CESifo WORKING PAPERS

8934
2021

March 2021

The Impact of Aggregate Uncertainty on Firm-Level Uncertainty

Joshy Easaw, Christian Grimme

CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editor: Clemens Fuest
https://www.cesifo.org/en/wp

An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
· from the RePEc website: www.RePEc.org
· from the CESifo website: https://www.cesifo.org/en/wp

CESifo *Working Paper No. 8934*

The Impact of Aggregate Uncertainty on Firm-Level Uncertainty

Abstract

We analyse the extent to which firm-level uncertainty is affected by aggregate uncertainty. Firm-level uncertainty is constructed from a large and monthly panel dataset of manufacturing firms. We find that aggregate uncertainty has a positive and robust impact on firm-level uncertainty. This effect holds across different types of domestic and international measures of aggregate uncertainty. However, the size of the impact is heterogeneous and depends on certain firm characteristics and the state of the business cycle. For example, the widely used economic policy uncertainty index matters to all firms' uncertainty only in recessionary periods, while it is relevant over the entire business cycle only to large firms' uncertainty.

JEL-Codes: C230, E320, E010.

Keywords: firm-level uncertainty, aggregate uncertainty, survey data.

Joshy Easaw
Cardiff University Business School
Aberconway Building, Colum Drive
United Kingdom – Cardiff CF10 3EU
EasawJ1@cardiff.ac.uk

*Christian Grimme**
ifo Institute – Leibniz Institute for Economic Research at the University of Munich
Poschingerstraße 5
Germany – 81679 Munich
grimme@ifo.de

*corresponding author

1 Introduction

During the last decade, there has been a heightened interest in the impact of uncertainty on the business cycle. Following the seminal work of Bloom (2009), a growing micro-econometric literature has analysed the effects of uncertainty on decisions made at the firm level concerning, for example, investment, employment, or prices.[1] Many of these studies rely on measures of aggregate uncertainty. However, what matters for the decisions of a firm is the firm's own view of economic uncertainty. This raises the question to what extent firm-level uncertainty is driven by aggregate uncertainty and whether the different types of aggregate uncertainty have similar effects on firm-level uncertainty.

We find that aggregate uncertainty has a positive and robust impact on firm-level uncertainty. This effect holds across different types of domestic and international measures of aggregate uncertainty. However, the size of the impact is heterogeneous and depends on certain firm characteristics and the state of the business cycle. For example, the widely used economic policy uncertainty index by Baker et al. (2016) matters to all firms' uncertainty only in recessionary periods, while it is relevant over the entire business cycle only to large firms' uncertainty.

To construct our measure of firm-specific uncertainty, we use confidential micro data of the German Ifo Business Cycle Survey, which contains information about individual production expectations and their realizations. We can thus construct a long, monthly history of firm-specific forecast errors following the strategy of Bachmann et al. (2013). We measure uncertainty using the firm-specific standard deviation of the forecast errors based on a rolling window of observations (Bachmann et al., 2019). The advantage of this measure is that it neither depends on some form of dispersion among firms, nor does it rest on the assumption of a representative firm. Furthermore, the survey enables us to use a set of firm-level control variables to help us isolate the effect of aggregate uncertainty on firm-specific uncertainty. Using survey data appears particularly valuable in our case, as the survey polls actual decision-makers at the firms

[1] Regarding investment, see, e.g., Leahy and Whited (1996), Guiso and Parigi (1999), Baum et al. (2008), Stein and Stone (2013), Baker et al. (2016), Bloom et al. (2019), Smietanka et al. (2018). Concerning employment, see, e.g. Stein and Stone (2013), Baker et al. (2016), Bloom et al. (2019). Regarding prices, see, e.g., Bachmann et al. (2019), Dixon and Grimme (2021), Koga et al. (2020). Also, credit conditions of firms depend on uncertainty, see, e.g., Alessandri and Bottero (2021), Bordo et al. (2016), Valencia (2017), Gilchrist et al. (2014), Barraza and Civelli (2019), Grimme and Henzel (2020).

in contrast to, for example, financial analysts (Bachmann et al., 2013). In addition, our data encompasses firms of all sizes in contrast to firm-level stock market data.

In the baseline model, we consider three domestic measures of aggregate uncertainty which reflect different types of uncertainty and volatility.[2] First, we use an index of macroeconomic uncertainty, which is an econometric measure of uncertainty. It is based on the aggregate volatility of econometric forecasts for many macroeconomic time series following the idea of Jurado et al. (2015) for the United States. For Germany, this measure is constructed by Grimme and Stöckli (2018). Second, we rely on data uncertainty, which reflects the uncertainty about the underlying macroeconomic state. The current state is described by real-time macroeconomic data, which is typically revised over time. Hence, data revisions can have an impact on the uncertainty about the actual economic state (see, e.g., Jo and Sekkel, 2019). In this paper, we construct two types of measures for data uncertainty for Germany, based on the measures proposed by Easaw et al. (2018) for the United States. Third, we include an index of policy uncertainty, which is a newspaper-based indicator proposed by Baker et al. (2016). For Germany, this measure counts the number of German newspaper articles that contain words related to uncertainty and economic policy.

For the domestic aggregate uncertainty measures, we find the following sets of results. Macroeconomic and data uncertainty are a positive and significant determinant for firm-level uncertainty. In contrast, policy uncertainty is important to all firms' uncertainty only in recessions. Going into a recession, firms may expect from the government to implement economic policies to fight the recession. Paying more attention to government's announcements and policies, firm-level uncertainty may react more elastically to uncertainty about economic policy.

Furthermore, policy uncertainty matters to the uncertainty of large firms over the entire business cycle, while sectoral affiliation does not play a role. Large firms appear to pay close attention to economic policy and their communication at all times. One reason could be the higher turnover of large firms. Selling more requires larger investments in multiple plants which

[2]When we refer to aggregate uncertainty in this paper, we mean the general uncertainty surrounding aggregate outcomes. This type of uncertainty is common to all firms. This is in contrast to the uncertainty of a firm about an aggregate outcome, which is sampled, for example, by Altig et al. (2021).

involves long-term planning. Therefore, large firms may be particularly sensitive to expected changes in government policies. Another reason could be that larger firms are more likely to attract government contracts (Baker et al., 2016), the award of which depends heavily on economic policy.

In an extension to the baseline model, we consider the possibility that international aggregate uncertainty may affect uncertainty of German firms (see, e.g., Caggiano et al. (2020) and references therein, for an example of spillover effects to real activity). We rely on two measures. First, we use a financial uncertainty index for the United States (Ludvigson et al., 2021). The construction of the index is akin to that of macroeconomic uncertainty: it is computed as the time-varying volatility in the unforecastable component of many U.S. financial time series. Second, we include an index of global economic policy uncertainty (Davis, 2016). This index is a GDP-weighted average of the national policy uncertainty indices proposed by Baker et al. (2016).

International aggregate uncertainty has a positive impact on uncertainty of German firms. U.S. financial uncertainty is a positive and significant determinant, and it is equally important to the two domestic proxies macroeconomic and data uncertainty. In contrast, global policy uncertainty is important only for large firms' uncertainty, similar to domestic policy uncertainty. If large firms are more likely to enter international collaborations, these firms may have more incentives to closely follow also economic policies in other countries. Compared with domestic policy uncertainty, however, global policy uncertainty does not become relevant to all firms in recessions. Hence, firms appear to pay more attention to domestic economic policy than to economic policies in other countries during recessions.

Several robustness checks confirm our findings. One of the checks addresses the concern over endogeneity of macroeconomic uncertainty. Estimating an instrument-type two-stage regression, we find no evidence for endogeneity of macroeconomic uncertainty. For data uncertainty and policy uncertainty, there is ex-ante little reason to worry about endogeneity. Firms' expectation errors, from which firms' uncertainty is derived, should not influence the statistical office's revision errors, which we use to construct data uncertainty. Policy uncertainty should not be affected by firm-level uncertainty within a month. The reason is that it takes time for the real effects of firm-level uncertainty to fully materialize and until appropriate economic policy measures are discussed and implemented.

The present analysis relates to three strands of the recent uncertainty literature. First, we add to the literature that assesses firm-level uncertainty (see, e.g., Bloom et al., 2017; Awano et al., 2018; Bachmann et al., 2018; Altig et al., 2021). These papers establish a relationship between firms' past experiences and their uncertainty. High volatile growth rates in the past or either high or low past growth realizations are associated with higher firm-level uncertainty. Our results corroborate this. Whenever firms deal with changes in their own situation, firm-level uncertainty increases. In addition, we find that different types of aggregate uncertainty proxies have a significantly positive impact on firm-level uncertainty.

Second, we also provide support for the use of aggregate uncertainty proxies in firm-level studies. Due to lack of data, several papers cannot rely on firm-level uncertainty measures (see some of the references in footnote 1). We show that the most widely used aggregate uncertainty proxies are all positively linked to firm-specific uncertainty. Furthermore, domestic and global economic policy uncertainty are only an important driver for larger firms, supporting the use of these measures particularly for stock-market listed firms.

The third strand of the literature relates to the concept of data uncertainty. Data uncertainty can arise because of data revisions due to to the arrival of new information, sampling errors, or methodological advances of statistical offices (see, e.g., Ashley et al., 2005). Carriero et al. (2015) introduce the idea that actual uncertainty may deviate from the uncertainty proxy. The resulting measurement error can generate a downward bias in the impact of uncertainty on the business cycle. Jo and Sekkel (2019) analyze the effects of data revisions for the estimation of macroeconomic uncertainty. Data uncertainty measures for GDP, for several sub-components of GDP, and for the GDP deflator have been suggested for the United States, for the United Kingdom, and for the Euro Area at a quarterly frequency (Glass and Fritsche, 2014; Easaw et al., 2018; Galvao and Mitchell, 2019). We complement this literature by constructing two monthly measures of data uncertainty related to industrial production for Germany.

The rest of the paper is as follows: Section 2 outlines and discusses the uncertainty indices used in the present analysis. Section 3 undertakes the empirical analysis, while Section 4 considers further robustness tests. Finally, Section 5 provides some concluding remarks.

2 Measuring Uncertainty

2.1 Ifo Business Cycle Survey

We use data from the German Ifo Business Cycle Survey (henceforth Ifo), which is a monthly survey among business entities. From the survey, the Ifo Business Climate Index is constructed, which is a much-followed leading indicator for economic activity in Germany. The Ifo Institute has been conducting the survey since 1949. Since then, its survey design has been adopted by other countries, e.g., the survey of the U.K. manufacturing sector by the Confederation of British Industry or the Tankan survey for Japanese firms.

We carry out the analysis for the manufacturing sector (IBS-IND, 2019). The focus on this sector is because the variables needed to construct the firm-level uncertainty measure are only available for the manufacturing sector. We use data starting in 1997 because vintage data for the construction of our measures of data uncertainty is unavailable before 1997.

The Ifo survey covers a relatively high number of participants. At the beginning of our sample, the average number of respondents is approximately 2,800; at the end the number declines to 1,700. Firms voluntarily participate in the survey, with only 10% of all firms being one-time participants. On average, firms participate 76 times. Moreover, the Ifo data covers all types of firm sizes and sectors (see Table A8 in the Appendix).

2.2 Construction of Firm-Level Uncertainty

To estimate firm-specific uncertainty, we use the following two qualitative questions:[3]

[3] The questions of the Ifo survey for manufacturing have been translated into English. Firms are explicitly asked to ignore differences in the length of months or seasonal fluctuations. The survey is conducted at the product level, so firms operating in different product groups are asked to fill out different questionnaires. However, only 0.7% of the responses are multiple products (Link, 2020). Therefore, we use the terms 'firm' and 'product' interchangeably.

Production ($prod_{i,t}$): Our domestic production activity with respect to product XY has 'increased', 'roughly stayed the same', or 'decreased'.

Production Expectation ($prod^e_{i,t}$): Expectations for the next 3 months: Our domestic production activity with respect to product XY will probably 'increase', 'remain virtually the same', or 'decrease'.

Firms respond to the survey between the beginning and the middle of the month. Therefore, $prod_{i,t}$ is the change in production reported in t about the preceding month, for instance in the December-survey, firms report the change in production from October to November. Expectations are formed about month t, $t+1$, and $t+2$, for example in the December-survey, firms report expectations for the months December, January, and February.

Firm-specific uncertainty can be derived using individual forecast errors. Following Bachmann et al. (2013), we calculate the firm-specific forecast error $FE_{i,t}$ by comparing the expectation $prod^e_{i,t-3}$ to the realizations in the subsequent three months, $\overline{prod}_{i,t} = prod_{i,t-2} + prod_{i,t-1} + prod_{i,t}$. Since the Ifo survey provides qualitative data, we code a production increase as 1, a decrease as -1, and unchanged production as 0. Therefore, $\overline{prod}_{i,t}$ is in the range $[-3, 3]$. Likewise, $prod^e_{i,t}$ can assume values of 1 (increase), 0 (unchanged), and -1 (decrease).

The forecast error, $FE_{i,t}$, is given by the difference between $\overline{prod}_{i,t}$ and $prod^e_{i,t-3}$. The error falls within a range of -4 and 4; for instance, -4 indicates a large negative forecast error: the firm expects production to increase, but production in fact declines in all three months. Table 1 summarizes the possible outcomes of $FE_{i,t}$.

Similar to Comin and Mulani (2006), Davis et al. (2007), and Bachmann et al. (2019), we measure firm-level uncertainty using the twelve month rolling window standard deviation of firm i's forecast errors as

$$\sigma_{i,t} = \sqrt{\frac{1}{12} \sum_{k=0}^{11} \left(FE_{i,t+3-k} - \overline{FE}_{i,t+3} \right)^2},$$

where $\overline{FE}_{i,t+3} = \frac{1}{12} \sum_{l=0}^{11} FE_{i,t+3-l}$ is the rolling mean of the forecast error based on a window size of twelve months. Note that $\sigma_{i,t}$ measures uncertainty at the time when expectations are formed. Forming believes about the standard deviation of future errors, firms use production expectations up to period t and production realizations up to period $t+3$. We therefore assume that the current forecast error, which is not observed in real time, and past forecast errors are representative of the uncertainty perceived at time t.[4] Note that this is closely related to the concept of a stochastic volatility model, which provides an estimate of the time varying expected forecast error variance based on past experience and the assumption that volatility is persistent.

The uncertainty measure is advantageous along several dimensions. Unlike cross-sectional forecast dispersion measures, which assume a close relationship between disagreement among forecasters and individual uncertainty, our measure, σ_i, is directly related to the variability of the expected forecast error of an individual firm. Moreover, σ_i is robust to first-moment shocks to production, since a bias in the forecast, for instance due to consistent over-prediction or "optimism", will not affect the standard deviation.

Our uncertainty measure is constructed from survey responses of firms to production expectations and realizations. In contrast, some recent surveys ask firms directly for their perceived uncertainty (Bloom et al., 2017; Awano et al., 2018; Bachmann et al., 2018; Altig et al., 2021). While these new types of measures provide new insights, they also have noteworthy drawbacks, so that they cannot yet be used for our type of analysis. The new uncertainty measures are based on either a one-time survey or surveys that have been conducted for a relatively short period at a quarterly or annual frequency. Therefore, conclusions are mostly drawn from the cross-section. In contrast, our study relies on monthly data that covers more than two decades from 1997 to 2019.

2.3 Construction of Data Uncertainty

We construct two measures of data uncertainty for Germany following the U.S. measures proposed by Easaw et al. (2018). Both measures rely on monthly revision errors which are computed from real-time data for industrial production. The data is obtained from the Deutsche Bundesbank and available starting with the vintage in June 1995.

The monthly vintage estimate of year-on-year production growth, denoted by $\hat{Y}_t^{t+l}$, describes production growth in month t published in the vintage $t+l$. The first estimate for German

[4] We, thus, assume a certain degree of rationality of the firm with respect to the current (expected) forecast error. However, the remaining past forecast errors are readily observed by the firm.

production growth is released about 5 weeks after the reference month t ended, so that the first announcement is in $t+2$, e.g., production growth in January is first published in the beginning of March, usually around the eighth. Hence, $l \geq 2$.

We define $t+L$ to be the vintage of the final release of production growth in reference month t, where $L > l$. Then, the revision error for production growth between $t+L$ and the earlier release in $t+l$ is given by: $\hat{Y}_t^{t+L} - \hat{Y}_t^{t+l}$. We define the final release to be 12 months after the first release, $L = t + l + 12$, since revisions after that are very rare.

Based on the revision errors, we compute our two measures of data uncertainty. The first measure, the Mean Squared Revision Error ($MSRE$), is derived from the average of the past 12 revision errors:

$$MSRE^t = \frac{1}{12} \sum_{i=0}^{11} \left(\hat{Y}_{t-14-i}^{t-i} - \hat{Y}_{t-14-i}^{t-12-i} \right)^2 \ , \tag{1}$$

where $MSRE^t$ includes information about production growth realizations up to vintage t.

To arrive at our second measure for data uncertainty, $GARCH$, we estimate the conditional volatility of the revision errors using a GARCH(1,1).[5] The mean equation is

$$\hat{Y}_{t-14}^{t} - \hat{Y}_{t-14}^{t-12} = c + \epsilon_t \ ,$$

where c is a constant. The equation for the conditional variance is

$$\begin{aligned} \sigma_t^2 &= \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \\ &= GARCH^t \ , \end{aligned} \tag{2}$$

where ω is a constant and $GARCH^t$ includes information about production growth realizations up to vintage t. The coefficients α and β are highly significant (see Table B10 in the Appendix).

[5]The Lagrange multiplier test rejects the null hypothesis of no ARCH(1) effects.

2.4 Construction of Macroeconomic, Policy, and Financial Uncertainty

Macroeconomic uncertainty for Germany is constructed by Grimme and Stöckli (2018).[6] The indicator is based on the aggregate volatility of econometric forecasts for many macroeconomic time series following the idea of Jurado et al. (2015) for the United States. Uncertainty of a variable is defined as the conditional volatility of the unforecastable component of the future value of that variable. These individual estimates are averaged to a single index that reflects macroeconomic uncertainty.

Policy uncertainty for Germany is a newspaper-based uncertainty index. This measure draws on two German newspapers and counts the number of articles that contain words related to uncertainty and economic policy such as regulation, expenditures, household, deficit, Bundesbank, or European Central Bank. Further details on the construction can be found in Baker et al. (2016).

As international measures of aggregate uncertainty, we, first, use a financial uncertainty index for the United States (Ludvigson et al., 2021). The construction of the index is akin to that of the macroeconomic uncertainty index: it is computed as the time-varying volatility in the unforecastable component of many U.S. financial time series. Second, we include an index of global economic policy uncertainty (Davis, 2016). This index is a GDP-weighted average of the domestic policy uncertainty indices proposed by Baker et al. (2016).

In Appendix B, we plot the three domestic and the two international measures of aggregate uncertainty. Furthermore, we provide cross-correlations and auto-correlations of the series.

[6] Meinen and Röhe (2017) construct a similar measure for Germany.

3 Empirical Analysis

3.1 The Empirical Model

We use the following model to estimate the effects of the domestic aggregate uncertainty measures on firm-level uncertainty:

$$\sigma_{i,t} \ = \ c_i \ + \ \alpha_1 \, MU_t \ + \ \alpha_2 \, DU_t \ + \ \alpha_3 \, PU_t \ + \ B \, X_{i,t} \ + \ \epsilon_{i,t} \ , \tag{3}$$

where $\sigma_{i,t}$ describes firm-level uncertainty, MU_t is macroeconomic uncertainty, DU_t is data uncertainty – proxied by either $MSRE$ or $GARCH$ –, and PU_t is policy uncertainty. To compare the relative size of the coefficients α_1, α_2, and α_3, all uncertainty proxies are standardized by subtracting the mean and dividing by the standard deviation, respectively. The firm-level uncertainty proxy is standardized at the firm level, that is, the mean and standard deviation are specific to the firm. c_i captures firm-specific fixed effects, $X_{i,t}$ is a vector of control variables, and $\epsilon_{i,t}$ represents the error term.

One of the advantages of the Ifo survey is that it includes many firm-level variables that allow us to control for first-moment effects.[7] The variable *Business Situation* is indicative of the current business situation of a firm. The forward-looking variables *Business Expectation* and *Expected Employees* are included to control for optimism or pessimism. The variables *Orders* and *Demand* account for demand-side effects and, also, have a forward-looking component.

The firm-specific control variables have three possible response categories, e.g., firms can assess their current business situation as good, satisfactory, or unsatisfactory. To account for possible asymmetric effects, these variables are included with both positive and negative values separately. For example, the variable *Business Situation* is divided into two sub-variables. If firm i at time t reports its state as good, the variable $Statebus^+_{i,t}$ is equal to one and $Statebus^-_{i,t}$ is equal to zero. If the firm answers that its state is unsatisfactory, $Statebus^+_{i,t}$ is equal to zero and $Statebus^-_{i,t}$ is equal to one. If the firm believes that its state is satisfactory, both $Statebus^+_{i,t}$ and $Statebus^-_{i,t}$ are equal to zero, which is the baseline. We proceed analogously with *Business Expectations*, *Expected Employees*, *Orders*, and *Demand*.

[7] Table A9 in the Appendix provides a detailed description of the variables.

We also include two sets of aggregate variables constructed from the Ifo data to control for aggregate effects that could be, otherwise, picked up by our proxies for aggregate uncertainty. We use the firm-level responses to the questions related to the business situation and business expectations and compute balance statistics. $Agg\ Statebus_t^+$ is computed as the fraction of firms in the cross-section that reply with a "good" state of business in month t. Similarly, $Agg\ Statebus_t^-$ is the fraction of firms with an "unsatisfactory" state in month t. Analogously, we obtain $Agg\ Expbus_t^+$ and $Agg\ Expbus_t^-$. The two sets of aggregate variables proxy the current economic state and economic expectations, respectively. Note that the Ifo Business Climate Index, which is a much-followed leading indicator for overall economic activity in Germany, is computed solely from the two questions related to the business situation and business expectations. Therefore, we think that the four aggregate variables we constructed pick up all aggregate shocks that are omitted and potentially correlated with the aggregate uncertainty measures. All four variables are standardized by subtracting the mean and dividing by the standard deviation, respectively. Finally, we include seasonal dummies to control for seasonal fluctuations.

3.2 Results Based on Domestic Aggregate Uncertainty

3.2.1 Baseline Results

We estimate model (3) using monthly data from May 1997 to June 2019. The results are obtained using a linear fixed effects model. The model controls for unobservable individual characteristics, which can influence the impact of aggregate uncertainty on the uncertainty of a firm.

Table 2 presents the results. The standard errors are clustered at the firm level. All four models include a constant, seasonal dummies, two sets of variables that relate to the aggregate state and expectations, and the three aggregate uncertainty measures. The models in columns (3) and (4) contain, in addition, the set of firm-specific variables described in the previous section. The models in columns (1) and (3) include *MSRE* as a proxy for data uncertainty (*Data Unc 1*), those in columns (2) and (4) use *GARCH* as a proxy (*Data Unc 2*).

Macroeconomic and data uncertainty are both positive and highly significant. Both measures are equally important for firm-level uncertainty since they are not statistically different from each other. An increase in either measure by one standard deviation increases firm-level uncertainty by 0.05 to 0.06 standard deviations. On the other hand, policy uncertainty is not significant, albeit positive.

The control variables are mostly highly correlated with firm-level uncertainty. Regarding the two sets of aggregate variables: both a deterioration of the current aggregate state and an improvement of aggregate expectations significantly increase firm-level uncertainty. Therefore, firms' uncertainty reacts asymmetrically to changes in aggregate conditions and expectations. For the current aggregate state only bad assessments are relevant for uncertainty, which may be explained by the fact that firms incur fixed costs. If the aggregate state turns bad, firms become more uncertain about whether they can still sell enough to cover their fixed costs. Conversely, during good aggregate states, firms thrive and always earn enough to pay the fixed costs. Therefore, there is only a small impact on their uncertainty. On the other hand, only expectations about a positive aggregate outlook matter for firm-level uncertainty. This could be due to the idea that improved aggregate expectations imply more diverse business opportunities in the future. Firms may become more uncertain as to how to respond with respect to investment and hiring workers in the short-term.

Finally, the firm-level controls are all positive and significant. Any improvement or deterioration of the firms-specific factors always increases firm-level uncertainty irrespective whether the firm-level variable is forward looking or about contemporaneous events. Therefore, whenever the firm deals with changes of its own situation or expectations, firm-level uncertainty increases, confirming the results of Bloom et al. (2017); Awano et al. (2018); Bachmann et al. (2018); Altig et al. (2021).

In the remainder of Section 3.2, we will check whether firm heterogeneity, sectoral heterogeneity, and cyclical downturns change the effects of aggregate uncertainty on firm-level uncertainty.

3.2.2 Firm Heterogeneity

We now focus on the impact of firm heterogeneity. In the present analysis, firm heterogeneity is determined by the size of the firm. The Ifo data provides details about the number of employees per firm. We classify firms into one of five size groups: 1-49, 50-199, 200-499, 500-999, and over 1000 employees. We estimate an augmented version of model (3), where the three aggregate uncertainty proxies are interacted with the five firm size categories. Figure 1 depicts the point estimates and standard errors for the model with firm-specific control variables.[8] Blue (red) denotes the model in which data uncertainty is proxied by $MSRE$ ($GARCH$).

Macroeconomic uncertainty has a positive and significant impact on business uncertainty for all firm sizes. The impact is slightly higher for firms that have between 500 and 999 employees. Data uncertainty is positive and significant for all sizes, except for the largest firms, and the impact is, again, highest for firms with 500 to 999 employees. In contrast, policy uncertainty is positive and significant only for the largest firms. For all other firm sizes, policy uncertainty appears not to be relevant for firm-level uncertainty.

Firm size seems to matter for the importance of aggregate uncertainty for firm-level uncertainty. Overall, larger firms are more exposed to aggregate uncertainty than smaller firms. Particularly, this holds for policy uncertainty. Large firms appear to pay closer attention to economic policy plans and their communication. One reason could be that large firms have a higher turnover. Selling more requires larger investments which may be more widespread across the country compared to a small firm that may consist of only one plant. This involves longer-term planning which may be particularly sensitive to (expected) changes in (regional) government policies. Paying more attention to economic policy is consistent with rational inattention models where the quality of firms' information about macroeconomic conditions partially reflects their incentives to track and process such information (see, e.g., Alvarez et al., 2011; Coibion et al., 2018; Gorodnichenko, 2008). Therefore, large firms may devout more resources to assessing the macroeconomic state that is heavily influenced by economic policy. Since large firms have relatively large balance sheets, they are also more able to absorb the cost

[8] We also ran the model without firm-control variables, yielding very similar results. Also, we estimated separate regressions for each firm size instead of interacting the aggregate uncertainty proxies with the firm size dummies. The results are very similar.

of collecting and processing this information. Another reason could be that larger firms are more likely to attract government contracts (Baker et al., 2016), the award of which depends heavily on economic policy.

3.2.3 Sectoral Heterogeneity

Next, we consider whether sectoral heterogeneity has an impact on the relationship between firm-level and aggregate uncertainty. We estimate an augmented version of model (3), where the three aggregate uncertainty measures are interacted with 11 sectoral dummies. Figure 2 plots the point estimates and standard errors for the model with firm-specific control variables.[9] Blue (red) denotes the model in which data uncertainty is proxied by $MSRE$ ($GARCH$).

Macroeconomic and data uncertainty have a significant impact on firm-level uncertainty for most of the sectors. For macroeconomic uncertainty the exceptions are food, transport, and furniture; for data uncertainty the exceptions are chemicals, transport, and furniture. Policy uncertainty does not demonstrate a clear and positive significance for any of the sectors. Therefore, policy uncertainty as a determinant for firm-level uncertainty appears to be driven by firm size, but not by sectoral affiliation.

3.2.4 Effect of Recessions

Now we focus on the impact of aggregate uncertainty on firm-level uncertainty at different stages of the business cycle. Several papers show that the effects of aggregate uncertainty on different macroeconomic variables are larger in recessions (see, for instance, Caggiano et al., 2014; Nodari, 2014). Since recessions are typically accompanied by increasing uncertainty, the relationship between aggregate and firm-level uncertainty may be stronger during recessionary periods. To control for recessionary periods, we augment model (3) by interacting the three aggregate uncertainty measures with a recession dummy. Recessions are dated by the German Council of Economic Experts, which reports a recession during the years 2001 to 2003 and during 2008/09.

[9] We also ran the model without firm-control variables, yielding very similar results. As before, we also estimate separate regressions for each sector. The results are very similar.

Table 3 shows that during recessions macroeconomic uncertainty has a smaller impact on firm-level uncertainty. Going into a recession, it appears as if firms have already accounted for and altered their behaviour and become more concerned with idiosyncrasies. Therefore, macroeconomic uncertainty has a smaller impact. A similar result is found for data uncertainty as depicted by $MSRE$; for the $GARCH$-measure the impact does not differ. In contrast, policy uncertainty seems to matter only during recessionary periods. During these periods, firms may reasonably expect governments to be decisive and clear in their approach to counter-recessionary policies. Paying more attention to government's announcements and policies, firm-level uncertainty reacts more strongly to uncertainty about economic policy.

3.3 Results Based on Domestic and International Aggregate Uncertainty

The impact of global uncertainty on domestic real activity has been emphasized by several recent papers (see, Caggiano et al. (2020) and references therein). Therefore, it is possible that international aggregate uncertainty may influence the uncertainty of domestic firms. To analyse this channel, we include two measures for international aggregate uncertainty to model (3). Specifically, we look at U.S. Financial Uncertainty and global economic policy uncertainty. We exclude German policy uncertainty in all regressions in which we include global policy uncertainty because the global index includes the German index as well.

Table 4 presents the results when data uncertainty is proxied by $MSRE$.[10] U.S. financial uncertainty is positive and significant. It is equally important to macroeconomic and data uncertainty for the uncertainty of German firms. Compared to Table 2, however, the coefficients of macroeconomic and data uncertainty become a bit smaller. Policy uncertainty remains insignificant, the coefficient becomes smaller compared to the baseline.

Global policy uncertainty is positive and significant if U.S. financial uncertainty is excluded. Compared to macroeconomic and data uncertainty, the coefficient for global policy uncertainty is less than half the size. However, including financial uncertainty on top, the impact of global policy uncertainty on firm-level uncertainty converges to zero.

[10]Table C12 in the Appendix presents the corresponding results for the $GARCH$-measure, which are similar.

Previously, we showed that domestic policy uncertainty had a strong impact on firm-level uncertainty for large-sized firms. We check whether this link also holds for global policy uncertainty. Specifically, we re-estimate the model in column (6) from Table 4 but interact global policy uncertainty with the five firm size categories established in Section 3.2.2. Figure 3 shows that global policy uncertainty is still important for the uncertainty of large firms. Therefore, large firms appear to have the incentive to closely follow also international economic policies. However, global policy uncertainty does not become significant in recessions in contrast to domestic policy uncertainty (see Tables C13 and C14 in the Appendix). Therefore, in recessionary times, firms appear to pay more attention only to domestic economic policy but not to international economic policy.

Overall, the results show that U.S. financial uncertainty matters to the uncertainty of German firms, while global policy uncertainty is only relevant for large firms.

4 Robustness

4.1 Reverse Causality

In principle, it is possible that firm-level uncertainty may have a contemporaneous impact on the aggregate uncertainty measures, especially on macroeconomic uncertainty. Macroeconomic uncertainty is derived from econometric forecasts for many macroeconomic time series. These include, among others, industrial production, unemployment, prices, and foreign trade. Since firm-level uncertainty can have an instant effect on these aggregate time series, macroeconomic uncertainty could also be affected in the same month.

For data uncertainty, there is little reason to worry about endogeneity. This measure is based on revision errors which arise due to the arrival of additional hard data or methodological improvements by the statistical offices. In contrast, firm-level uncertainty is constructed from firms' expectation errors which mostly arise from shocks. Therefore, the volatility of revision errors should not be influenced by the volatility of firms' expectation errors.

For policy uncertainty, reverse causality may also be less of an issue. Strong increases in firm-level uncertainty reduce investment and production within the first six months (see, e.g., Bloom, 2009). This may lead to discussions about appropriate economic policy measures in the subsequent months, potentially resulting in increases in policy uncertainty. However, this chain of effects takes time and should not happen within a month. Hence, policy uncertainty should not be contemporaneously affected by firm-level uncertainty.

To mitigate the endogeneity concerns for macroeconomic uncertainty, we estimate an instrument-type two-stage regression. We use two sets of instruments proposed in the literature (see, e.g., Stein and Stone, 2013; Bloom et al., 2019): oil price volatility and exchange rate volatility. Oil price volatility is the volatility of the expected return on the WTI Crude Oil Forward Index. Here, we use 3-month forward prices obtained from Bloomberg. Exchange rate volatility is captured by two bilateral exchange rate volatilities (Euro vs. US-Dollar and Euro vs. Japanese Yen). Specifically, we rely on Thomson Reuters' 3-month option implied volatilities.[11]

In the first stage, we regress macroeconomic uncertainty on oil price volatility and exchange rate volatility, data uncertainty, policy uncertainty, and the proxies for the aggregate state and aggregate expectations. The results of the first stage are presented in Panel (a) of Table 5. The two sets of instruments are positive and significant and have explanatory power for macroeconomic uncertainty which is supported by the high values of the F-statistic.

In the second stage, we perform a firm-level regression which is identical to the baseline model except that macroeconomic uncertainty is replaced by the fitted values from the first-stage regression, i.e., the part of macroeconomic uncertainty that is explained by the exogenous variables. Standard errors in the second stage are bootstrapped based on 250 repetitions. Panel (b) of Table 5 shows that the results are similar to those of our baseline model (Table 2). The coefficients for macroeconomic uncertainty are only slightly smaller. Comparing, for example, column (4) of the two tables, respectively, the coefficient decreases from 0.049 to 0.043. Therefore, endogeneity of macroeconomic uncertainty does not appear to be a concern.

4.2 Construction of Firm-Level Uncertainty

Thus far, the measure of firm-level uncertainty is based on a backward-looking window of 12 forecast errors. As a further robustness check, we now consider variations to this.

[11]Due to lack of data before 1999, we link the implied volatility to the realized volatility of exchange rate forward rates, which we obtain from Macrobond.

First, we change the window size and instead use 9, 10, 11, 13, 14, and 15 monthly forecast errors. The results for $MSRE$ are presented in Table 6.[12] The models are estimated with all the firm-specific controls. Column (1) displays the results for the baseline uncertainty measure as a point of comparison. Both macroeconomic and data uncertainty continue to be positive and significant across all specifications. Policy uncertainty is insignificant at least at the 5% level. Therefore, our baseline findings remain robust.

Second, instead of a backward-looking window, we now use a symmetric window, which includes past and expected future forecast errors. Our baseline uncertainty measure is derived from past and present forecast errors. The proceeding is thus similar to an econometrician who makes an assessment using a stochastics volatility model which estimates the expected forecast error variance based on past forecast errors. However, if we assume rational expectations on the part of the firm, our uncertainty measure could also contain forecast errors from subsequent months that are only observed ex-post.

Table 7 depicts the results for $MSRE$.[13] The models are estimated with all the firm-specific controls. Column (1) displays the results for the baseline uncertainty measure. Compared to the baseline finding, the results remain qualitatively the same. Both macroeconomic and data uncertainty are positive and significant. Using a symmetric window, the effects of both measures of aggregate uncertainty appear to become even larger. In contrast, policy uncertainty is insignificant.

5 Concluding Remarks

The purpose of the paper is to assess the impact of aggregate uncertainty on firm-level uncertainty. A number of recent firm-level studies have analysed the effects of uncertainty on firm outcomes using measures of aggregate uncertainty. Regardless, individual firms undertake decisions based on the uncertainty they face, respectively. Indeed, in part, firm-level uncertainty may be driven by aggregate uncertainty. Hence, we attempt to provide some insight into the reliability of different measures of aggregate uncertainty as proxies for firm-level uncertainty. We use data

[12] Replacing $MSRE$ with $GARCH$ yields similar results (see Table C15 in the Appendix).

[13] We obtain similar results when we use $GARCH$ (see Table C16 in the Appendix).

from the German Ifo Business Cycle Survey to construct a firm-specific uncertainty measure. This measure is available monthly for a large panel of firms. Estimating panel regressions, we link several measures of domestic and international aggregate uncertainty, which reflect different types of uncertainty and volatility, to firm-level uncertainty.

Our empirical investigation provides three results. First, firm-level uncertainty positively responds to macroeconomic and data uncertainty. Second, in recessions, economic policy uncertainty becomes a positive contributor to firm-level uncertainty. However, over the entire business cycle, policy uncertainty matters only for the uncertainty of large firms. Third, international aggregate uncertainty has also a positive influence on firm-level uncertainty. While uncertainty of all German firms is affected by U.S. financial uncertainty, global policy uncertainty is important only for large firms' uncertainty.

Given that economic policy uncertainty appears to be the most widely-used uncertainty measure in the micro-econometric literature, our results suggest when to best use this indicator. Policy uncertainty seems to be particularly suitable for micro-level studies that focus on either large firms, such as stock-market listed firms, or cyclical downturns.

Table 1: Firm-Specific Forecast Errors

Expectation $prod^e_{i,t-3}$	**Realization** $\overline{prod}_{i,t}$	**Forecast Error** $FE_{i,t}$
Increase	> 0	0
Increase	≤ 0	$\overline{prod}_{i,t} - 1$
Unchanged	> 0	$\overline{prod}_{i,t}$
Unchanged	$= 0$	0
Unchanged	< 0	$\overline{prod}_{i,t}$
Decrease	< 0	0
Decrease	≥ 0	$\overline{prod}_{i,t} + 1$

Notes: $prod^e_{i,t-3}$ refers to production expectations in the Ifo survey. Realized change in production $\overline{prod}_{i,t}$ is the sum of $prod_{i,t}$, $prod_{i,t-1}$, and $prod_{i,t-2}$, based on the Ifo survey. The index t denotes the time of the survey.

Table 2: Baseline Results

Dependent Variable: Firm-Level Uncertainty				
	(1)	(2)	(3)	(4)
Macro Unc	0.053***	0.054***	0.049***	0.049***
	(0.009)	(0.009)	(0.008)	(0.008)
Data Unc 1	0.058***		0.059***	
	(0.007)		(0.007)	
Data Unc 2		0.054***		0.060***
		(0.007)		(0.007)
Policy Unc	0.008*	0.006	0.007	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Agg Statebus$^+$	-0.019	-0.021	-0.031*	-0.027*
	(0.016)	(0.016)	(0.016)	(0.016)
Agg Statebus$^-$	0.085***	0.077***	0.053***	0.046***
	(0.015)	(0.015)	(0.014)	(0.014)
Agg Expbus$^+$	0.063***	0.058***	0.042***	0.043***
	(0.009)	(0.009)	(0.009)	(0.009)
Agg Expbus$^-$	-0.002	-0.000	-0.021*	-0.014
	(0.012)	(0.012)	(0.011)	(0.011)
Statebus$^+$			0.038***	0.038***
			(0.014)	(0.014)
Statebus$^-$			0.223***	0.223***
			(0.014)	(0.014)
Expbus$^+$			0.103***	0.103***
			(0.011)	(0.011)
Expbus$^-$			0.031***	0.031***
			(0.010)	(0.010)
Orders$^+$			0.189***	0.189***
			(0.009)	(0.009)
Orders$^-$			0.158***	0.158***
			(0.009)	(0.009)
Expempl$^+$			0.074***	0.074***
			(0.017)	(0.017)
Expempl$^-$			0.140***	0.139***
			(0.013)	(0.013)
Demand$^+$			0.208***	0.209***
			(0.009)	(0.009)
Demand$^-$			0.128***	0.128***
			(0.009)	(0.009)
No. of obs.	330,847	330,847	325,391	325,391
R-squared	0.02	0.02	0.06	0.06
MU=DU	0.71	0.94	0.36	0.33
MU=PU	0.00	0.00	0.00	0.00

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies and a constant. Models (3) and (4) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 1* and *Data Unc 2*: data uncertainty ("DU") proxied by MSRE and GARCH, respectively; *Policy Unc*: economic policy uncertainty ("PU"); *Agg Statebus* and *Agg Expbus*: proxies for aggregate state and expectations. $MU = DU$ and $MU = PU$: Wald-test for coefficient equality (p-values).

Table 3: Aggregate Uncertainty Interaction with Recession Dummy

Dependent Variable: Firm-Level Uncertainty				
	(1)	(2)	(3)	(4)
Macro Unc	0.059***	0.054***	0.056***	0.051***
	(0.010)	(0.010)	(0.009)	(0.010)
Macro Unc × Recession	-0.041***	-0.012	-0.045***	-0.020
	(0.013)	(0.014)	(0.013)	(0.013)
Data Unc 1	0.073***		0.078***	
	(0.010)		(0.010)	
Data Unc 1 × Recession	-0.028**		-0.033***	
	(0.011)		(0.011)	
Data Unc 2		0.058***		0.064***
		(0.009)		(0.009)
Data Unc 2 × Recession		0.009		0.002
		(0.011)		(0.011)
Policy Unc	0.005	0.002	0.004	0.000
	(0.006)	(0.005)	(0.005)	(0.005)
Policy Unc × Recession	0.014*	0.016**	0.015**	0.016**
	(0.007)	(0.007)	(0.007)	(0.007)
Recession	0.002	-0.057**	0.013	-0.039
	(0.024)	(0.026)	(0.023)	(0.025)
Control Variables	no	no	yes	yes
No. of obs.	330,847	330,847	325,391	325,391

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Aggregate uncertainty proxies are interacted with recession dummy. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, and proxies for aggregate state and expectations. Models (3) and (4) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty; *Data Unc 1* and *Data Unc 2*: data uncertainty proxied by MSRE and GARCH, respectively; *Policy Unc*: economic policy uncertainty. *Recession*: dummy for recessionary periods.

Table 4: Domestic and International Aggregate Uncertainty

Dependent Variable: Firm-Level Uncertainty						
	(1)	(2)	(3)	(4)	(5)	(6)
Macro Unc	0.058***	0.029***	0.029***	0.054***	0.023**	0.022**
	(0.009)	(0.010)	(0.010)	(0.008)	(0.010)	(0.009)
Data Unc 1	0.057***	0.044***	0.044***	0.059***	0.044***	0.044***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Policy Unc		0.002			-0.000	
		(0.004)			(0.004)	
Global Policy Unc	0.021**		0.002	0.019**		-0.002
	(0.008)		(0.008)	(0.008)		(0.008)
Financial Unc		0.042***	0.042***		0.045***	0.045***
		(0.008)	(0.008)		(0.008)	(0.008)
Control Variables	no	no	no	yes	yes	yes
No. of obs.	330,847	330,847	330,847	325,391	325,391	325,391
MU=GPU	0.00		0.03	0.00		0.04
DU=GPU	0.00		0.00	0.00		0.00
MU=FU		0.39	0.42		0.14	0.12
DU=FU		0.83	0.80		0.97	0.93

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, and proxies for aggregate state and expectations. Models (4) to (6) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 1*: data uncertainty ("DU") proxied by MSRE; *Policy Unc*: economic policy uncertainty ("PU"); *Global Policy Unc*: Global Policy Uncertainty Index ("GPU"); *Financial Unc*: U.S. financial uncertainty ("FU"). $MU = GPU$, $DU = GPU$, $MU = FU$, and $DU = FU$: Wald-test for coefficient equality (p-values).

Table 5: Endogeneity of Macroeconomic Uncertainty

(a) First Stage				
Dependent Variable: Macroeconomic Uncertainty				
Vol Oil	0.013***	0.014***		
	(0.002)	(0.002)		
Vol USD	0.110***	0.107***		
	(0.019)	(0.020)		
Vol YEN	0.045***	0.046***		
	(0.013)	(0.013)		
Data Unc 1	0.123***			
	(0.045)			
Data Unc 2		0.146***		
		(0.044)		
Policy Unc	-0.314***	-0.311***		
	(0.044)	(0.043)		
Agg Statebus^{+}	0.771	0.907		
	(0.703)	(0.696)		
Agg Statebus^{-}	-2.757***	-2.762***		
	(0.714)	(0.709)		
Agg Expbus^{+}	3.364**	3.466**		
	(1.406)	(1.354)		
Agg Expbus^{-}	-2.599***	-2.670***		
	(0.989)	(0.976)		
No. of obs.	265	265		
F-Test	83.9***	83.6***		
(b) Second Stage				
Dependent Variable: Firm-Level Uncertainty				
	(1)	(2)	(3)	(4)
Fitted values of Macro Unc	0.046***	0.048***	0.042***	0.043***
	(0.012)	(0.010)	(0.010)	(0.010)
Data Unc 1	0.056***		0.058***	
	(0.007)		(0.006)	
Data Unc 2		0.052***		0.058***
		(0.007)		(0.007)
Policy Unc	0.010	0.008	0.008	0.006
	(0.007)	(0.007)	(0.007)	(0.006)
Control Variables	no	no	yes	yes
No. of obs.	330,847	330,847	325,391	325,391

* p < 0.10, ** p < 0.05, *** p < 0.01.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Panel (a): first stage: OLS regression of macroeconomic uncertainty on volatility of oil price futures, expected volatility of Euro vs. US-Dollar and Euro vs. Yen, data uncertainty, policy uncertainty, proxies for aggregate state and expectations, and a constant. F-test: test of excluded instruments (Kleibergen-Paap test). Panel (b): second stage: OLS regression of firm-level uncertainty on firm- and time-fixed effects, seasonal dummies, proxies for the aggregate state, and a constant. Firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. Models (3) and (4) include, in addition, all firm-specific control variables described in Section 3.1. *Macro Unc*: macroeconomic uncertainty; *Data Unc 1* and *Data Unc 2*: data uncertainty proxied by MSRE and GARCH, respectively; *Policy Unc*: economic policy uncertainty. Clustered (by firm) standard errors are in parentheses and computed using a bootstrap with 250 repetitions.

Table 6: Robustness: Window Size of Uncertainty

Dependent Variable: Firm-Level Uncertainty	Baseline	9 months	10 months	11 months	13 months	14 months	15 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Macro Unc	0.049***	0.046***	0.047***	0.048***	0.052***	0.054***	0.055***
	(0.008)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Data Unc 1	0.059***	0.056***	0.058***	0.059***	0.061***	0.061***	0.062***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Policy Unc	0.007	0.004	0.005	0.005	0.008*	0.008*	0.008*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Control Variables	yes	yes	yes	yes	yes	yes	yes
No. of obs.	325,391	349,154	339,901	331,968	317,613	310,848	304,569
MU=DU	0.36	0.32	0.29	0.29	0.41	0.53	0.60
MU=PU	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by a rolling window standard deviation of a firm's forecast errors: window size changes between 9 and 15 months, baseline is 12 months. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 1*: data uncertainty ("DU") proxied by MSRE; *Policy Unc*: economic policy uncertainty ("PU"). *MU = DU* and *MU = PU*: Wald-test for coefficient equality (p-values).

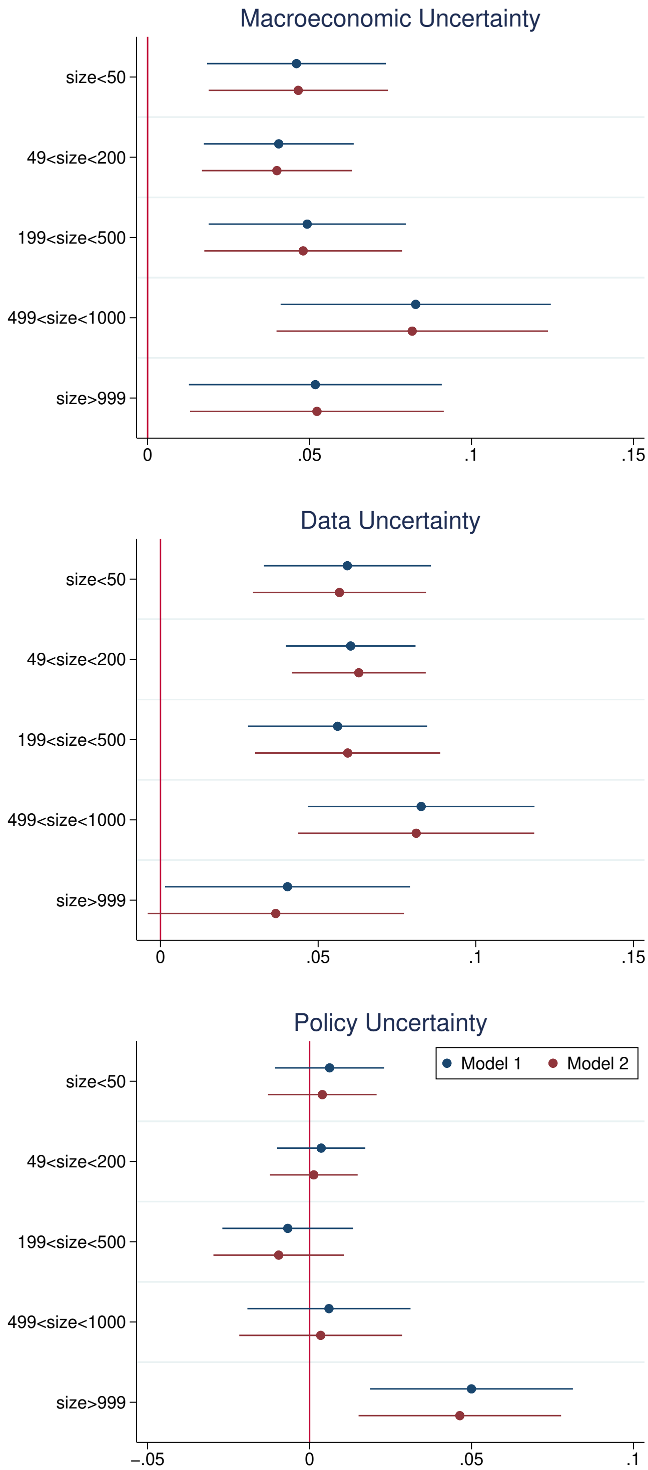
Table 7: Robustness: Symmetric Window Size of Uncertainty

Dependent Variable: Firm-Level Uncertainty	Baseline	9 months	11 months	13 months	15 months
	(1)	(2)	(3)	(4)	(5)
Macro Unc	0.049***	0.058***	0.065***	0.072***	0.078***
	(0.008)	(0.007)	(0.008)	(0.009)	(0.010)
Data Unc 1	0.059***	0.065***	0.070***	0.073***	0.076***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.008)
Policy Unc	0.007	-0.006	-0.005	-0.005	-0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Control Variables	yes	yes	yes	yes	yes
No. of obs.	325,391	341,313	322,821	306,982	292,552
MU=DU	0.36	0.47	0.70	0.95	0.87
MU=PU	0.00	0.00	0.00	0.00	0.00

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

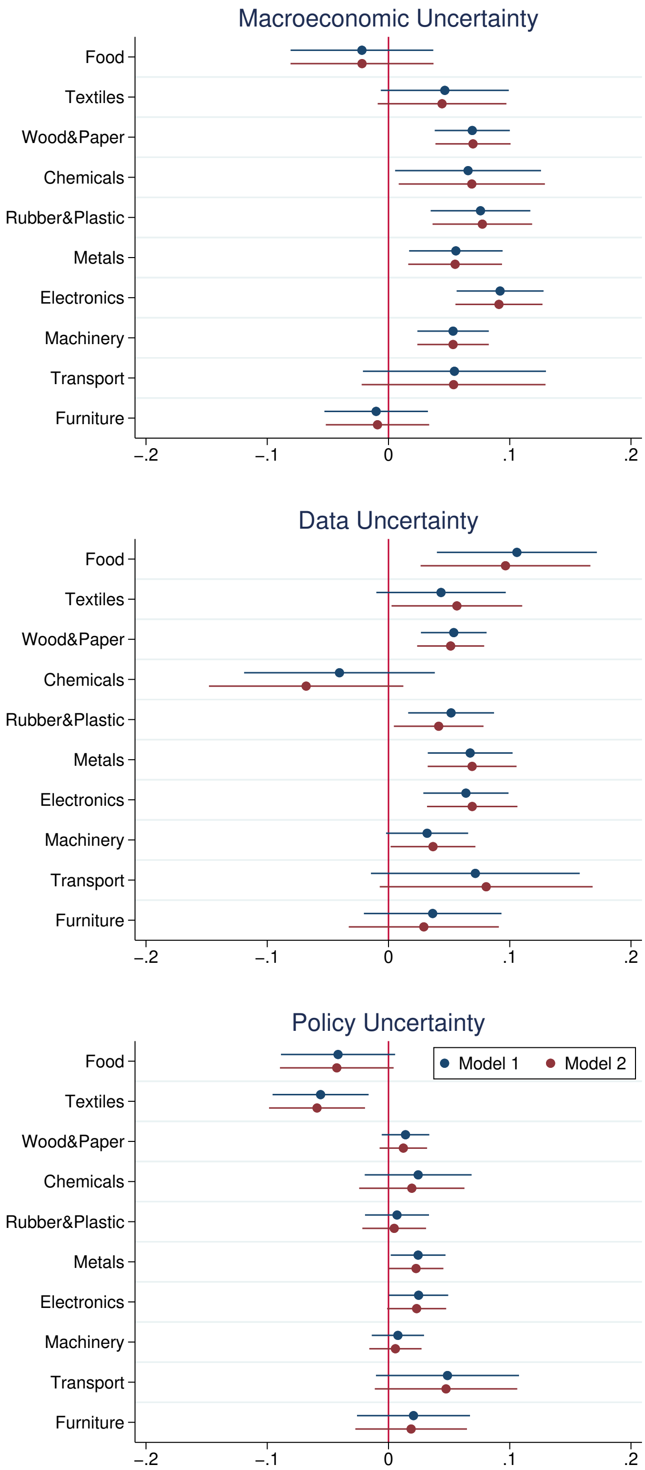
Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by a rolling window standard deviation of a firm's forecast errors: window is symmetric and window size changes between 9 and 15 months, baseline is 12 months and asymmetric window. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 1*: data uncertainty ("DU") proxied by MSRE; *Policy Unc*: economic policy uncertainty ("PU"). *MU = DU* and *MU = PU*: Wald-test for coefficient equality (p-values).

Figure 1: Aggregate Uncertainty Interacted with Firm Size



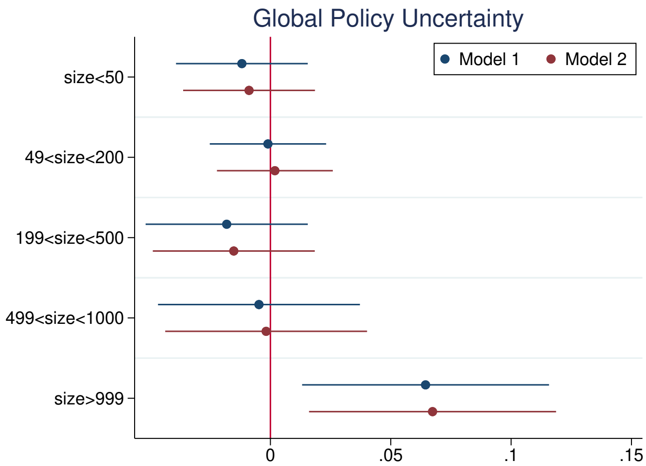
Notes: The figure reports coefficients and standard errors (clustered by firm). Aggregate uncertainty proxies are interacted with firm size dummies. Estimated using a linear panel fixed effects model. Included in the two models are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific variables described in Section 3.1. *Model 1* estimated with *Data Unc 1*, *Model 2* estimated with *Data Unc 2*. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors.

Figure 2: Aggregate Uncertainty Interacted with Sector Dummies



Notes: The figure reports coefficients and standard errors (clustered by firm). Aggregate uncertainty proxies are interacted with sector dummies. Estimated using a linear panel fixed effects model. Included in the two models are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific variables described in Section 3.1. *Model 1* estimated with *Data Unc 1*, *Model 2* estimated with *Data Unc 2*. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors.

Figure 3: Global Policy Uncertainty Interacted with Firm Size



Notes: The figure reports coefficients and standard errors (clustered by firm). Global policy uncertainty interacted with firm size dummies. Estimated using a linear panel fixed effects model. Included in the two models are seasonal dummies, a constant, proxies for aggregate state and expectations, four aggregate uncertainty measures (macroeconomic, data, global policy, and financial), and all firm-specific control variables described in Section 3.1. *Model 1* estimated with *Data Unc 1*, *Model 2* estimated with *Data Unc 2*. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors.

References

Alessandri, P. and M. Bottero (2021). Bank lending in uncertain times. *European Economic Review*, forthcoming.

Altig, D., J. M. Barrero, N. Bloom, S. J. Davis, B. H. Meyer, and N. Parker (2021). Surveying business uncertainty. *Journal of Econometrics*, forthcoming.

Alvarez, F. E., F. Lippi, and L. Paciello (2011). Optimal price setting with observation and menu costs. *The Quarterly Journal of Economics 126*(4), 1909–1960.

Ashley, J., R. Driver, S. Hayes, and C. Jeffery (2005, Spring). Dealing with data uncertainty. *Bank of England Quarterly Bulletin*, 23–30.

Awano, G., N. Bloom, T. Dolby, P. Mizen, R. Riley, T. Senga, J. V. Reenen, J. Vyas, and P. Wales (2018). A firm-level perspective on micro- and macro-level uncertainty. ESCoE Discussion Paper No. 2018-10.

Bachmann, R., B. Born, S. Elstner, and C. Grimme (2019). Time-varying business volatility and the price setting of firms. *Journal of Monetary Economics 101*, 82–99.

Bachmann, R., K. Carstensen, S. Lautenbacher, and M. Schneider (2018). Uncertainty and change: Survey evidence of firms' subjective beliefs. Mimeo.

Bachmann, R., S. Elstner, and E. R. Sims (2013). Uncertainty and economic activity: Evidence from business survey data. *American Economic Journal: Macroeconomics 5*(2), 217–249.

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

Barraza, S. and A. Civelli (2019). Economic policy uncertainty and the supply of business loans. Universidad de San Andres Working Paper No 134.

Baum, C. F., M. Caglayan, and O. Talavera (2008). Uncertainty determinants of firm investment. *Economics Letters 98*(3), 282–287.

Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica 77*(3), 623–686.

Bloom, N., I. Alfaro, and X. Lin (2019). The finance uncertainty multiplier. Stanford Mimeo.

Bloom, N., S. J. Davis, L. Foster, B. Lucking, S. Ohlmacher, and I. Saporta-Eksten (2017). Business-level expectations and uncertainty. Stanford Mimeo.

Bordo, M. D., J. V. Duca, and C. Koch (2016). Economic policy uncertainty and the credit channel: Aggregate and bank level U.S. evidence over several decades. *Journal of Financial Stability 26*, 90–106.

Caggiano, G., E. Castelnuovo, and J. M. Figueres (2020). Economic policy uncertainty spillovers in booms and busts. *Oxford Bulletin of Economics and Statistics 82*(1), 125–155.

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

Carriero, A., H. Mumtaz, K. Theodoridis, and A. Theophilopoulou (2015). The impact of uncertainty shocks under measurement error: A proxy SVAR approach. *Journal of Money, Credit and Banking 47*(6), 1223–1238.

Coibion, O., Y. Gorodnichenko, and S. Kumar (2018). How do firms form their expectations? New survey evidence. *American Economic Review 108*(9), 2671–2713.

Comin, D. and S. Mulani (2006). Diverging trends in aggregate and firm volatility. *The Review of Economics and Statistics 88*(2), 374–383.

Davis, S. J. (2016). An index of global economic policy uncertainty. NBER Working Paper No. 22740.

Davis, S. J., J. Haltiwanger, R. Jarmin, and J. Miranda (2007). Volatility and dispersion in business growth rates: Publicly traded versus privately held firms. In D. Acemoglu, K. Rogoff, and M. Woodford (Eds.), *NBER Macroeconomics Annual 2006, Volume 21*, pp. 107–180.

Dixon, H. and C. Grimme (2021). State-dependent or time-dependent pricing? New evidence from a monthly firm-level survey: 1980–2017. Cardiff Economics Working Paper No. E2021/1.

Easaw, J., R. Golinelli, and S. Heravi (2018). Professionals forecasting inflation: The role of inattentiveness and uncertainty. Mimeo.

Galvao, A. B. and J. Mitchell (2019). Measuring data uncertainty: An application using the Bank of England's "Fan Charts" for historical GDP growth. WBS EMF Working Paper Series No. 24.

Gilchrist, S., J. Sim, and E. Zakrajšek (2014). Uncertainty, financial frictions, and investment dynamics. NBER Working Paper No. 20038.

Glass, K. and U. Fritsche (2014). Real-time macroeconomic data and uncertainty. DEP Discussion Papers No. 6/2014.

Gorodnichenko, Y. (2008). Endogenous information, menu costs and inflation persistence. NBER Working Paper No. 14184.

Grimme, C. and S. Henzel (2020). Increasing business uncertainty and credit conditions in times of low and high uncertainty: Evidence from firm-level survey data. CESifo Working Paper No. 8791.

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

Guiso, L. and G. Parigi (1999). Investment and demand uncertainty. *The Quarterly Journal of Economics 114*(1), 185–227.

IBS-IND (2019). Ifo business survey industry 1/1980 – 06/2019. LMU-ifo Economics & Business Data Center, Munich.

Jo, S. and R. Sekkel (2019). Macroeconomic uncertainty through the lens of professional forecasters. *Journal of Business & Economic Statistics 37*(3), 436–446.

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

Koga, M., Y. Koichi, and T. Sakata (2020). Strategic complementarity and asymmetric price setting among firms. BIS Paper No. 111i.

Leahy, J. V. and T. M. Whited (1996). The effect of uncertainty on investment: Some stylized facts. *Journal of Money, Credit and Banking 28*(1), 64–83.

Link, S. (2020). Harmonization of the Ifo business survey's micro data. *Journal of Economics and Statistics 240*(4), 543–555.

Ludvigson, S. C., S. Ma, and S. Ng (2021). Uncertainty and business cycles: Exogenous impulse or endogenous response. *American Economic Journal: Macroeconomics*. forthcoming.

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

Nodari, G. (2014). Financial regulation policy uncertainty and credit spreads in the U.S. *Journal of Macroeconomics 41*, 122–132.

Smietanka, P., N. Bloom, and P. Mizen (2018). Business investment, cash holding and uncertainty since the great financial crisis. Bank of England Staff Working Paper No. 753.

Stein, L. C. D. and E. C. Stone (2013). The effect of uncertainty on investment, hiring, and R&D: Causal evidence from equity options. Unpublished Paper.

Valencia, F. (2017). Aggregate uncertainty and the supply of credit. *Journal of Banking & Finance 81*, 150–165.

Appendix

A Details on the Ifo Data

Table A8: Frequency of Observations

	Number of Employees				
Industry Sector	1–49	50–199	200–499	500–999	$\geq$ 1000
Food and tobacco	36.3	36.8	13.6	7.3	6.0
Textile products	29.8	44.6	18.5	4.3	2.8
Leather	33.7	36.3	23.1	6.5	0.3
Cork and wood products	65.6	24.7	6.7	1.8	1.1
Furniture and jewelery	26.2	44.6	19.4	6.9	2.8
Paper and publishing	38.1	41.4	13.9	5.2	1.5
Elect. and opt. equipment	25.7	34.8	18.7	11.1	9.8
Chemical products	29.7	31.3	17.9	9.5	11.7
Rubber and plastic	34.3	37.8	14.5	7.4	6.0
Other non-metallic products	30.8	35.4	20.1	9.3	4.5
Metal products	31.4	37.9	18.3	6.8	5.7
Machinery and equipment	21.3	33.5	21.1	11.5	12.5
Transport equipment	11.9	19.7	16.2	15.4	36.8

Notes: This table provides the shares of observations in each industry sector for sub-samples of different firm sizes. The frequencies are computed for the period 1997 to 2019.

Table A9: Questionnaire

Number	Label	Question	Response Categories		
Q1	*Production*	Our domestic production activity with respect to product XY have ...	increased	roughly stayed the same	decreased
Q2	*E(Production)*	Expectations for the next 3 months: Our domestic production activity with respect to product XY will probably ...	increase	remain virtually the same	decrease
Q3	*Business Situation*	We evaluate our business situation with respect to XY as ...	good	satisfactory	unsatisfactory
Q4	*Business Expectations*	Expectations for the next 6 months: Our business situation with respect to XY will in a cyclical view ...	improve	remain about the same	develop unfavourably
Q5	*Orders*	Our orders with respect to product XY have ...	increased	roughly stayed the same	decreased
Q6	*Employment Expectations*	Expectations for the next 3 months: Employment related to the production of XY in domestic production unit(s) will probably ...	increase	roughly stay the same	decrease
Q7	*Demand*	The situation of demand for XY has ...	improved	not changed	deteriorated

Notes: This table provides the translated questions and response possibilities of the ifo survey for manufacturing. For the production questions Q1 and Q2, firms are explicitly asked to ignore differences in the length of months or seasonal fluctuations.

B Aggregate Uncertainty Measures

Table B10: Computing Data Uncertainty from a GARCH(1,1)

Dependent Variable: Revision Error $\left(\hat{Y}^{t}_{t-14} - \hat{Y}^{t-12}_{t-14}\right)$	
Conditional Mean Equation	
c	-0.196***
	(0.043)
Conditional Variance Equation	
α	0.093***
	(0.025)
β	0.887***
	(0.0722)
ω	0.012
	(0.007)
Observations	273
ARCH-LM Test	16.0***

* p < 0.10, ** p < 0.05, *** p < 0.01.

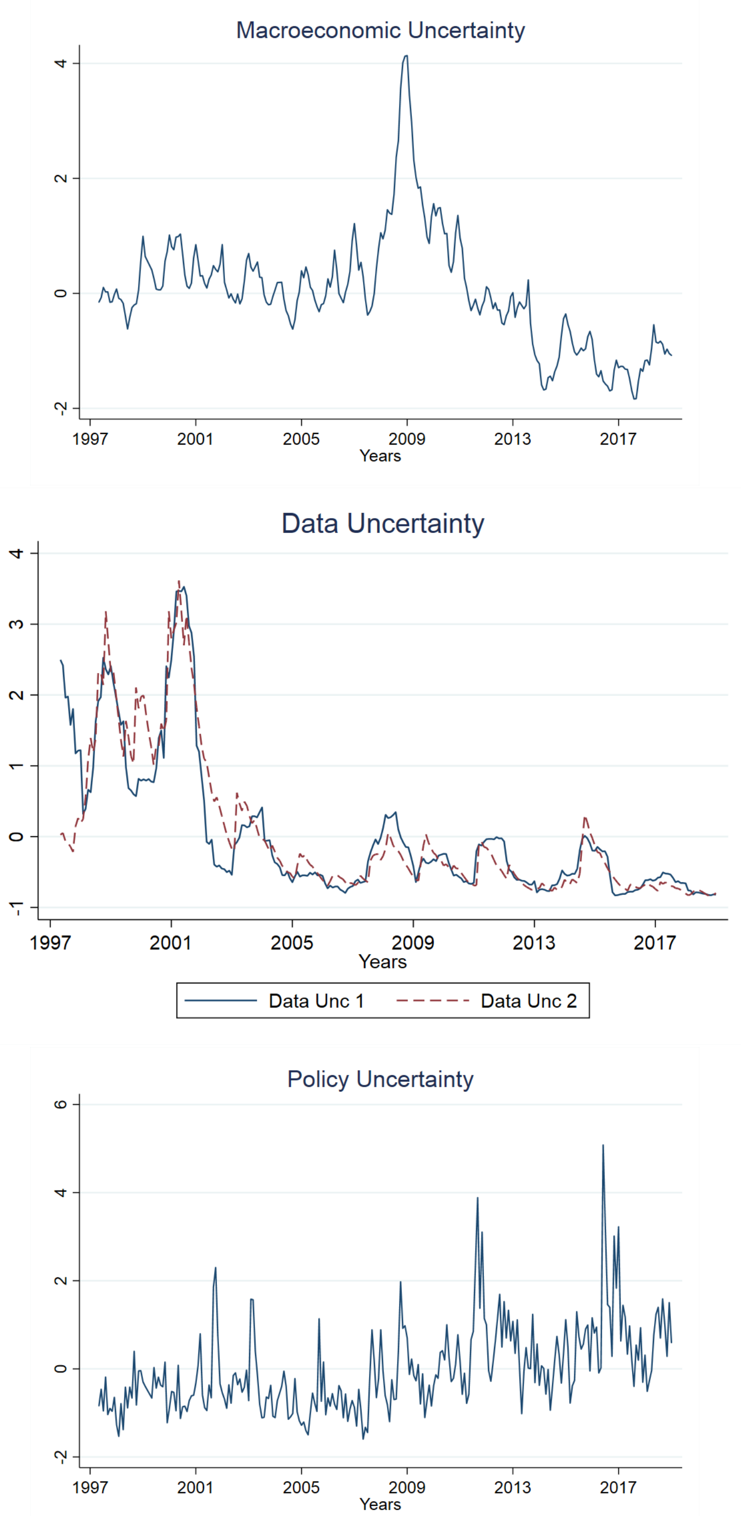
Notes: The table reports coefficients, standard errors in parentheses. The conditional mean equation is $\hat{Y}^{t}_{t-14} - \hat{Y}^{t-12}_{t-14} = c + \epsilon_t$, where $\hat{Y}^{t}_{t-14}$ denotes production growth in $t-14$, known in vintage t. The equation for the conditional variance is $\sigma^2_t = \omega + \alpha\epsilon^2_{t-1} + \beta\sigma^2_{t-1}$, c and ω are both constants. *ARCH-LM Test*: test for autoregressive conditional heteroskedasticity.

Table B11: Cross-Correlations and Autocorrelations of Aggregate Uncertainty Measures

	Macro Unc	Data Unc 1	Data Unc 2	Policy Unc	Global Policy Unc	Financial Unc
Macro Unc	1.00					
Data Unc 1	0.20	1.00				
Data Unc 2	0.21	0.89	1.00			
Policy Unc	-0.22	-0.21	-0.23	1.00		
Global Policy Unc	-0.28	-0.31	-0.34	0.79	1.00	
Financial Unc	0.66	0.43	0.50	0.03	0.04	1.00
Autocorrelation	0.97	0.97	0.98	0.64	0.90	0.98

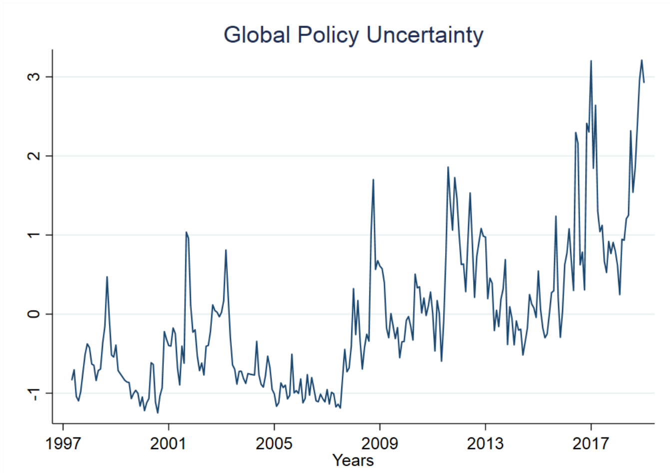
Notes: Pairwise unconditional time-series correlation coefficients. *Macro Unc*: macroeconomic uncertainty for Germany, mean of conditional volatility of the unforecastable component of a set of macroeconomic variables; *Data Unc 1* and *Data Unc 2*: data uncertainty for Germany, proxied by mean squared past revision error and conditional volatility from GARCH model, respectively; *Policy Unc*: economic policy uncertainty for Germany, newspaper-based uncertainty index; *Global Policy Unc*: international economic policy uncertainty, newspaper-based uncertainty index; *Financial Unc*: mean of conditional volatility of the unforecastable component of a set of financial variables for the United States. *Autocorrelation*: first order autocorrelation. The time period is from 1997:m5 till 2019:m3.

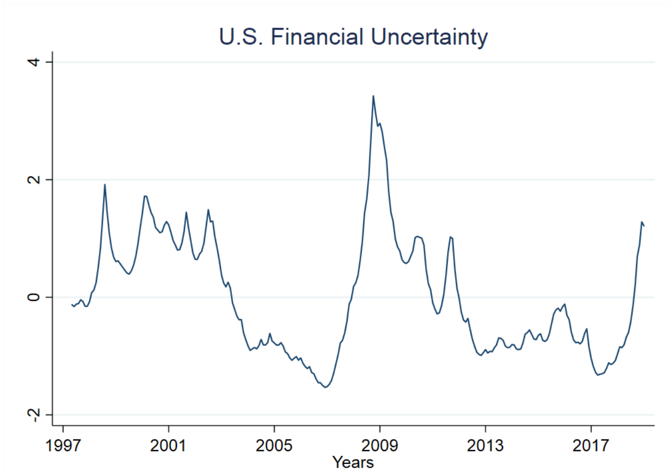
Figure B4: Measures of Domestic Aggregate Uncertainty



Notes: Macroeconomic uncertainty: mean of conditional volatility of the unforecastable component of a set of macroeconomic variables. Data uncertainty: *Data Unc 1* proxied by MSRE (mean squared past revision error) and *Data Unc 2* proxied by GARCH (conditional volatility from GARCH model). Policy uncertainty: newspaper-based uncertainty index. The measures are rescaled to have zero mean and a standard deviation of one. The time period is from 1997 to 2019.

Figure B5: Measures of International Aggregate Uncertainty





Notes: Global Policy uncertainty: newspaper-based uncertainty index. Financial uncertainty: mean of conditional volatility of the unforecastable component of a set of financial variables for the United States. The measures are rescaled to have zero mean and a standard deviation of one. The time period is from 1997 to 2019.

C Further Robustness Checks

Table C12: Domestic and International Aggregate Uncertainty

Dependent Variable: Firm-Level Uncertainty						
	(1)	(2)	(3)	(4)	(5)	(6)
Macro Unc	0.059***	0.033***	0.035***	0.053***	0.028***	0.029***
	(0.009)	(0.010)	(0.010)	(0.008)	(0.010)	(0.009)
Data Unc 2	0.054***	0.036***	0.037***	0.060***	0.042***	0.042***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)
Policy Unc		0.001			-0.001	
		(0.004)			(0.004)	
Global Policy Unc	0.020**		0.005	0.017**		0.001
	(0.008)		(0.008)	(0.008)		(0.008)
Financial Unc		0.038***	0.036***		0.038***	0.037***
		(0.009)	(0.009)		(0.008)	(0.008)
Control Variables	no	no	no	yes	yes	yes
No. of obs.	330,847	330,847	330,847	325,391	325,391	325,391
MU=GPU	0.00		0.01	0.00		0.02
DU=GPU	0.00		0.00	0.00		0.00
MU=FU		0.76	0.96		0.50	0.58
DU=FU		0.93	0.92		0.79	0.73

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, and proxies for aggregate state and expectations. Models (4) to (6) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 2*: data uncertainty ("DU") proxied by GARCH; *Policy Unc*: economic policy uncertainty ("PU"); *Global Policy Unc*: Global Policy Uncertainty Index ("GPU"); *Financial Unc*: U.S. financial uncertainty ("FU"). $MU = GPU$, $DU = GPU$, $MU = FU$, and $DU = FU$: Wald-test for coefficient equality (p-values).

Table C13: Domestic and International Aggregate Uncertainty: Interaction with Recession Dummy

Dependent Variable: Firm-Level Uncertainty						
	(1)	(2)	(3)	(4)	(5)	(6)
Macro Unc	0.063***	0.035***	0.036***	0.059***	0.032***	0.032***
	(0.010)	(0.012)	(0.011)	(0.009)	(0.011)	(0.011)
Macro Unc × Recession	-0.041***	-0.061***	-0.062***	-0.044***	-0.067***	-0.067***
	(0.014)	(0.016)	(0.016)	(0.013)	(0.016)	(0.015)
Data Unc 1	0.072***	0.052***	0.052***	0.077***	0.054***	0.054***
	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
Data Unc 1 × Recession	-0.025**	-0.011	-0.010	-0.030***	-0.014	-0.013
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Policy Unc		-0.001			-0.002	
		(0.005)			(0.005)	
Policy Unc × Recession		0.013*			0.014*	
		(0.007)			(0.007)	
Global Policy Unc	0.017*		0.002	0.014*		-0.001
	(0.009)		(0.009)	(0.009)		(0.008)
Global Policy Unc × Recession	0.021*		0.016	0.021*		0.015
	(0.012)		(0.013)	(0.012)		(0.013)
Financial Unc		0.039***	0.038***		0.040***	0.039***
		(0.009)	(0.009)		(0.009)	(0.009)
Financial Unc × Recession		0.057***	0.058***		0.059***	0.060***
		(0.017)	(0.018)		(0.017)	(0.017)
Recession	0.002	-0.061**	-0.061**	0.012	-0.051**	-0.052**
	(0.025)	(0.026)	(0.027)	(0.024)	(0.025)	(0.026)
Control Variables	no	no	no	yes	yes	yes
No. of obs.	330,847	330,847	330,847	325,391	325,391	325,391

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Aggregate uncertainty proxies are interacted with recession dummy. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, and proxies for aggregate state and expectations. Models (4) to (6) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty; *Data Unc 1*: data uncertainty proxied by MSRE; *Policy Unc*: economic policy uncertainty; *Global Policy Unc*: Global Policy Uncertainty Index; *Financial Unc*: U.S. financial uncertainty. *Recession*: dummy for recessionary periods.

Table C14: Domestic and International Aggregate Uncertainty: Interaction with Recession Dummy

Dependent Variable: Firm-Level Uncertainty						
	(1)	(2)	(3)	(4)	(5)	(6)
Macro Unc	0.059***	0.032***	0.034***	0.055***	0.030***	0.031***
	(0.010)	(0.012)	(0.011)	(0.009)	(0.011)	(0.011)
Macro Unc × Recession	-0.010	-0.034**	-0.034**	-0.017	-0.042**	-0.042**
	(0.014)	(0.017)	(0.017)	(0.014)	(0.016)	(0.016)
Data Unc 2	0.058***	0.027***	0.028***	0.064***	0.033***	0.034***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Data Unc 2 × Recession	0.011	0.027**	0.028**	0.005	0.021*	0.021*
	(0.011)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)
Policy Unc		-0.005			-0.006	
		(0.005)			(0.005)	
Policy Unc × Recession		0.018**			0.018**	
		(0.007)			(0.007)	
Global Policy Unc	0.018**		0.001	0.015*		-0.002
	(0.009)		(0.009)	(0.009)		(0.008)
Global Policy Unc × Recession	0.020*		0.020	0.017		0.017
	(0.012)		(0.013)	(0.012)		(0.013)
Financial Unc		0.045***	0.043***		0.044***	0.043***
		(0.010)	(0.010)		(0.009)	(0.009)
Financial Unc × Recession		0.040**	0.043**		0.041**	0.044**
		(0.018)	(0.018)		(0.017)	(0.018)
Recession Dummy	-0.059**	-0.098***	-0.100***	-0.042*	-0.081***	-0.085***
	(0.027)	(0.027)	(0.028)	(0.026)	(0.026)	(0.027)
Control Variables	no	no	no	yes	yes	yes
No. of obs.	330,847	330,847	330,847	325,391	325,391	325,391

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Aggregate uncertainty proxies are interacted with recession dummy. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, and proxies for aggregate state and expectations. Models (4) to (6) include, in addition, all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by the twelve month rolling window standard deviation of a firm's forecast errors. *Macro Unc*: macroeconomic uncertainty; *Data Unc 2*: data uncertainty proxied by GARCH; *Policy Unc*: economic policy uncertainty; *Global Policy Unc*: Global Policy Uncertainty Index; *Financial Unc*: U.S. financial uncertainty. *Recession*: dummy for recessionary periods.

Table C15: Robustness: Window Size of Uncertainty

Dependent Variable: Firm-Level Uncertainty	Baseline	9 months	10 months	11 months	13 months	14 months	15 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Macro Unc	0.049***	0.046***	0.047***	0.048***	0.051***	0.053***	0.055***
	(0.008)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Data Unc 2	0.060***	0.055***	0.057***	0.059***	0.062***	0.062***	0.062***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Policy Unc	0.004	0.002	0.002	0.002	0.006	0.006	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Control Variables	yes	yes	yes	yes	yes	yes	yes
No. of obs.	325,391	349,154	339,901	331,968	317,613	310,848	304,569
MU=DU	0.33	0.42	0.36	0.33	0.38	0.47	0.60
MU=PU	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by a rolling window standard deviation of a firm's forecast errors: window size changes between 9 and 15 months, baseline is 12 months. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 2*: data uncertainty ("DU") proxied by GARCH; *Policy Unc*: economic policy uncertainty ("PU"). $MU = DU$ and $MU = PU$: Wald-test for coefficient equality (p-values).

Table C16: Robustness: Symmetric Window and Window Size of Uncertainty

Dependent Variable: Firm-Level Uncertainty	Baseline	9 months	11 months	13 months	15 months
	(1)	(2)	(3)	(4)	(5)
Macro Unc	0.049***	0.059***	0.066***	0.073***	0.079***
	(0.008)	(0.007)	(0.008)	(0.009)	(0.010)
Data Unc 2	0.060***	0.060***	0.063***	0.066***	0.069***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Policy Unc	0.004	-0.009**	-0.008**	-0.009*	-0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Control Variables	yes	yes	yes	yes	yes
No. of obs.	325,391	341,313	322,821	306,982	292,552
MU=DU	0.33	0.93	0.82	0.54	0.42
MU=PU	0.00	0.00	0.00	0.00	0.00

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table reports coefficients; clustered (by firm) standard errors are in parentheses. Estimated using a linear panel fixed effects model. Included in all models but not shown in the table are seasonal dummies, a constant, proxies for aggregate state and expectations, and all firm-specific control variables described in Section 3.1. Dependent variable is firm-level uncertainty measured by a rolling window standard deviation of a firm's forecast errors: window is symmetric and window size changes between 9 and 15 months, baseline is 12 months and asymmetric window. *Macro Unc*: macroeconomic uncertainty ("MU"); *Data Unc 1*: data uncertainty ("DU") proxied by GARCH; *Policy Unc*: economic policy uncertainty ("PU"). $MU = DU$ and $MU = PU$: Wald-test for coefficient equality (p-values).