Bavarian Graduate Program in Economics

BGPE Discussion Paper

No. 212

Uncertainty shocks and employment fluctuations in Germany: the role of establishment size

Tim Kovalenko

September 2021

ISSN 1863-5733

Editor: Prof. Regina T. Riphahn, Ph.D.
Friedrich-Alexander-Universität Erlangen-Nürnberg

B G P E Discussion Paper Series

Uncertainty shocks and employment fluctuations in Germany: the role of establishment size*

Tim Kovalenko‡1

1 *University of Erlangen-Nürnberg, Germany*

August 29, 2021

Abstract

Uncertainty shocks are found to adversely affect labor market outcomes. Most studies attribute labor adjustments costs for the propagation of macroeconomic uncertainty to the labor market. Given that large establishments in Germany face higher labor adjustments cost, they should be affected more strongly by these shocks. Therefore, this paper studies the effects of uncertainty shocks on employment adjustments in large and small establishments employing four structural vector auto-regressive models with quarterly data for Germany in the period 1991-2014. These four models estimate effects of uncertainty shocks on employment, worker flows, job flows as well as worker churn, both for establishments with less than 100 and with at least 100 employees. The results suggest that uncertainty shocks induce considerable employment fluctuations in large establishments, while they have barely an effect on small establishments. Furthermore, large establishments adjust their labor input in response to an uncertainty shock by delaying the replacement of workers who leave these establishments.

Keywords: Uncertainty Shocks, Employment, Worker Flows, Job Flows, Worker Churn, Establishment Size, Structural Vector Auto-Regression, Germany
JEL - Classification: E24, E32, J63

---

*I thank Claus Schnabel, Daria Bühler and the participants of the collaborative doctoral seminar of the University of University of Erlangen-Nürnberg and Julius-Maximilians-Universität of Würzburg, the IWF Doctoral Seminar as well as several internal doctoral seminars for helpful comments and suggestions.

‡Correspondence to: University of Erlangen-Nürnberg, School of Business, Economics and Society, Chair of Labor and Regional Economics, Lange Gasse 20, 90403 Nuremberg. E-mail: tim.kovalenko@fau.de.

Declaration of Interests: The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

1. Introduction

Macroeconomic uncertainty, i.e. the inability to accurately predict future macroeconomic outcomes, has received much attention in the last decade since the seminal work by Bloom (2009). He demonstrates theoretically and empirically for the U.S. that uncertainty shocks have a contractionary effect, i.e. they decrease GDP and employment temporarily. Following this work, Caggiano, Castelnuovo, and Groshenny (2014) and Leduc and Liu (2016) find a sharp increase in U.S. unemployment as a response to an uncertainty shock. Besides this effect on unemployment, prices decrease as a response, which is why Leduc and Liu (2016) refer to uncertainty changes as demand shocks. For Germany, Popescu and Smets (2010) present some evidence for an increase in unemployment, while Bachmann, Elstner, and Sims (2013) report a decline in manufacturing production, employment and average hours in manufacturing.

More labor market related studies find a decrease in the job-finding rate (Guglielminetti, 2016; Riegler, 2019), vacancies and labor market tightness (Guglielminetti, 2016) and an increase in the separation rate (Riegler, 2019) due to uncertainty shocks. Moreover, Mecikovsky and Meier (2019) show a reduction in job creation and a rise in job destruction. All these results are based on U.S. data. However, little is known on the impact of uncertainty shocks on German labor market flows.

Usually the effects of uncertainty shocks are estimated for overall economic aggregates. Yet, there are potential differences in the responses of establishments by their size according to widespread theoretical models explaining the propagation of uncertainty shocks to the labor market. The reason is that most studies in this field attribute labor adjustment costs for an impact of uncertainty shocks on employment (see Bloom, 2009). According to Jung (2014), large establishments face higher adjustment costs in Germany. Thus, I expect large establishments to be affected more by uncertainty shocks. Indeed, using data for Germany, I will show in this paper that the effect of uncertainty on employment is driven by large establishments, i.e. uncertainty shocks affect primarily establishments with 100 and more employees. To investigate the mechanisms behind the employment adjustments, I estimate the responses of worker flows, job flows and worker churn in small and large establishments to uncertainty shocks. It turns out that worker inflows to large establishments decrease, while outflows do not respond significantly. At the same time, job creation decreases and job destruction increases in these establishments. These results imply that large establishments decrease their hiring activities as well as the replacement of laid off workers (since job destruction increases, while the outflow of workers is unaffected). This interpretation is confirmed by decreasing worker churn in large establishments after an uncertainty shock. For small establishments, I barely find evidence for any employment adjustments in response to this shock.

To be able to estimate the described relationships, I need time series data on employment and labor market flows for differently sized establishments. A recently constructed dataset by Stüber and Seth (2019) provides this kind of data for Germany. My preferred measure for uncertainty is the volatility of expected forecast errors as proposed by Jurado, Ludvigson, and Ng (2015) and constructed by Grimme and Stöckli (2018) for Germany. Yet, the results are not sensitive to the choice of the uncertainty indicator. Following the literature, I use structural vector auto-regressive models for the estimations.

In the literature, it is mostly agreed upon that uncertainty shocks played a key role for the severe decline in economic activity and increase in unemployment during and after the great recession in the U.S. (see Shoag & Veuger, 2016; Basu & Bundick, 2017).[1] Following these results, early evaluations suggest that the COVID-19 outbreak created an enormous uncertainty shock, which causes an even more serve economic downturn than the great recession (Altig et al., 2020; Caggiano, Castelnuovo, & Kima, 2020; Leduc & Liu, 2020). Even though there is no evidence for Germany yet, it is safe to say that uncertainty is an important driver for the recession caused by the COVID-19 outbreak (see e.g., Bardt & Grömling, 2020). To develop effective policy instruments coping with recessions caused by these shocks (like the current one), it is important to know which economic agents are affected and how exactly they respond.

This study provides a more detailed picture to the effects of uncertainty shocks than previous studies were able to. Indeed, the results provided in this paper have implications that can be used to cope with the economic downturn due to the COVID-19 pandemic. Merkl and Weber (2020) argue that this pandemic caused a ”recruitment crisis” in Germany, i.e. establishments drastically reduced hiring of employees. They suggest to subsidize new hires to prevent a substantial and persistent increase in unemployment. Their finding is consistent with my result concerning the decrease in worker inflows due to an uncertainty shock, but I only find this effect for large establishments. Thus, if such policies are effective, they should be applied on large establishments as they are the ones reducing hiring activities. However, it may well be that in times of high uncertainty such subsidies are less effective than in ”normal” times as establishments are too far away from their hiring threshold (see Bloom et al., 2018). Thus, constructing instruments to provide certainty for the whole economy or, more specifically, for the large establishments may be crucial.

This paper contributes to the literature in three ways. Firstly, I provide evidence that uncertainty shocks primarily affect employment stocks and flows in large establishments. Secondly, this paper is the first one providing empirical evidence on the impact of uncertainty on worker and job flows in Germany. Finally, the literature has not considered the effects on worker churn yet. I show that decreasing worker churn in large establishments in times of high uncertainty is an important channel for the decrease in employment.

This paper proceeds as follows. Section 2 provides a literature review and theoretical considerations on the propagation of uncertainty shocks on the labor market. Section 3 introduces the empirical approach as well as the data used in the analysis. The results are

[1] Note that, there are different views on the importance of uncertainty shocks for the downturn during the Great Recession (see e.g., Born et al., 2018).

presented in section 4. Sections 5 elaborates the role of economic sectors, while section 6 concludes.

2. Related literature and theoretical considerations

There is a rich literature on the differences of large and small businesses over the business cycle. For instance, Moscarini and Postel-Vinay (2008) show that large firms in the U.S. are more cyclical sensitive than small firms in terms of employment. Similarly, according to Moscarini and Postel-Vinay (2012) large firms destroy more jobs in recessions and create more job in expansions compared to small firms. Fort, Haltiwanger, Jarmin, and Miranda (2013), on the other hand, find small young firms to be affected the most by cyclical shocks. Yet, little is known about the differences of responses to uncertainty shocks by firm/establishment size. Even though uncertainty shocks are associated with business cycles, they may trigger different adjustment processes than the usual demand and supply shocks. I discuss the findings of the effects of uncertainty shocks and why these effects may differ by establishment size in the following.

In order to progress with the main arguments, I need to clarify the notion of uncertainty first. The literature refers to uncertainty shocks as second moment shocks, i.e. changes in volatility of certain stochastic processes. In theoretical models they usually appear as changes in the volatility of the productivity process (see e.g., Leduc & Liu, 2016). An increase in this kind of volatility implies that large positive and negative realizations of productivity become more likely. Thus, future productivity levels become harder to predict. Since productivity shocks are usually the only source of fluctuations in these models, the entire economic development becomes less certain.

Starting with Bloom (2009), several studies have demonstrated that uncertainty shocks lead to economic contractions. Employing U.S. data, Bloom (2009) finds a decline in industrial production and employment as responses to an uncertainty shock in the short run, while in the medium run these variables rebound and exceed their initial values. Basu and Bundick (2017) provide a more detailed picture by showing negative responses of output, consumption, investment, hours worked, prices and the interest rate to an uncertainty shock. Moreover, Leduc and Liu (2016) and Born et al. (2018) find a considerable increase in unemployment in the aftermath of this shock. An extensive literature supports these results for the most part (see e.g. Katayama & Kim, 2018; Mumtaz & Theodoridis, 2018; Claeys & Vašíček, 2019; Larsen, 2020). In addition, Caggiano et al. (2014) report a more pronounced response of unemployment when an uncertainty shock hits in a recession.

There are some studies focusing on the uncertainty effects in the labor market beyond employment and unemployment (mostly using U.S. data). For instance, Riegler (2019) finds a decrease in the job-finding rate and an increase in the separation rate in response to an uncertainty shock. Additionally, Guglielminetti (2016) finds drops in vacancies and labor market tightness, while Fontaine (2021) reports a decline in the labor force participation rate. Using data on job flows, Mecikovsky and Meier (2019) find a rise in job destruction and a drop in job creation in response to an uncertainty shock.

Carrière-Swallow and Céspedes (2013) show that uncertainty shocks unfold considerably more pronounced contractionary effects in emerging economies, while de Wind and Grabska (2016) find more pronounced effects for economies of continental Europe compared to Anglo Saxon economies. More specifically, their estimates imply a short run decrease of industrial production by 0.5% to 1% in Germany. Furthermore, Popescu and Smets (2010) report (in some specifications) a decrease in output and increase in unemployment using German data. Bachmann et al. (2013) show for Germany that uncertainty shock decrease manufacturing production and average hours temporarily while employment drops permanently. Employing numerous uncertainty indicators, Meinen and Röhe (2017) find a temporary decline in German investment. Also Grimme and Stöckli (2018) present a temporary decline in the production of non-capital goods and capital goods (used as a measure of investment).

Most studies refer to capital and labor adjustments costs as the main reason for an impact of uncertainty shocks on the real economy. The intuition is that in times of high uncertainty, firms delay adjustments of their capital and employment stocks until they are able to predict economic outcomes with more certainty. The reason is that some costs of adjusting the capital and/or employment stock are irreversible. With a similar argument, consumers postpone their consumption activities, which may lead to an economic downturn (Bloom, 2014). In the case of labor adjustment such costs include recruitment, training, severance pay etc. (see Bloom, 2014). In the presence of these costs, a job match will be a long term relationship. If the future is hard to predict firms are less willing to take the risk of such a long term relationship, i.e. they rather wait and see what is about to come. They postpone their hiring activities. Put differently, with increasing uncertainty, mistakes in the labor adjustment of firms become more likely such that firms respond to these changes by inactivity to avoid costly adjustments due to these mistakes. Therefore, the literature refers to this kind of behavior in times of high uncertainty ”wait-and-see-dynamics” (Bachmann et al., 2013). In the model view, an uncertainty shock increase firms' real option of inactivity. Still, there will be workers leaving the firms (e.g. due to quits) and, hence, employment is going to decline.

Thus, the main channel of uncertainty shocks affecting the labor market is through mechanisms implied by labor adjustments cost. There are several reasons for differences in labor adjustment costs by the size of establishments (see Jung, 2014, p. 184). Large establishments are usually more experienced in human resources affairs. They typically have a distinct department with experts dealing with hiring and firing. Also, it is probably easier to attract potential employees just by the size of the establishment itself. These arguments hint at lower labor adjustments costs in large establishments. On the other hand, there are institutional and theoretical reasons for higher adjustment costs in these establishments. Even though large establishments are typically more experienced with hiring, there is evidence that they spend more time and money to fill a vacancy (see Blatter, Muehlemann, & Schenker, 2012). Moreover, large establishments face institutional restrictions which small establishments do not. For example, dismissal protection applies only for establishments with 10 or more employees in Germany. Moreover, Ellguth and Kohaut (2019) and Schnabel (2020) show an increasing presence of works councils by establishments size. In Germany, works councils embody several rights with respect to co-determination. Most importantly for this work, they embody co-determination rights in the establishment dismissal decisions (for more details, see Grund, Martin, & Schmitt, 2016). Thus, the German institutions imply higher firing costs for large establishments. Another argument for higher adjustment cost of these establishments may be that small establishments are able to adjust their labor input more easily due to a lean management structure (see Jung, 2014, p. 184).

All in all, theory does not provide an unambiguous prediction if small or large establishments feature larger labor adjustment costs. Empirically, Jung (2014, pp. 183) shows evidence for larger labor adjustment costs in large establishments for Germany. Hence, employment dynamics in these establishments should respond more strongly to uncertainty shocks. Similarly, Kölling (2012) find higher (in absolute terms) labor demand elasticities to wages and capital costs in large establishments.

More recent studies question the adjustment costs as the main channel of uncertainty shocks affecting the labor market. Mecikovsky and Meier (2019) argue that in the presence of labor adjustment cost, both job creation and job destruction should fall in response to an uncertainty shock. The reason is the increased probability of a large positive productivity shock in times of high uncertainty. An establishment would not take the ”risk” of missing a possibility to exploit such a large positive productivity shock. Thus, they would have a tendency to freeze in times of high uncertainty, i.e. decreasing job creation and job destruction. This theoretical prediction is at odds with U.S. data shown by Mecikovsky and Meier (2019) as job destruction increases after an uncertainty shock. Similarly, Schaal (2017) argues that the ”wait-and-see-dynamics” by themselves imply not only a decrease in hirings but also a decrease in separations. Yet, Riegler (2019) reports empirically an increase in the separation rate and a decrease in the job-finding rate.

Arellano, Bai, and Kehoe (2019) and Fernández-Villaverde and Guerrón-Quintana (2020) propose financial frictions as an important channel of uncertainty shocks to affect the real economy. Mecikovsky and Meier (2019) show that this channel is in line with U.S. data since this channel predicts a decrease in job creation and an increase in job destruction. The main idea is that the wage bill can exceed the revenue of establishments, since they have to hire and fire workers before observing their productivity realization. If financial markets are frictionless these establishments can borrow to pay the wage bill. In an economy with financial frictions establishments cannot fully insure against shocks. Thus, they face a risk of defaulting. An uncertainty shock increases the default risk and, therefore, increases the interest rate establishments have to pay to insure against a default (see Arellano et al., 2019). To avoid a costly default, establishments reduce their labor input in response to the uncertainty shock. They do so by reducing job creation and increasing job destruction (Mecikovsky & Meier, 2019).

Intuitively, this channel should affect small establishments more since they probably face more pronounced financial constraints, e.g. due to a lack of collateral. Indeed, small establishments reported more often that they faced problems raising funds from credit institution in Germany (Arndt, Buch, & Mattes, 2009). On the other hand, Arellano et al. (2019) point out that agency frictions (i.e. managers' incentives to use establishments' funds to promote projects with private benefits) are crucial for this channel to work. In the absence of agency frictions, establishments would have an incentive to self-insure against defaulting by maintaining a buffer of funds. For this reason, they would not be forced to reduce their labor input in times of high uncertainty. Typically, a small establishment in Germany is owner-operated and, hence, does not face this kind of agency frictions.

Moreover, it is conceivable that uncertainty shocks create financial frictions in the first place. Indeed, Buch, Buchholz, and Tonzer (2015) show that banks decrease loan supply in times of high uncertainty. In certain times large establishments rarely face financial friction. However, in uncertain times financial institutions tighten up credit. As large establishments usually rely on these external funds, they face a risk of defaulting now. To cope with the altered situation, they have to reduce the labor input. Presumably, small establishments always face financial frictions (e.g. due to a lack of collateral) and, hence, in this respect, little changes for these establishments if an uncertainty shock hits. This argument is consistent with Arellano, Bai, and Zhang (2012), who show that small firms have lower leverage and grow faster than large firms in less developed financial markets. Yet, there are studies with the opposite implication. For instance, Siemer (2019) reports evidence for a more pronounced impact of financial frictions on the employment decline in small establishments in the U.S. during the great recession. Whether these results could be replicated with German data is an interesting question on its own right. The more manufacturing oriented economy of Germany may considerably differ in terms of the capital intensity of large and small establishments. Therefore, the financial frictions may have different impacts on large and small establishments in Germany.

All in all, the theoretical considerations show that uncertainty shocks should play an important role in the labor adjustment of establishments. To see which transmission channels are at play we need to study worker flows and job flows in addition to employment stocks. Further, an argument can be made for both, uncertainty shocks affecting small or large establishments more strongly. To be able to develop effective policies it is important to know which establishments are affected and how they respond. For these reasons, I study empirically the responses of employment stocks, worker flows, job flows and worker churn of small and large establishments to uncertainty shocks in the following.

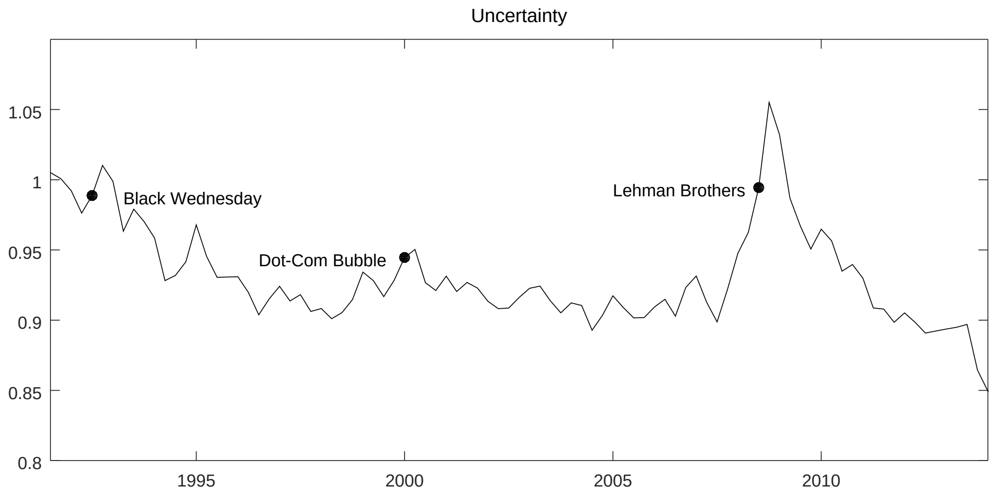
3. Empirical Specification

I follow the literature on uncertainty shocks in using time series data to estimate the effects of uncertainty shocks. The goal is to estimate these effects on German labor indicators aggregated by different establishment sizes. German time series data on labor market stocks and flows by establishment size is taken from the public release data of the administrative wage and labor market flow panel (see Stüber & Seth, 2019). It contains quarterly time series aggregates on employment stocks, worker inflows and worker outflows of employees as well as job creation and job destruction. Using inflows and outflows as well job creation and job destruction, I am able to calculate worker churn as worker inflows less job creation plus worker outflows less job destruction (see e.g. Bachmann et al., 2021). In this analysis, I use only the data on western German establishments to circumvent problems due to the transition process in eastern Germany after the reunification. Further, this analysis is based on the employees that Stüber and Seth (2019) refer to as ”regular workers”, i.e. all (marginal) part-time employees, apprentices, employees in partial retirement, interns, etc. are excluded. Note, worker inflows and outflows are conceptually similar but not equal to hires and separations. The reason is that, for instance, an apprentice becoming a regular worker is an inflow but would usually not be defined as a hire (see Stüber & Seth, 2019). To avoid confusion I stick to the terms ”worker inflows” and ”worker outflows”. In the main specifications, I define small establishments as those with $1-99$ and large establishments as those with more than 100 employees in $t-1$, following Jung (2014). Obviously, the choice of 100 employees to distinguish small and large establishments is arbitrary to a certain extent. Therefore, I show in a robustness check that my results are not driven by this choice.

Another important choice in this analysis is the uncertainty indicator. Since the seminal work by Bloom (2009), many uncertainty indicators have been proposed. Most notably are the implied volatility index (i.e. the volatility of option price of certain stocks) measured by VIX in the U.S. and VDAX in Germany (see Bloom, 2009), firm-level production expectation dispersion (EDISP) measured by business survey questions on expected production development in the next period (see Bachmann et al., 2013; Meinen & Röhe, 2017), the economic policy uncertainty index (EPU) based on newspaper articles mentioning the different variants of the buzz words trio ”uncertainty”, ”economy” and ”legislations” (see Baker, Bloom, & Davis, 2016) and the expected volatility of forecast errors (see Jurado et al., 2015). In this analysis, I employ the latter index for two main reasons. Firstly, it measures the expected volatility based on macroeconomic indicator (therefore, this measure is referred to as macroeconomic uncertainty) and, hence, is arguably more relevant for employment adjustments than stocks based indices, exceptions of other businesses and economic policy uncertainty. For instance, the results of Caldara, Fuentes-Albero, Gilchrist, and Zakrajšek (2016) imply that this uncertainty indicator is most relevant for industrial production. Secondly, Grimme and Stöckli (2018) compute the measure of

Jurado et al. (2015) for Germany such that this measure is readily available in a comprehensive form. On the other hand, the implied volatility and EPU measures face some drawbacks in this regard. In the case of the implied volatility, there have been changes in the computation of the indicator in Germany (VDAX vs. VDAX-NEW). While the newspaper based indicator relies on only two newspapers in Germany (see online appendix of Baker et al., 2016). Nonetheless, I provide robustness checks with all three alternative uncertainty measures.[2]

Figure 1: Macroeconomic Uncertainty Index for Germany



Source: Own depiction based on Grimme and Stöckli (2018).

The quarterly averages of the uncertainty index by Grimme and Stöckli (2018) are displayed in figure 1. We see spikes in uncertainty after some noticeable events (three of which are marked in the figure). On 16 September 1992 Great Britain withdrew from the European Exchange Rate Mechanism (ERM) due to speculative attacks on the pound. It resulted in turmoil within the ERM and, therefore, in an increase in macroeconomic uncertainty thereafter. Similarly, the Dot-Com Bubble led to a rise in uncertainty in the early 2000s. It is not a surprise that the largest spike in uncertainty appeared during the financial crisis 2008/2009 after Lehman Brothers filed for bankruptcy. Also, while uncertainty was probably an important driver of the recession caused by the financial crisis, the large increase of uncertainty during this crisis suggests that it also responded to the overall macroeconomic environment (i.e. the economic downturn affected uncertainty).

Table 1 shows descriptive statistics and simple (lagged) correlations to give some further idea on the properties of the main variables. The standard deviation and autocorrelation coefficient

[2]Christian Grimme provides the German macroeconomic uncertainty measure related to the publication Grimme and Stöckli (2018) on his personal website https://sites.google.com/site/econgrimme/data-on-uncertainty (accessed on 20 July 2020). VDAX is taken from the website https://www.boerse.de/historische-kurse/VDAX/DE0008467408 (accessed on 25 March 2020). EDISP for Germany is provided by Meinen and Röhe (2017) in the supplementary material. Baker et al. (2016) provide the EPU for Germany via the website https://www.policyuncertainty.com (accessed on 25 September 2019).

Table 1: Descriptive statistics and correlations

	StD	AC(1)	Correlation with Uncertainty$_{t-j}$ $j=0$	$j=1$	$j=2$	$j=3$	$j=4$
Uncertainty	0.04	0.88					
Employment in large establishments	0.01	0.90	0.22	0.14	0.04	-0.06	-0.16
Employment in small establishments	0.01	0.86	0.29	0.29	0.30	0.28	0.26
Inflows in large establishments	0.10	0.82	0.04	-0.09	-0.17	-0.19	-0.18
Inflows in small establishments	0.06	0.70	0.11	0.04	0.02	0.01	0.01
Outflows in large establishments	0.07	0.38	0.25	0.20	0.16	0.17	0.14
Outflows in small establishments	0.06	0.33	0.18	0.19	0.15	0.18	0.17
JC in large establishments	0.14	0.58	-0.05	-0.18	-0.22	-0.24	-0.21
JC in small establishments	0.06	0.39	0.07	0.02	0.02	0.00	0.02
JD in large establishments	0.14	0.41	0.22	0.27	0.32	0.35	0.30
JD in small establishments	0.08	0.24	0.14	0.20	0.19	0.23	0.22
Churn in large establishments	0.09	0.82	0.09	-0.02	-0.12	-0.14	-0.14
Churn in small establishments	0.07	0.82	0.14	0.06	0.01	0.02	0.01

Notes: The estimates in this table are based on German quarterly time series data from 1991Q3 to 2014Q4. StD denotes standard deviation, AC(1) autocorrelation of order one, JC job creation and JD job destruction. All series except uncertainty are seasonally adjusted, in logarithms and de-trended using the HP-filter (smoothing parameter $= 1,600$).

of uncertainty indicates that this measure features fluctuations on business cycle frequencies and is very persistent. Standard deviations and autocorrelation coefficients of the labor market variables are broadly in line with Bachmann et al. (2021) who use the same data basis. Also, these statistics do not differ for large and small establishments markedly (except maybe for job creation and job destruction). Surprisingly, the correlation coefficients of uncertainty and employment in large and small establishments indicate a positive association. However, the correlation turns negative for large establishments when uncertainty is lagged by three or four quarters. Since uncertainty is very persistent, the initial lagged correlation coefficients with employment in large establishments are presumably driven by the contemporaneous correlation. On the other hand, the correlation coefficients with employment in small establishments remain roughly equal when uncertainty is lagged.

As expected, inflows and job creation in large establishments are negatively correlated with uncertainty (except for the small positive contemporaneous correlations coefficient with inflows). The respective correlation coefficients with small establishments are near zero. Outflows and job destruction in large and small establishments are positively correlated with (lagged) uncertainty. Note that, for the most part the (lagged) correlation coefficients are considerably larger for large establishments. The contemporaneous correlation coefficient for uncertainty and worker churn in large establishments is positive, while the lagged correlations turn negative. For small establishments all correlation coefficients are positive and - expect for the contemporaneous correlation - near zero.

To account for the dynamics implied by the (lagged) correlations and possible feedback loops, the literature employs structural vector auto regressions (SVAR) for the identification of uncertainty shocks and the estimation of their impacts (see e.g. Bloom, 2009; Leduc & Liu, 2016). To identify the relevant channels of these shocks affecting the labor market, I estimate four VAR models:

1. **Employment stocks model** incorporating the number of employees in the respective establishments.
2. **Worker flows model** incorporating worker inflows and worker outflows.
3. **Job flows model** incorporating job creation and job destruction.
4. **Worker churn model** incorporating the churning of workers.

Further, I follow the literature on the choice of additional variables in the VAR. Thus, besides the uncertainty indicator and labor market variables of small and large establishments, I include inflation (growth rate of the GDP deflator) and the interest rate (three months interbank rate). All variables except the uncertainty indicator are seasonally adjusted. Moreover, the labor market variables are in logarithms and detrended using the HP-Filter ($\lambda = 1,600$ due to the quarterly frequency of the data), which is frequently done in the literature (see e.g. Bloom, 2009; Caggiano et al., 2014; Caggiano, Castelnuovo, & Nodari, 2021).[3] The VAR reads as follows:

$$Y_t = \nu + A_1 Y_{t-1} + A_2 Y_{t-2} + u_t \quad (1)$$

where Y_t is a vector consisting of the uncertainty indicator, vector W_t, interest rate, inflation (in exactly that order). The elements of vector W_t depend on the estimated model. For the employment stocks model the vector contains employment stocks in large and small establishments, for the worker flows model worker inflows and worker outflows in large and small establishments, for the job flows model job creation and job destruction for large and small establishments and for the worker churn model worker churn in large and small establishments. Thus, the VAR systems for the employment stocks model and worker churn model consist of five series, while those for the worker flows model and job flows model consist of seven series. The

[3] Departing from Bloom (2009), I do not filter all series in the VAR, but only the labor market variables. To demonstrate that the filtering does not alter the results I re-estimate the SVAR models in first differences and in log-levels as robustness checks. The estimation outcomes are provided in the appendix.

lag length of equation 1 is two which is suggested by the Akaike Information Criterion for each model (where the maximal lag length is four[4]). The estimation period is 1991Q3 to 2014Q4. The starting date is determined by the availability of the macroeconomic uncertainty index, while the end date is marked by the AWFP data availability.[5]

The identification of uncertainty shocks is achieved by a Cholesky decomposition of the covariance matrix $E[u_t u_t'] = \Sigma_u$ of the residuals in equation 1. Since the uncertainty indicator is ordered first in the VAR, this procedure implies that only an uncertainty shock can affect the uncertainty indicator contemporaneously. This is a usual assumption in the literature (see e.g. Bachmann et al., 2013; Leduc & Liu, 2016; Oh, 2020). Note that, all other shocks can affect the uncertainty indicator, but only with a lag of one quarter. Angelini, Bacchiocchi, Caggiano, and Fanelli (2019) exploit heteroscedasticity in U.S. data to show that this assumption is not rejected by the data. Nevertheless, I will report two robustness checks to demonstrate that the results presented in this paper do not rely on this assumption. In the first check, I order the uncertainty indicator last in the VAR, i.e. the uncertainty indicator can be affected immediately by all shocks in the system. The second check involves the inclusion of the German GDP ordered first in the VAR such that business cycles shocks can affect the uncertainty indicator immediately, while uncertainty shocks affect GDP only with a lag of one quarter.

4. Results

As usual when working with SVAR models, I will reveal the results in form of empirical impulse response functions (IRF). Additionally, I will illustrate the importance of uncertainty shocks on particular variables with the help of forecast error variance decomposition (FEVD).

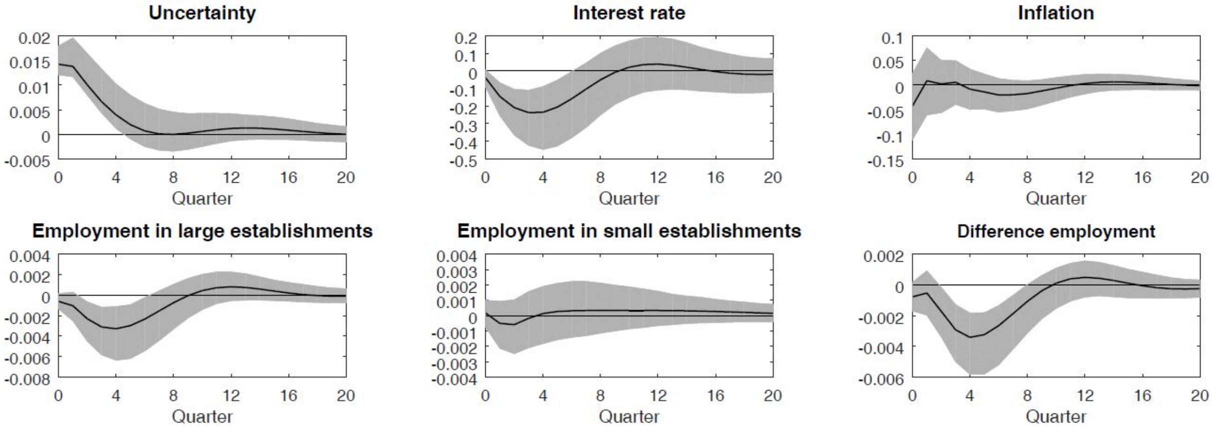
4.1 Uncertainty and the stock of employment

First, I present the effects of uncertainty shocks on employment stocks by establishment size. The respective IRFs are shown in figure 2. As expected, uncertainty increases on impact in response to an uncertainty shock. Similar to e.g. Leduc and Liu (2016), the uncertainty index increases by 1.5 index points on impact and returns to its initial value within one year. On the contrary, the interest rate decreases on impact. This response is u-shaped with the lowest point (decline by 2-3 percentage points) three quarters after the shock appears. Again, previous studies find very similar responses (see e.g. Caggiano et al., 2014; Leduc & Liu, 2016; Basu & Bundick, 2017). Inflation barely responses at all. We see a statistically and economically insignificant decrease five to six quarters after the shock. The results in the literature concerning

[4]When a maximal lag length of eight is applied, the Akaike Information Criterion chooses also two lags for each model except for the worker flows model. For the latter the Akaike Information Criterion suggests a lag length of eight. However, the results appear to be overfitted if this lag length is used.

[5]I use parts of the Matlab code provided by Lutz Kilian on his personal website in the context of the publication Kilian and Lütkepohl (2017) for the estimation.

Figure 2: IRFs to uncertainty shocks: employment stocks model



Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

inflation are mixed. Some studies find no significant effect of uncertainty on inflation (Caggiano et al., 2014), while others show a significant decline (Leduc & Liu, 2016; Basu & Bundick, 2017; Oh, 2020). Overall, the responses of these three variables are in line with previous studies and, hence, provide credibility to the main results discussed in the following.

Employment in large establishments decreases markedly in an u-shaped manner in response to an uncertainty shock. After four to five quarters, the response reaches its lowest point where the results indicate that employment in large establishments declines by 0.33% from its trend value. Approximately two years after the shock, employment in large establishments returns to its initial value. A decline of 0.33% may appear as quite low and irrelevant, but it implies a reduction by 24,000 employees (based on the average stock of employees in large establishments over the time span) and, thus, is economically significant. Furthermore, Bachmann et al. (2013) report a similar percentage decline of employment in manufacturing as a response to an uncertainty shock for Germany. Also, the shape of the response is very similar to the theoretical response of employment to a demand uncertainty shock in the model of Kaas and Kimasa (2021), which is calibrated to German data.

The response of employment in small establishments is insignificant, both statistically and economically. The point estimates indicate a response of virtually zero at each considered horizon. Thus, small establishments seem to be basically unaffected by an uncertainty shock. To demonstrate that there is a statistically significant difference in the responses of small and large establishments, I report the difference of the IRFs (IRF of large establishments - IRF of small establishments) together with the respective bootstrap confidence bands. The difference IRF clearly indicates that the negative response of the large establishments is more pronounced and, in addition, that the difference in the responses is statistically significant.

Another piece of evidence confirming these results is the FEVD shown in table 2. While

Table 2: Forecast error variance decomposition: employment stocks model

Horizon	$h = 1$	$h = 4$	$h = 8$	$h = 12$	$h = 16$	$h = 20$
Variable						
Employment in large establishments	0.02	0.11	0.19	0.19	0.19	0.19
Employment in small establishments	0.00	0.01	0.01	0.01	0.01	0.01

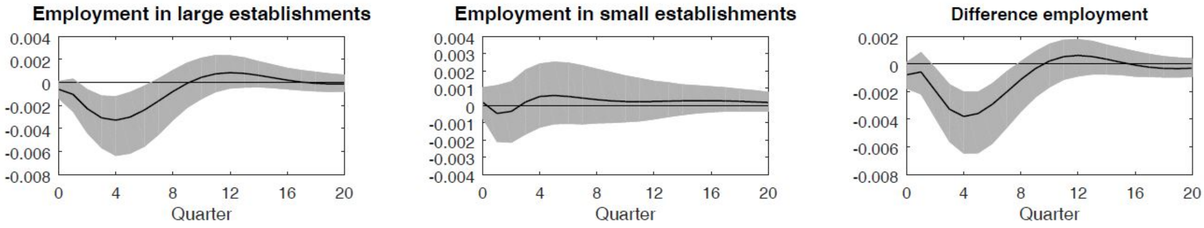
Notes: Only the contributions of an uncertainty shock are depicted. h represents the forecast horizon in quarters.

uncertainty shocks contribute considerably to the forecast error variance of employment in large establishments (about one-fifth from the eight quarter onwards), they are basically irrelevant for the forecast error variance of employment in small establishments. Thus, the FEVD is consistent with the results shown in figure 2. However, even though an uncertainty shock is an important driver of employment in large establishments, it is worth noting that other shocks (e.g. conventional demand and supply shocks) seem to explain a substantial part of the forecast error variance of employment in general.

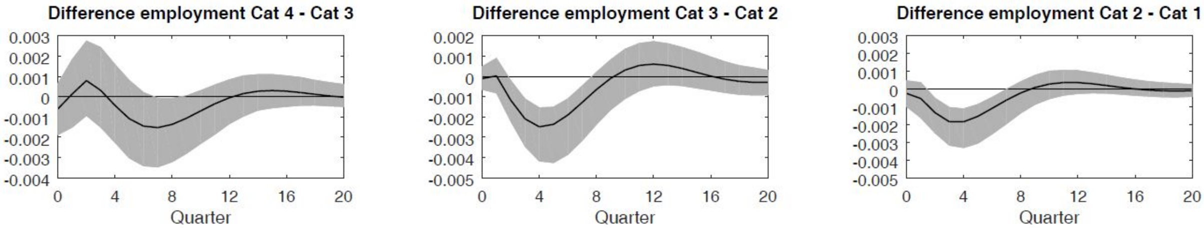
The results shown above are robust to various modeling choices, and even if accounted for some potential pitfalls. First, I address the latter. Analyses observing establishments sizes over time may suffer from well-known statistical fallacies. In particular, the so-called reclassification bias may be a serious issue in the context of this paper. Suppose, an uncertainty shock hits and establishments reduce their employment stock for the reasons described in section 2. Large establishments close to the cutoff of 100 employees (the cutoff separating large and small establishments) may end up having less than 100 employees such that they are reclassified as small establishments in the following period. Thus, employment in small establishments would increase by the number of employees of the previously large establishments, counteracting the direct (potentially negative) effect of the uncertainty shock. Such a relation may mechanically cause the near zero response of employment in small establishments. Moreover, due to the reclassification, the responses of employment in large establishments may be overstated (by the opposite argument as stated above). There is no straightforward way of fixing this issue. Yet, in their related work, Moscarini and Postel-Vinay (2012) state that the reclassification bias does not drive their main implications. Figure 3 presents three pieces of evidence showing that the reclassification bias is also not the driving force for this work. The three panels of figure 3 represent the respective checks.

First, I repeat the analysis excluding establishments with 50–99 employees from the small establishment size bin as a buffer zone. Since reclassified large establishments end up in this size category with high probability, we should get an indication whether these reclassifications explain the near zero response of employment in small establishments. The results shown in figure 3a are very similar to the main results. Thus, the robustness check suggests that the reclassification bias is not responsible for the near zero response of employment in small establishments.

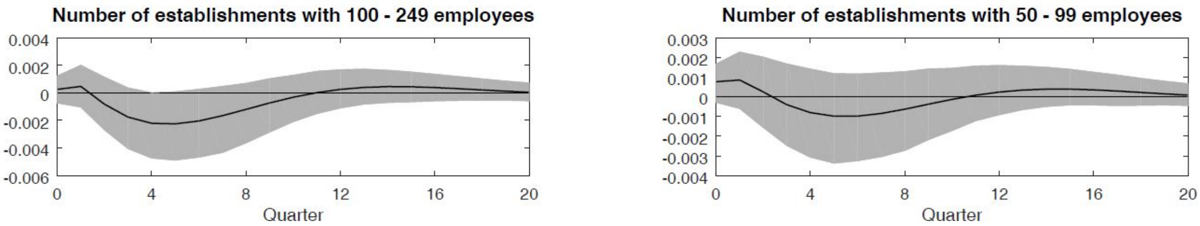
Figure 3: Robustness analysis: reclassification bias



(a) Without mid-sized establishments



(b) Four establishment size categories



(c) Number of establishments

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications. Cat 1, Cat 2, Cat 3 and Cat 4 refer to establishment size categories with 1-9, 10-99, 100-249 and at least 500 employees, respectively.

Still, even in the light of the above robustness check there may be an argument that the reclassification bias drives the result. When labor input is reduced in all establishment size categories in response to an uncertainty shock, there may be reclassifications in each size category to the next smaller one (even if the respective size category is not included in the estimation model). Thus, the time series on employment in small establishments may absorb the reclassified establishments (e.g. some of the buffer zone establishments from the robustness check above) after the shock. In this way the dynamics in small establishments may be driven by the reclassification bias even if establishments subject to the reclassifications are not explicitly included in the estimation model. Loosely speaking, the reclassifications may be baked into the time series by the data generating process. To cope with this issue, I repeat the analysis with four roughly equal size categories instead of two, i.e. establishments in category 1 have 1-9 employees, in category 2 10-99, in category 3 100-499 and category 4 at least 500.[6] The idea is that the two middle categories 2 and 3 experience both inflows and outflows of establishments

[6]As a matter of fact, there are less employees in establishments in category 1 than in the other categories. However, it has no bearing on the argument.

due to reclassifications after a shock if the reclassification bias is a serious issue. Since the four categories are roughly equally sized (in terms of the sum of the number of employees) inflows and outflows of employees should cancel each other out in the middle categories. Therefore, differences in the response of establishments in these two middle categories should not reflect the reclassification bias. Indeed, the results presented in 4b show that the response of employment in category 3 is stronger than in category 2, i.e. the reduction in employment after an uncertainty shock is statistically significantly stronger in larger establishments. Interestingly, the response of the category 4 is stronger than the response of category 3 (at later horizons) as well as the response of category 2 compared to the response of category 1. These results imply that the effect of an uncertainty shock may increase with establishment size in a way which goes beyond the distinction in the two size categories shown in figure 2.

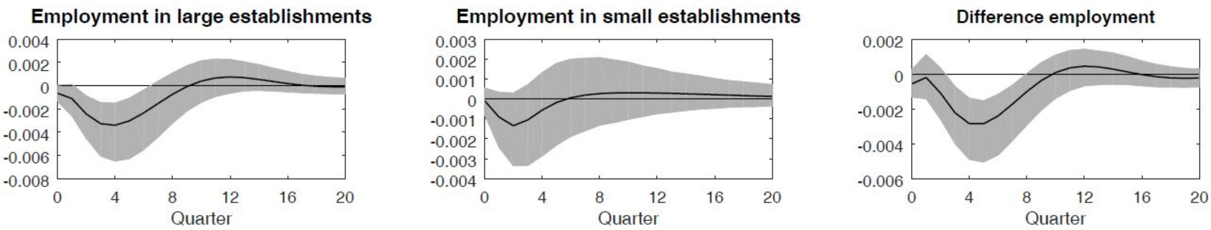
Another piece of evidence is presented in figure 3c. Since establishments at risk of being reclassified are near the threshold with a high probability, I show IRFs of the number of establishments (instead of the number of employees in the respective establishments) with 49 to 99 and 100 to 249 employees. If the reclassification bias is a serious issue, I would expect a stark decrease in the number of the larger establishments and a stark increase in the number of the smaller establishments. Both responses are statistically insignificant and, hence, do not provide evidence for the reclassification bias. However, the response of the larger establishments is only borderline insignificant. Thus, these results should not be overemphasized. But taking the point estimate at its lowest point at face value, it implies a decrease in the number of large establishments of 35. As they presumably had around 100 employees before the shock hit, the result implies a reduction by 3500 to 4000 employees as response. Clearly this number is far too low to explain the reduction by 24,000 employees in the main results. Moreover, the point estimate of the smaller establishments rather implies a decrease than increase at the relevant horizon, which suggests again that the reclassification bias plays only a minor role (if at all).

Robustness checks to some modeling choices described in section 3 are presented in figure 4. First, I show that the near zero response is not driven by the smallest establishments. Very small establishments are known to behave differently than the larger ones. Of major importance for this paper is that establishments with 10 or less employees are exempt from dismissal protection in Germany. Thus, they face very different adjustment costs than establishments above this threshold. Therefore, I repeat the analysis considering only establishments with at least 10 employees[7] presented in figure 4a. Employment in small establishments seems to be reduced more when these establishments are excluded. However, the response remains statistically insignificant and employment in large establishments still responds significantly stronger. Note however, using the data at hand, I am not able to differentiate between establishments subject to the dismissal protection law perfectly. There are two reasons for this. First, within the estimation period, there has been a change in the number of employees that an establishment needs to

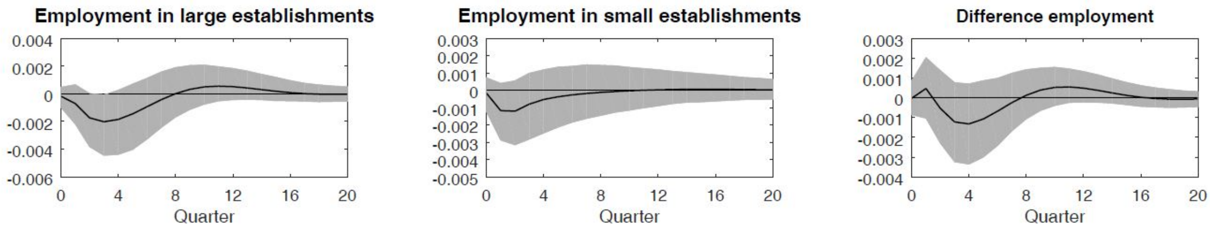
[7]Unfortunately, there is no size category with more than 10 employees available in public release of the AWFP data such that the employed size category does not correspond perfectly to the dismissal protection law.

employ such that the law applies (from more than five to more than ten). Second, according to the law, part-time employees are counted partially depending on their weekly hours, which I am not able to determine in this dataset. Nevertheless, this robustness check provides evidence that the main results are not driven by the dismissal protection law for the smallest establishments.

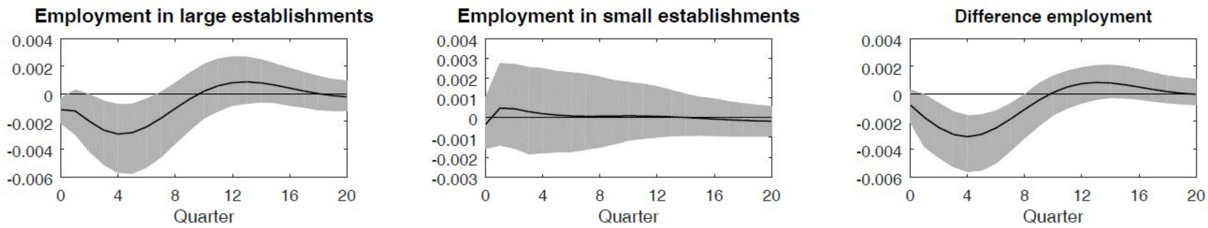
Figure 4: Robustness analysis: modeling choices



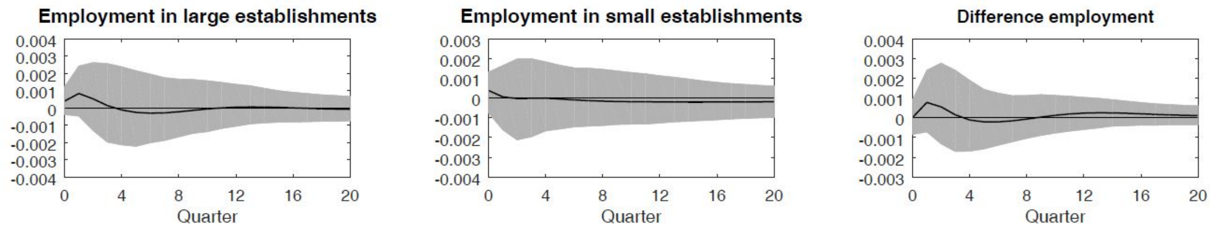
(a) Without establishments with less than 10 employees



(b) VDAX as uncertainty indicator



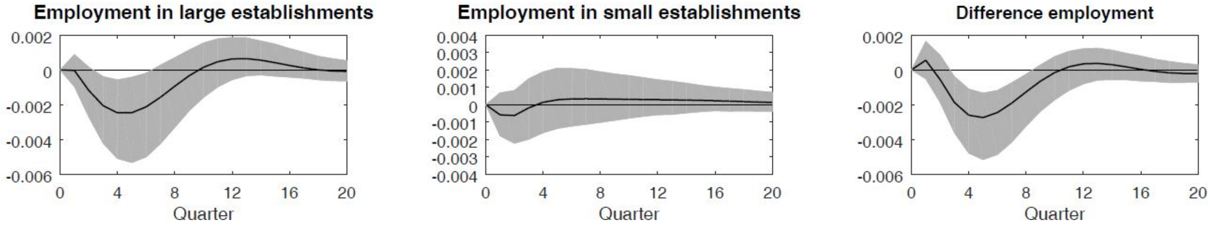
(c) Production expectation dispersion as uncertainty indicator



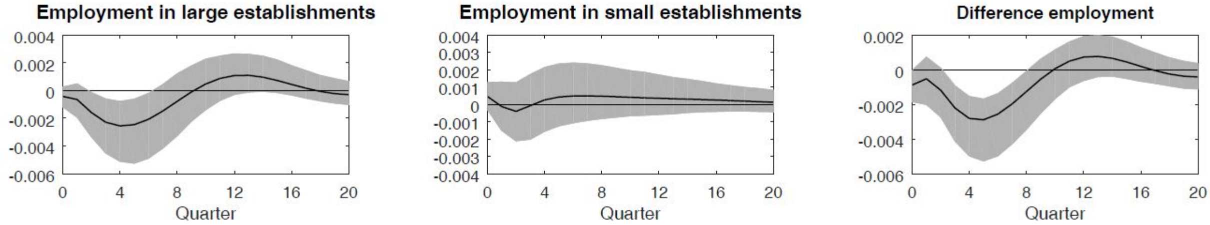
(d) Economic policy uncertainty as uncertainty indicator

Figure continues on next page.

Figure 4: Robustness analysis: modeling choices



(e) Uncertainty ordered last



(f) GDP ordered first

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Since there are several uncertainty indicators discussed in the literature, I check if the shown implications hold when I use another indicator for the estimation. Results with the stocks based volatility index VDAX are shown in figure 4b. Again, we see a (borderline) statistically significant decrease in employment in large establishments, while employment in small establishments does not respond significantly. However, the difference between these two responses is not statistically different from zero at any horizon in this specification (probably due to the generally less precise estimates). When the production expectation dispersion measure is employed (figure 4c), the estimation results closely resemble their main analysis counterparts. These results also imply a more pronounced impact of uncertainty shocks on employment in large establishments. Figure 4d shows IRFs when another popular uncertainty indicator is used, namely economic policy uncertainty by Baker et al. (2016). Here we do not see any statistically significant response. This result may indicate that economic policy uncertainty measures something different than the other indicators. Interestingly, when employing this uncertainty indicator together with higher dimensional VARs, Meinen and Röhe (2017) also cannot provide statistically significant responses of uncertainty shocks on investment in Germany (while other indicators imply marked decreases in investment).

One may argue that uncertainty can very well respond to changes in macroeconomic environment within a quarter and, hence, that the identification of uncertainty shocks employed in this work is flawed. To cope with this argument, I provide two robustness checks where I either order the uncertainty indicator last in VAR or include GDP ordered first in VAR. The results in figure 4e and 4f demonstrate that the implications of the main results are unaffected.

Additional robustness checks are provided in the Appendix. The results are robust to various specifications of the VAR, i.e. estimation of the VAR with lag length $p = 1$ as suggested by the

BIC (figure A1a), estimation of the VAR with lag length $p = 4$ which is frequently chosen when working with quarterly data (figure A1b), estimation of the VAR in first differences (figure A1c) and estimation of the VAR in log-levels (figure A1d). The estimation outcomes of the VAR in first differences and log-levels clearly indicate that employing the HP-filter does not alter the main implications qualitatively, quantitatively, nor with respect to the timing of the responses (similarly, Bloom (2009) demonstrates an invariance of IRFs to the application of the HP-filter in the case of the estimation of uncertainty shocks).

All in all, the presented results show robustly that employment in large establishments drops significantly in response to an uncertainty shock while I find no evidence for an effect on employment in small establishments. As described in section 2, the reason for a more substantial impact of an uncertainty shock on large than small establishments might be that small establishments face lower adjustment costs, are less affected by financial frictions or simply do not rely on external finance. Spillover effects from large to small establishments are already implicitly included in the VAR and, thus, the inability to account for spillover effects cannot be the explanation for these results. However, a possible explanation might be that small establishments are affected by an uncertainty shock after all, but face two opposing effects. First, they might be negatively affected in the same manner as large establishments (contractionary effect of the uncertainty effect as described in section 2). Second, small establishments may have the incentive to increase employment after an uncertainty shock since large employers poach less employees from small ones and labor market tightness decreases due to the decrease in employment by large establishments (for a more detailed elaboration on this argument see Moscarini & Postel-Vinay, 2012). These two effects may cancel each other out such that we do not see an effect of an uncertainty shock on the employment of small establishments. The subsequent analysis with labor market flows is able to verify if the described effects are at play here.

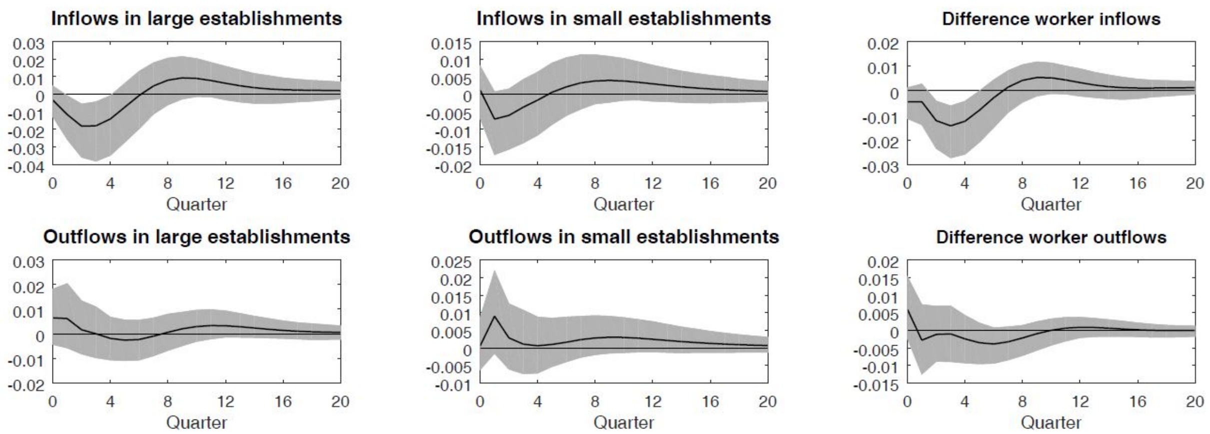
4.2 Uncertainty and worker flows

What are the channels in the reduction in employment in large establishments after an uncertainty shock? What is the reason for the near zero response of employment in small establishments? Are there opposing effects at work in the latter case? To shed more light on these questions, I study the responses of worker flows in small and large establishments to uncertainty shocks. Estimation results for the SVAR with worker flows are presented in figure 5.

We see a statistically significant decline in worker inflows in large establishments for approximately one year. At its peak, worker inflows are reduced by about 2%. The shape of the response resembles the employment response in large establishments. The response of worker outflows, on the other hand, is markedly less pronounced. Even though it increases in the first periods after the shock, the response is never statistically significantly different from zero. These results imply that the reduction in employment in large establishments after an uncertainty shock is mainly driven by the decrease in inflows to these establishments. Taking the point estimates at face value, the decrease in worker inflows indicates a drop by about 21,300 employees at the end of the fifth quarter. This number is broadly in line with the results presented in figure 2.

The shape of the response of worker inflows in small establishments is similar to the large establishments counterpart, indicating a decline in the short run. It is, however, statistically insignificant at each considered horizon. Furthermore, the respective negative response is statistically significantly more pronounced in large establishments. Worker outflows in small establishments do not respond statistically significantly, either. Here, we do not see an statistically significant difference in the response of large and small establishments. Thus, the results imply that the differences in the employment response mainly stems from the difference in the response of worker inflows. Furthermore, the results do not support the idea that small establishments make use of the withdraw of large establishments from the labor market to partially increase/replace their workforce. If these mechanics were at work, we would expect an increase in inflows in small establishments.

Figure 5: IRFs to uncertainty shocks: worker flows model



Notes: The solid lines depict the point estimates of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

The statistically insignificant response of worker outflows in large establishments presented in this section provide an additional indication that the reclassification bias does not drive the results presented in section 4.1. Worker outflows in large establishments have to increase considerably such that the reclassification bias becomes a serious problem. Moreover, worker flows are less prone to the reclassification bias. The reason is that the stock of workers of a reclassified establishments is not of particular interest and, hence, does not bias the results here by mechanically adding the stock of employees to the opposite size categories. Therefore, the consistence of the results in this section with those presented for employment stocks imply that the reclassification bias does not drive the results.

Again, the IRF results are largely supported by the FEVD shown in table 3. An uncertainty shock is particularly important for inflows in large establishments. For this series, uncertainty shocks explain an considerable share of the forecast error variance, especially at longer horizons. However, as already noted in the discussion of the FEVD of employment stocks, there have to be other important factors driving the dynamics since uncertainty shocks do not explain an overwhelming share of the forecast error variance. Inflows in small establishments as well as outflows in large and small establishments seem not be affected severely by uncertainty shocks as the forecast error variance is negligibly affected by these shocks.

Table 3: Forecast error variance decomposition: worker flows model

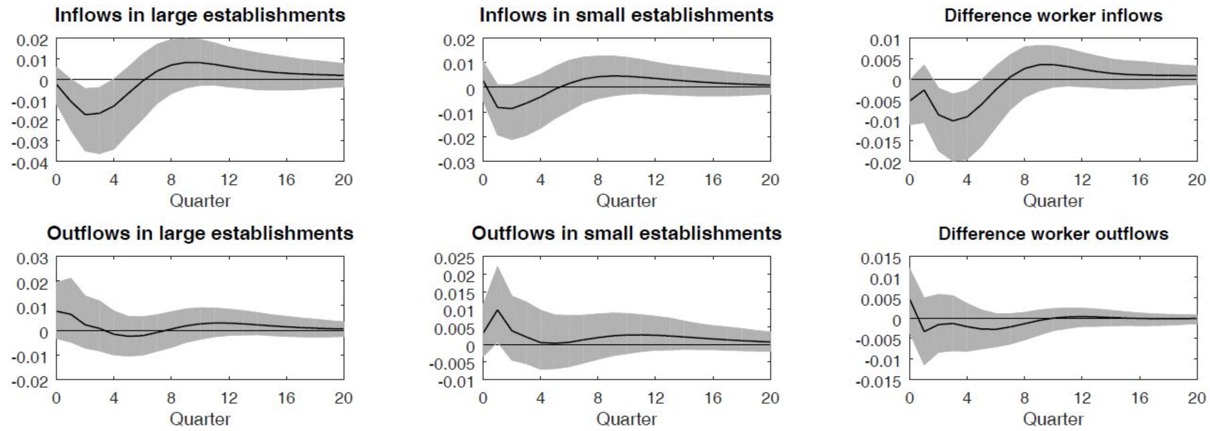
Horizon	$h = 1$	$h = 4$	$h = 8$	$h = 12$	$h = 16$	$h = 20$
Variable						
Inflows in large establishments	0.01	0.11	0.11	0.13	0.14	0.14
Inflows in small establishments	0.00	0.04	0.04	0.05	0.06	0.06
Outflows in large establishments	0.01	0.02	0.02	0.02	0.02	0.03
Outflows in small establishments	0.00	0.02	0.02	0.03	0.03	0.03

Notes: Only the contributions of an uncertainty shock are depicted. h represents the forecast horizon in quarters.

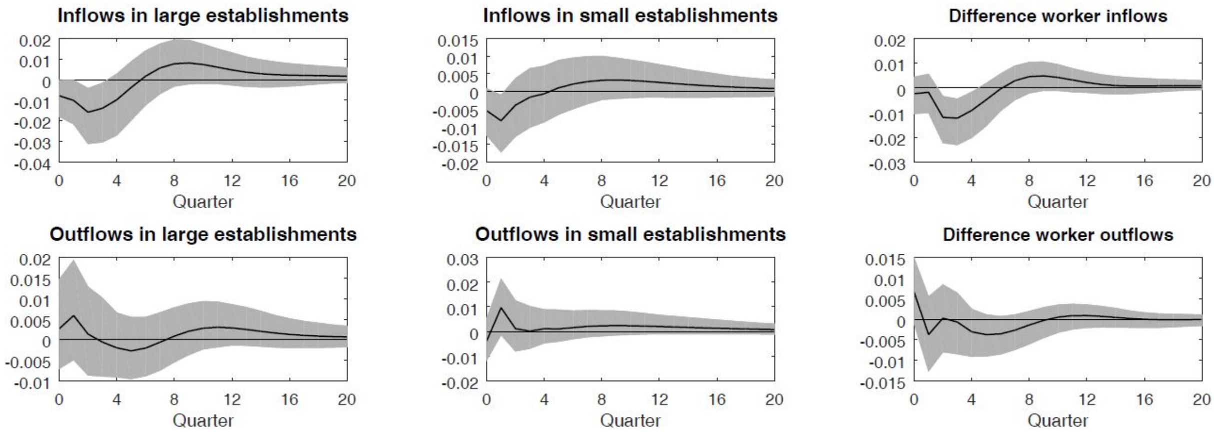
Furthermore, the results presented in this section are robust to various specifications. When I repeat the analysis without establishments with less than 10 employees (see figure 6a), the results are basically unaffected. Considering the other uncertainty indicators (VDAX, firm-level production expectation dispersion and policy uncertainty), does not alter the main implications, either (see figure 6b, 6c and 6d, respectively). In all three cases, the negative effect on worker inflows is statically significantly stronger for large establishments and we do not see evidence for an effect on worker outflows (neither for large establishments nor for small establishments). Thus, these findings are not limited to the chosen uncertainty indicator. Also, ordering the uncertainty indicator last or including GDP in first order does not alter the results (see figure 6e and 6f).

Additional robust checks for the worker flows model are presented in the appendix. With lag size $p = 1$ the estimations show the same tendency as the main results. However, none of the results are statistically significant in this specification. Yet, with lag size $p = 4$ the IRFs provide the same implications as the main results. Moreover, the results are robust to specifying the model in first differences as well as in levels.

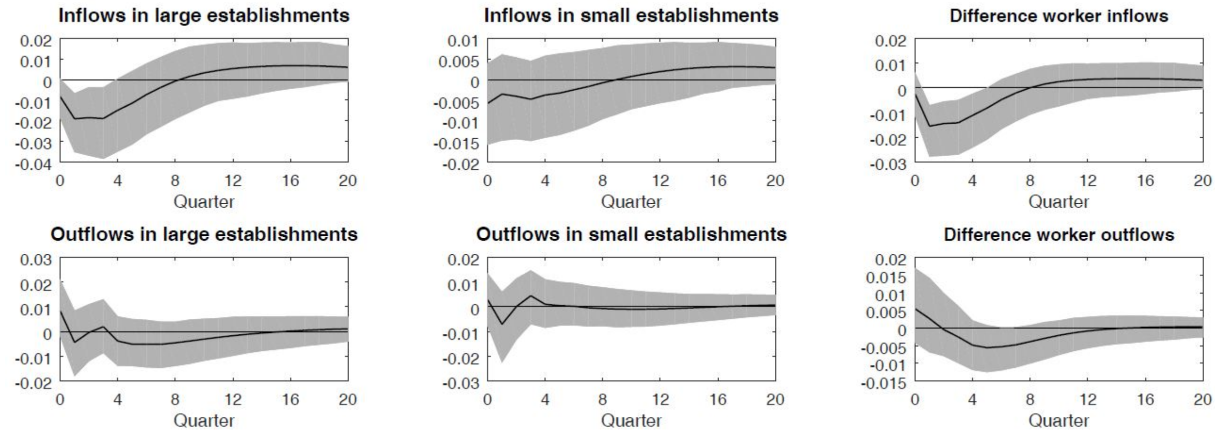
Figure 6: Robustness analysis: worker flows model



(a) Without establishments with less than 10 employees



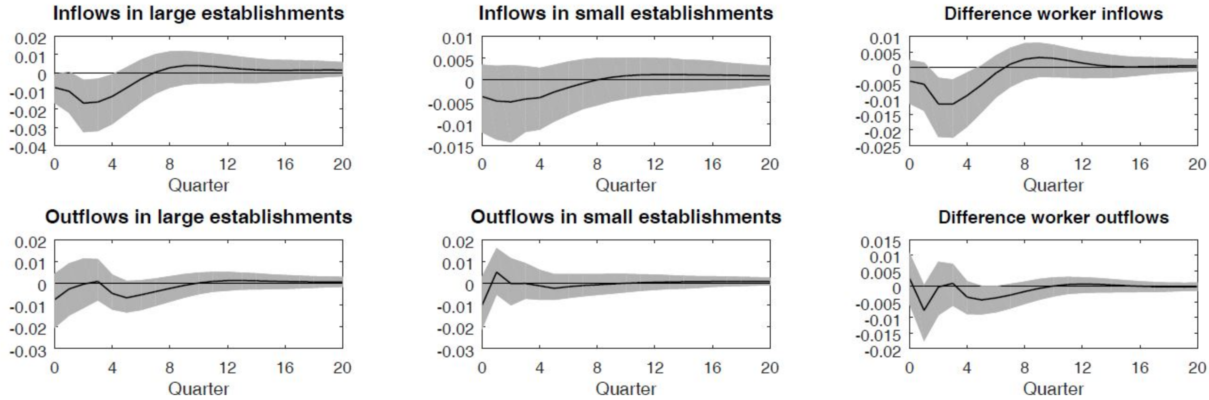
(b) VDAX as uncertainty indicator



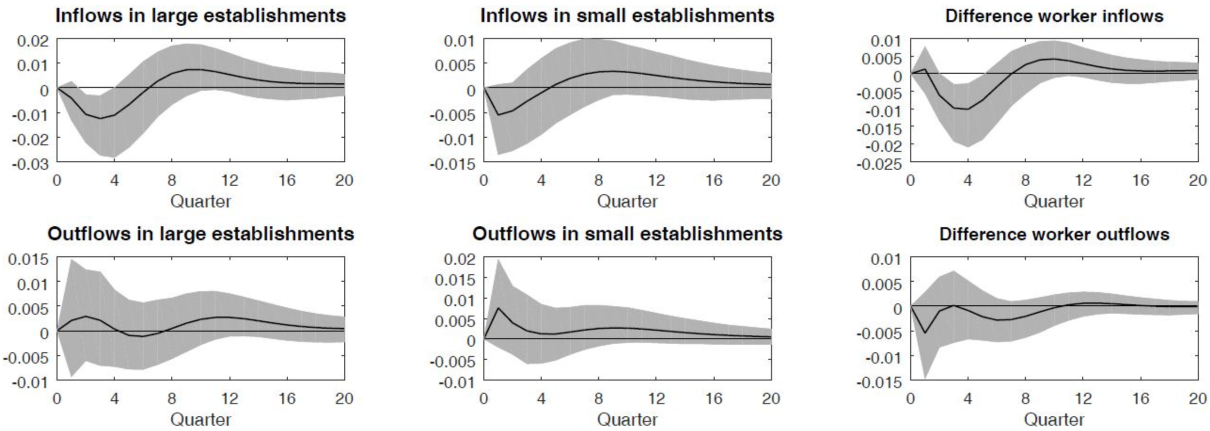
(c) Firm-level production expectation dispersion as uncertainty indicator

Figure continues on next page.

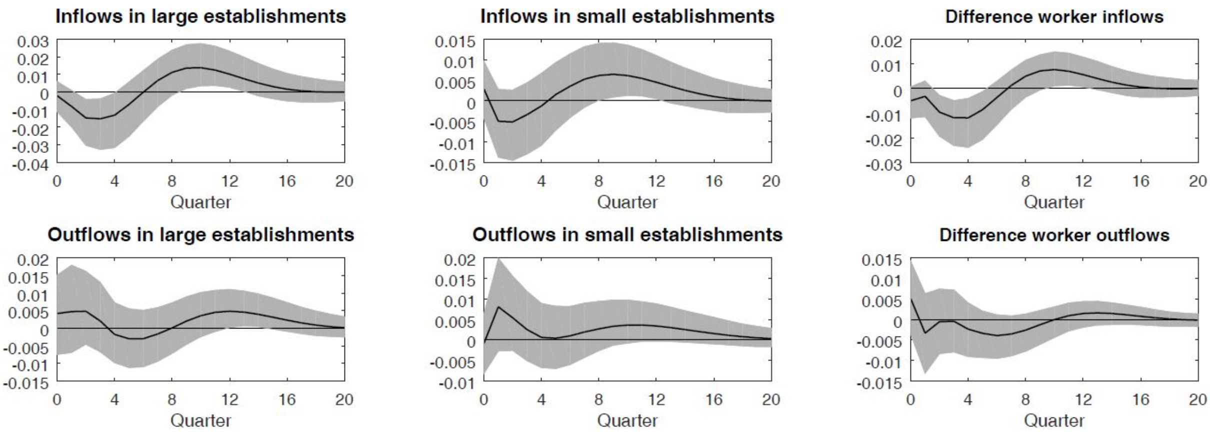
Figure 6: Robustness analysis: worker flows model



(d) Economic policy uncertainty as uncertainty indicator



(e) Uncertainty ordered last



(f) GDP ordered first

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

The analysis of worker flows is in line with the results presented for employment stocks. I find a statistically and economically significant reduction in worker inflows in large establishments, while I do not find evidence for an response of small establishments of any kind. Thus, in times of high uncertainty, large establishments seem to reduce their hiring activities. The decline in hiring is in line with the study by Riegler (2019) based on U.S. data (but not distinguishing by establishment size). However, in contrast to Riegler (2019), I do not find evidence that the establishments increase layoffs at the same time. The reason may be the strict dismissal protection in Germany (especially for large establishments). Indeed, there is a literature discussing the so called ”attrition channel” of employment reduction by establishments, i.e. the reduction of employment by means of reducing hiring and relying on quits to avoid costly layoffs (see e.g. Bellmann, Gerner, & Upward, 2018). Abowd and Kramarz (2003) attribute high separation costs due to strict dismissal protection in France for the use of the hiring margin to reduce employment. Similarly, Merkl and Stüber (2019) show that German establishments reduce primarily hiring rather than raising separations to adjust to a drop in (establishment level) value added. Also, their results suggest a relatively more pronounced reliance on the hiring margin in large establishments (where overall large establishments adjust less to a drop in value added). Yet, Bellmann et al. (2018) show that German establishments do not only rely on the reduction of hiring to reduce employment, but also use the separations margin. However, they also show an increasing reliance of the ”attrition channel” to reduce employment with establishment size. Also, Bellmann et al. (2018) do not discuss the reasons for the establishments' reductions in employment, but consider just general decreases in employment. In the face of a temporary increase in uncertainty, it is unreasonably for establishments to go for costly layoffs when they are uncertain about the number of employees they are going to need in the next periods. Thus, a reduction in hiring and unchanged separations is in line with the ”wait-and-see-dynamics” implied by labor adjustments costs and discussed in the uncertainty literature.

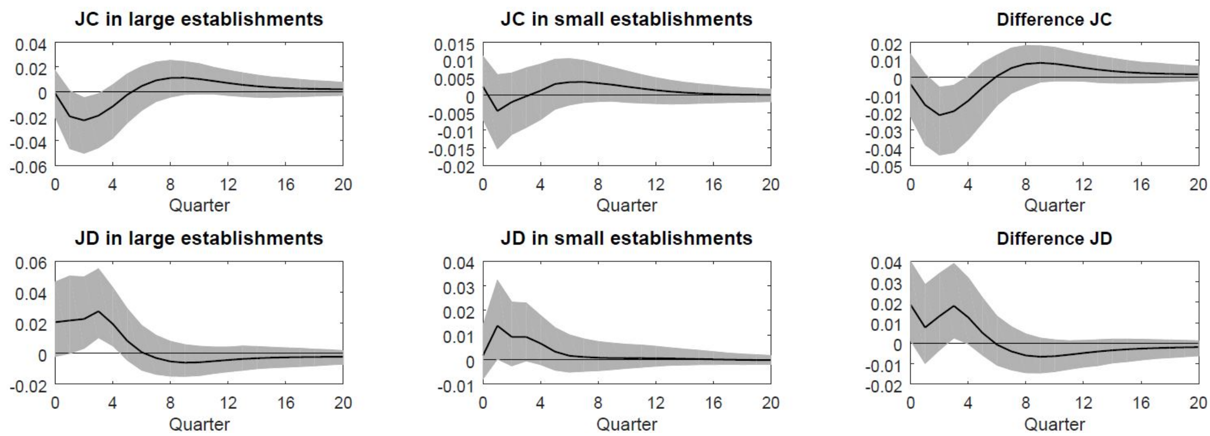
Moreover, these findings are consistent with Merkl and Weber (2020) who claim that the rise in German unemployment in the aftermath of the COVID pandemic is mainly due to a reduction of hiring activities. It is apparent that the COVID pandemic poses not only an uncertainty shock. Yet, the literature discusses uncertainty induced by the pandemic as a key driver of the current economic downturn (see e.g. Caggiano et al., 2020). The results shown in this section add to this literature in the sense that it might be mainly the large establishments reducing their hiring activities in uncertain times. Hence, they should get special attention in these times.

4.3 Uncertainty and job flows

The results discussed above are in line with the ”wait-and-see-dynamics” implied by labor adjustment costs of establishments. The existence of these costs has also implications for job flows. In times of high uncertainty, creating new jobs is risky. Thus, I expect that establishments expand less in these times (or less establishments expand at all), implying a decrease in job creation. As described in section 2, the implication for job destruction is less clear cut. If uncertainty shocks transmit through labor adjustment costs to the labor market, job destruction should decrease. The reason is that establishments are not willing to take the risk of missing out very positive economic outcomes (extreme outcomes, both positive and negative, are more likely if uncertainty is high) and, hence, they reduce job destruction. Otherwise they would need to engage in a costly hiring of workers if the economic outcome is extremely positive. On the other hand, if the transmission channel of uncertainty shocks is associated with financial frictions, establishments will increase job destruction. Otherwise they would face the risk of defaulting since financial institution tighten up credit (see Mecikovsky & Meier, 2019). Furthermore, one may argue that uncertainty shocks induce recessionary pressure by reducing households' consumption (Bloom, 2014) and, therefore, force establishments to destroy jobs.

What do the empirical results in figure 7 tell us? Similar to the decrease in worker inflows in large establishments, we see a decrease in job creation in these establishments. Thus, large establishments expand indeed less after an uncertainty shock. They do so by reducing job creation by 2% at the lowest point of the response after two to three quarters. Afterwards, the job creation series returns to its initial value. Hence, this response is consistent with the response of employment in large establishments. For small establishments I cannot provide evidence for a change in job creation as the response is statistically insignificant. But I am able to establish that the response of job creation is statistically significantly stronger for large establishments.

Figure 7: IRFs to uncertainty shocks: job flows model



Notes: JC denotes job creation and JD denotes job destruction. The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

In contrast to worker outflows, we see a statistically significant increase in job destruction in large establishments after an uncertainty shock. Three quarters after the shock, job destruction in these establishments increases almost by 3% compared to its trend value. Afterwards the series returns to its initial value. Taking the responses of job creation and job destruction together, the results imply a reduction by about 25,000 jobs after five quarters compared to a situation without the hit by the uncertainty shock. We see an increase in job destruction in small establishments, too. It is, however, (borderline) statistically insignificant. Perhaps even of higher relevance is the result that job destruction increases statistically significantly stronger in large establishments. As pointed out by Mecikovsky and Meier (2019), the more pronounced increase in job destruction indicates that large establishments rely more on external funds. Therefore, they need to destroy jobs if liquidity becomes more valuable in response to an uncertainty shock.

The described relations are again confirmed by the FEVD of this model shown in table 4. We observe that both, job creation and job destruction, are considerably more affected by uncertainty shocks in large establishments. The order of magnitude uncertainty shocks are able to explain job flows of large establishments is in the range of estimates for employment stocks and worker flows. For small establishments we see a somewhat larger contribution of uncertainty shocks compared to the employment stock model. However, it is hard to tell, whether these results are only due to estimation noise or whether there is a structural reason behind them.

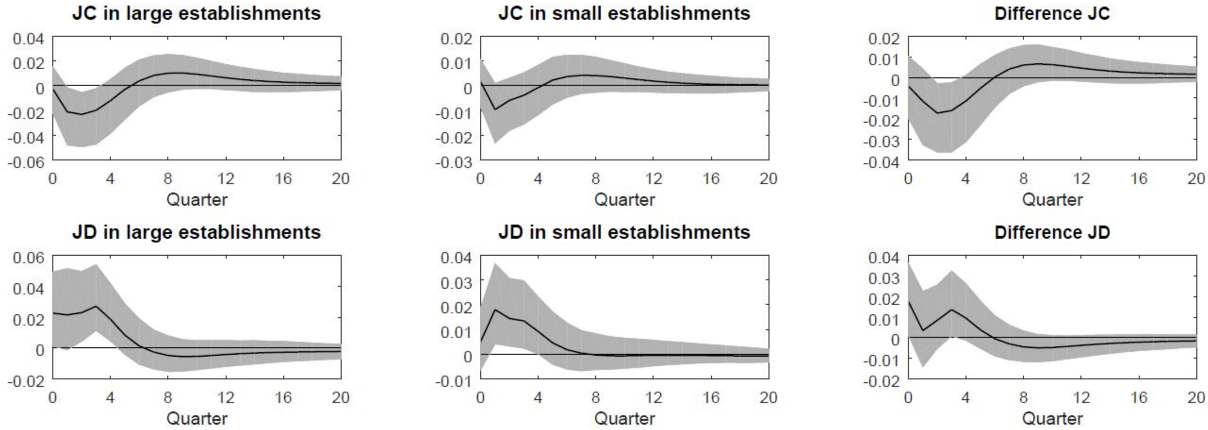
Table 4: Forecast error variance decomposition: job flows model

Horizon	$h = 1$	$h = 4$	$h = 8$	$h = 12$	$h = 16$	$h = 20$
Variable						
JC in large establishments	0.00	0.07	0.08	0.09	0.10	0.10
JC in small establishments	0.00	0.01	0.02	0.03	0.03	0.03
JD in large establishments	0.03	0.10	0.12	0.12	0.12	0.12
JD in small establishments	0.00	0.05	0.06	0.06	0.06	0.06

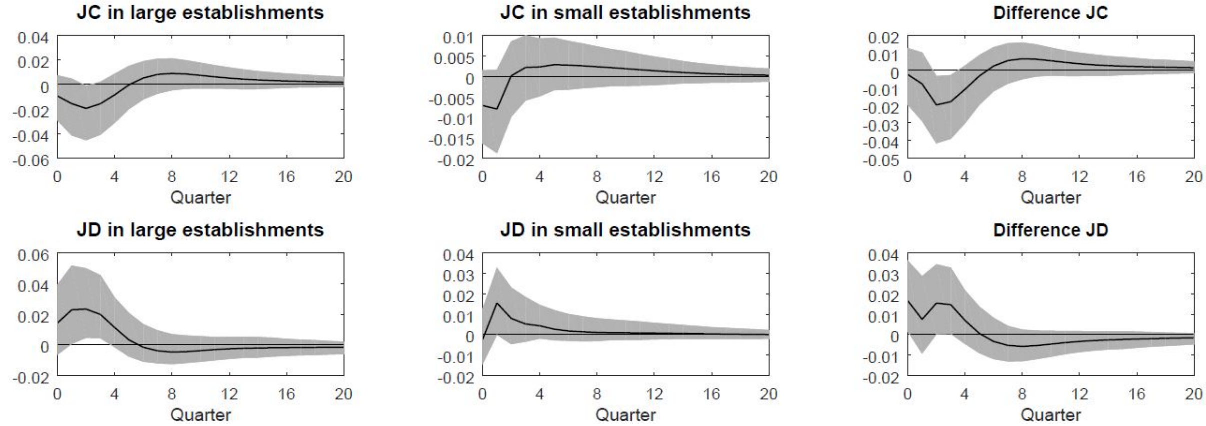
Notes: JC denotes job creation and JD denotes job destruction. Only the contributions of an uncertainty shock are depicted. h represents the forecast horizon in quarters.

Robustness checks for the job flows model are provided in figure 8. Excluding establishments with less than 10 employees from the analysis (see figure 8a) does not change the implications for job creation in large and small establishments. However, there is a statistically significant increase in job destruction in small establishments in this specification. This result implies that the statistical insignificance of the job destruction response in small establishments in figure 7 is driven by the smallest establishments. Perhaps predominantly these establishments do not rely on external credit and, hence, they face no need to destroy job in times of high uncertainty. Yet, the response in large establishments is still statistically significantly more pronounced (even though it is 'only' borderline significant).

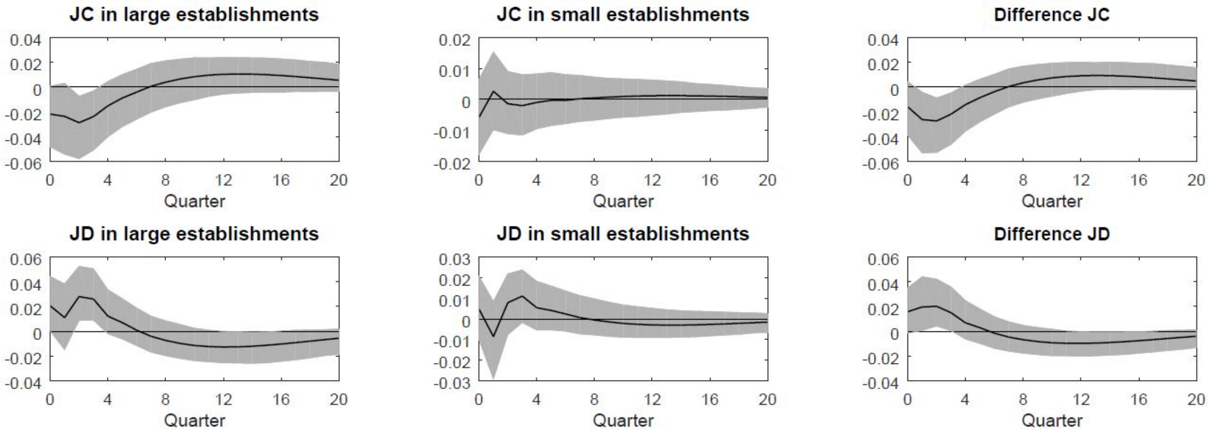
Figure 8: Robustness analysis: job flows model



(a) Without establishments with less than 10 employees



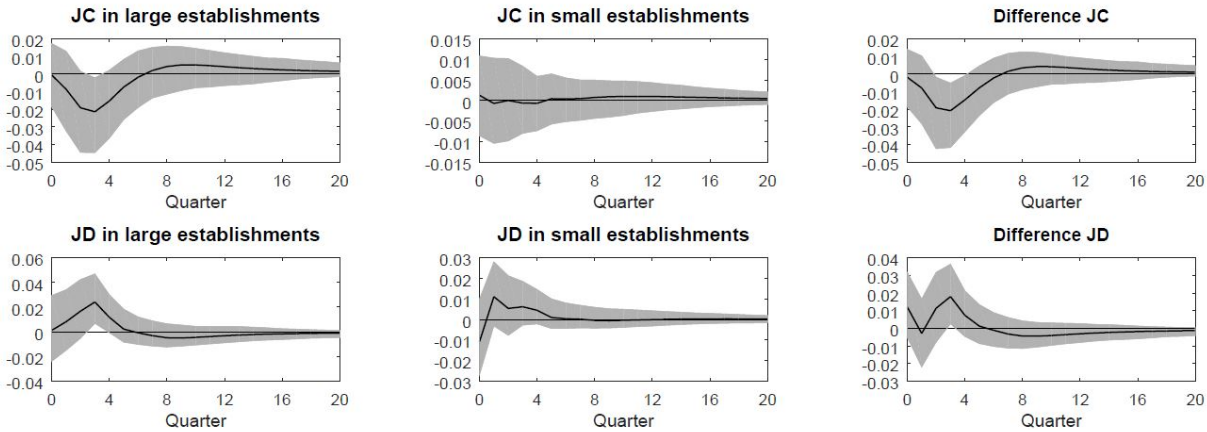
(b) VDAX as uncertainty indicator



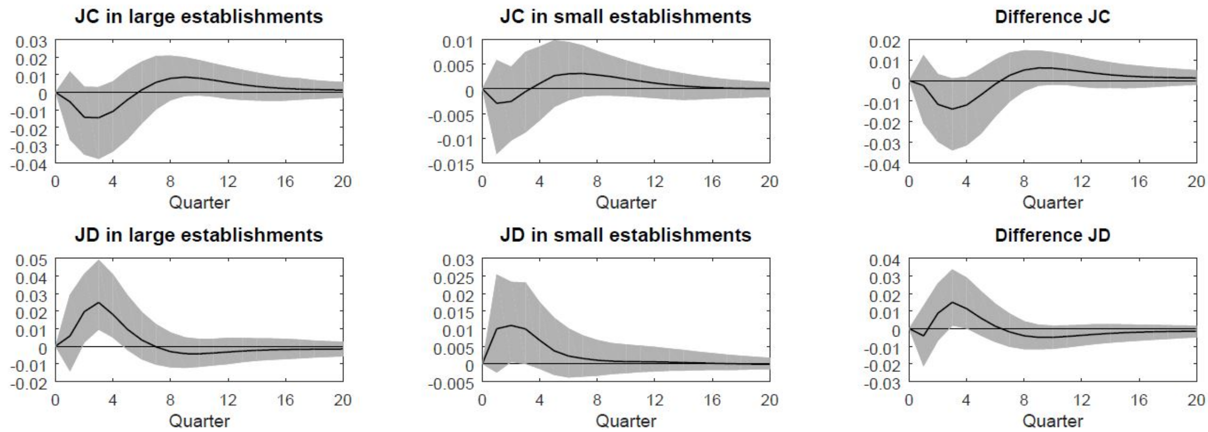
(c) Production expectation dispersion as uncertainty indicator

Figure continues on next page.

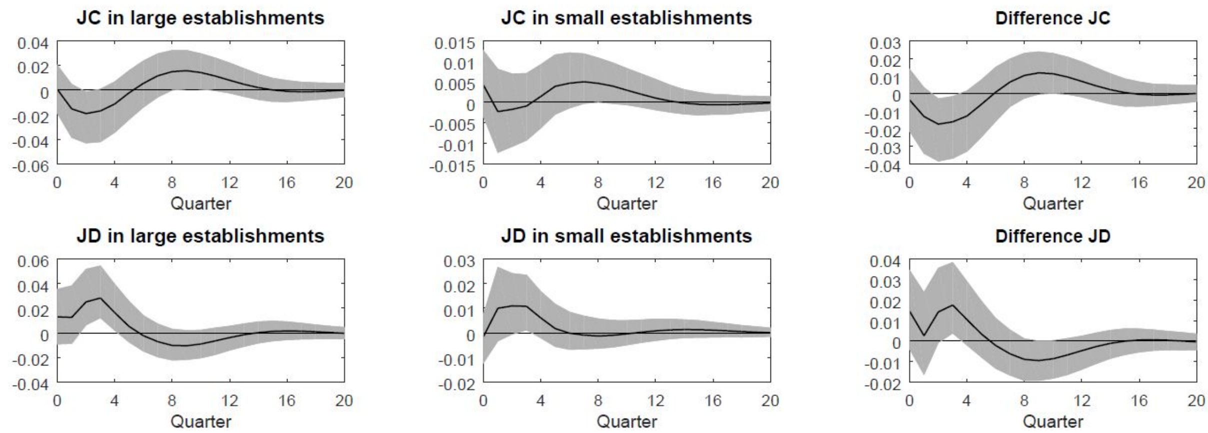
Figure 8: Robustness analysis: job flows model



(d) Economic policy uncertainty as uncertainty indicator



(e) Uncertainty ordered last



(f) GDP ordered first

Notes: JC denotes job creation and JD denotes job destruction. The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Using the VDAX (see figure 8b), firm-level production expectation dispersion (see figure 8c) and economic policy uncertainty (see figure 8d) as uncertainty indicators does not change the main implications. Thus, the estimation results are not restricted to the chosen uncertainty indicator. But ordering the uncertainty last in VAR results in some notable changes. The response of job creation in large establishments as well as the differences of job creation between large and small establishments are not statistically significant in this specification. Yet, the general tendency of these responses is the same as in the main results for the job flows model. Furthermore, the responses of job destruction in this specification show the same implications as the main results (except the borderline statistically significant response of small establishments). Also, the model with GDP in the first position in the VAR gives similar results as the main specification (see figure 8f).

The additional robustness checks are shown in figures A4 and A5 in the appendix. When lag size $p = 1$ is used for the estimation, none of the IRFs are statistically significant. Yet, the point estimates show the same tendency as the main job flows results. On the other hand, with lag size $p = 4$ the IRFs show the same implications as the main results. Estimating the VAR in first differences implies that only the increase of job destruction in large establishments as well as the difference in job destruction between large and small establishments are statistically significant. Again, the remaining IRFs show the same tendency as their counterparts in the main results. The same is true when the VAR is estimated in log-levels. However, the respective IRFs show no statistically significant decrease in job creation in large establishments nor in the difference of job creation in large and small establishments in the short run (the results rather imply a positive difference at longer horizons). The difference in job destruction between large and small establishments is statistically significantly negative at longer horizons (at shorter horizons the point estimate still shows a positive difference). These results correspond to the increase in employment in large establishments at longer horizons when the employment stock model is estimated in log-levels shown in figure A1d. This rebound effect at longer horizons is not new to the uncertainty shock literature. For instance, Bloom (2009) finds similar effects for industrial production and employment at longer horizons.

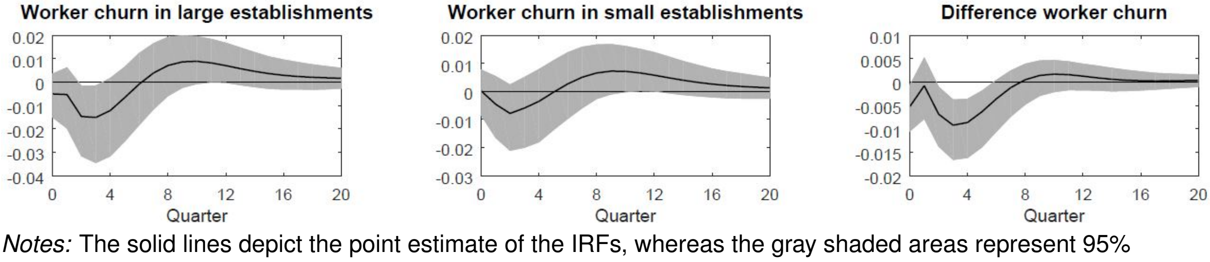
All in all, the robustness checks show that the main results are mostly robust. However, they are less robust than the results provided by the employment stock model and the worker flow model. Nevertheless, it is safe to say that I find evidence for fluctuations caused by uncertainty shocks in large establishments but not in small establishments (or the impact on small establishments is less pronounced). Following the reasoning by Mecikovsky and Meier (2019), the simultaneous increase in job creation and decrease in job destruction in these establishments provide evidence that financial frictions are the relevant transmission channel of uncertainty shocks to the labor market. Yet, combing the evidence on worker flows and job flows, there is an alternative explanation with the involvement of the adjustment costs. I am going to elaborate on this argument in the next section.

4.4 Uncertainty and worker churn

From the sections 4.2 and 4.3 we know that large establishments adjust to an uncertainty shock by a decrease in worker inflows as well as by a decrease in job creation and increase in job destruction. Worker outflows, on the other hand, do not respond statistically significant. What possibly drives these findings? The reduction in worker inflows and job creation is straightforward to explain. As the future is uncertain, establishments rather delay hiring and expansion by job creation since the risk of having too many employees is high. They do not increase layoffs (at least not statistically significant) as worker outflows seem not to respond to uncertainty shocks. The reason may be simply the strict employment protection for large establishments in Germany implying large adjustment costs in the case of layoffs. Nonetheless, job destruction increases statistically significant. Thus, employees which regularly leave these establishments (at the trend value of worker outflows) seem not to be replaced in uncertain times and, hence, job destruction increases. This reasoning implies a decrease in the so-called worker churn, i.e. the replacement of workers in the process of labor adjustment (a similar reasoning is brought up by Lazear & Spletzer, 2012). Indeed, Bachmann et al. (2021) attribute uncertainty about match quality for cross sectional differences in worker churn at the establishment level and show that worker churn is pro-cyclical.

To see if the decrease in worker churn is indeed a relevant channel in the adjustment to uncertainty shocks, I extend the analysis by estimating a VAR with worker churn in large and small establishments. The results are shown in figure 9. As indicated by the results in the sections above, we see a statistically significant decrease in worker churn in response to an uncertainty shock. After three quarters, worker churn decreases by 1.5% and returns to its initial value afterwards. Again, we do not see a statistically significant response of worker churn in small establishments in the short-run. The shape of the response is similar to that of the large establishments, implying a possibly similar adjustment in large and small establishments (only that the short-run response of small establishments lacks statistical power). Yet, the decrease in worker churn is statistically significantly larger in large establishments as the difference of the respective IRFs is statistically significantly negative.

Figure 9: IRFs to uncertainty shocks: worker churn model



Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Interestingly, about one and a half years after the shock we see an increase in worker churn above the initial value in large and small establishments (at about the same time uncertainty returns to its initial value, see figure 2). At later horizons these increases are statistically significant. The point estimates for employment, worker inflows and job creation in large establishments imply similar overshooting effects (in some cases similar responses can be seen in small establishments). Yet, these overshooting effects are not statistically significant except for the worker churn model. Thus, the worker churn results imply that large establishments 'freeze' in uncertain time by reducing replacement hiring and make up for these labor adjustments when uncertainty is at its normal level again. These implications are consistent with the "wait-and-see-dynamics" caused by labor adjustment costs as discussed in the macroeconomic uncertainty literature (see e.g. Bachmann et al., 2013). Small establishments increase worker churn at later horizons statistically significantly, too. They probably need to respond to the increased worker churn in large establishments by replacement hiring since large establishments adjust partially by pouching from small establishments (see Moscarini & Postel-Vinay, 2012).

The FEVD, presented in table 5, has similar implications as the IRFs. It implies that uncertainty shocks contribute considerably more to the forecast error variance of worker churn in large establishments than in small establishments. This result is apparent at each considered horizon, but is in particular striking (in relative terms) four to eight quarters after an uncertainty shock hits. Also, in the case of worker churn, there must to be other shocks driving the forecast error variance, similar to the implications of the FEVD results presented for the other three estimation models. I.e. uncertainty shocks have a sizable contribution to the forecast error variance (especially in the case of large establishments) but cannot explain the bulk of the variation.

Table 5: Forecast error variance decomposition: worker churn model

Horizon	$h=1$	$h=4$	$h=8$	$h=12$	$h=16$	$h=20$
Variable						
Worker churn in large establishments	0.01	0.07	0.8	0.10	0.11	0.12
Worker churn in small establishments	0.00	0.03	0.03	0.06	0.07	0.08

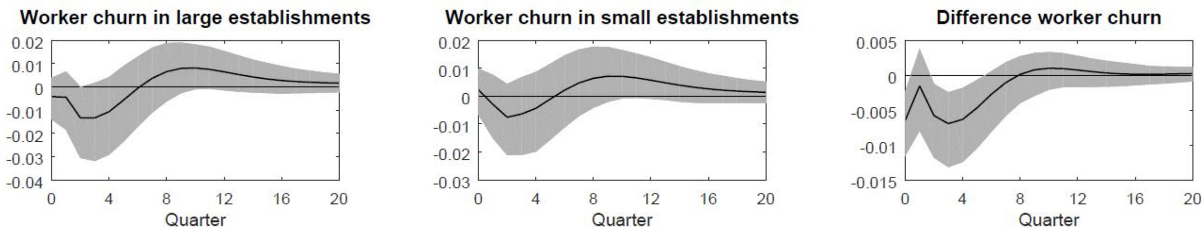
Notes: Only the contributions of an uncertainty shock are depicted. h represents the forecast horizon in quarters.

Figure 10 shows the familiar robustness checks. Omitting establishments with less than 10 employees from the time series on small establishments does not change the implications (see figure 10a). Employing the alternative uncertainty measures VDAX, firm-level production expectation dispersion and economic policy uncertainty does not changes them, either (see figure 10b,figure 10c and figure 10d, respectively). When the uncertainty indicator is ordered last, the IRFs show statistically insignificant drops of worker churn in large and small establishments in the short run. Yet, the difference of the IRFs indicates that worker churn in large establishments decrease statistically significantly more pronounced. When GDP is included in first position in the VAR, the responses are similar to the main results.

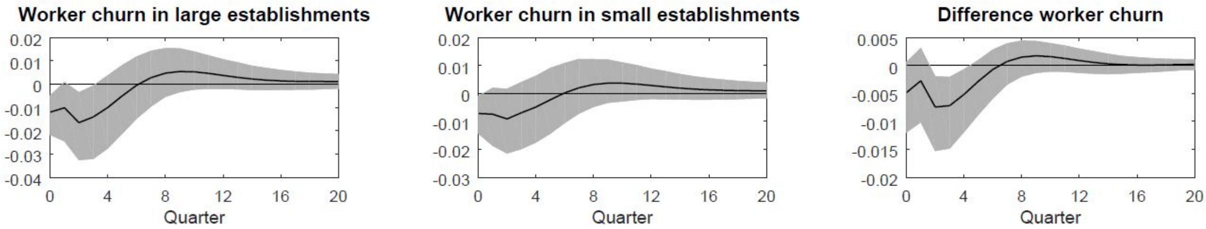
The remaining robustness checks are provided in the appendix (see figure A6). Most of the checks indicate that the results are robust. Only when the lag length $p = 1$ is employed or the VAR is estimated in log-levels, there is no statistically significant drop in worker churn in the short run. Yet, in both cases the response in large establishments is statistically significantly more pronounced. Also, most of the robustness checks feature the overshoot effect in large establishments in the medium run.

Consistent with my results for employment stocks, worker flows and job flows, worker churn only responds statistically significantly in large establishments. The analysis in this section provide evidence that large establishments adjust their labor input in times of high uncertainty by reducing replacement hiring, i.e. worker churn decreases after an uncertainty shock. Thus, large establishments 'freeze' temporarily in response to an uncertainty shock by not replacing regular worker outflows, which results in increased job destruction and decreased worker churn. Moreover, the results on worker churn imply that the establishments delay replacement hiring since worker churn exceed the initial value after uncertainty returned to its usual value.

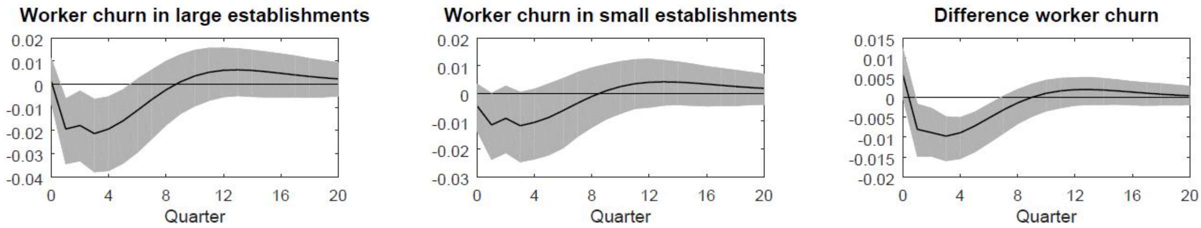
Figure 10: Robustness analysis: worker churn model



(a) Without establishments with less than 10 employees

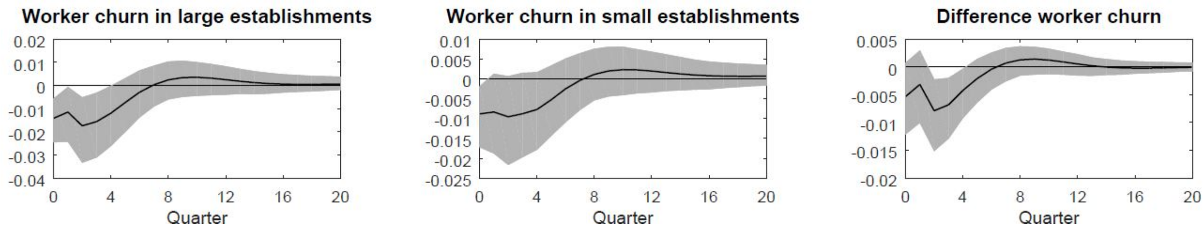


(b) VDAX as uncertainty indicator

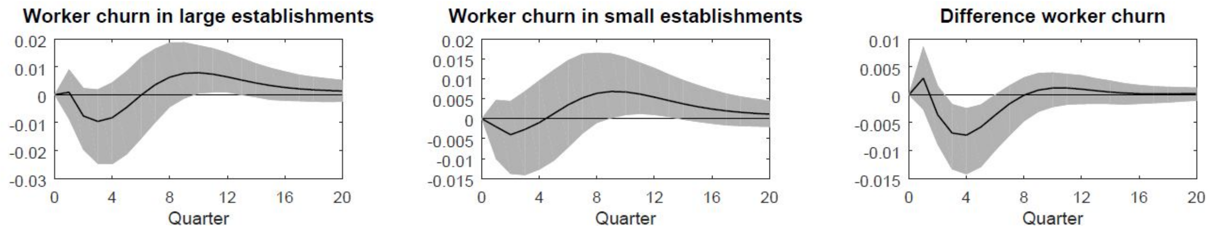


(c) Production expectation dispersion as uncertainty indicator

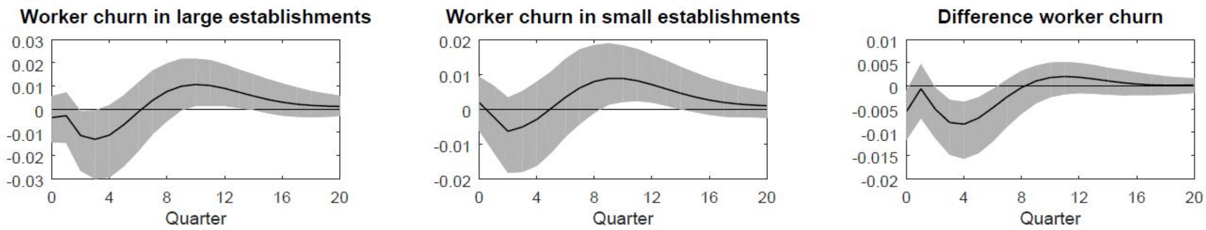
Figure continues on next page.



(d) Economic policy uncertainty as uncertainty indicator



(e) Uncertainty ordered last



(f) GDP ordered first

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

5. The role of sector differences

Are the results presented in section 4 driven by differences in establishment size distributions by sectors? Using the same data source as this analysis, Kovalenko, Schnabel, and Stüber (2020) show that there are considerable differences in the establishment size distribution between manufacturing and services in western Germany. I follow their classification in manufacturing and service establishments to get an idea of the role of the sector composition within the establishment size categories. To highlight the concern, table 6 shows average establishment sizes for manufacturing and the service sector in 2014Q1. The sector classification is based on the 1993 German Classification of Economic Activities (WZ 93) (see Statistisches Bundesamt, n.d.). I define the manufacturing sector as establishments active in Manufacturing (sector D in WZ 93). The service sector consists of establishments active in wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (sector G), hotels and restaurants (sector H), transport, storage and communications (sector I), financial intermediation (sector J), or real estate, renting and business activities (sector K) (see Stüber & Seth, 2019; Kovalenko et al., 2020).

The service sector employs nearly 2 million more employees than the manufacturing sector in 2014Q1. However, the number of establishments in the service sector is even more than 4 times as large as in manufacturing. Thus, the average establishment size is quite different in those two sectors. While it it 32.55 in manufacturing, it amounts only to 9.75 in the service sector. Thus, establishments in manufacturing are considerably larger than in the service sectors. Therefore, a large fraction of the large establishments size category as defined in section 3 presumably consists of manufacturing establishments.

Table 6: Descriptive statistics by sector in 2014Q1

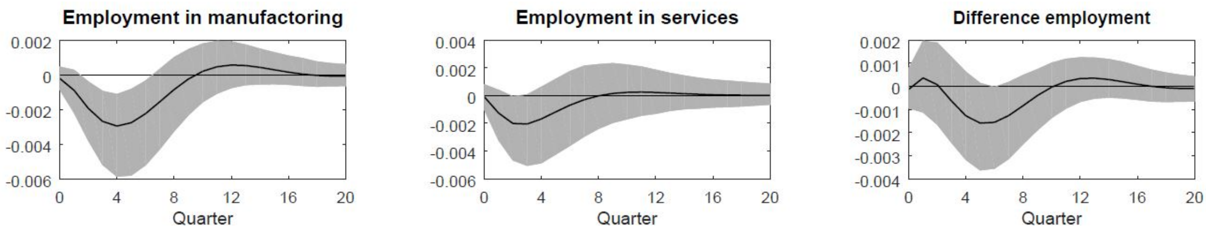
Sector	Number of establishm.	Number of employees	Average establishm. size
Manufacturing	145,377	4,731,302	32.55
Services	673,059	6,563,489	9.75

So, manufacturing establishments play an integral part for the results presented in section 4. The question arises if it is rather the specific characteristics of manufacturing establishments than those of large establishments that drive the result. There may be various reasons for differences in the impact of uncertainty shocks on manufacturing and service establishments. The demand of manufactured goods and services may respond differently to uncertainty shocks (car purchases vs. retail trade in uncertain times). Also, differences in human capital endowment may be quite different in manufacturing and services and, hence, there may be crucial differences in labor adjustment costs (hiring engineers vs. salespersons).

To check if the sectors are the driving force for the results, I repeat the analysis described in section 3 with time series on manufacturing and services instead of large and small establishments. These sectors are defined as described above. There are two reasons not including time series for large and small establishments for both manufacturing and services. Firstly, the public release data does not provide sector specific time series by establishment size (see Stüber & Seth, 2019). Also, employing the disaggregate AWFP data to compute these time series comes at a cost of relying on a random sample instead on the universe of the western German establishments. Thus, it may hinder the comparability to the main results. Secondly, including separate series by sector and size category in the VAR may impose a serious curse of dimensionality problem. The number of parameters to estimate would increase from 55 to 105 in models 1 and 4 and from 105 to 253 for models 2 and 3. Thus, especially for the worker flows model and job flows model estimating the VAR will become highly imprecise or even infeasible. Estimating separate VAR models for manufacturing and services is not preferable either as there are feedback effects after an uncertainty shock in these sectors (e.g. from financial intermediaries to assembly establishments).

Figure 11 shows the responses of employment in manufacturing and services to an uncertainty shock. There is a clear negative short run response in manufacturing establishments. It resembles the response in large establishments (see figure 2) which is expected since a large fraction of the large establishments are in the manufacturing sector. Yet, the point estimate implies a slightly lower percentage decrease in employment than the respective estimate in large establishments, probably due to the inclusion of smaller establishments in the series. More striking is the statistically significant decrease in service establishments (even if the response is only borderline significant). The point estimate implies a reduction by about 12,500 employees which is quite considerable. The employment drops in manufacturing and service sector sum up to a overall decline by about 26,000 five quarters after the shock. This decline is in line with the decrease in large establishments shown in figure 2. So, the argument that it is solely the manufacturing sector driving the difference between large and small establishments is rejected. Also, the difference between the responses is less pronounced than with large and small establishments (it is borderline statistically significant only in the sixth quarter after the shock). This highlights again that it rather the establishment size than the sector driving the difference in the main results.

Figure 11: IRFs to uncertainty shocks in the stocks model by sector

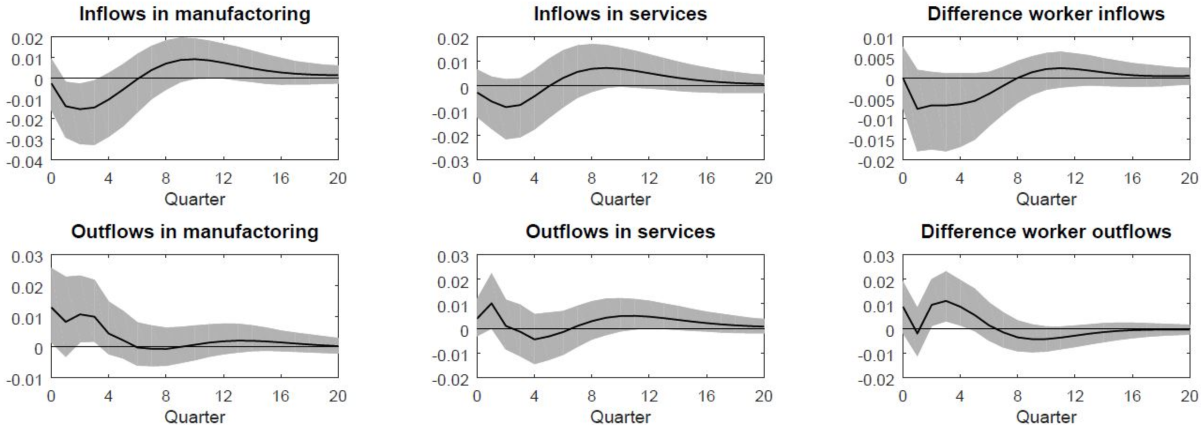


Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Considering the flows models shown in figures 12 to 14 gives a similar picture. For instance, there is a statistically significant decline in inflows in manufacturing establishments after an uncertainty shock (figure 12), while the corresponding response in services is statistically insignificant. Yet, I cannot establish a statistically significant difference between the responses of inflows in these two sectors. Thus, it is unlikely that the statistically significant difference between inflows in large and small establishments stems from the sector composition. Moreover, the response in outflows in manufacturing differs from the responses in large establishments as outflows in manufacturing increases statistically significantly. The reason may be that the manufacturing sector is relatively capital intensive. In uncertain times, banks lower the supply of loans (Buch et al., 2015), investment decrease (Meinen & Röhe, 2017) and, hence, it is likely that the capital stock of manufacturing establishments depreciates. Therefore, some manufacturing establishments may be forced to reduce employment by laying off workers.

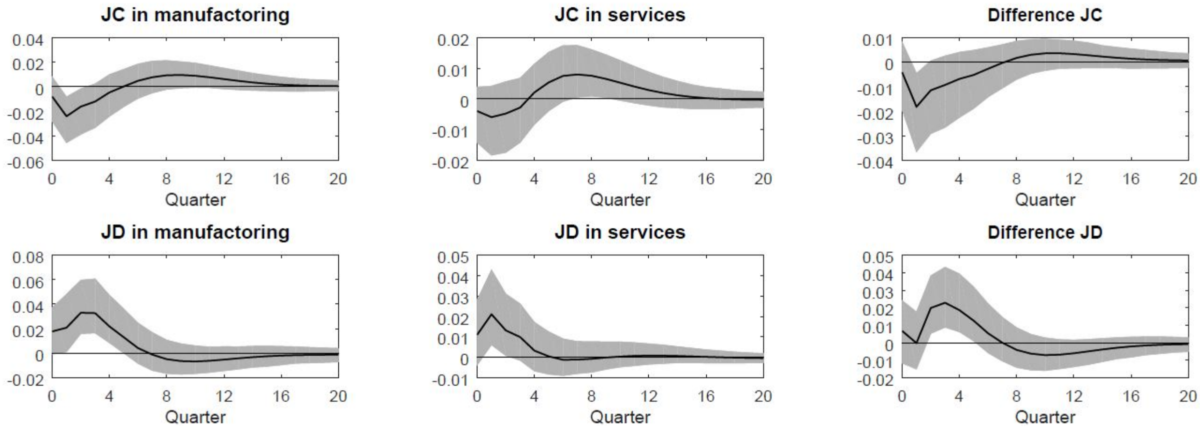
In the job flows model (figure 13) we see a decrease in job creation and increase in job destruction in manufacturing similar to the responses of large establishments. For the service sector, there is no statistically significant response in job creation in the first year after an uncertainty shock but there is an increase about two years after the shock. Also, job destruction increases statistically significantly after the shock (which is different from the response in small establishments). The case of worker churn in the two sectors (figure 14) is similar to inflows. The responses in manufacturing and services are similar to large and small establishments, but there is no statistically significant difference in these responses between the sectors.

Figure 12: IRFs to uncertainty shocks in the worker flows model by sector



Notes: The solid lines depict the point estimates of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

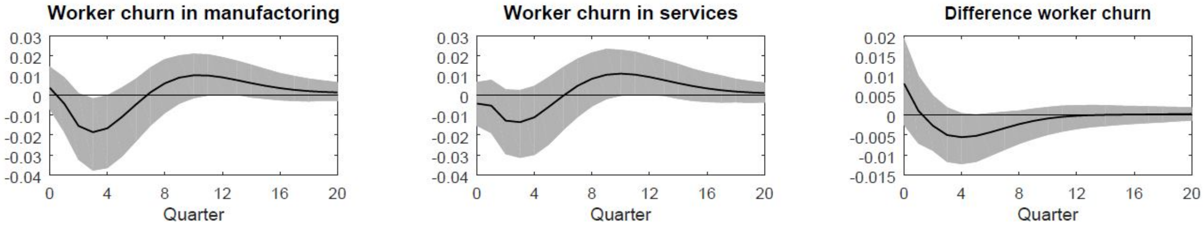
Figure 13: IRFs to uncertainty shocks in the job flows model by sector



Notes: JC denotes job creation and JD denotes job destruction. The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

All in all, it is apparent that manufacturing establishments play an important role for the responses of large establishments as this size category is presumably dominated by this sector. Yet, the results presented in this section suggest that is not solely manufacturing establishments driving the results for large establishments nor service establishments driving the results for small establishments. From an economic policy perspective, this is an important insight as tracking down large establishments quickly to provide assistance in uncertainty times is rather easy.

Figure 14: IRFs to uncertainty shocks in the worker churn model by sector



Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

6. Conclusion

This paper shows that in response to an uncertainty shock, employment in large establishments decreases statistically significant for about 1.5 years. Employment in small establishments, on the other hand, does not show a statistically significant response at any horizon. These findings are robust to various specifications and also hold if accounted for the reclassification bias. To analyze the driving forces behind these findings, I estimate the effects of uncertainty shocks on worker flows and job flows in large and small establishments. The results imply that large establishments adjust to uncertainty shocks by reducing worker inflows (while worker outflows are not statistically significant affected) as well as reducing job creation and increasing job destruction. Again, there is no statistically significant response of small establishments in this domain.

The results in this paper imply that worker churn in large establishments should decrease in response to uncertainty shocks. Indeed, I find a statistically significant reduction in worker churn in large establishments, but again not in small ones. Thus, large establishments adjust to increased uncertainty by reducing their hiring activities without an increase in layoffs (at least not statistically significant). Those employees leaving these establishments at the regular basis are not replaced, leading to the observed increase in job destruction and, therefore, to the decrease in worker churn. When uncertainty returns to its usual level, we see an increase in worker churn above the initial value in large and small establishments. These findings imply a postponement of replacement hirings of large establishments during uncertain times. After uncertainty returned to its initial value, small establishments respond to large establishments' increased worker churn by increasing worker churn by themselves. Pouching of large establishments from small establishments and the need of the latter to replace the pouched workers is the likely reason for this finding (see Moscarini & Postel-Vinay, 2012).

As argued by Mecikovsky and Meier (2019), the increase in job destruction indicates that financial frictions are the key reason for the effect of uncertainty shocks on the labor market. However, the results discussed above indicate that large establishments do ”freeze” temporarily in uncertain times by delaying their labor adjustments. These findings may be explained by the existence of labor adjustments costs. In the end, both financial frictions and labor adjustment cost are likely to play an important role in the transmission of uncertainty shocks on large establishments.

It is worth noting that the analysis at hand faces some drawbacks. With the employed data, I am not able to analyze the intensive margin of labor adjustments. Reducing hours instead of workers may be an important channel especially for small establishments due to the indivisibility of workers. Yet, it seems implausible that the small establishments reduce hours but do not reduce job creation nor worker inflows. Another drawback is the inability to split worker outflows in layoffs and quits. It would be quite interesting to see if workers respond to uncertainty by reducing quits (which is conceivable since large establishments reduce hiring and, therefore reduce job opportunities for workers).

Despite these drawbacks, the results of this analysis have important policy implications. First of all, since the large establishments are those reducing employment in uncertain times, policy measures targeting these establishments can be more cost-efficient than providing state aid to the whole economy. For example, bailouts of large firms and programs targeting primarily large firms (e.g. scrappage program in Germany) in the Great Recession have been heavily criticized by the media and some economists. Since such policies potentially reduce uncertainty primarily for large establishments, my results provide some justification for this kind of state aid in uncertain times. Moreover, traditional counter-cyclical measures affecting the whole economy may be ineffective if they fail to reduce the uncertainty for the large establishments which drives the decrease in employment.

Furthermore, the results presented here can provide some interesting insights in the economy’s adjustment to the recession caused by the COVID-19 pandemic. Caggiano et al. (2020) and Leduc and Liu (2020) argue that uncertainty is a key driver in the economic downturn. Indeed, the increase in unemployment is attributed to the decrease in hiring activities in Germany (Merkl & Weber, 2020). This is in line with the presented results on the decrease in worker inflows in large establishments. Thus, reducing uncertainty by providing a clear road map in dealing with the pandemic would have been a cost effective and reasonably measure.

References

Abowd, J. M., & Kramarz, F. (2003). The costs of hiring and separations. *Labour Economics*, *10*(5), 499–530.

Altig, D., Baker, S., Barrero, J. M., Bloom, N., Bunn, P., Chen, S., ... Thwaites, G. (2020). Economic uncertainty before and during the COVID-19 pandemic. *Journal of Public Economics*, *191*, 104274.

Angelini, G., Bacchiocchi, E., Caggiano, G., & Fanelli, L. (2019). Uncertainty across volatility regimes. *Journal of Applied Econometrics*, *34*(3), 437–455.

Arellano, C., Bai, Y., & Kehoe, P. J. (2019). Financial Frictions and Fluctuations in Volatility. *Journal of Political Economy*, *127*(5), 2049–2103.

Arellano, C., Bai, Y., & Zhang, J. (2012). Firm dynamics and financial development. *Journal of Monetary Economics*, *59*(6), 533–549.

Arndt, C., Buch, C. M., & Mattes, A. (2009). Firm-Specific Factor Market Constraints and FDI: Evidence from Germany. *Centro Studi Luca d'Agliano Working Papers*, *No. 269*.

Bachmann, R., Bayer, C., Merkl, C., Seth, S., Stüber, H., & Wellschmied, F. (2021). Worker churn in the cross section and over time: New evidence from Germany. *Journal of Monetary Economics*, *117*, 781–797.

Bachmann, R., Elstner, S., & Sims, E. R. (2013). Uncertainty and Economic Activity: Evidence from Business Survey Data. *American Economic Journal: Macroeconomics*, *5*(2), 217–49.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics*, *131*(4), 1593–1636.

Bardt, H., & Grömling, M. (2020). Kein schnelles Ende des Corona-Schocks: Ökonomische Einschätzungen deutscher Unternehmen. *IW-Trends Vierteljahresschrift zur empirischen Wirtschaftsforschung*, *47*(2), 21–41.

Basu, S., & Bundick, B. (2017). Uncertainty shocks in a model of effective demand. *Econometrica*, *85*(3), 937–958.

Bellmann, L., Gerner, H.-D., & Upward, R. (2018). Job and worker turnover in German establishments. *The Manchester School*, *86*(4), 417–445.

Blatter, M., Muehlemann, S., & Schenker, S. (2012). The costs of hiring skilled workers. *European Economic Review*, *56*(1), 20–35.

Bloom, N. (2009). The Impact of Uncertainty Shocks. *Econometrica*, *77*(3), 623–685.

Bloom, N. (2014). Fluctuations in Uncertainty. *Journal of Economic Perspectives*, *28*(2), 153–76.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., & Terry, S. J. (2018). Really uncertain business cycles. *Econometrica*, *86*(3), 1031–1065.

Born, B., Breuer, S., & Elstner, S. (2018). Uncertainty and the Great Recession. *Oxford Bulletin of Economics and Statistics*, *80*(5), 951–971.

Buch, C. M., Buchholz, M., & Tonzer, L. (2015). Uncertainty, bank lending, and bank-level heterogeneity. *IMF Economic Review*, *63*(4), 919–954.

Caggiano, G., Castelnuovo, E., & Groshenny, N. (2014). Uncertainty shocks and unemployment dynamics in US recessions. *Journal of Monetary Economics*, *67*, 78–92.

Caggiano, G., Castelnuovo, E., & Kima, R. (2020). The global effects of Covid-19-induced uncertainty. *Economics Letters*, *194*.

Caggiano, G., Castelnuovo, E., & Nodari, G. (2021). Uncertainty and monetary policy in good and bad times: A replication of the vector autoregressive investigation by Bloom (2009). *Journal of Applied Econometrics*, *forthcoming*.

Caldara, D., Fuentes-Albero, C., Gilchrist, S., & Zakrajšek, E. (2016). The macroeconomic impact of financial and uncertainty shocks. *European Economic Review*, *88*, 185–207.

Carrière-Swallow, Y., & Céspedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. *Journal of International Economics*, *90*(2), 316–325.

Claeys, P., & Vašíček, B. (2019). Transmission of uncertainty shocks: Learning from heterogeneous responses on a panel of EU countries. *International Review of Economics & Finance*, *64*, 62–83.

de Wind, J., & Grabska, K. (2016). The Impact of Uncertainty Shocks: Continental Europe versus the Anglo-Saxon World. *CPB Discussion Paper*, *No 335*.

Ellguth, P., & Kohaut, S. (2019). Tarifbindung und betriebliche Interessenvertretung: Ergebnisse aus dem IAB-Betriebspanel 2018. *WSI-Mitteilungen*, *72*(4), 290–297.

Fernández-Villaverde, J., & Guerrón-Quintana, P. A. (2020). Uncertainty shocks and business cycle research. *Review of Economic Dynamics*, *37*, S118–S146.

Fontaine, I. (2021). Uncertainty and labour force participation. *Oxford Bulletin of Economics and Statistics*, *83*(2), 437–471.

Fort, T. C., Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2013). How firms respond to business cycles: The role of firm age and firm size. *IMF Economic Review*, *61*(3), 520–559.

Grimme, C., & Stöckli, M. (2018). Measuring macroeconomic uncertainty in Germany. *CESifo Forum*, *19*(1), 46–50.

Grund, C., Martin, J., & Schmitt, A. (2016). Works councils, quits and dismissals in Germany. *German Journal of Human Resource Management*, *30*(1), 53–75.

Guglielminetti, E. (2016). The labor market channel of macroeconomic uncertainty. *Bank of Italy Temi di Discussione (Working Paper)*, *No. 1068*.

Jung, S. (2014). *Betriebliche Beschäftigungsanpassung im Konjunkturzyklus*. Dr. Kovac Verlag.

Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring uncertainty. *American Economic Review*, *105*(3), 1177–1216.

Kaas, L., & Kimasa, B. (2021). Firm dynamics with frictional product and labor markets. *International Economic Review*, *62*(3), 1281–1317.

Katayama, M., & Kim, K. H. (2018). Uncertainty shocks and the relative price of investment goods. *Review of Economic Dynamics*, *30*, 163–178.

Kilian, L., & Lütkepohl, H. (2017). *Structural vector autoregressive analysis*. Cambridge University Press.

Kölling, A. (2012). Firm size and employment dynamics: Estimations of labor demand elasticities using a fractional panel probit model. *Labour*, *26*(2), 174–207.

Kovalenko, T., Schnabel, C., & Stüber, H. (2020). Is the German labour market granular? *Applied Economics Letters*, *forthcoming*.

Larsen, V. H. (2020). Components of uncertainty. *International Economic Review*, *forthcoming*.

Lazear, E. P., & Spletzer, J. R. (2012). Hiring, churn, and the business cycle. *American Economic Review*, *102*(3), 575–79.

Leduc, S., & Liu, Z. (2016). Uncertainty shocks are aggregate demand shocks. *Journal of Monetary Economics*, *82*, 20–35.

Leduc, S., & Liu, Z. (2020). The Uncertainty Channel of the Coronavirus. *FRBSF Economic Letters*, *2020*(07).

Mecikovsky, A. M., & Meier, M. (2019). Do Plants Freeze upon Uncertainty Shocks? *CRC TR 224 Discussion Paper Series*, *No. 075*.

Meinen, P., & Röhe, O. (2017). On measuring uncertainty and its impact on investment: Cross-country evidence from the euro area. *European Economic Review*, *92*, 161–179.

Merkl, C., & Stüber, H. (2019). Value added, wages and labour market flows at the establishment level. *Applied Economics Letters*, *26*(2), 135–142.

Merkl, C., & Weber, E. (2020). Raus aus der Neueinstellungskrise! *Wirtschaftsdienst*, *100*(7), 507–509.

Moscarini, G., & Postel-Vinay, F. (2008). The timing of labor market expansions: New facts and a new hypothesis. *NBER Macroeconomics Annual*, *23*(1), 1–52.

Moscarini, G., & Postel-Vinay, F. (2012). The contribution of large and small employers to job creation in times of high and low unemployment. *American Economic Review*, *102*(6), 2509–39.

Mumtaz, H., & Theodoridis, K. (2018). The changing transmission of uncertainty shocks in the US. *Journal of Business & Economic Statistics*, *36*(2), 239–252.

Oh, J. (2020). The propagation of uncertainty shocks: Rotemberg versus Calvo. *International Economic Review*, *61*(3), 1097–1113.

Popescu, A., & Smets, F. R. (2010). Uncertainty, Risk-taking, and the Business Cycle in Germany. *CESifo Economic Studies*, *56*(4), 596–626.

Riegler, M. (2019). *The Impact of Uncertainty Shocks on the Job-Finding Rate and Separation Rate.* (Mimeo. Online available `https://www.mriegler.com/research`; retrieved 16 August 2021.)

Schaal, E. (2017). Uncertainty and unemployment. *Econometrica*, *85*(6), 1675–1721.

Schnabel, C. (2020). Betriebliche Mitbestimmung in Deutschland: Verbreitung, Auswirkungen und Implikationen. *Perspektiven der Wirtschaftspolitik*, *21*(4), 361–378.

Shoag, D., & Veuger, S. (2016). Uncertainty and the Geography of the Great Recession. *Journal of Monetary Economics*, *84*, 84–93.

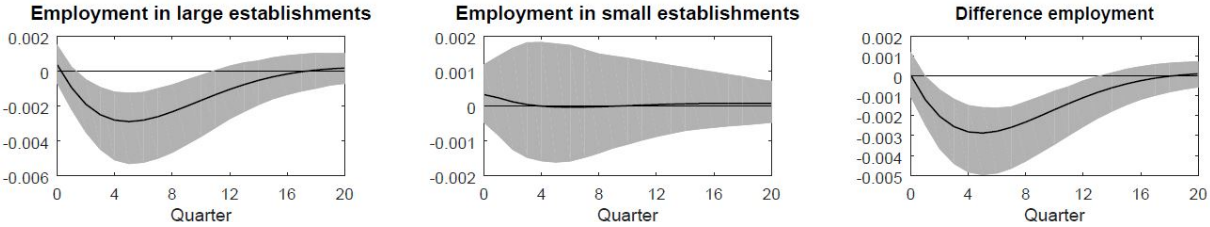
Siemer, M. (2019). Employment effects of financial constraints during the Great Recession. *Review of Economics and Statistics*, *101*(1), 16–29.

Statistisches Bundesamt. (n.d.). *German Classification of Economic Activities, Edition 1993 (WZ 93).* Website. (Online available `https://www.destatis.de/DE/Methoden/Klassifikationen/Gueter-Wirtschaftsklassifikationen/Downloads/klassifikation-wz-1993-englisch.pdf`; retrieved 11 June 2021.)

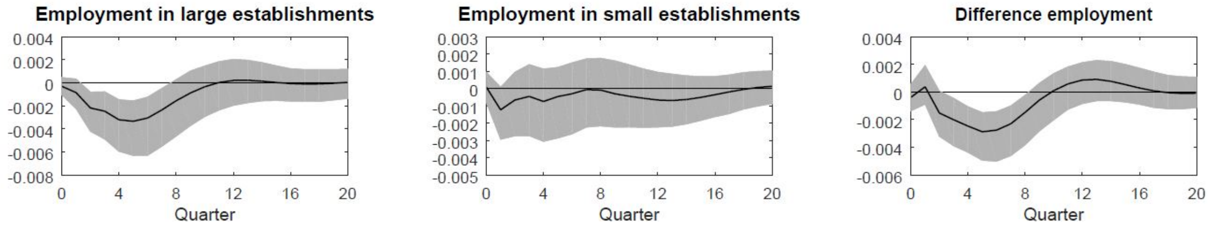
Stüber, H., & Seth, S. (2019). The public release data of the administrative wage and labor market flow panel. *Jahrbücher für Nationalökonomie und Statistik*, *239*(2), 333–344.

Appendix

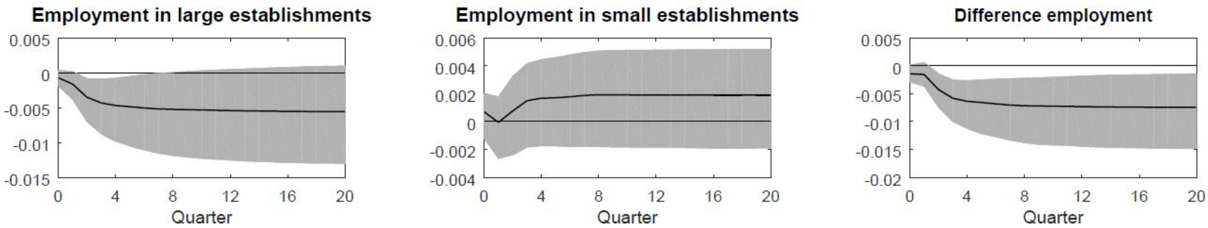
Figure A1: Additional robustness analysis



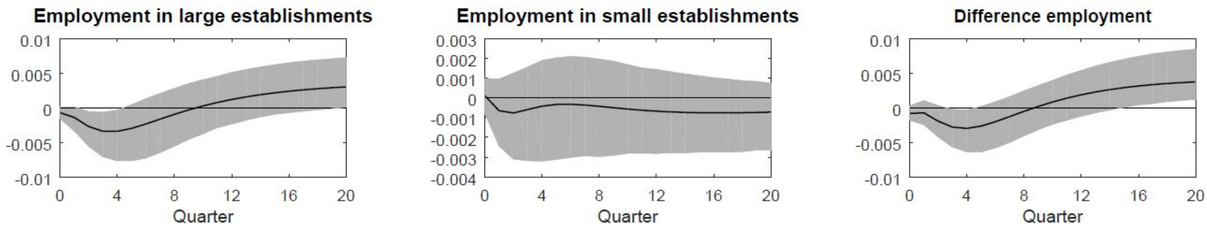
(a) VAR with lag length $p = 1$



(b) VAR with lag length $p = 4$



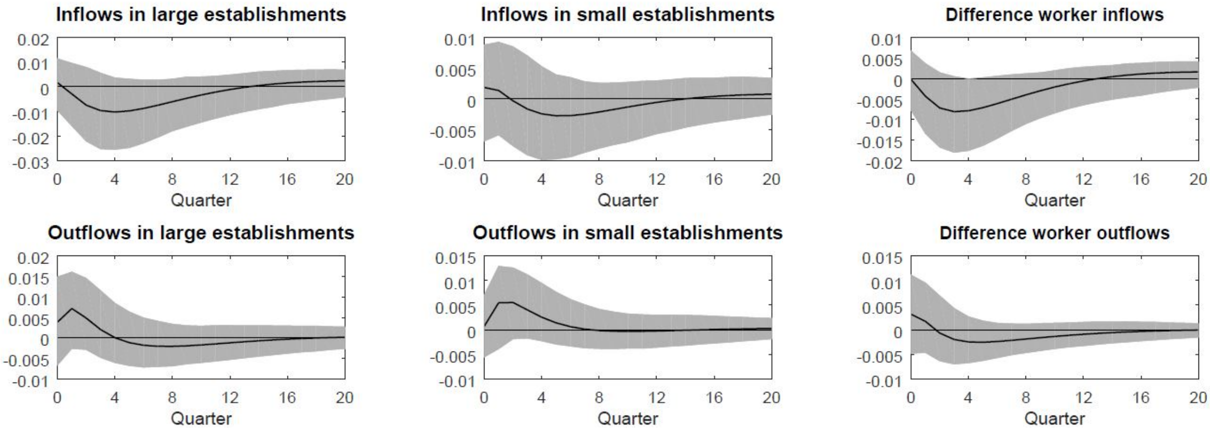
(c) Variables in the VAR in first differences



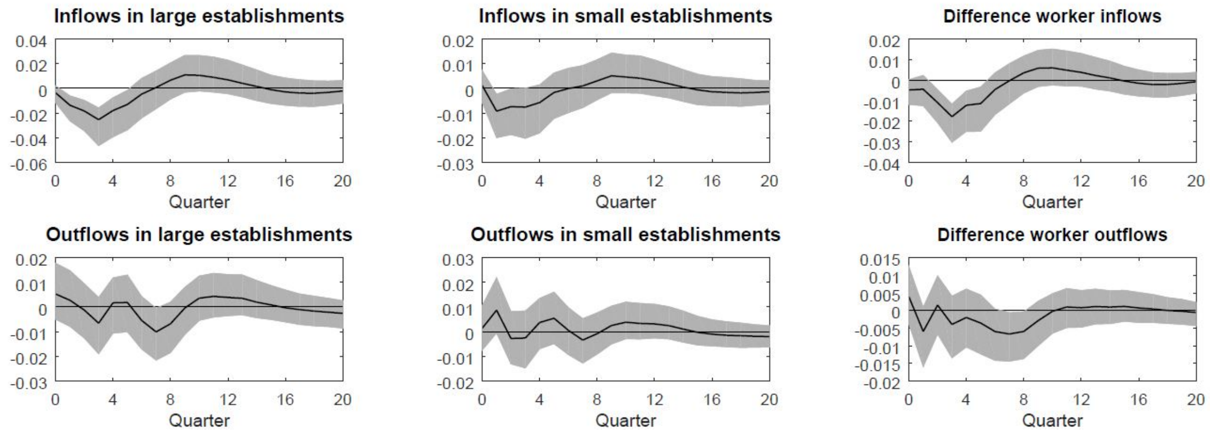
(d) Variables in the VAR in log-levels

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Figure A2: Additional robustness analysis: worker flows - part 1



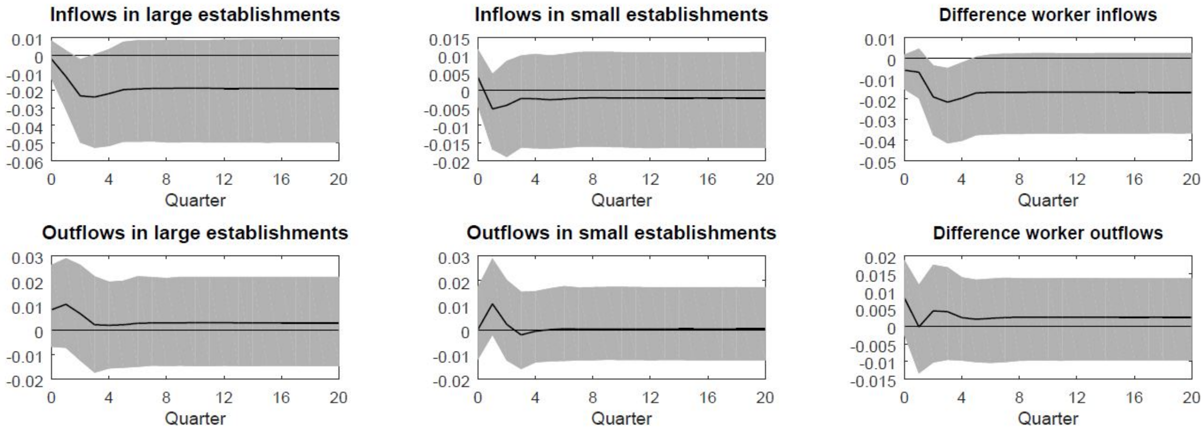
(a) VAR with lag length $p = 1$



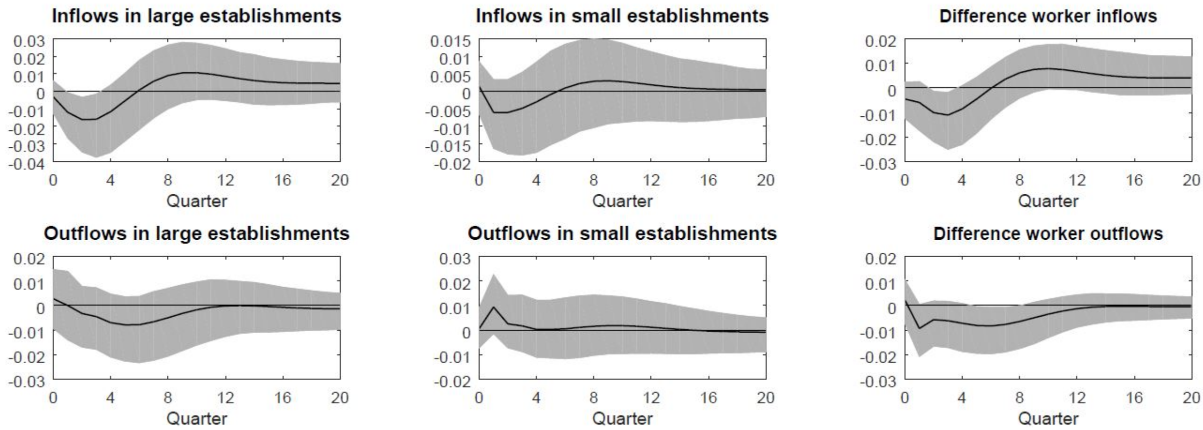
(b) VAR with lag length $p = 4$

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Figure A3: Additional robustness analysis: worker flows - part 2



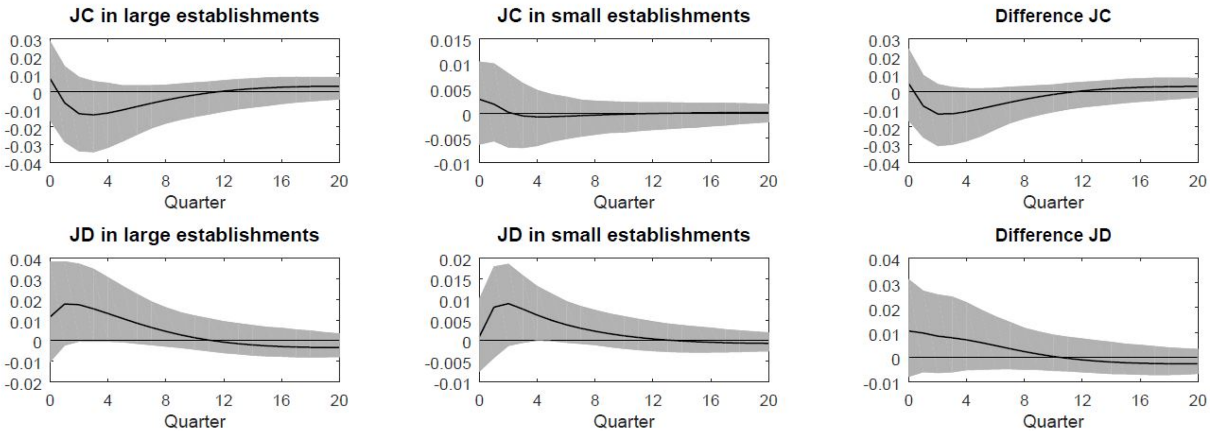
(a) Variables in the VAR in first differences



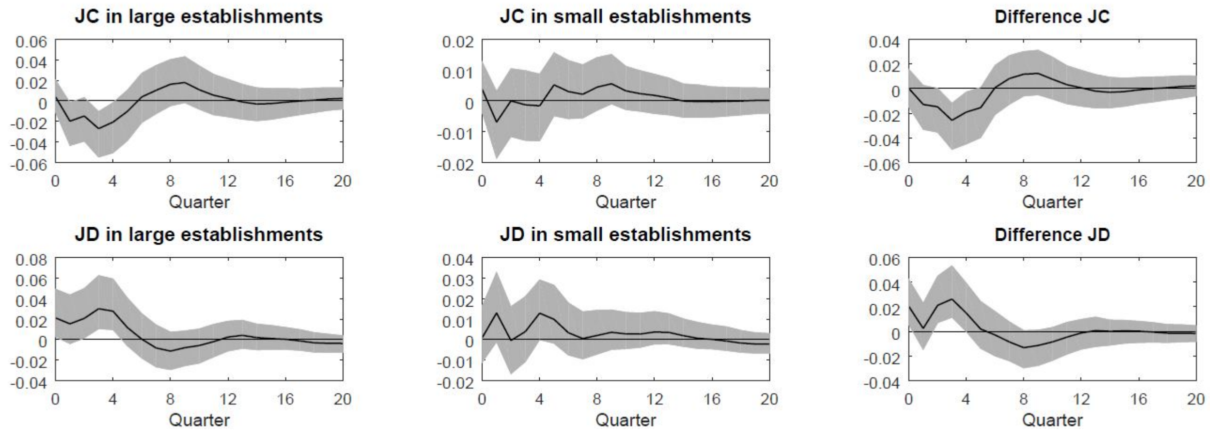
(b) Variables in the VAR in log-levels

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Figure A4: Additional robustness analysis: job flows - part 1



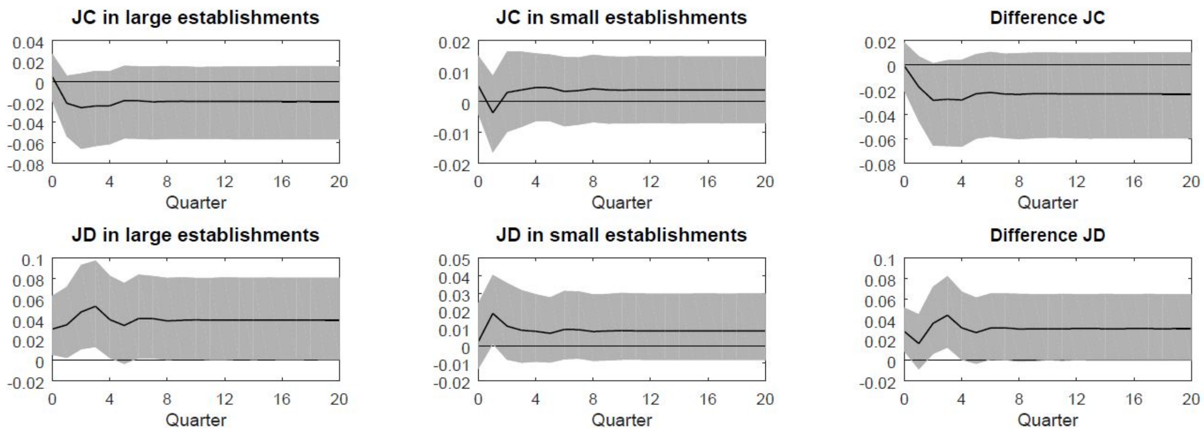
(a) VAR with lag length $p = 1$



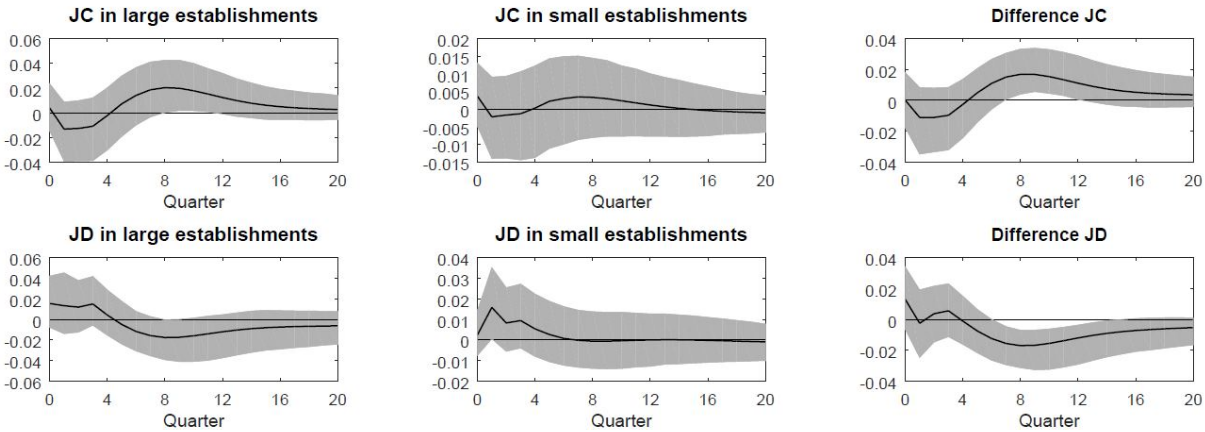
(b) VAR with lag length $p = 4$

Notes: JC denotes job creation and JD denotes job destruction. The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

Figure A5: Additional robustness analysis: job flows - part 2



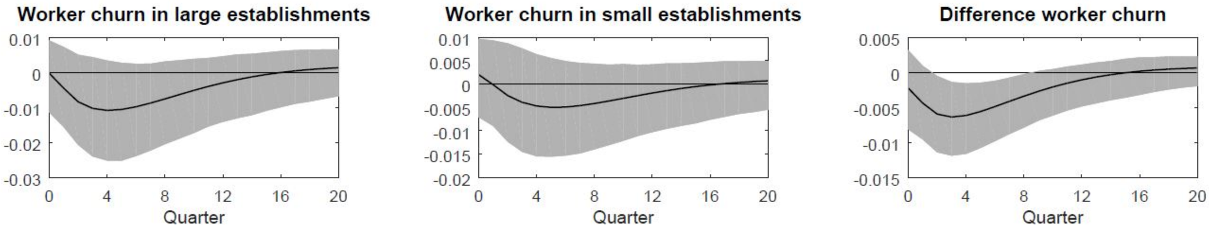
(a) Variables in the VAR in first differences



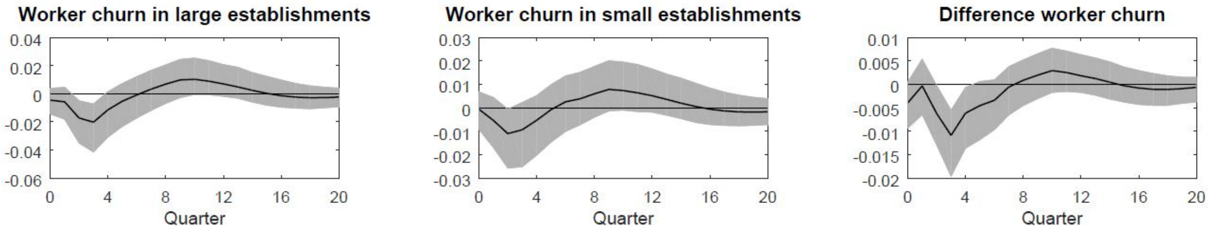
(b) Variables in the VAR in log-levels

Notes: JC denotes job creation and JD denotes job destruction. The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.

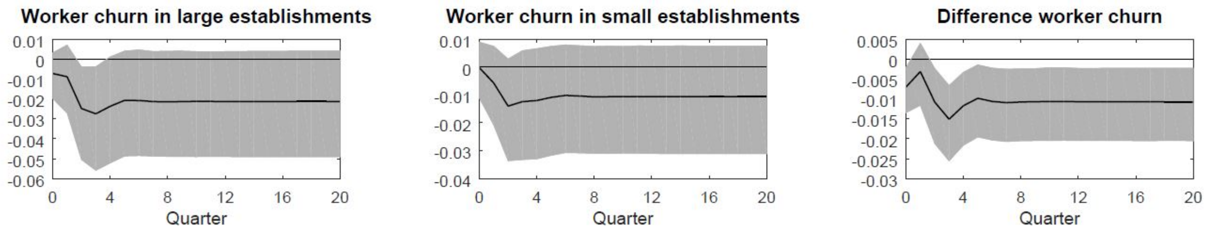
Figure A6: Additional robustness analysis: worker churn



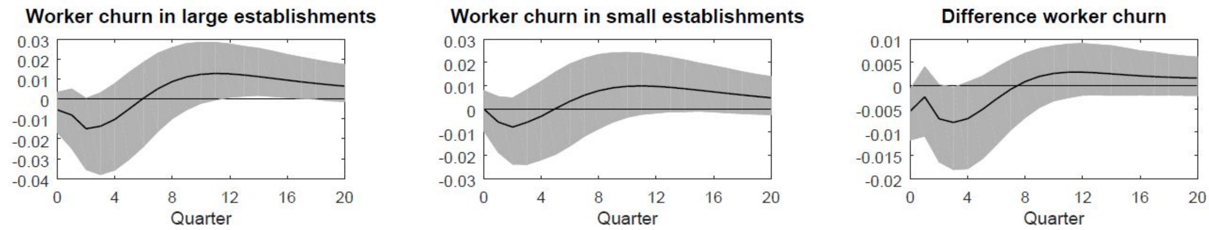
(a) VAR with lag length $p = 1$



(b) VAR with lag length $p = 4$



(c) Variables in the VAR in first differences



(d) Variables in the VAR in log-levels

Notes: The solid lines depict the point estimate of the IRFs, whereas the gray shaded areas represent 95% confidence intervals based on 2,000 bootstrap replications.