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LABOUR REALLOCATION DYNAMICS IN GERMANY DURING THE COVID-19 PANDEMIC AND PAST RECESSIONS

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Abstract:

How do recessions affect labour reallocation dynamics? Using data for Germany we document that gross job reallocation has been slightly countercyclical in the past and has increased slightly in previous recessions. This mild countercyclicality results from procyclical job creation rates and slightly more countercyclical job destruction rates. The recession caused by the COVID-19 pandemic has been atypical in this regard. While the reallocation of workers within sectors declined due to lower hiring and separation rates, the reallocation of workers between sectors surprisingly increased. Finally, we document that short time work likely played a substantial role in reducing separation rates, thus dampening the reallocation process during the COVID-19 recession in Germany.

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1. Introduction

As the German economy continues to recover from the COVID-19 pandemic, economic policy discussions will increasingly focus on the pandemic's impact on medium- and long-term economic impact. Gauging the economic effects of the COVID-19 recession, however, is fraught with difficulties as the comparison to previous recessions, and especially the Great Financial Crisis (GFC), is hampered by various unique features that characterize the current crisis. Other than the GFC, for instance, the COVID-19 crisis was set off by an exogenous supply and demand shock and mitigated by immediate and more extensive policy support (Gourinchas et al., 2020; Conseil National de Productivité, 2021). Physical distancing requirements and lockdown measures coupled with shifts in consumer behaviour, e.g. a potentially lasting shift towards digital-intensive services, also led to a strongly heterogeneous impact of the crisis across industries (GCEE, 2021).

A central determinant of the pandemic's medium- to long-term economic consequences will be the pandemic's impact on productivity. Productivity growth in turn is shaped by the efficient reallocation of resources from low-productivity to high-productivity firms, sectors and regions plays a critical role (Foster et al., 2001, 2006, 2008). The special role of recessions for the reallocation process has been recognized at least since Schumpeter (1939). Schumpeter argued that recessions are a time of elevated creative destruction, forcing unproductive firms to leave the market ("cleansing"), and in turn, accelerating the process of productivity-enhancing reallocation (Caballero and Hammour, 1994; Clementi and Palazzo, 2016). Contesting theories, on the other hand, posit that a rise in market frictions during recessions could curb the productivity-enhancing reallocation process ("scarring" or "sullying"). Financial frictions or a lower propensity of workers to switch jobs during a recession, for instance, could also increase reallocation costs and dampen the growth of more productive firms (Barlevy, 2002, 2003). Similarly, policy measures that aim to stabilize particularly hard-hit firms during a recession, such as short-time work schemes, could also reduce the pressure on firms to adjust and dampen reallocation (Boeri and Brücker, 2011).

Considering the distinct features of the COVID-19 crisis in Germany involving policy responses prioritizing preservation over reallocation, e.g. through short-time work schemes ("Kurzarbeit"), pervasive business support measures, or the suspension of the duty to file for insolvency, it is unclear at this stage whether the crisis led to a cleansing or sullying effect.

In this paper we aim to shed light at the potential longer-term consequences of the pandemic on productivity by analysing the labour reallocation channel of the COVID-19 crisis in Germany. In order to place the current dynamics in the broader historical context, we first investigate the cyclical behaviour of labour reallocation between 1976 and 2013 in West Germany. We show that the job reallocation rate is mildly countercyclical, i.e. negatively correlated with the output gap. The low negative correlation results from the opposite movement of job creation and job destruction – the two components of job reallocation – over

the business cycle. While job creation is procyclical, i.e. decreased during previous recessions, job destruction is countercyclical, i.e. increased during previous recessions. To further look into the specific role of recessions for labour reallocation, we use a linear projection approach to estimate impulse responses of several reallocation indicators to a recessionary shock. This analysis shows that reallocation dynamics during past German recessions were mostly driven by a substantial increase in job destruction and business closure rates while business and job creation contracted only slightly. However, in the aftermath of recessions job destruction subsided while job creation increased.

Turning to the second part of our analysis, we examine how worker reallocation has evolved since the outbreak of the COVID-19 pandemic. Unlike in previous recessions - but as intended by policy makers – overall worker reallocation has been substantially dampened during the pandemic, likely due to a variety of policy support instruments, including extended short-time work arrangements. Interestingly, however, we find that worker reallocation between sectors (intersectoral reallocation) has grown over the crisis, with some sectors losing and others gaining in terms of employment, underlining the heterogeneous nature of the crisis. Even though these sectoral shifts have not contributed positively to productivity growth in Germany, the continued movement of workers towards sectors thriving despite the economic downturn, suggests that the crisis has not curbed down on structural change altogether.

2. Reallocation and productivity growth

In well-functioning market economies, the nature and pace of reallocation is typically high and closely tied to the distribution of productivity (Lentz and Mortensen, 2005; Decker et al., 2020). Inputs are reallocated from low-productive businesses to high-productive businesses, allowing more productive businesses to expand while pressuring less productive firms to contract or exit the market. As a result, output market share is also reallocated to more productive businesses.

Firm dynamics contribute to reallocation dynamics by freeing up scarce resources captured in firms downsizing or exiting the market and thereby creating new investment and employment opportunities e.g. for startups. Even without entailing changes to the company's size, however, the reallocation of resources between firms can improve the matching of resources to their most productive use, thus generating productivity gains. Rigidities in the supply and mobility of resources, e.g. through financial market frictions or mobility constraints, in turn impair the efficient matching of resources to firms and therefore the productivity-enhancing reallocation of labour and capital.

While reallocation is desirable if it leads to aggregate productivity gains, an increase in factor reallocation also raises the potential for mismatches between the types of capital and labour firms demand and the types the economy can readily supply, and potentially costly labour market disruptions. The expense and time required for workers to change jobs, for instance, could raise frictional

unemployment. Moreover, workers finding employment in an occupation different from their previous job typically experience an average earnings penalty of about 15 % (IMF, 2021), pointing to large personal and social costs in cases where reallocation entails unemployment (Helliwell and Huang, 2014; Reichert and Tauchmann, 2016). On the firm side, periods of accelerated reallocation driven by external circumstances, e.g. through recessions, can come at the cost of losing valuable intangible capital such as company-specific knowledge, thereby jeopardizing firm-level productivity growth.

In the following empirical analysis, we specifically focus on labour reallocation. Following the literature, we then distinguish between job reallocation (i.e. changes in the allocation of jobs across firms, regardless of the individual worker who fills a job) and worker reallocation (i.e. changes in the allocation of individual workers across firms).

Gross job reallocation rates are measured using changes to the firm size resulting from job creation and job destruction within a given period of time. If a firm increases its number of employees, the increase is considered job creation at the firm level; if it decreases its number of employees, this decrease is considered job destruction. Gross job creation is then measured as the sum of all jobs created by the firms who increased their workforce, whereas gross job destruction is calculated as the sum of all jobs destroyed among firms who decreased their workforce. Finally, gross job reallocation is calculated as the sum of gross job creation and gross job destruction.

Since workers can also switch between firms without changes to the firm's size (e.g. if a leaving worker is immediately replaced), and thus without job creation or destruction, reallocation dynamics are further informed by worker reallocation rates. In this case, the movement of individual workers is measured by the number of hirings and separations, where gross worker reallocation is then calculated as the sum of all hirings and separations.

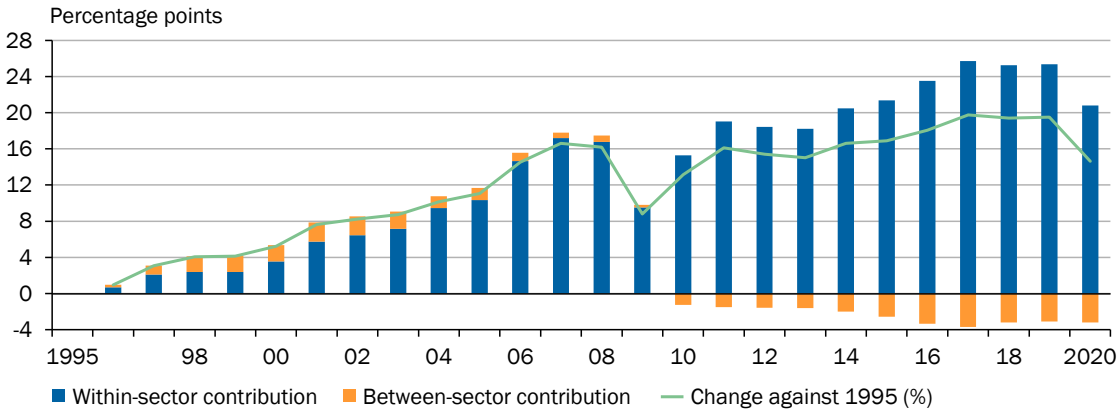
Acknowledging that an increase in the rates of job or worker reallocation could also reflect high movements in or out of the labour market, much of the literature has turned to measures of excess reallocation (Davis and Haltiwanger, 1999; Barrero et al., 2021). Excess reallocation is calculated as the difference between gross job or worker reallocation rate minus the absolute net change in employment. If gross job reallocation was mostly caused by either the creation or the destruction of jobs, the sum of the two would be close to the net change in employment, resulting in low excess reallocation. However, if both job creation and job destruction are high at the same time, their sum would be significantly different from the net rate of change, resulting in high excess reallocation.

Breaking down aggregate movements, the literature further distinguishes between intersectoral and intrasectoral reallocation of workers. Intersectoral reallocation, i.e. the movement between industries, can be assessed through the sum of the absolute value of changes in the employment shares of industries, as proposed by David (2021). As most of the reallocation occurs within industries, however, the focus often lies on intra-sectoral reallocation rates. In most developed economies, the reallocation of jobs between companies within an

industry contributes significantly more to productivity growth than the reallocation between industries, given the latter often results from the growth of relatively unproductive service sectors (Figure 1; Dieppe, 2021; Lopez-Garcia and Szörfi, 2021; GCEE, 2015, 2019).

↘ FIGURE 1

Cumulative contributions to labour productivity[1] growth since 1995



1 – Real gross value added per person employed.

Sources: Federal Statistical Office, own calculations

3. Labour reallocation over the business cycle

Along with the increased availability of establishment and worker level micro data, an extensive empirical literature on job and worker reallocation over the business cycle and its impact on productivity growth has emerged. For the United States, Foster et al. (2016) and Haltiwanger et al. (2021) document that the positive contribution of reallocation to productivity growth is substantial and has increased in past recessions. During the financial crisis in the years 2007 to 2009 the contribution to productivity growth broke down, however. In the European context, Bartelsman et al. (2019) show for a number of EU member states that between 2007 and 2015 productivity-enhancing reallocation was higher during times of low growth of industrial production except for the years 2009 to 2011. Overall these studies provide evidence for a mild countercyclicality of productivity-enhancing labour reallocation in the past.

Firm creation and firm closures are important drivers of labour reallocation and also vary substantially over the business cycle. In the US, firm creation and in particular the growth potential of new firms has been shown to decrease in recessions (Moreira, 2016; Sedláček and Sterk, 2017). Potential explanations include more severe financial frictions (Smirnyagin, 2020) and worse outside options for entrepreneurs after the failure of a startup in recessions (Garcia-Trujillo, 2021). While the procyclicality of firm creations is well documented, the evidence with respect to the cyclicality of firm exits is less clear. Tian (2017, 2018) shows that the measured cyclicality of firm exits crucially depends on the indicator which is used to measure the business cycle. For example, the firm exit rate is acyclical if the deviation of the unemployment rate or the deviation of GDP from

a HP-filtered trend is used as a measure of the cycle. It is countercyclical if the deviation of GDP growth from its trend is used. Tian (2017) also shows that a high firm creation rate in a given year leads to high firm exit rates in subsequent years, possibly due to the substantially higher exit rates of young firms. Thus, the procyclicality of firm creation might confound the analysis of the cyclicality of firm exit.

The cyclicality of job reallocation in Germany

While the literature on labour reallocation over the business cycle for the US is quite extensive, there are only few studies investigating the German experience. Recently Bachmann et al. (2021) have investigated worker reallocation in Germany. They have shown that job-to-job transitions of workers are procyclical. This procyclicality in turn is shown to be the main driver of the procyclicality of aggregate worker reallocation in Germany. In order to study the cyclicality of worker reallocation in Germany, Bachmann et al. (2021) have used the Administrative Wage and Labor Market Flow Panel (AWFP) of the German Institute for Employment Research (IAB). The AWFP covers West Germany between Q2 1975 to Q4 2014 and East Germany between Q2 1992 and Q4 2014 and provides establishment-level data on job creation and destruction, worker flows and wages differentiated by worker characteristics at a quarterly frequency. The AWFP thus allows the analysis of job and worker reallocation at a quarterly frequency over a period of almost 40 years in West Germany. We add to the analysis of Bachmann et al. (2021) by focussing our analysis on job instead of worker reallocation and by explicitly looking at the impact of recessions on job reallocation, while Bachmann et al. (2021) use the deviation of the unemployment rate from its trend as their main cyclical indicator.

Data: We use the public release version of the AWFP (Stüber and Seth, 2019) to study the cyclicality of aggregate job reallocation and the role of recessions for the reallocation process in Germany. The public release version of the AWFP aggregates the establishment level information along various dimensions of establishment characteristics, e.g. by industry or by size class. In order to avoid time series breaks, our analysis focuses on West Germany. We trim the first quarter of the data as we cannot calculate establishment closures in this quarter. Our final dataset thus covers West Germany between 1975 Q3 and 2014 Q4.

As indicators for the business cycle we use data on aggregate gross value added (GVA_t) and the unemployment rate (U_t). The data on quarterly value added in West Germany come from the Federal Statistical Office. Data for the monthly unemployment rate in West Germany come from the German Federal Employment Agency. We convert the monthly unemployment rates into quarterly unemployment rates by calculating the quarterly means. Data on recessions in Germany come from the GCEE (2021) which has dated all recessions at a quarterly frequency since the introduction of quarterly GDP data in 1971.

Variables: From the AWFP we use data on the aggregate number of jobs created (JC_t) and the aggregate number of jobs destroyed (JD_t) for quarter t. We construct gross reallocation as the sum of the number of jobs created and the number of

jobs destructed ($GR_t = JC_t + JD_t$), net job growth as the difference between job creation and destruction ($NET_t = JC_t - JD_t$) and excess job reallocation as the difference between reallocation and absolute net job growth ($ER_t = GR_t - |NET_t|$). Furthermore, we construct two proxies for number of opened and closed establishments. We classify all establishments that have a positive number of employees in the current quarter and had no employees in the previous quarter as opened establishments (OE_t). We can then construct a proxy for closed establishments using the fact that the number of active establishments at the end of a quarter (E_t) is equal to the sum of active establishments at the end of the previous quarter (E_{t-1}) and opened establishments (OE_t) minus the number of closed establishments (CE_t), i.e. ($E_t = E_{t-1} + OE_t - CE_t$). Rearranging we get the number of closing establishments as $CE_t = E_{t-1} + OE_t - E_t$. Note that both proxies for opening and closing establishments contain some noise as we cannot distinguish between genuine establishment openings or closures and establishments that appear or vanish as a result of mergers, acquisitions and divestments or due to temporary closures.

We convert all job flows to job flow rates[1] by dividing each variable by the end-of-period stock of jobs. We convert the establishment openings and closures to opening and closure rates by dividing each variable by the total stock of active establishments in the corresponding period. As the raw job flows, the job flow rates, the opening and closure rates as well as the value added and unemployment data exhibit substantial seasonality we seasonally adjust all variables using the X-13 ARIMA CENSUS procedure.

Cyclicality: In order to study the cyclical behaviour of job flows, we detrend all variables using a HP-filter with a smoothing parameter of 1,600 and calculate the percentage deviation of each variable from the trend. For example, the percentage deviation of the job creation rate is calculated as:

$$JCR_{dev,t} = \frac{JCR_{cyc,t}}{JCR_{trend,t}}$$

As the main business cycle indicator, we use the output gap, calculated as the percentage deviation of real GVA from its trend. We use the output gap as the main business cycle indicator as it aligns well with the recessions identified by the GCEE (2021). As a robustness check we also use the quarterly percentage change in GVA and the quarterly percentage point change in the unemployment rate as business cycle indicators. Both indicators react more quickly at the beginning of a recession[2] but are less well suited to measure the depth of a recession.

We study the cyclicality of job flows and business dynamics by calculating the correlation between the deviation of each variable from its trend and the output gap at different horizons h. For example, for the job creation rate we calculate:

[1] For every variable X we denote the corresponding rate by XR i.e. JC denotes job creation and JCR denotes the job creation rate.

[2] The correlation with the output gap i.e. the cyclical component of GVA peaks at a lead of three quarters.

$$\rho_h^{JCR} = cor\left(JCR_{dev,t+h}, GVA_{dev,t}\right)$$

The results are shown in Table 1. In the first row we show the correlation with the percentage point change in the quarterly unemployment rate. The change in the unemployment rate is countercyclical, i.e. higher when the output is below trend. As the highest negative correlation is at -2 to -4 quarters, the change in the unemployment rate leads the output gap at two to four quarters.

↘ TABLE 1

Cyclicality of selected reallocation variables in West Germany in the years 1975 to 2014

Variable h	Correlation with the output gap[1] at time t[2]										
	–5	–4	–3	–2	–1	0	1	2	3	4	5
Change of the unemployment rate $(t+h)$[3]	–0.48	–0.53	–0.57	–0.54	–0.47	–0.36	–0.16	0.04	0.24	0.40	0.49
Reallocation rate $(t+h)$[4]	–0.02	–0.06	–0.05	–0.04	–0.13	–0.13	–0.12	–0.07	0.00	0.06	0.13
Excess reallocation rate $(t+h)$[4]	0.09	0.06	0.06	0.09	0.09	0.03	0.02	–0.00	–0.01	0.01	–0.01
Rate of job creation $(t+h)$[4]	0.51	0.56	0.59	0.56	0.45	0.32	0.09	–0.05	–0.17	–0.34	–0.42
Rate of job destruction $(t+h)$[4]	–0.42	–0.48	–0.52	–0.51	–0.47	–0.36	–0.18	–0.03	0.14	0.27	0.41
Business start-up rate $(t+h)$[4]	0.57	0.55	0.50	0.40	0.24	0.11	–0.08	–0.21	–0.28	–0.37	–0.40
Business closure rate $(t+h)$[4]	–0.30	–0.34	–0.31	–0.25	–0.16	–0.11	–0.02	0.03	0.04	0.04	0.01

1 – Deviation of the real GVA from its Hodrick-Prescott filtered trend (in %). 2 – Observations on the basis of quarterly figures in West Germany from 1975Q3 to 2014Q4. 3 – Difference between the unemployement in period $t+h$ and $t+h-1$ in percentage points. 4 – Deviation of the respective variable from its Hodrick-Prescott filtered trend (in %).

Sources: Administrative Wage and Labor Market Flow Panel (AWFP), Stüber and Seth (2019), own calculations

Turning to the reallocation indicators, we show that the aggregate job reallocation rate behaves slightly countercyclical. Considering the different leads and lags shows the strongest negative correlation for the contemporaneous correlation between the reallocation rate and the output gap. The low correlation overall is the result of the cyclical countermovement of job creation and job destruction, the two components of the reallocation rate. The job creation rate is strongly procyclical and leads the output gap. The output gap is most strongly correlated with the job creation rate at leads of two to four quarters. The contemporaneous correlation however is also positive. The correlations turn negative at a lag of two quarters and become more negative as the lag increases. This indicates that job creation tends to decrease after periods with a high positive output gap and vice versa tends to increase after periods with a highly negative output gap. The cyclical behaviour of the job destruction rate is almost exactly opposite to that of the job creation rate. The job destruction rate is strongly countercyclical with the strongest negative correlations at leads of one to four quarters. The correlation becomes positive at a lag of three quarters and further increases up to a lag of five quarters. Thus, job destruction tends to increase after periods with a highly positive output gap and vice versa tends to decrease after periods with a highly

negative output gap. Business creation and business closures exhibit a similar behaviour to job creation and destruction respectively. Business creation is procyclical and leads the output gap with the highest positive correlation at a lead of five quarters. Business closures are countercyclical with the strongest correlation at a lead of four quarters.

Overall these results are consistent with the analysis of cyclicality in Bachmann et al. (2021), who use the cyclical component of unemployment as a business cycle indicator. In a boom we observe high job and business creation and low job and business destruction as well as slightly lower reallocation. In a recession, when the output gap is negative, we observe low job and business creation, high job and business destruction and slightly higher aggregate reallocation. All indicators except for aggregate reallocation lead the output gap cycle by about three quarters and thus are particularly high or low at the beginning of a boom or recession. Interestingly, the changing sign of the correlations of job creation and destruction with the output gap at higher lag lengths points to a higher level of job creation and a lower level of job destruction in the aftermath of recessions. This finding could be interpreted as an indication for the cleansing nature of recessions with higher job destruction during recessions laying the foundation for higher job creation in their aftermath.

Local projections: To further investigate the role of recessions for labour reallocation, we estimate impulse response functions of all labour reallocation indicators to a recessionary shock with a local projection (Jordà, 2005) approach. This approach allows to control for possible interrelationships between the various measures of job reallocation and isolate the effect of a reduced-form recessionary shock on job reallocation. For example, the findings from Tian (2017) suggest that it is important to control for lagged labour reallocation when estimating the effect of recessions on labour reallocation. We use the recessions dated by the GCEE (2021) to construct the recession indicator REC_t, which takes the value 1 if the German economy was in a recession in quarter t and the value 0 otherwise. We estimate the impulse response functions for each variable[3] $y \in X = \{GVA, U, JCR, JDR, GRR, OER, CER\}$ using the estimation equation

$$y_{t+h} = \alpha_h + \sum_{p=1}^{6} \beta_p^h REC_{t-p} + \boldsymbol{\gamma_p^h X_{t-p}} + \delta_h^1 t + \delta_h^2 t^2 + u_{t+h}^h \,, h = 0, 1, \dots, 12$$

where y_{t+h} is the outcome variable of interest in quarter $t+h$, α_h is the intercept, REC_{t-p} is the recession indicator, and $\boldsymbol{X_{t-p}}$ is the vector of variable outcomes in quarter $t-p$. We include the lagged variables up to a lag of six quarters and also include a quadratic time trend in the estimation. The impulse response at time $t+h$ to a reduced-form recession shock at t (switching REC_t from 0 to 1) is then given by β_1^h. As we include a time trend, the impulse responses can be interpreted as deviations from this trend. These impulse responses are shown in Figure 2.

Gross value added declines relative to trend after a recessionary shock with the strongest decline after three quarters and a trough of a little more than -2.5

[3] Note that in contrast to the analysis on cyclicality we do not detrend the variables using a HP filter prior to the analysis but use the raw variables instead.

percent relative to trend. The job reallocation rate increases by 0.2 percentage points two quarters after a recessionary shock and remains elevated until around two years after the shock when it returns to trend. The job creation rate changes by up to -0.23 percentage points below trend after one quarter and is not significantly different from trend after six quarters. The job destruction rate increases by up to 0.28 percentage points above trend after two quarters and is not significantly different from trend after seven quarters.

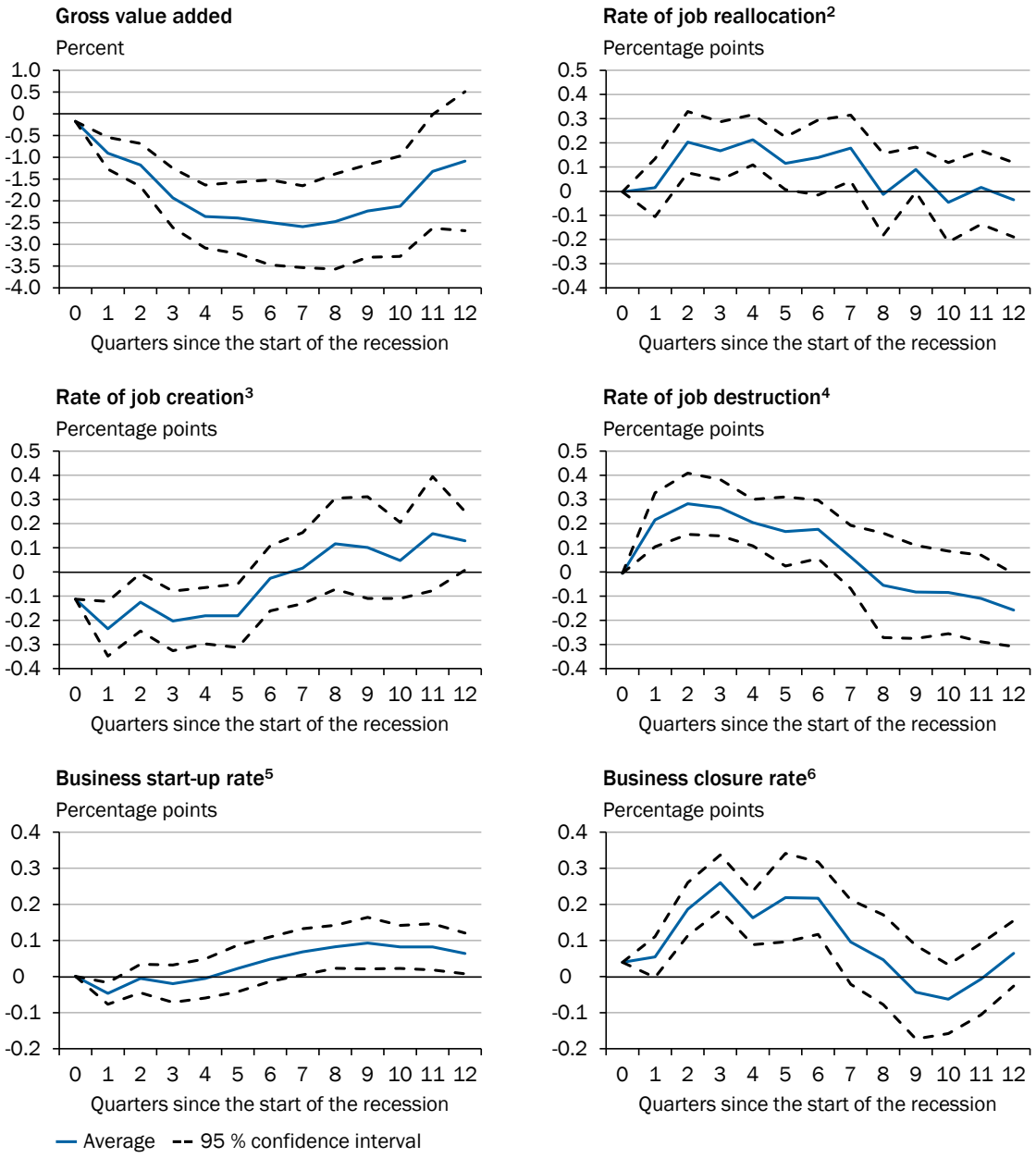
The results on business dynamism point in a similar direction. Recessions are primarily a time of elevated business destruction. Business creation only decreases very little in response to a recessionary shock and is not statistically significantly different from trend in the twelve quarters following the shock. In contrast, the business closure rate increases significantly after a recessionary shock, peaking at 0.26 percentage points above trend and declining afterwards.

Overall, both the estimated impulse responses and the analysis of the cyclicality of job reallocation point in the same direction. Recessions have been times of slightly elevated job reallocation due to a relatively strong increase in job destruction, which is slightly countervailed by a slightly milder decrease in job creation. While the decrease in job creation could indicate a mild sullying effect of previous recessions in Germany, the relatively stronger increase in job destruction would suggest that the cleansing effect has been relatively stronger. The impact on job flows has been strongest early in a recession and subsided about six to seven quarters after the recessionary shock.

↘ FIGURE 2

Increase in job reallocation in previous recessions driven by increase in job destruction

Reallocation rate over the course of previous recessions in Germany[1]



1 – Impulse response of each variable to a recession shock that causes the recession indicator to change from 0 to 1. Based on an indicator that assumes the value 1 if a quarter falls in a recession as dated by the GCEE. Calculated on the basis of quarterly figures for the period 1975Q3 to 2014Q4 in West Germany. 2 – Number of jobs created and destroyed between t–1 and t in relation to the total number of all jobs in t. 3 – Number of jobs created between t–1 and t in relation to the total number of all jobs in t. 4 – Number of jobs destroyed between t–1 and t in relation to the total number of all jobs in t. 5 – Number of establishments that had no employees earning above the threshold for social insurance contributions at time t–1 and a positive number of such employees at time t, in relation to the total number of all establishments that had employees earning above the threshold for social insurance contributions at time t. 6 – Number of establishments that had a positive number of employees subject to social insurance contributions at time t–1 and no such employees at time t, in relation to the total number of all establishments that had employees subject to social insurance contributions at time t.

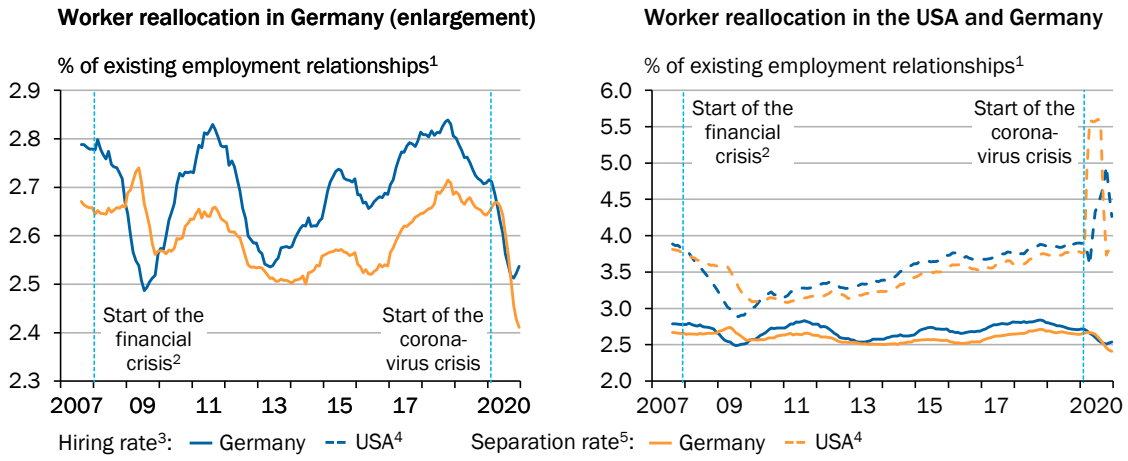
Sources: Administrative Wage and Labor Market Flow Panel (AWFP), Stüber and Seth (2019), own calculations

4. The reallocation of labour during the COVID-19 Pandemic

Qualitatively applying the empirical results obtained above to the COVID-19 recession would suggest a strong increase in job destruction, a decrease in job creation in the early quarters of the crisis, and an increase in business closures. Surprisingly, however, Figure 3 (left panel) illustrates an atypical pattern of worker reallocation during the COVID-19 pandemic in Germany. While the hiring rate decreased between March and December 2020 - as one would expect and as was the case during the GFC – the separation rate follows a similar trajectory, pointing to a decline in the rate of overall worker reallocation. Importantly, these rates are only based on the workers earning above the threshold for paying social insurance contributions, as the same data are not available for workers in marginal employment.

↘ FIGURE 3

Worker reallocation during the coronavirus crisis rises in the USA and falls in Germany



1 – Six-month moving average. The series are seasonally and calendar adjusted using X-13-ARIMA-SEATS. 2 – Start of the financial crisis dated at December 2007 in the USA and at January 2008 in Germany. 3 – Ratio of the number of jobs above the earnings threshold for social insurance contributions begun between t–1 and t to the number of jobs subject to social insurance contributions existing at t–1. 4 – Excluding employees in agriculture, domestic staff, employees at non-profit organisations and non-civilian employees of the military (nonfarm payrolls). 5 – Ratio of the number of jobs above the earnings threshold social insurance contributions ended between t–1 and t to the number of jobs above the threshold for social insurance contributions existing at t–1.

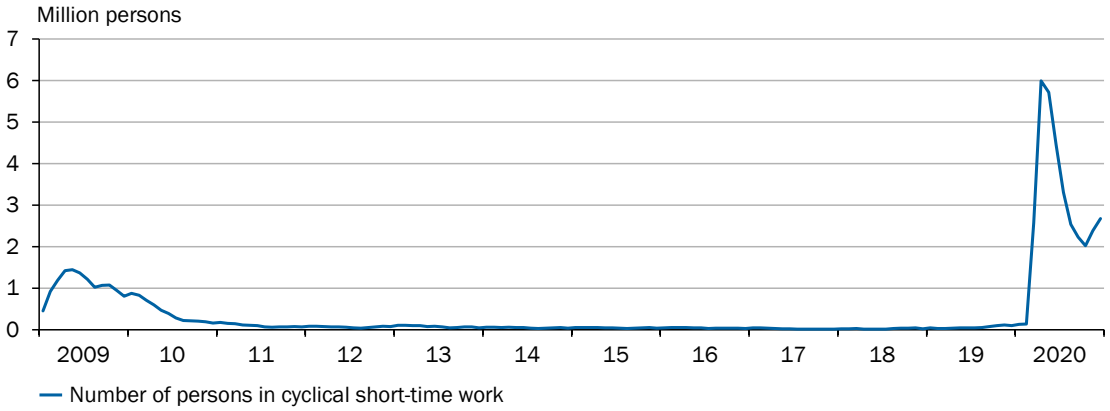
Sources: BLS, Federal Employment Agency, own calculations

Several policy measures likely contributed to this development: First, the suspension of the duty to file for insolvency under the COVID-19 Insolvency Suspension Act (CovInsAG), which applied from March 2020 to September 2020 for reasons of illiquidity or overindebtedness, until December 2020 for overindebtedness only, and until April 2021 for businesses that had applied for government support during the period from November 2020 to February 2021. Second, the generous business support measures granted by the German government to firms experiencing liquidity and solvency problems through grants and loans. And third, the extension of the short-time work arrangements

("Kurzarbeit"), allowing employers to reduce their employees working hours rather than laying them off. *Kurzarbeit* benefited 6 million workers in April 2020, compared to 1.4 million workers at the height of the GFC (Figure 4). While all these measures most certainly helped stabilizing employment, as intended by policy makers, they also likely dampened reallocation dynamics e.g. by reducing the pressure on firms to shed workers and by reducing workers' incentives to search for alternative job opportunities in firms and sectors that had proven to be more resilient to the crisis.

↘ FIGURE 4

Realised short-time work in Germany



Source: Federal Employment Agency
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The German trajectory, defined by a reallocation slump, stands in contrast to the dynamics observed for the US labour market though (Figure 3, right panel). In the US, reallocation rates sharply increased at the beginning of the pandemic, albeit evidence of a bounce-back emerged as early as the second quarter of 2020. Together with the observation that reallocation rates in the US generally hover on a higher level than German rates, this finding underscores the differing degree of employment protection legislation as well as the different types of emergency measures taken by the two countries.

For instance, while European countries, and Germany in particular, heavily relied on a reduction of hours worked to stabilize the economy, labour market demands in the US were mostly adjusted through the number of employees, i.e. through headcounts (GCEE, 2021). Short-time work schemes, whereby employees experiencing a reduction in hours are entitled to collect parts of their unemployment compensation benefits to replace a portion of their lost wages, exist in several US states. However, their take-up remains low due to administrative bottlenecks, lack of employer awareness, weak financial incentives for employers (employers are liable for their part of social-security contributions for hours not worked) and limits to the maximum reduction in working hours (OECD, 2020). To bypass such problems, the Federal Government introduced the Paycheck Protection Program through the Coronavirus Aid, Relief, and Economic Security (CARES) Act bill, aiming to help small businesses cover near-term operating expenses through a forgivable loan (if employment and compensation

levels are maintained) and provide an incentive for employers to retain their employees. First evaluations, however, conclude that employment effects of the program were small compared to the program's size and that firms often used the loans to make non-payroll fixed payments and build up savings buffers instead of maintaining employment (Granja et al., 2020).

Another much discussed reason for the low take up of the Paycheck Protection and short-time work schemes lies in the expansion of the states' ability to provide unemployment insurance (UI) for workers impacted by the COVID-19 pandemic, which notably included a 600 US Dollar per week boost to UI benefits from April to July 2020. Ganong et al. (2020) estimate that under the extended UI, the median replacement rate for unemployment benefits recipients amounted to 134 %, suggesting that two-thirds of jobless workers received more money while being unemployed than they were able to earn while working, and one in five workers received twice as much. As a result, federal supplement unemployment benefits may have encouraged layoffs during the pandemic, where workers and employers were better off opting for extended unemployment benefits rather than maintaining the work relationship.

Intrasectoral reallocation

As described above, and documented extensively by the literature, the majority of reallocation dynamics typically capture movements within sectors, as workers changing jobs tend to reallocate to firms with similar worker needs (see for instance Davis and Haltiwanger, 1999; Foster et al., 2006). Barrero et al. (2021) list several examples based on anecdotal evidence supporting the idea that intrasectoral reallocation might have increased throughout the pandemic, including the restaurant industry where demand shifted to takeout- and delivery-oriented chains. Similarly, more digitalised firms, weathering the crisis better than their less digitised peers, may have attracted workers previously employed by less digitalised firms. Cutter and Thomas (2020) for instance describe in the Wall Street Journal that Silicon Valley's startups were forced to freeze hiring processes or fire employees that were later hired by big-tech companies. While such dynamics could entail productivity benefits, where higher digitalisation is linked to higher productivity, they might also nourish concerns over growing market concentration (Bajgar et al., 2021).

Assessing such intrasectoral dynamics, however, would require worker mobility as well as job creation and destruction data at the firm level, which are not yet available for the period of the COVID-19 crisis. We therefore revert to data from the survey "BeCovid- Establishments in the COVID-19 crisis" collected by the German Institute for Employment Research, targeting approximately 2,000 firms of all sizes in various sectors of the economy in three-week intervals since September 2020. Besides a permanent set of questions related to the firm's characteristics (e.g. size, location, sector), the general impact of the pandemic on the firm's performance and recent hirings and firings, each wave contains a thematic focus, such as ICT-investment or continued education and training.

Using a simple probit model, we first test whether hiring and firing probabilities were linked to firm size, measured by the number of employees. We augment the model using a set of firm controls, including its sector classification, a dummy indicating whether the firm is located in East Germany ("region East"), the percentage of the workforce subject to short-time work arrangements during the crisis ("STW"), as well as a proxy for the firm's liquidity ("liquidity") based on the question of how many weeks the firms could survive on cash buffers until insolvency. Our binary dependent variable captures whether the firm has recently hired or fired employees, respectively. For firms interviewed in the first wave the question relates to the period since the onset of the crisis (i.e. between March 2020 and September 2020), in all subsequent waves firms are asked about their hiring and firing dynamics in the past three weeks. Standard errors are heteroscedasticity-consistent.

$$Y_i = \alpha + \beta_1 sector_i + \beta_2 size_i + \beta_3 region_i + \beta_4 liquidity_i + \beta_5 STW_i + \varepsilon_i$$

Results reported in Table A.1. display the expected sign for most control variables. In particular, higher liquidity is associated with a higher probability of hiring and a lower probability of firing, while the reverse holds true with respect to the share of short-time workers, a proxy of financial instability. Results further suggest that larger firms had a statistically significantly higher probability of both hiring and firing new employees relative to SMEs. However, the effects are stronger for hiring dynamics, as firms in the category of 250+ employees appear to be five times as likely to hire new staff, but only three times as likely to fire their workers compared with their smaller peers (Table 2). Overall, these findings point to an intra-sectoral reallocation towards larger firms.

↘ TABLE 2

Average marginal effects of firm size on worker reallocation[1]

Dependent binary variable	Hirings	Firings
1 to 9 employees	0.165 ***	0.116 ***
10 to 49 employees	0.475 ***	0.189 ***
50 to 249 employees	0.734 ***	0.292 ***
250+ employees	0.807 ***	0.354 ***

1 – This table displays the average marginal effects obtained from equations (1) and (5) where a binary hiring (or firing) variable is regressed on a set of control variables using a probit model. ***, **, and * represent $p < 0.01$, $p < 0.05$ and $p < 0.1$ respectively.

Sources: Backhaus et al. (2021a, 2021b), IAB BeCovid – wave 01-14 v1, own calculations

Absent firm-specific productivity data at the current margin, we further analyse the link between employment growth and the degree of firm digitalisation, which has previously been associated with productivity growth (Berlingieri et al., 2018; Gal et al., 2019). More digitised firms may have better adapted to the COVID-19 shock, thus attracting human resources that were laid off by other, less resilient firms. As there exists no standalone variable to measure firm digitalisation, digitalisation is proxied by a variable assessing whether the firm allows workers to work from home, the share of workers with a laptop or a computer connected

to the internet, and a question capturing whether the firm has invested in digital technologies because of the pandemic.[4] Regressions with either variable only include observations from their respective wave of questions since each of these features was only surveyed in one wave.

Results extending the equation with the variables proxying the degree to which firms are digitized, however collectively yield insignificant results, possibly due to a high degree of correlation between the firm's size and each proxy.[5] This implies that while there are reasons to assume that employees have moved from smaller to larger firms, the same pattern is (so far) not apparent for firms with various levels of digitalisation.

Intersectoral reallocation

With a view to assessing the reallocation dynamics between sectors, i.e. the intersectoral reallocation rate, we study the relative change in employment by sector. We follow the example of David (2021), who finds that during the COVID-19 period the US has experienced a prolonged period of high worker reallocation across sectors (relative to previous recessions), albeit much of the reallocation after the initial months seems to have been a reversion toward the pre-crisis allocation of labour. Reallocation dynamics also appear to have been much less exceptional compared to previous recessions, when the leisure and hospitality sectors are excluded, which experienced a particularly stark decline in employment due to containment measures, behavioural consumption adjustments and revenue losses. A recent analysis of European economies by Lopez-Garcia and Szörfi (2021) confirms that during the pandemic the reallocation of resources between sectors contributed between 30 and 40% of aggregate productivity growth, thus deviating from pre-crisis periods where sector reallocation contributed negatively to aggregate productivity growth.

The proposed index by David (2021) specifically measures the extent to which workers reallocate across sectors, where $I_{t\to t+h}$ measures the fraction of workers who move between sectors from month t to month $t+h$ using E_t^i, the share of total employment in sector i in month t.

$$I_{t\to t+h} = \frac{1}{2}\sum_i |E_{t+h}^i - E_t^i|$$

If all sectors grow (or shrink) proportionally, the index value would be zero. However, if employment growth displays strongly differing patterns across sectors, the same index takes a high value. To account for the possibility of workers leaving the labour market altogether, in which case there would be no reallocation *between* sectors, we refine the analysis by adding an artificial sector capturing workers that have left the labour market. Without this sector, relative employment weights by sector could change, thus increasing the index, even when

[4] In the original survey, these variables are labelled "home0100", "digit0100", and "digit0600".

[5] Correlation statistics between individual variables could not be obtained due to data confidentiality issues.

workers only exit the active workforce. The artificial sector is then excluded when calculating the index. Data underlying these calculations are retrieved from the Federal Employment Agency for Germany and the International Labour Organisation for the US and represent the sum of employees subject to social security contributions and marginally employed persons (for Germany only) using quarterly data calculated from the averages of the monthly values.

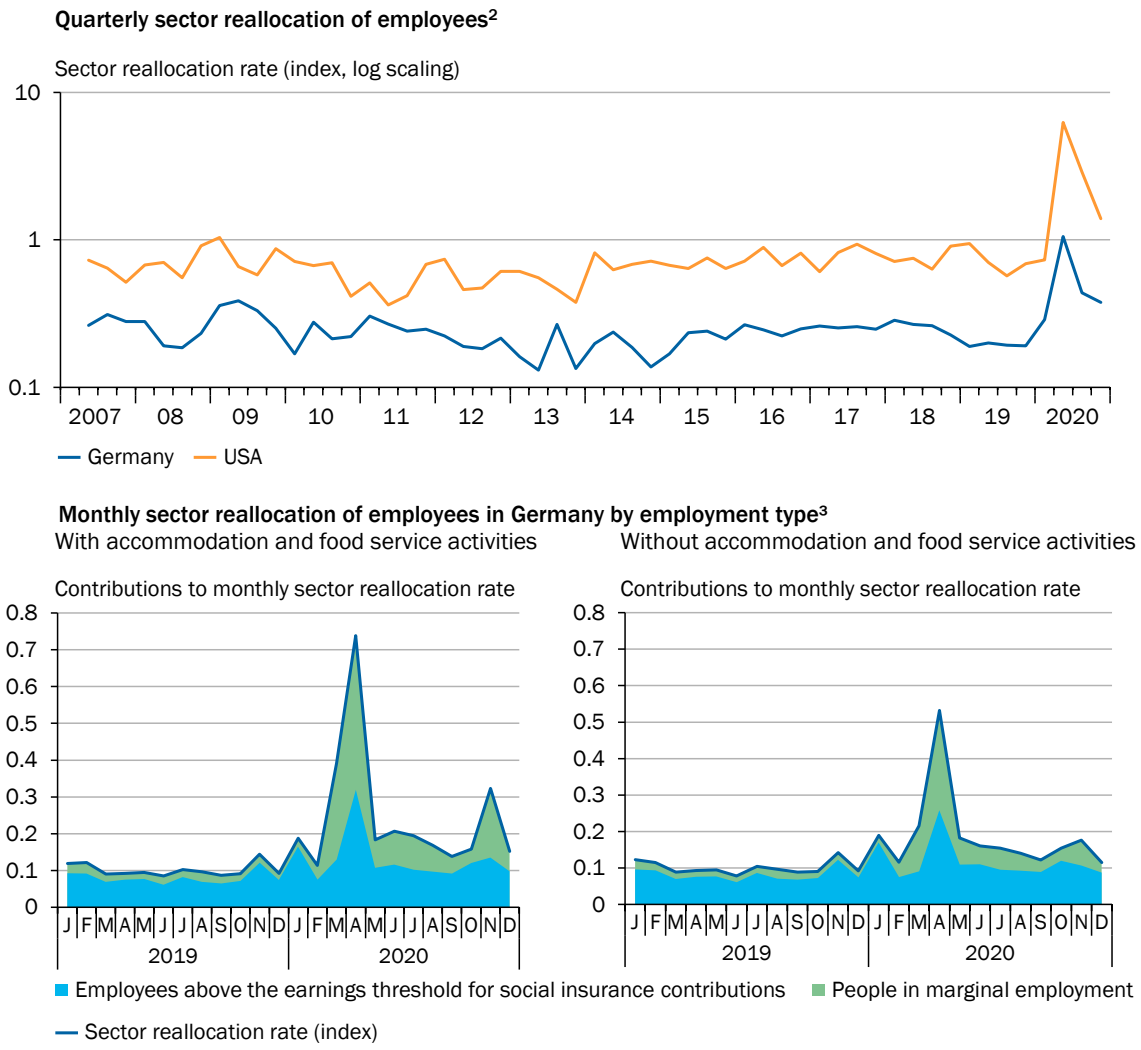
In line with David (2021) and as displayed by Figure 5, COVID-19 indeed appears to have led to an exceptional reallocation shock across German sectors. These dynamics are unusual, both with respect to pre-pandemic years as well as with respect to the GFC. Again, US reallocation rates are higher than German ones, for the reasons discussed above, including a more flexible labour market and the absence of comparable social protection systems.

Dissecting the index into the share of employees subject to social security contributions and those that are in marginal employment further reveals that much of this development is driven by the reallocation of the marginally employed. Unlike employees subject to social security contributions, marginally employed were not eligible for short-time work compensation. Another reason why marginally employed contribute strongly to intersectoral worker dynamics might be linked to their overrepresentation in sectors that were particularly hard hit during the pandemic, including leisure and hospitality. As illustrated by Table A.2., the share of marginally employed workers in accommodation and food activities was as high as 45.99 % during March-December 2020, relative to a median across sectors of 14.8 %.

Similar to David (2021) we then repeat the same calculation excluding the leisure and hospitality sector, to determine whether reallocation dynamics were in fact only steered by these two sectors. Results displayed in Figure 5 (bottom right) however suggest that while both sectors significantly contributed to the development observed during the early stages of the pandemic, the strong increase in intersectoral reallocation still holds when excluding the two sectors, suggesting an economy-wide trend.

↘ FIGURE 5

The sector reallocation rate[1] of employees rose sharply during the pandemic



1 – The sector reallocation rate shows how much movement of the workforce there is between sectors of the economy. Sum of the absolute change in share of the workforce employed in the economic sectors. According to the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4). Seasonally adjusted. 2 – Calculated on the basis of economic sections (one letter). 3 – Calculated on the basis of economic divisions (two digits).

Sources: David (2021), Federal Employment Agency, ILO, own calculations

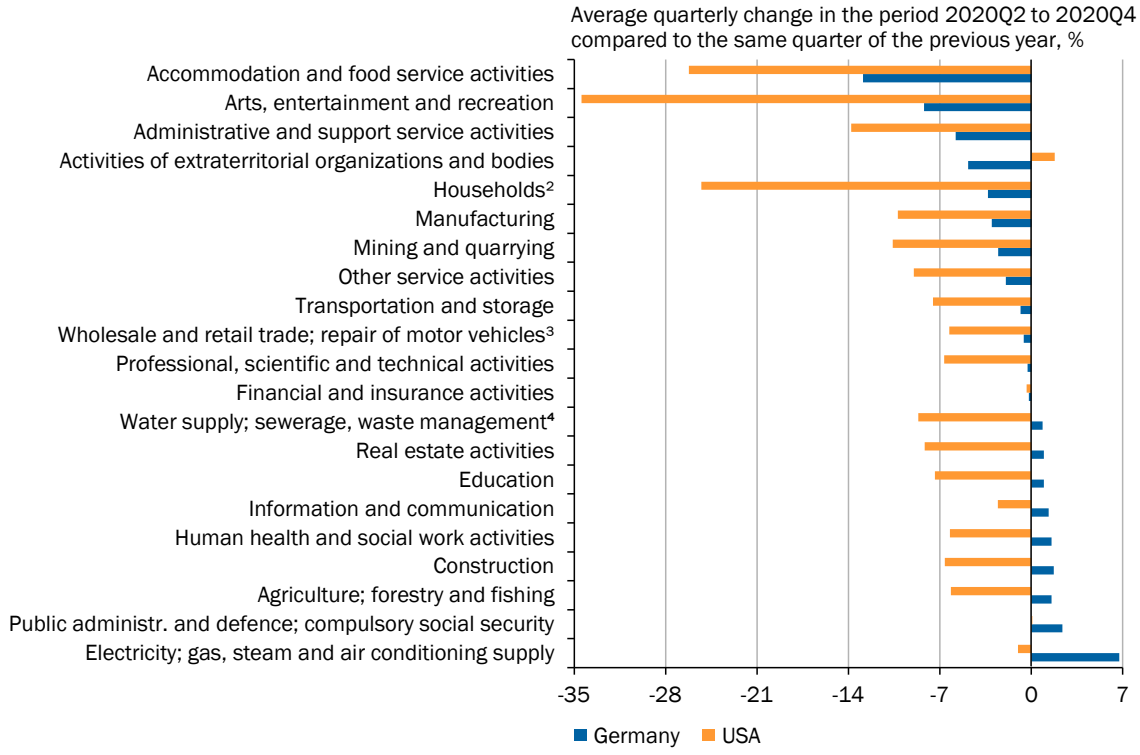
To get a sense of employment flows, we use the relative change of employment by sector, illustrating which sectors have gained and lost in terms of employment during the crisis. While the German hospitality and leisure sectors, for instance, significantly reduced the number of employees over the year 2020, the construction sector, public administration or the energy sector recorded employment growth (Figure 6). The sectoral shifts recorded during this period, however, appear to still contribute negatively to labour productivity growth (Figure 1), although this finding may be linked to few relatively unproductive sectors recording substantial employment growth (e.g. public administration). In the medium term, permanently higher employment growth may still set in for more productive sectors, possibly leading to a positive contribution of intersectoral reallocation to productivity growth. For comparison, no US sector

with the exception of extraterritorial activities, recorded employment growth throughout 2020.

Strong sectoral shifts may be a source of concern if they slow the recovery in sectors whose workforce may have permanently moved to other sectors. This concern is supported by anecdotal evidence, whereby the leisure and hospitality sector struggle to find new staff, leaving many positions unfilled (Vogt, 2021). In the US, the same sectors appear to encounter difficulties hiring new workers, although first data indicate that these workers may have exited the labour market altogether, as the rate of labour force participation markedly declined during the pandemic and the number of retirees surged (Bloomberg, 2021). Some economists attribute this observation to lower job security, but also to closed schools and child care institutions and fears of contracting the virus in the workplace (Look et al., 2021).

↘ FIGURE 6

Changes in employment by sector in 2020 were highly heterogeneous[1]



1 – According to the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4). 2 – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use. 3 – And motorcycles. 4 – And remediation activities.

Sources: Federal Employment Agency, ILO, own calculations

Reallocation and "Kurzarbeit"

Compared with earlier recessions, Germany strongly relied on its well-established short-time work scheme ("Kurzarbeit") to prevent job losses and stabilize labour markets (GCEE, 2020). In practice, *Kurzarbeit* provides a subsidy to employers who place workers on a reduced schedule rather than laying them off. The worker

earns regular wages for the hours worked and a percentage of the regular wage for the hours not worked. During the pandemic, the number of workers under short-time work arrangements rose to unprecedented levels, reaching 6 million in April 2020 compared to only 1.4 million workers at the peak of the GFC.

Overall, Germany's *Kurzarbeit* program was widely credited with mitigating unemployment and supporting domestic demand during the COVID-19 recession (IAB, 2020). Aiyar and Mai Chi (2021) also found that absent the expansion of German short-time work rules, unemployment would have increased by an additional 3 percentage points on average at the trough of the recession and the contraction in consumption could have been 2 to 3 times larger.

At the same time, concerns are mounting that sticking with short-time work arrangements for too long may dampen the productivity-enhancing reallocation process (Boeri and Brücker, 2011; Aiyar and Mai Chi, 2021; Andrews et al., 2021). In the short term, maintaining the relation between employers and their workers can be critical to preserve valuable intangible capital (e.g. firm-specific knowledge). The longer extraordinary short-time work rules remain in place, however, the likelier it becomes that short-time work impedes the reallocation of workers to more resilient and potentially more productive firms. Indeed, the design of the extended short-time work arrangements introduced during the pandemic in Germany suggest a reallocation-impeding effect, by minimizing the individual incentive to search for a new job through rising compensation schemes (GCEE, 2020). Under the *Kurzarbeit* program, workers receive 60 % of the net pay lost during the short-time working (or 67 %, if they have at least one child) up until the fourth month. However, that amount rises to up to 80 % by the seventh month (or to 87 % for employees with children; Federal Employment Agency, 2021).

Against this background, Andrews et al. (2021) examine the extent to which short-time work affects the productivity-enhancing reallocation of jobs by calculating the difference in employment growth between high-productivity and low-productivity firms under the Australian short-time work program JobKeeper. The study finds that the productivity-enhancing reallocation was particularly strong in local job markets with a higher share of short-time workers at the onset of the pandemic, and attributes this to the large number of productive but illiquid firms that were supported by the short-time working arrangements. As the economy recovered, however, firms with low productivity also increasingly benefited from the program, so that by the end of 2020 local job markets in which a high proportion of employees were still receiving short-time working allowance, hardly any productivity-enhancing reallocation was measured.

In the absence of comparable firm-level productivity data, we aim to better understand the effect of *Kurzarbeit* on reallocation dynamics using the correlation between worker hiring and separation rates and the share of workers on short-time work schemes as a proportion of all workers subject to social security contributions. Figure 7 shows that even in economic sectors with a high proportion of short-time workers, who were presumably hard hit by the crisis, separations remained roughly the same as in 2019, although one would have

expected these sectors to also shed labour in an attempt to adjust to changing labour demands.[6] Labour demand adjustment, it seems, occurred over the hiring channel, as suggested by the strongly negative correlation between the change in worker inflows relative to 2019 and the share of workers on short-time work.

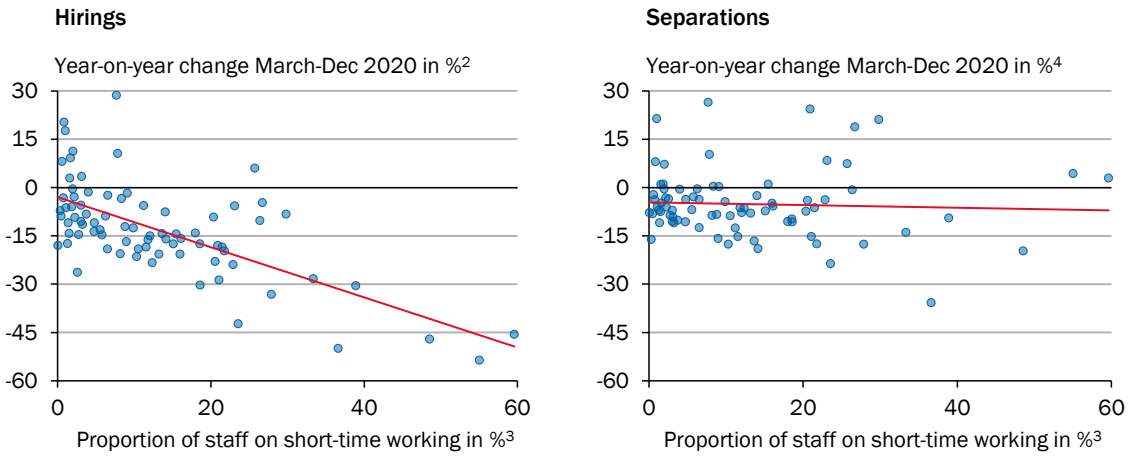
While this correlation illustrates the desired effect of the short-time work scheme, which was to preserve jobs, it also shows that even in economic sectors with a high share of short-time workers separations remained unaffected by the crisis. It should be noted though that terminating employment contracts for operational reasons if an employer has accepted to place his workers on short-time work is more difficult than in normal times, as the employer must justify why a certain position would now permanently be cancelled. These reasons must go beyond those that already led to the introduction of short-time work and external causes, including economic losses or unprofitability, will often not be sufficient (Federal Employment Agency, 2021). Thus, the design of short-time work scheme likely restricted firms that had accepted the short-time subsidy by the government from shedding workers.

While the question under which conditions short-time work schemes lead to a less productivity-enhancing reallocation of resources (or to a misallocation of resources) requires further analysis, its regulatory design as well as existing market conditions likely determine its effects on the economy and productivity. Aiyar und Mai Chi (2021), for instance, emphasize that job retention schemes are associated with greater misallocation in economies above a certain threshold of initial misallocation. This implies that if the economy is characterized by otherwise efficient reallocation dynamics, well designed short-time programs can still be a suitable policy tool to stabilize labour markets. At the same, the Australian experience demonstrates that the longer short-time working schemes are in place, the more likely they become to distort the productivity-enhancing reallocation process.

[6] A detailed list of sectors and their share of workers on short-time work arrangement can be found in the Appendix (Table A.3.).

↘ FIGURE 7

In sectors with a high proportion of short-time working, hirings have dropped more sharply but separations have not risen more sharply[1]



1 – According to the classification of economic activities, 2008 edition (WZ 2008). The divisions (two-digit) shown here are 10 to 18 and 20 to 99. 2 – Average of the monthly year-on-year changes in hiring rate of employees earning above the threshold for social insurance contributions per sector in the period March to December 2020. 3 – Average number of employees on short-time work as a proportion of the total number of employees earning above the threshold for social insurance contributions in the period March to December 2020. 4 – Average of the monthly year-on-year changes in separation rate of employees earning above the threshold for social insurance contributions per sector in the period March to December 2020.

Sources: 608, Federal Employment Agency, own calculations

5. Conclusion

Our analysis shows that the reallocation dynamics during the COVID-19 recession in Germany differed substantially from the dynamics observed in past recessions. During past recessions the job destruction rate increased substantially while the job creation rate only decreased slightly. As a result, aggregate job reallocation tended to increase during recessions. In the aftermath of recessions job creation increased while job destruction subsided, which suggests that past recessions in Germany had a cleansing effect.

During the COVID-19 recession aggregate worker reallocation decreased. While similar to previous recessions, the hiring rate dropped markedly, the separation rate, which usually increases at the beginning of recessions, also dropped. The substantial public stabilization measures put forward during the COVID-19 recession likely contributed to the decline in worker reallocation. Short-time work schemes allowed companies to keep existing employment relationships despite a drop in economic activity. Hard hit sectors, with a high share of workers in short-time work schemes, primarily adjusted their labour demand through a decrease in hirings instead of a combination of fewer hirings and more separations. In terms of stabilizing employment relationships, short-time work has thus by and large been successful. However, as changes in consumer behaviour or production technologies, which were initially thought to be temporary, become more likely to be permanent, a prolonged strong reliance on stabilization measures could dampen productivity enhancing reallocation.

Even though aggregate worker reallocation declined during the COVID-19 recession in Germany, the strong heterogeneity of the COVID-19 shock led to an increase in the reallocation of employment between industries. This intersectoral reallocation of labour was substantially higher than during the GFC, although its contribution to productivity growth remains negative for the time being.

Going forward, additional research is needed on the causes of lower intrasectoral reallocation of workers and jobs during the COVID-19 recession and on the consequences of lower intrasectoral reallocation for productivity growth. Insights from such analyses are important to inform the debate on suitable stabilization policies and on the need for policies that enable productivity-enhancing reallocation.

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Appendix

↘ TABLE A.1.

Probit regression results [1]

Binary dependent variable	(1) Hirings	(2) Hirings	(3) Hirings	(4) Hirings
A Agriculture; forestry and fishing	(omitted)	(omitted)	(omitted)	(omitted)
B Mining and quarrying	1.564 ***	(empty)	(empty)	(empty)
C Manufacturing	-0.048	-0.103	-0.155	0.194
D Electricity; gas, steam and air conditioning supply	0.711 **	0.102	-0.458	0.508
E Water supply; sewerage, waste management[2]	-0.319	-0.640	0.266	1.185
F Construction	0.107	0.020	-0.217	0.584
G Wholesale and retail trade; repair of motor vehicles[3]	0.140	0.107	0.055	0.792
H Transportation and storage	0.225	0.000	0.243	1.332 *
I Accommodation and food service activities	0.309	0.267	-0.331	0.349
J Information and communication	0.232 *	0.247	0.134	1.139
K Financial and insurance activities	0.223	0.256	0.142	0.989
L Real estate activities	-0.115	-0.291	-0.144	0.801
M Professional, scientific and technical activities	0.117	-0.008	-0.040	0.788
N Administrative and support service activities	0.435 ***	0.274	0.532	1.481 *
P Education	0.142	-0.080	0.050	1.019
Q Human health and social work activities	0.466 ***	0.391	0.237	0.940
R Arts, entertainment and recreation	0.262	0.339	0.273	1.234
S Other service activities	0.023	-0.039	-0.564	0.056
10 to 49 employees	0.948 ***	0.946 ***	0.962 ***	0.901 ***
50 to 249 employees	1.669 ***	1.711 ***	1.547 ***	1.454 ***
250+ employees	1.922 ***	1.952 ***	1.930 ***	1.824 ***
Region (East)	-0.022	0.048	0.105	0.067 ***
Liquidity	0.013	0.027	0.020	-0.046
Share of short-time workers	-0.901 ***	-0.811 ***	-0.982 ***	-1.282 ***
Option to work from home		-0.081		
Share of workers with computer/laptop			-0.002	
Digital investment due to pandemic				0.074
Constant	-1.149 ***	-1.062 ***	0.105 ***	-1.696 ***
Number of observations	11,298	3,351	1,772	1,097
McFadden Pseudo R2	0.2188	0.2299	0.2220	0.1937

1 – This table shows the results of equations (1) and (5) where a binary hiring (or firing) variable is regressed on a set of control variables using a probit model. Regression 2, 3, 4, 6, 7 and 8 further include variables capturing digitalisation at the firm level through various proxies. ***, **, and * represent $p < 0.01$, $p < 0.05$ and $p < 0.1$ respectively. Standard errors are robust. 2 – And remediation activities. 3 – And motorcycles.

Sources: Backhaus et al. (2021a, 2021b), IAB BeCovid – wave 01-14 v1, own calculations

↘ TABLE A.1. CONTINUED

Probit regression results [1]

Binary dependent variable	(5) Firings	(6) Firings	(7) Firings	(8) Firings
A Agriculture; forestry and fishing	(omitted)	(omitted)	(omitted)	(empty)
B Mining and quarrying	0.361	0.771	1.359	1.553 *
C Manufacturing	-0.230 *	-0.049	0.063	0.226
D Electricity; gas, steam and air conditioning supply	(empty)	(empty)	(empty)	(empty)
E Water supply; sewerage, waste management[2]	-0.022	0.144	-0.190	0.042
F Construction	-0.106	0.008	-0.049	0.191
G Wholesale and retail trade; repair of motor vehicles[3]	-0.191	-0.106	0.007	0.079
H Transportation and storage	0.041	0.173	0.281	0.458
I Accommodation and food service activities	0.023	0.032	0.274	0.293
J Information and communication	-0.314 **	-0.051	-0.051	-0.167
K Financial and insurance activities	-1.065 ***	-0.678 *	-0.927	(empty)
L Real estate activities	-0.703 ***	-0.452	0.073	0.249
M Professional, scientific and technical activities	-0.324 **	-0.207	0.008	0.086
N Administrative and support service activities	0.749 ***	0.811 **	1.090 ***	1.312 ***
P Education	-0.393 **	-0.198	-0.320	-0.001
Q Human health and social work activities	-0.381 ***	-0.303	-0.217	-0.243
R Arts, entertainment and recreation	-0.446 **	-0.458	(empty)	(empty)
S Other service activities	-0.303 **	-0.320	-0.137	(omitted)
10 to 49 employees	0.337 ***	0.273 ***	0.540 ***	0.386 **
50 to 249 employees	0.695 ***	0.626 ***	0.799 ***	0.519 ***
250+ employees	0.879 ***	0.721 ***	0.909 ***	0.643 ***
Region (East)	0.047	-0.014	0.146	0.020
Liquidity	-0.123 ***	-0.116 ***	-0.100 ***	-0.120 ***
Share of short-time workers	0.091	0.009	0.037	0.064
Option to work from home		0.014		
Share of workers with computer/laptop			0.010	
Digital investment due to pandemic				0.062
Constant	-0.531 ***	-0.661 ***	-1.198 ***	-1.032 ***
Number of observations	11,278	3,351	1,759	1,049
McFadden Pseudo R2	0.0931	0.0833	0.1129	0.1027

1 – This table shows the results of equations (1) and (5) where a binary hiring (or firing) variable is regressed on a set of control variables using a probit model. Regression 2, 3, 4, 6, 7 and 8 further include variables capturing digitalisation at the firm level through various proxies. ***, **, and * represent $p < 0.01$, $p < 0.05$ and $p < 0.1$ respectively. Standard errors are robust. 2 – And remediation activities. 3 – And motorcycles.

Sources: Backhaus et al. (2021a, 2021b), IAB BeCovid – wave 01-14 v1, own calculations

↘ TABLE A.2.

Proportion of marginally employed persons[1]

	Sector[2]	March–Dec 2019	March–Dec 2020	Difference in percentage points[3]
		%		
A	Agriculture; forestry and fishing	40.70	41.57	0.86
B	Mining and quarrying	6.79	6.80	0.01
C	Manufacturing	7.56	7.08	– 0.48
D	Electricity; gas, steam and air conditioning supply	5.53	5.14	– 0.40
E	Water supply; sewerage, waste management[4]	8.08	7.75	– 0.33
F	Construction	14.46	14.48	0.02
G	Wholesale and retail trade; repair of motor vehicles[5]	21.79	21.32	– 0.47
H	Transportation and storage	20.97	19.90	– 1.07
I	Accommodation and food service activities	49.22	45.99	– 3.23
J	Information and communication	12.04	10.93	– 1.11
K	Financial and insurance activities	7.12	7.03	– 0.09
L	Real estate activities	49.43	48.38	– 1.06
M	Professional, scientific and technical activities	16.73	15.77	– 0.96
N	Administrative and support service activities	30.25	29.49	– 0.76
O	Public administr. and defence; compulsory social security	6.49	6.12	– 0.38
P	Education	15.86	14.78	– 1.08
Q	Human health and social work activities	13.64	13.13	– 0.50
R	Arts, entertainment and recreation	46.72	43.86	– 2.87
S	Other service activities	29.60	28.05	– 1.55
T	Households[6]	87.44	86.94	– 0.50
U	Activities of extraterritorial organizations and bodies	0.39	0.39	– 0.00

1 – Average number of marginally employed persons as a proportion of the total number of employees in the period March to December 2020. 2 – According to the classification of economic activities, 2008 edition (WZ 2008). 3 – Deviations in the differences due to rounding. 4 – And remediation activities. 5 – And motorcycles. 6 – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use.

Sources: Federal Employment Agency, own calculations

↘ TABLE A.3.

Proportion of staff on short-time working[1]

Sector[2]		March–Dec 2019	March–Dec 2020	Difference in percentage points[3]
		%		
A	Agriculture; forestry and fishing	0.06	1.40	1.34
B	Mining and quarrying	0.01	4.74	4.73
C	Manufacturing	0.80	17.24	16.44
D	Electricity; gas, steam and air conditioning supply	0.00	1.02	1.02
E	Water supply; sewerage, waste management[4]	0.02	2.32	2.30
F	Construction	0.09	3.47	3.38
G	Wholesale and retail trade; repair of motor vehicles[5]	0.03	10.60	10.56
H	Transportation and storage	0.06	10.53	10.47
I	Accommodation and food service activities	0.01	41.44	41.43
J	Information and communication	0.04	7.61	7.57
K	Financial and insurance activities	0.00	2.03	2.03
L	Real estate activities	0.00	4.74	4.73
M	Professional, scientific and technical activities	0.08	10.35	10.27
N	Administrative and support service activities	0.04	10.96	10.91
O	Public administr. and defence; compulsory social security	0.00	0.58	0.58
P	Education	0.00	3.02	3.02
Q	Human health and social work activities	0.00	2.74	2.74
R	Arts, entertainment and recreation	0.01	28.01	28.00
S	Other service activities	0.04	12.11	12.08
T	Households[6]	0.00	0.78	0.78
U	Activities of extraterritorial organizations and bodies	0.00	0.05	0.05

1 – Average number of employees on short-time work as a proportion of the total number of employees earning above the threshold for social insurance contributions in the period March to December 2020. 2 – According to the classification of economic activities, 2008 edition (WZ 2008). 3 – Deviations in the differences due to rounding. 4 – And remediation activities. 5 – And motorcycles. 6 – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use.

Sources: Federal Employment Agency, own calculations