Log. of lagged endogenous variable $(t-1)$*(use of STW, yes = 1, no = 0)		0.011 (0.010)		−0.192 * (0.082)
Interaction variables: dummy indicating decreasing employment (endogenous variable) *				
Log. of lagged endogenous variable $(t-1)$	0.005 * (0.002)	0.013 (0.007)	−0.038 (0.045)	−0.105 ** (0.010)
Interaction variable: Log. of lagged endogenous variable $(t-1)$*(use of STW, yes = 1, no = 0)		−0.011 (0.012)		0.144 (0.137)
No. of observations (firms; instruments)	16,169 (6547; 257)	14,951 (6167; 388)	14,832 (6133; 237)	14,832 (6133; 381)
Wald test χ^2 (df.)	327,778.57 ** (65)	321,145.50 ** (65)	15,109.70 ** (62)	14,717.79 ** (65)
First order (z-value)	−3.8016 **	−3.4141 **	3.7926 **	−3.7435 **
Second order (z-value)	1.2271	1.3363	−0.0586	−0.0289

Note: BeCOVID panel waves 1 to 24, Windmeijer (2005) WC-robust standard errors. ** and * denote significance at the 0.01, and 0.05-level, respectively. Also included are 10 dummies from very strong negative impact to very strong positive impact, base: no impact, and 5 dummies from "1 to 2 weeks" to "generally sufficient reserves", base: "1 to 2 weeks". The regressions contain additional covariates: log. of average daily remuneration in 2020, share of unskilled workers, area of supply of goods and services, foreign ownership, the existence of a works council, dummies indicating the different waves, business activities, liquidity, industries firm size and a constant. Please see Table 1 for further details.

7. Discussion

There is hardly any literature on the use of STW on a large-scale level. Fitzenberger and Walwei (2023) point out that establishments used short spells of STW during the pandemic, so that they conclude that an overuse of STW was unlikely. This argument is supported by our result that the adjustment process occurs very fast. Comparing our results with

those of the existing literature using firm-level data, they are mostly corroborated, but there are also remarkable deviations. First, the rapid rates of adjustment postulated by the literature are apparent when high-frequency data are used. The one to two quarters reported by Hamermesh (1993, p. 261) does not contradict our estimates. In addition, the faster adjustment speed when STW is accounted for can also be taken as an indication that labour hours are adjusted faster than the number of workers. This also confirms the studies that present STW as an efficient way of labour hoarding to resume the production of goods and services quickly after the end of the recession (Crimmann et al. 2012; Cooper et al. 2017; Cahuc et al. 2018). However, there is no or very weak evidence of potential negative effects. In contrast to Cooper et al. (2017), STW appears to cause no or very little delay in employment adjustment. In addition, it appears that it is possible to recall workers from STW back to work quasi-immediately. This also dispels the concerns that STW is used too intensively beyond what is efficient (cf. Cahuc and Nevoux 2019). Differences in national legislation on STW may also play a major role here. Nevertheless, from our work, we can conclude that STW does not lead to significant production losses because of its inefficient use.

8. Conclusions

During the COVID-19 pandemic, many countries adopted STW schemes on a large scale to allow for a flexible and fast adjustment of employment. Thus, unemployment was avoided and employment could rapidly rebound after the COVID-19 'crisis-related' shutdowns. However, both the OECD and IMF questioned the efficiency of the STW schemes in the reallocation of workers from unviable jobs to industries and firms with better prospects. Furthermore, adjustments of regulations of STW during the crisis provided additional incentives to lock-in employees in their current jobs. Estimating dynamic labour demand models to investigate the effect of STW on employment, we are able to analyse the behaviour of establishments during the pandemic. The high-frequency establishment-level data allow the estimation of dynamic labour demand models for 24 waves of the Survey *Establishments in the COVID-19 crisis.* To the best of our knowledge, this study is the first for Germany and is among few others that use high-frequency employer data to estimate dynamic labour demand. The results differ significantly from those obtained, for example, using panel data with an annual interview interval. It becomes clear that the adjustment processes take place much faster than described by previous studies. This shows the special relevance of the data we used for our analyses.

Both the implementation of exceptional STW measures to increase the attractiveness of STW during the pandemic and the incentives created to finish individual STW episodes contributed to the high speed of the adjustment process. To account for the cost efficiency of STW, the OECD (2021, 2022) favoured the co-financing by establishments, e.g., by an "experience rating" scheme, which is designed in such a way that establishments using STW allowances over a long time during difficult times have to make repayments or pay higher social security contributions during normal times. Against the background of our empirical results on the rapid exit of establishments from their use of STW and the short spells of STW reported by Fitzenberger and Walwei (2023), such a strategy seems to be unnecessary.

Moreover, our empirical results corroborate the hypotheses that firms' ability to preserve existing jobs in the short-run decreases the time necessary to adjust the number of employees actually working in the respective establishments. In addition, our results show that the employment adjustment in establishments using STW during the COVID-19 crisis occurred almost immediately, within one month only. Thus, in contrast to the evidence for France, our analyses do not reveal any lock-in effects. Furthermore, the speed of adjustment is slower in establishments with reductions in total employment.

Despite the obvious advantages of a high-frequency panel to estimates adjustments processes, there are some caveats with the data. One is the lack of current wage information, and the other the rather short length of the panel. Both could affect the validity of the

outcome and should be overcome when new high-frequency data on firms are collected in establishments' surveys.

Further research should be devoted to merging establishment and administrative data records on STW and full employment biographies (vom Berge et al. 2021). Of interest is also more information about the establishments' biographies available from the Establishment History Panel (Ganzer et al. 2021). Additionally, the mass and fluctuating use of STW schemes suggests considering simplified criteria and procedures (Weber and Yilmaz 2023).

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Note

[1] The estimation results without the use of robust standard errors are statistically significant in each case. However, the small values rather indicate a small influence. The *p*-values for robust standard errors are 0.2 in each case. The estimation results are available from the authors on request.

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