Demand or Supply? Price Adjustment Heterogeneity during the Covid-19 Pandemic**

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Abstract

We study price-setting behavior and subjective perceptions in German firm-level survey data to infer the relative importance of supply and demand during the Covid-19 pandemic. Demand shortages dominate at the onset of the pandemic. A reported negative impact of Covid-19 on current business is associated with a rise in the probability to decrease prices up to ten percentage points in this episode. Supply forces gain in importance during the ensuing sudden surge in inflation and firms perceive goods supply shortages as most restrictive. Firms adversely affected during the early inflation decline show no higher probability of price increases.

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1 Introduction

The 2020 Covid-19 recession and its aftermath has been disrupting economies across the globe. This paper estimates the relative importance of supply and demand in this episode, a key determinant for the scope and design of effective stabilization policy. To this end, we study producers' price-setting decisions along the extensive margin as well as their subjective perceptions about the nature of adverse effects due to the pandemic using German firm-level panel data from the ifo Business Climate Survey (ifo-BCS).

The results suggest that demand plays a dominant role to understand the early decline in economic activity in the wake of the Covid-19 pandemic. Relative to those weakly affected, firms that report a negative impact of Covid-19 on their current business situation are up to ten percentage points—or three standard deviations—more likely to decrease prices. In a standard demand–supply framework, increasing prices reflect supply shortages and decreasing prices reflect demand shortages, all else equal. Similarly, firms attribute the most adverse effects of the pandemic to domestic and foreign demand through the spring of 2021. After that, supply forces gain in importance and firms perceive goods supply shortages as the most adverse effect. Firms that lowered their prices at the onset of the pandemic due to a more adverse impact do not show a relatively higher chance for price increases. Firms' subjective perceptions suggest persistent adverse effects of the pandemic at the firm level.

Consistent with these findings, aggregate producer price inflation in 2020 declined in the wake of the Covid-19 pandemic, followed by a sudden surge in 2021. However, firm-level panel data offer at least four advantages over aggregate time series: we can (i) control for other determinants of price adjustments that affect inflation irrespective of the Covid-19 outbreak, including the preceding decline in economic activity, (ii) overcome aggregation issues that potentially bias inflation dynamics,[1] (iii) track rapid changes in

[1] Cavallo (2020) and Alvarez and Lein (2020) show that short-run shifts in expenditure patterns bias price indices of *aggregate* inflation. This challenge does not apply to individual price quotes.

economic activity, given the monthly frequency of the data, and (iv) link observed price-stetting behavior to additional firm-level outcomes and firms' perceptions. For example, the survey questionnaire regularly asks firms about the role of (intermediate) goods supply and labor supply shortages. Another major advantage of firm-level panel data over time series or sectoral data is that it enables us to investigate the occurrence of price adjustments across and within industries.

The empirical analysis uses the German ifo Business Climate Survey (ifo-BCS). The ifo-BCS is a monthly, mostly qualitative, firm-level survey among a representative sample of roughly 6,000 firms in key sectors of the German economy. Central for this paper are its regular questions about price setting and additional information on firm-specific economic activity that allow to control for several determinants of price-setting behavior. Specifically, we observe realized and three-months ahead planned price changes along the extensive margin together with firms' current business situation and business expectations. Planned price changes are also available for goods and services that are temporarily not in trade due to Covid-19 containment measures. Our baseline analysis therefore studies planned price changes. We obtain similar results when we use realized price changes. Planned and actual price-setting behavior in the ifo-BCS relatively closely co-move with aggregate producer price inflation and the correlation with quantitative changes in industry-specific producer price indices is relatively high, considering the data only provides qualitative survey information on the extensive margin of price adjustment.[2] A supplement to the ifo-BCS contains questions related to Covid-19. Among other things, firms in the survey assess the impact of the pandemic on their current business situation and, infrequently, report their perceptions on the relative importance of supply and demand forces.

We show that price decreases underlying the decline in inflation occur broadly across industries. Because the frequency of price decreases in any given industry is low, the fact

[2]The micro data underlying the German producer price index are not available for this time period.

that a larger share of firms now decreases prices results in higher firm-level heterogeneity within industries. Arguably, this fact is more consistent with low demand (e.g., due to low sentiment or high uncertainty), for supply shortages in only some sectors would result in more heterogeneous effects across industries. Price increases during the sudden surge in inflation are relatively more concentrated in some industries.

We estimate the effects of Covid-19 on the probability to adjust prices in the ifo-BCS during the decline in producer price inflation in April and May 2020. Prior to the pandemic, firms that are differentially affected by Covid-19 display very similar dynamics in planned price changes. Our baseline specification includes sector-by-time fixed effects which flexibly control for industry-specific trends and heterogeneous effects across sectors, for example due to sector-specific government regulations related to the pandemic or differential reliance on oil in conjunction with the sharp decline in oil prices. Despite this flexible approach to control for sector-specific differences in price-setting behavior during the pandemic, we find a substantial rise of up to ten percentage points in the probability of planned price decreases for firms with a strongly negative impact relative to firms with no or only weak impact of Covid-19. This effect is economically large and implies substantial firm-level heterogeneity in price-setting due to differential exposure to the pandemic within sectors. We also find a concurrent decline in the probability of planned price increases for these firms. Conversely, positively affected firms display an approximately eight percentage point higher chance of planned price increases and are less likely to plan price decreases. Since more than half of the firms report negative effects due to Covid-19 while only five percent report positive effects, these findings suggest a key role for demand during the early decline of inflation.

To some extent, the price decreases in 2020 also reflect quality deterioration in the supply of certain goods and services due to added health risks (see, e.g., Eichenbaum et al., 2021). This is important for policy, since it is critical to differentiate between health risks and economic forces behind price decreases. We follow Mongey et al. (2021) in

accounting for firm exposure to health risks and use a contact intensity index based on O*NET survey data and a work from home capacity index by Alipour et al. (2021).[3] We find that health risks across sectors are associated with a higher chance of a price decrease, while the probability to decrease prices remains significantly elevated in 2020, consistent with additional demand forces weighing on price adjustment.

We then study the sudden surge in inflation. In 2021, the fraction of price increases strongly rises across firms to levels well above those before the pandemic. Firms that were adversely affected at the onset of the crisis do not drive this result. The probability to raise prices and reverse earlier price decreases is not significantly higher at the extensive margin in these firms. Consistent with this finding, firms' subjective perceptions reported in the survey suggest that supply shortages at the end of the sample are not associated with demand deficiencies at the onset of the pandemic. Hence, demand shortages and supply disruptions during the early decline in inflation appear to display persistent effects on the level of firm prices. (Intermediate) Goods supply shortages gain in relative importance over time, broadly across firms and in some sectors in particular, which drives the observed increase in between-industry variation. Labor supply shortages, oil exposure, and energy prices are not significantly correlated with price increases across sectors once we control for (intermediate) goods supply shortages, which strongly correlate with the frequency of price increases.

A growing empirical literature studies the impact of Covid-19 on firms, in particular on prices and demand.[4] Behavioral responses in consumer expenditures possibly mirror heterogeneity in pricing to some extent. Jaravel and O'Connell (2020) find a spike in UK consumer price inflation at the onset of the Covid-19 pandemic. Interestingly, UK producer prices declined in this period, in line with our results. Similarly, Meyer et al. (2022) find that US firms expect to decrease their output prices at the onset of the pandemic.

[3] Kaplan et al. (2020) employ a similar distinction between regular and social sectors in the economy.

[4] For example, see Bartik et al. (2020); Buchheim et al. (2022a); Hassan et al. (2020) on the firm-level impact of Covid-19 and Baker et al. (2020); Cabral and Xu (2021); Carvalho et al. (2020); Cavallo (2020); Chetty et al. (2020) on prices and consumer spending.

Balduzzi et al. (2020) show that credit constraints and deaths due to Covid-19 correlate with firms' planned price increases. Alekseev et al. (2022) find evidence that deteriorating financial conditions lead to more price decreases. In a robustness exercise, we control for credit constraints and find a lower probability of price increases in credit constrained firms. The main estimates for the effect of Covid-19 on price adjustment remain unchanged in this exercise.

A few studies directly address the relative importance of demand and supply in the pandemic. Brinca et al. (2021) find that labor supply dominates labor demand at the onset of the pandemic. In line with our findings, Meyer et al. (2022) find that US firms mainly assess the pandemic as demand-driven.

Existing theoretical and quantitative work on the pandemic concentrates on sectoral heterogeneity (e.g., Guerrieri et al., 2022). Our results suggest a complementary and important role for firm-level heterogeneity. We therefore bridge this literature with empirical work on firms in the pandemic by capturing the relative importance of firm-level and sectoral heterogeneity. Firm heterogeneity mostly matters for the decline in inflation and sectoral heterogeneity relatively more during its surge.[5] Research on the transmission of the Covid-19 pandemic further highlights the importance of weak demand (e.g., Baqaee and Farhi, 2022; Caballero and Simsek, 2021; Eichenbaum et al., 2021; Guerrieri et al., 2022). Our finding that prices tend to decrease rather than increase at the beginning of the pandemic provides direct reduced-form empirical evidence consistent with this line of work. Lastly, the evidence for persistence in the firm-level impact of Covid-19 adds to similar findings for employment and revenues in US firms (Barrero et al., 2021).

The remainder of this paper is as follows. Section 2 explains the data and descriptive statistics, including a variance decomposition of between and within industry heterogeneity. Section 3 studies the differential impact of the pandemic on firms and the role of health risks in the early decline in inflation. Section 4 presents results for the sudden surge in inflation. Section 5 concludes.

[5] These results are consistent with models of price adjustment in which idiosyncratic shocks dominate firm-level price-setting behavior (e.g., Nakamura and Steinsson, 2010).

2 Data and Descriptive Statistics

The main data source is the ifo Business Climate Survey (ifo-BCS), a long-standing monthly survey among a large panel of German firms.[6] We limit the analysis to the manufacturing, services, and retail/wholesale industries that cover approximately 5,500 firms per survey wave on average.[7] Table A.1 in the Online Appendix compares the distribution of firms across size classes and industries in the survey to administrative data. The ifo-BCS provides a very good representation of the German economy along these dimensions.

The survey is mostly qualitative, including questions about firms' business situation and expectations, planned and realized price changes, as well as questions related to the supply and demand of goods and services. Since March 2020, the survey questionnaire includes supplemental questions related to the Covid-19 pandemic.[8]

The questions on price setting ask whether firms plan to increase, decrease, or leave unchanged their prices over the following three months, as well as a similar question on price realizations in the preceding month.[9] The frequency of realized price changes in the ifo-BCS is on average essentially the same as in administrative micro data underlying the German producer price index (Balleer and Zorn, 2019). Planned and realized price changes in the ifo-BCS are informative about aggregate inflation. Figure A.1 in the Online Appendix documents a relatively high correlation over time of these measures with

[6] See Sauer and Wohlrabe (2020) for extensive documentation of the ifo-BCS. The survey questionnaires are predominantly filled out by senior management such as firm owners, members of the executive board, or department heads (Sauer and Wohlrabe, 2019). The ifo Business Climate Index, a widely recognized leading indicator of the German business cycle, is based on the ifo-BCS. More generally, Lehmann (2020) demonstrates high predictive power of aggregated ifo-BCS data for gross domestic product, industrial production, employment, investment, exports, and inflation.

[7] We leave out firms in construction and insurance due to a lack of comparability to the survey questionnaires in manufacturing, services, and retail/wholesale. Data harmonization across sectors follows Link (2020). In April and May 2020, the sample comprises of on average 5,485 firms per month (1,941 in manufacturing, 1,937 in services, and 1,607 in retail/wholesale). Table A.2 in the Online Appendix provides more detailed information on the industry composition.

[8] Online Appendix C presents translations of all survey questions used in this paper.

[9] The ifo-BCS questions on planned and realized price changes are used in several articles. Bachmann et al. (2019) study the relation between uncertainty and price setting, Balleer et al. (2020) investigate the link between financial constraints and price setting, Link (2019) examines the effect of the 2015 minimum wage introduction on firms' price setting, and Enders et al. (2019) study the effect of monetary policy announcements on firms' planned price changes.

aggregate inflation rates reported by the Federal Statistical Office, considering the data provides only qualitative survey information on the extensive margin of price adjustment and conceptional differences between aggregate inflation and planned price changes.[10] In general, the correlation is slightly higher for planned than for realized price changes and highest in manufacturing with a correlation coefficient of 0.84. Figure A.2 in the Online Appendix documents the corresponding correlation at the level of 2- and 3-digit industries. Several industries exhibit a correlation above 0.6, especially when products are homogeneous within industry.[11]

In the wake of the Covid-19 pandemic, certain goods and services were temporarily not available or transferable due to government regulations and supply-chain disruptions. As a result, their market prices were either not observed or might not yet have responded to the pandemic shock. The baseline analysis therefore considers planned price changes that are available for goods and services not in trade and possibly include intended price responses to the pandemic. However, we obtain similar results when we use realized price changes or restrict our sample to businesses not affected by closure.

Figure 1 shows the frequency of planned and realized price increases from 2018:M01 to 2021:M08. Price increases display seasonal patterns and rise at the turn of the year.[12] Reflecting an earlier-starting decline in economic activity, the frequency of price increases falls throughout 2019 while the frequency of price decreases rises gradually. Planned price decreases then spike in April 2020, after the Covid-19 pandemic hit Germany in March 2020. Similarly, realized price decreases also climb and peak shortly after. The timing of abrupt movements is in line with Buchheim et al. (2022b), who show that the

[10] We use the producer price index (PPI) for manufacturing firms, the wholesale price index (WPI) for wholesale, and the retail price index (RPI) for retailers. The German Federal Statistical Office does not provide a monthly producer price index for services. The implications of our results for CPI inflation are unclear. In general, the correspondence between the NACE industry classification system used in the ifo-BCS and the COICOP classification used in the CPI is ambiguous (Addessi et al., 2017; Ganglmair et al., 2021). Moreover, the number of firms in the ifo-BCS in industries with direct correspondence to the CPI is small.

[11] Industries with a weak correlation often reflect a high diversity of product, e.g., the Computer, Electronic and Optical Products industry.

[12] Nakamura and Steinsson (2008) document similar seasonal patterns in US producer price micro data.

Covid-19 pandemic hit after most firms in the ifo-BCS filled the March 2020 survey questionnaires.[13] On June 6, 2020, the German government unexpectedly announced a temporary reduction of the value added tax (VAT) rate effective July through December 2020. Although the survey questionnaire asks about prices excluding the VAT, the corresponding survey guideline is hidden in a footnote. It is possible that some firms falsely report price decreases due to the VAT rate cut and price increases when it expires, which we cannot rule out. At the beginning of 2021, price increases skyrocket, way above the typical seasonal pattern and continue to rise over the course of 2021.[14]

The initial downward price adjustments occur broadly across industries while the ensuing upward price adjustments are relatively more concentrated in a few large industries. We rely on the following decomposition to establish this result:

$$var(p_{ij}) \equiv \overline{p}(1-\overline{p}) = \underbrace{\sum_j \frac{N_j}{N}\overline{p_j}\left(1-\overline{p_j}\right)}_{within} + \underbrace{\sum_j \frac{N_j}{N}\left(\overline{p_j}-\overline{p}\right)^2}_{between}, \tag{1}$$

where p_{ij} is a binary indicator for price adjustment by firm i in industry j, N_j denotes the number of firms in sector j, N is the total number of firms, $\overline{p}_j$ is the industry mean of p_{ij}, and $\overline{p}$ its unconditional mean. The notation suppresses a time subscript for convenience. The second equality follows because p_{ij} is the realization of a Bernoulli random variable. The decomposition is an application of the law of total variance. We apply it separately to price increases and price decreases for each month in the sample.

Equation (1) is useful because it allows to relate time variation in the frequency of price adjustment (the cross-sectional mean of p_{ij}) to shifts in the cross-sectional distribution (the

[13] In early March, only a few German counties were strongly affected by Covid-19. Subsequently, infection rates increased exponentially resulting in nation-wide school closures on March 13 and a nation-wide curfew on March 22. Buchheim et al. (2022b) document that firms' business outlook decreased strongest after March 13. Since roughly three out of four survey respondents filled in their survey questionnaire before, April 2020 is the first month in which the majority of survey respondents report reactions to Covid-19.

[14] In addition to seasonality and the VAT cut expiration, there were other one-off factors that possibly affected producer prices in January 2021. First, the German minimum wage increased in January 2021 from 9.35 Euro to 9.50 Euro and further to 9.60 in July 2021. Second, a consumer tax on carbon emissions was introduced.

cross-sectional variance of p_{ij}) arising from variation within and between industries. The first term is a weighted average of dispersion in price adjustment within industries and captures the degree of firm-level heterogeneity within industries. The second term is a weighted variance of price adjustment frequencies across industries and captures variation between industries. The between-variance moves if the change in price adjustment frequencies is proportional or heterogeneous across sectors. Changes in larger sectors enter with larger weight.

The left panel of Figure 2 plots the share of variance explained by between-industry variation over the sample period, based on two-digit NACE industries and at least five observations per sector. Between-industry variation accounts for about five percent of the variation in price increases and for a little less than five percent in price decreases through 2020:M03. There are no marked changes around the onset of the pandemic. Within-industry and between-industry variation both contribute proportionately to the changes in the frequency of price adjustment observed in Figure 1, while within-industry differences explain the bulk of it. Between-industry variation becomes disproportionately important during the sudden surge in inflation. Its relative share in the frequency of price increases triples, up to 15 percent.

To illustrate this result, the right panel of Figure 2 compares the frequency of planned price increases across two-digit NACE industries in 2020:M08 and 2021:M08. The size of each bubble represents the relative number of firms in each sector. The figure shows an increase in between-industry variation between 2020:M08 and 2021:M08. While the frequency of price increases is higher in almost all industries in August 2021 compared to August 2020, the increase in the frequency of price increases is not uniform across industries and becomes more dispersed. For some industries, the frequency of price increases remains the same (those close to or on the 45 degree line). For other, relatively large industries, the frequency of price increases rises particularly strongly: retail, wholesale, paper products, metal products, and electrical equipment industries.

These findings do not change if we restrict the sample to at least twenty observations per two-digit industry or use four-digit industries, in which case the relative shares are about 10 percent each prior to the pandemic and jump to around 25 percent during the sudden surge in inflation in the case of price increases. The results remain essentially the same if we restrict the sample to a balanced panel. We also observe similar patterns within manufacturing and retail, but not in services. This finding suggests that variation between services on the one hand, and manufacturing and retail on the other also accounts for rising between-variation. Lastly, these results also carry over to realized price changes.

Taken together, the initial downward price adjustments underlying the early decline in inflation occur broadly across industries. This finding is arguably more consistent with relatively high importance of low aggregate demand (e.g., due to low sentiment or high uncertainty), for negative supply shocks would result in more heterogeneous effects across industries. Section 3 further explores the determinants of rising firm-level heterogeneity as well as the role of industry-specific health risks in this episode. During the sudden surge, price increases become relatively more concentrated in some, relatively large sectors. This finding suggests an increasing relative importance of supply shortages. Section 4 further investigates the role of skilled labor shortages, energy costs, (intermediate) goods supply shortages, and oil exposure during this period and finds goods supply shortages across sectors to be important. Overall, however, the share of price adjustments explained by variation across industries remains below a third.

3 The Early Decline in Inflation

We focus on April and May 2020 to study price adjustment behavior underlying the early decline in inflation for three reasons: First, at the beginning of the pandemic we can unambiguously tell whether a price is higher or lower relative to the pre-pandemic period.

That is no longer possible as the pandemic evolves, as we do not observe the intensive pricing margin. Second, the decline in inflation is most pronounced in these months. Third, falsely reported price decreases due to the VAT rate cut announced in June possibly raise the frequency of price decreases across all firms and blur the analysis. However, in light of Figure 1, we expect this effect to be small, if anything, and uniform across firms.

We first infer the relative importance of demand and supply from firms' price adjustments behavior, relying on variation within industries. Thus, the analysis relates the observed rising firm-level heterogeneity during the early decline in inflation to the differential impact of the pandemic across firms. We then address health risks as a prominent narrative behind sector-level heterogeneity at the onset of the pandemic.

3.1 Price Adjustment Behavior

Since April 2020, the ifo-BCS asks firms to assess the impact of the Covid-19 pandemic on their business situation on a seven-point scale ranging from -3 "negative" to $+3$ "positive". We refer to these *Covid-19 impact* categories as "strongly negative" (-3), "negative" (-2), "weakly negative" (-1), and "no impact" (0), with analogous labels for the positive categories.

Section B.1 in the Online Appendix provides extensive descriptive statistics on *Covid-19 impact*. We summarize the main findings. First, there is substantial firm-level heterogeneity in *Covid-19 impact* mirroring the large within-industry variation in price adjustments of Section 2. Second, more adverse *Covid-19 impact* is associated with worse business conditions, pessimistic business expectations, lower capacity utilization, and stronger expected revenue losses. We also find large heterogeneity in firms' price-setting behavior during the early decline in inflation that correlates with *Covid-19 impact*. As documented in Section B.2 in the Online Appendix, positively affected firms tend to increase their prices, while negatively affected firms tend to decrease their prices in all sectors, in particular in retail/wholesale. In industries in which the majority of firms report low

orders, negatively affected firms decrease prices more and increase prices less.

We now formally explore differences in price adjustments across *Covid-19 impact* categories during the early decline in inflation in April and May 2020 while controlling for other determinants of price-setting behavior. Our baseline analysis focuses on planned price changes. We obtain similar results when we use realized price changes or when we restrict our sample to open business, i.e., those not affected by closure due to lockdowns.[15]

First, we estimate the following regression, *separately* for each month-year t between 2018:M01 and 2020:M05:

$$Y_{i,t} = \delta_{-3}\mathbb{1}\left(Covid_{i,04/20} = -3\right) + \delta_{-2}\mathbb{1}\left(Covid_{i,04/20} = -2\right) + \delta_{\{2;3\}}\mathbb{1}\left(Covid_{i,04/20} = 2 \vee 3\right) + X'_{i,t-3}\beta + \gamma_s + u_{i,t}. \quad (2)$$

Here, $Y_{i,t}$ refers to an indicator for planned price increases or decreases over the following three months for firm i. The indicator variables group firms according to their *Covid-19 impact* in April 2020 as being strongly negatively affected ($Covid_{i,04/20} = -3$), negatively affected ($Covid_{i,04/20} = -2$), or positively affected ($Covid_{i,04/20} = 2 \vee 3$), while firms with weak or no *Covid-19 impact* serve as the control group.[16]

In addition, we include two-digit NACE industry fixed effects (γ_s), and separate indicators for positive and negative responses to the questions about business situation, business expectations, and orders, each lagged by three months and collected in $X_{i,t-3}$, to control for past economic activity of firms.

Figure 3 shows the time series of the frequency of planned price increases and decreases for each *Covid-19 impact* category, net of controls. In every month, the difference between each line relative to the group of firms with weak or no *Covid-19 impact* corresponds to the estimated coefficient δ_i, with $i = -3, -2, \{2;3\}$, from Equation (2). The

[15] See Figure A.3 and Table A.4 as well as Table A.5 in the Online Appendix.

[16] We group the positive *Covid-19 impact* categories because of their low number of observations.

frequency-weighted mean of all lines in a given month equals the month's sample mean.[17]

Planned price changes display similar patterns across *Covid-19 impact* categories before the pandemic. The left panel of Figure 3 illustrates that the frequency of planned price decreases displays essentially identical dynamics across impact categories prior to 2020:M03, indicated by the first vertical red line, when measures to prevent the spread of Covid-19 were installed (see Footnote 13). Likewise, the right panel shows that the frequency of planned price increases displays similar dynamics across impact categories prior to 2020:M03. This suggests that these similar trends would have continued in the absence of Covid-19.

However, we observe that price-setting behavior of firms in different *Covid-19 impact* categories is highly heterogeneous after 2020:M03. The frequency of planned price decreases skyrockets for strongly negatively affected firms, rapidly rises for firms with negative impact, and remains at similar levels for positively affected firms. There is no comparable spike in the frequency of planned price increases that would suggest upward price pressure at the beginning of the pandemic. The frequency of planned price increases remains at similar levels for firms with positive impact and falls for those with (strongly) negative impact. Overall, this suggests a strongly disinflationary effect of *Covid-19 impact* and large differences across firms within industries.

Next, we exploit the panel dimension of the ifo-BCS and the timing of events to account for level differences, seasonality, and business cycle movements observable in Figure 3, i.e., slight upward and downward trends in planned price decreases and increases, respectively, consistent with the cooling of the German economy during this period. We estimate the following panel regression on the sample 2018:M01 to 2020:M05:

$$Y_{i,t} = \delta_{-3}\mathbb{1}\left(Covid_{i,t} = -3\right) + \delta_{-2}\mathbb{1}\left(Covid_{i,t} = -2\right) + \tag{3}$$
$$\delta_{\{2;3\}}\mathbb{1}\left(Covid_{i,t} = 2 \vee 3\right) + X'_{i,t-3}\beta + \alpha_i + \gamma_{t,s} + u_{i,t}.$$

[17] See Yagan (2015) for a similar approach in a different context.

Month-year fixed effects ($\gamma_{t,s}$) at the level of two-digit NACE industries flexibly control for industry-specific trends, for example due to differential reliance on oil in conjunction with the sharp decline in oil prices. They also control for heterogeneous effects during the Covid-19 pandemic across sectors. As before, we therefore rely on within-industry variation in pricing decisions due to *Covid-19 impact*. Relative to Equation (2), we set the grouped *Covid-19 impact* categories to zero for all observations prior to 2020:M04. Firm fixed effects absorb time-invariant characteristics in price-setting behavior.

Figure 4 presents estimation results for planned price decreases (blue; filled) and planned price increases (red; hollow). Panel (a) contains estimates based on a sample pooling firms in all industries, while Panel (b) presents regression results when estimating Equation (3) separately for firms in manufacturing, retail/wholesale, and services.[18]

On the one hand, firms reporting a negative impact of Covid-19 tend to lower prices. In the pooled sample of Panel (a), the probability of planned price decreases spikes by ten percentage points for firms strongly negatively affected, relative to the base category of weak or no *Covid-19 impact*, net of controls. For negatively affected firms, the probability of planned price decreases rises by about five percentage points. By contrast, positively affected firms experience a decline in the chance of planned price decreases by about two percentage points. All estimates are statistically significant and economically very large compared to the unconditional two-digit sectoral frequency of planned price decreases of 3.7 percent and within-sector standard deviation equal 3.4 percentage points in the period 2018:M01–2019:M12.

On the other hand, negative *Covid-19 impact* is associated with less frequent price increases. Strongly negatively affected firms display an approximately four percentage points lower chance of planned price increases. By contrast, firms that report a positive impact on their business situation show an eight percentage points rise in the prob-

[18] Panel (a) of Figure 4 refers to Columns 3 and 6 of Table A.3 in the Online Appendix. Columns 1 and 4 of that table contain, for completeness, estimation results when only the *Covid-19 impact* category indicators are included in the regression.

ability of planned price increases, relative to the unconditional two-digit sectoral frequency of 21.2 percent and within-sector standard deviation equal 9.2 percentage points in 2018:M01–2019:M12.

Columns 2 and 5 of Table A.3 in the Online Appendix display results with month-year fixed effects instead of time-by-industry fixed effects (level differences across industries are absorbed by firm effects). The coefficients are very similar compared to our main specification in Figure 4. This result suggests that large firm-level heterogeneity within industry plays an important role for price-setting behavior during the early decline in inflation. This reflects the large within-industry variation in *Covid-19 impact* described in Section 2.

Panel (b) of Figure 4 shows that (strongly) negative *Covid-19 impact* is associated with higher probability of planned price decreases across all sectors. The point estimate for the effect of positive *Covid-19 impact* on the chance of planned price increases is similar across sectors but less precisely estimated if we do not pool observations. A statistically significant decline in the probability of planned price increases for firms reporting a strongly negative impact is only observable in the retail/wholesale sector, while the drop in the probability of planned price decreases for positively affected firms is significant only in manufacturing. The upshot is that the main pattern of a higher chance of planned price decreases in (strongly) negatively affected firms, which represent more than half of all firms, is robust and not specific to any of the broad sectors we consider.

While the large majority of firms generally does not plan to change their prices (compare Panel C of Table B.1 in the Online Appendix), prices become more flexible across all *Covid-19 impact* categories. Column 9 of Table A.3 in the Online Appendix shows that in firms with strongly negative impact, the probability of planned price changes increases by about six percentage points, reflecting the increased likelihood of planned price decreases. The same is true for firms negatively affected by Covid-19, which increase the chance of planned price changes by about three percentage points. The probability of planned price

changes for firms with positive impact rises by about five percentage points, reflecting an increase in the probability of planned price increases. Again, these estimates are economically sizable compared to the unconditional two-digit sectoral frequency of planned price change of 24.9 percent and within-sector standard deviation equal 8.9 percentage points in the period 2018:M01–2019:M12.

These results speak to the relative importance of supply and demand shortages at the beginning of the pandemic. The result that negatively impacted firms have a higher probability to decrease prices suggests that demand shortages dominate. In a basic demand–supply framework, a reduction in the supply of goods and services leads to increasing prices, holding demand constant. Conversely, given production, demand shortages lead to decreasing prices.

These results remain robust in five alternative specifications presented in Table A.6 in the Online Appendix. First, we weight the regressions by firm size to account for the relative importance of a firm in aggregate price indices.[19] Second, we control for credit constraints. Financial frictions interact with price-setting behavior (Gilchrist et al., 2017; Kim, 2020; Balleer et al., 2020) and possibly also determine *Covid-19 impact* (Alekseev et al., 2022; Balduzzi et al., 2020). To measure credit constraints, we rely on a quarterly (at the end of each quarter) question in the ifo-BCS that asks whether firms negotiated for loans with banks over the past three months and, if so, the terms offered. We define firms as credit constrained if their most recent response was "restrictive" (in 2020:M04 and 2020:M05 we use the 2020:M03 value, for instance) and add this indicator as a control. Financial constraints significantly reduce the frequency of price increases, similar in size to *Covid-19 impact*. The estimated effects of *Covid-19 impact* remain virtually unchanged in this case.

[19] We construct firm weights following the procedure used by the ifo Institute in calculating the ifo Business Climate Index (see Sauer and Wohlrabe, 2020, for details): The ifo-BCS micro data contain weights that are based on the number of employees in manufacturing and based on revenues in retail, wholesale, and services. The weights are scaled such that in a given industry their sum equals that industry's share in gross value added.

Third, we include industry-by-time fixed effects at the 4-digit instead of the 2-digit industry level which allows for differential effects within broader sectors but also reduces the number of observations slightly due to some cells being occupied by a single observation. Fourth, we restrict the sample to complete price spells and add indicator variables to control for Taylor pricing, i.e., price changes that occur in fixed time intervals (e.g., every six months, see Lein, 2010 and Bachmann et al., 2019). Fifth, respondents may also consider realized price changes in answering the survey question on *Covid-19 impact*. Consequently, *Covid-19 impact* would be lower if prices decreased for a given change in output. This concern is partly alleviated by using planned price changes instead of realized price changes. Here, we estimate Equation (3) on a subsample of firms which did not change prices in the current month. In all of these alternative specifications, the main results remain robust.

3.2 Health Risks and Planned Price Adjustments

In this section, we investigate the role of health risks for price adjustments during the early decline in inflation. Health risks associated with physical contacts are a key characteristic of the Covid-19 pandemic. Adverse *Covid-19 impact* is associated with larger health risks (see Online Appendix B.1). For policy, it is critical to differentiate between health risks and economic forces. If policymakers seek to contain the pandemic at minimal economic cost, stimulus policy to stabilize demand shortages related to health risks would backfire, for instance.[20]

Yet, health risks vary mostly across sectors and Section 2 shows that between-industry variation does not play a dominant role in price adjustments. Indeed, variation in health risks across sectors is only weakly positively related to the frequency of price decreases and very weakly negatively related to the frequency of price increases, as Online Appendix B.1 documents. We therefore expect the role of health risks for price changes

[20] Fetzer (2022), for example, shows that a subsidy for food and non-alcoholic drinks in restaurants in the United Kingdom had a causal effect on higher Covid-19 infection rates.

during the early decline in inflation to be limited.

To explore this more formally, we split the sample by health risk exposure at the sectoral level. We use O*NET survey data to measure contact intensity to co-workers and customers at work at the five-digit industry level.[21] Possible answer categories for the relevant question range from 0 ("I don't work near other people (beyond 100 ft.)") to 100 ("Very close (near touching)"). We combine this measure with the share of workers in each two-digit industry able to work-from-home (WfH) provided by Alipour et al. (2021) and define "high health risk exposure" by above-median contact intensity and below-median WfH capacity.[22] The remaining observations are grouped as "low health risk exposure".

First, we re-estimate Equation (2) replacing *Covid-19 impact* with this indicator for high health risk exposure. Figure 5 shows the observed trends in the probability of planned price decreases and planned price increases of high health risk exposure sectors parallel those of low health risk exposure sectors. In Panel (b), the probability of planned price increases is in general higher for high health risk exposure sectors. During the Covid-19 pandemic, the probability of planned price decreases rises and the probability of planned price increases drops in both groups, but relatively stronger so in high health risk exposure sectors.

Next, we quantify the differential effect of high risk exposure during the Covid-19 pandemic in a difference-in-differences regression:

$$Y_{i,t} = \delta_1 \mathbb{1}\left(HighHealthRisk_i = 1\right) + \delta_2 \mathbb{1}\left(CrisisPeriod = 1\right) + \\ \delta_3 \mathbb{1}\left(HighHealthRisk_i = 1\right) \times \mathbb{1}\left(CrisisPeriod = 1\right) + X'_{i,t-3}\beta + u_{i,t}. \quad (4)$$

[21] We thank Martin Popp for constructing this data by weighting the O*NET survey information on physical proximity with occupational employment per sector using the Integrated Employment Biographies (IEB) of the Institute for Employment Research (IAB) in Germany. More details about the O*NET data is available here: https://www.onetonline.org/find/descriptor/result/4.C.2.a.3.

[22] Results are similar if we only use above-median O*NET contact intensity to define high health risk exposure. Table A.2 in the Online Appendix provides summary statistics for these Covid-19 infection risk proxy variables by two-digit industry.

Again, $Y_{i,t}$ denotes an indicator for a planned price decrease or a planned price increase of firm i at time t, controlling for past economic activity ($X_{i,t-3}$). The coefficient δ_1 captures any level differences in the probability to change prices between high and low health risk exposure before the Covid-19 pandemic. The coefficient δ_2 measures a level effect on the probability to change prices of low health risk exposure firms during the Covid-19 pandemic after 2020:M03, and δ_3 describes the differential effect on high health risk exposure firms.

Table 1 presents results. Column (1) shows that high health risk exposure firms are about five percentage points more likely to decrease their price during the Covid-19 pandemic relative to low health risk exposure firms. The probability of a planned price decrease remains significantly elevated by about six percentage points in low health risk exposure firms, consistent with the notion of firm-level heterogeneity and additional demand forces impacting planned price-setting behavior during the Covid-19 pandemic. Column (3) shows that the probability of planned price increases drops during the Covid-19 pandemic and is not statistically different across low and high health risk exposure.[23]

As alternatives to the health risk exposure measure constructed from the O*NET contact intensity index and the WfH capacity index, we also consider the heuristic classification of "high contact goods and services" by Eichenbaum et al. (2020). Columns (2) and (4) report estimates using this alternative measure and show that the probability of a planned price decrease increases during the Covid-19 pandemic. However, the effect on high health risk exposure firms is not statistically different from those of low health risk exposure firms in the case of price decreases. These firms are significantly more likely to raise their prices during the early decline in inflation though.

In sum, our results suggest that exposure to health risks plays a significant role for price adjustment between sectors. However, a substantial part of the decline in price adjustments cannot be associated with health risks.

[23] We also investigated spillover effects between low and high health risk firms through the input-output network. To do so, we added an interaction term of health risks in two-digit industries upstream or downstream, weighted by their input or output shares, and a crisis period indicator, without any effect on the reported estimates.

4 The Sudden Surge in Inflation

We now study the sudden surge in inflation in 2021. First, are those firms adversely affected at the beginning of the pandemic that decreased their prices more likely to raise their prices in 2021? Second, does the relative importance of supply and demand shift over time? To this end, we study firms' subjective perceptions about the adverse effects of the pandemic given in the survey. Third, the variance decomposition in Section 2 shows that, unlike the early decline in inflation, this episode is associated with an increase in the relative importance of variation across industries up to a third. What explains this increase? We study industry variation in intermediate input supply shortages, labor supply shortages, and exposure to oil and energy prices.

4.1 Price Adjustment Behavior

Figure 6 shows how *Covid-19 impact* affects price-setting behavior through 2021:M08. Here, we re-estimate Equation (3) replacing current *Covid-19 impact* with its average between 2020:M04 to 2021:M03. We use the average of *Covid-19 impact* to fix the composition of firms and study whether these firms are more likely to raise prices during the sudden surge. Fixing the composition does not affect the results as *Covid-19 impact* is very persistent over time.[24]

At the onset of the crisis, these effects compare to those we estimate in the previous section shown in Figure 4. Negatively affected firms plan to decrease their prices more often throughout the pandemic. The effect on the frequency of planned price decreases spikes at the onset of the pandemic, then declines and rises again towards the end of 2020 when the second wave of the pandemic hits Germany. The frequency to decrease prices drops towards the end of the sample.

[24] Figure A.4 in the Online Appendix shows that the share of firms within each *Covid-19 impact* category is persistent over time. Relative to Table B.1 in the Online Appendix, the average relationship between *Covid-19 impact* and business conditions, business expectations, capacity utilization, expected revenue changes, and price-setting behavior in the full sample is essentially unchanged.

The surge in price increases is not primarily driven by firms adversely affected at the beginning of the Covid-19 pandemic that increase their prices more often in 2021. Even though the estimated probability to decrease prices converges across *Covid-19 impact* groups, negatively affected firms still decrease prices more often than positively affected firms. At the beginning of the pandemic, the frequency of planned price increases falls across all *Covid-19 impact* categories bar positively affected firms, bottoms out in 2020:M07, and starts to strongly climb in 2020:M09 across firms to levels well above those before the pandemic. Still, positively affected firms continue to be more likely to revise prices upwards than weakly and negatively affected firms.[25] A similar pattern emerges when we directly condition on pricing decisions early in the pandemic independent from *Covid-19 impact*. Only a third of the firms that decreased their prices in April 2020 increase their prices in June, July, or August 2021. The corresponding frequency of those firms that increased their prices in April 2020 is twice as high.[26]

One caveat of our analysis is that we do not observe the intensive margin of price adjustment. It is possible that adversely affected firms do not increase prices more often, but when they do, they increase prices more substantially. Yet, a substantial share of more than 60% of adversely affected firms chooses no price increases at all.

The VAT rate cut in 2020:M06 does not appear to impede the analysis. There are no abrupt changes in the differential effects *across Covid-19 impact* categories, the variation which the estimation strategy we pursue relies upon. To the extent that some firms falsely report price changes, these will be most likely absorbed by the time fixed effect.

4.2 Firms' Perceptions

In addition to differences in pricing across *Covid-19 impact*, Figure 6 shows that price increases become more frequent overall, speaking to the increasing relative importance of

[25] Figure A.3 in the Online Appendix documents the estimated effect on realized prices.
[26] See Figure A.5 in the Online Appendix.

supply. We collect additional direct descriptive evidence for the extended sample which corroborates the relative importance of supply. In June 2020, November 2020, February 2021, and June 2021, the ifo-BCS added a question asking managers about the subjective reasons for the adverse effects of Covid-19 [SQ6 in Online Appendix C]. Specifically, the question assesses the adverse effects of financing conditions, labor input, supply-chain disruptions (goods supply), government containment regulations, and demand (domestic and foreign, separately) due to the Covid-19 crisis. Possible answers categories range from "no effect" (+1) to "large adverse effect" (+5). To capture their relative importance at the firm level at a given point in time, we compare each subjective reason relative to the firm mean of all those remaining. Figure 7 shows the relative importance of the three predominant subjective reasons for the pooled sample and separately for each sector. Positive values represent relatively important reasons and negative values relatively unimportant reasons. Overall, deficiencies in domestic and foreign demand dominate as the most important determinant for adverse economic effects through the spring of 2021. This independent evidence reinforces the relative importance of demand inferred from price adjustment behavior in the previous section. After that, supply shortages become the most adverse effect. Patterns are qualitatively similar across sectors. Demand shortages, especially in foreign demand, are perceived as more important among manufacturing firms, while goods supply shortages are more important in retail/wholesale and less in services.

Lastly, demand deficiencies at the onset are not related to supply shortages later on in the pandemic. Figure A.6in the Online Appendix relates the relative importance of demand and supply in June 2020 and 2021 net of sectoral fixed effects and controls. While the relative importance of supply increased for all industries, there is no apparent shift from relative demand to relative supply within industry.

4.3 Sectoral Outcomes

Figure 8 relates planned price increases to potential sources of upward pressures on prices across sectors. The left column plots the share of firms with planned price increases in a given sector against the share of firms perceiving (skilled) labor and (intermediate) goods shortages. The right column plots the share of firms with planned price increases against the share of energy costs and oil exposure in total production in a given sector. All panels aggregate at the two-digit NACE industry level and use data on planned price increases from July 2021. We observe skilled labor supply shortages and oil price exposure for the entire economy, (intermediate) goods supply shortages in manufacturing and retail/wholesale, and energy costs only in manufacturing. The size of each bubble represents the relative number of firms in each sector. We label the five sectors from Section 2 that contribute most to the rise in between-variance.

(Intermediate) Goods supply shortages are positively associated with price increases during the surge in inflation. Table A.7 in the Online Appendix contains univariate and joint regression results for the share of planned price increases on each of the variables shown. The negative relation between price increases and labor shortages is statistically insignificant, and labor shortages in sectors that drive the surge in between-variance do not stand out. The share of energy costs in general do not significantly relate to price increases. The sectors that drive the sudden surge in inflation rather tend to have large oil exposure and in particular perceive (intermediate) goods supply shortages. In a multivariate regression on all variables, (intermediate) goods supply shortages emerge as the single significant explanatory variable for planned price increases. A ten percentage point increase in the share of firms perceiving (intermediate) goods supply shortages is associated with a rise in the share of planned price increases by 4.6 percentage points. These results suggest that supply-chain disruptions in some sectors drive the increase in between-variance. Consistent with this evidence, we find that indicators for retail/wholesale and manufacturing alone can explain 67% of the sectoral differences (see Column (8) in Ta-

ble A.7). Hence, prices for goods and services diverge strongly. Rising sectoral heterogeneity in turn accounts for up to a third of the observed price adjustments during the sudden surge in inflation (see Section 2).

5 Conclusion

We infer the relative importance of demand and supply during the Covid-19 pandemic by studying price-setting behavior and subjective perceptions in German firm-level survey data. The estimates presented in Figure 4 imply that, at the onset of the pandemic, (strongly) negative *Covid-19 impact* is associated with a five (ten) percentage points increase in the probability of planned price decreases, relative to weak or no *Covid-19 impact*. Differences in health risks across sectors are important, but do not account for the substantial heterogeneity in price adjustment behavior within industries. Through the lens of a simple demand-supply framework, these results thus suggest an important role for demand shortages, driven by economic forces, at the onset of the Covid-19 pandemic. Otherwise, a reduction in supply would have reversed the observed price-setting behavior, with higher probability of price increases associated with negative *Covid-19 impact*. The fact that survey respondents report demand shortages as the primary reason for the adverse effects due to Covid-19, both at the onset of the pandemic and as it unfolds, provides additional, more direct evidence in support of this result. Our results provide reduced-form evidence for theoretical channels that highlight the role of demand deficiencies in the pandemic and suggest a role for policy to stabilize aggregate demand while containing the Covid-19 pandemic.

The fact that within-industry variation accounts for the bulk of price adjustments during the early decline in inflation is no contradiction to the body of theoretical and quantitative work that considers the role of sectoral heterogeneity, but highlights the relative importance of firm heterogeneity. The propagation channels stressed by this literature

(e.g., complementarities in consumption or input-output networks) possibly also operate within industries. Additional reasons for within-sector heterogeneity, for instance management skills or other business characteristics such as online representation or service (see Bloom et al. (2021) for direct evidence), need to be considered as well. This result is important for policy as it advises caution against targeted industry-specific stimulus to buffer the Covid-19 shock.

Upward price adjustments during the sudden surge in inflation are not due to adversely affected firms that lowered their prices at the beginning of the pandemic. Instead, we find broad-based (intermediate) goods supply shortages across firms as well as some heterogeneity in industry exposure to account for the sudden surge in inflation. A key question for inflation dynamics therefore is the persistence of goods supply shortages. Labor supply shortages, energy prices, and oil exposure are not significantly correlated across sectors once we control for goods supply shortages.

Another potentially important determinant of price adjustment are firms' inflation expectations. Ongoing data collection efforts show that firms' inflation expectations in our sample have substantially increased from below 2% in 2020:M12 to over 3.5% in 2021:M09 on average (see Figure A.7 in the Online Appendix). They therefore potentially contribute significantly and substantially to the surge in price increases. At this moment, we are not able to link these expectations to the firm-level pricing decisions in our sample and investigate this channel more closely. We leave this exploration to future work once data linkage becomes possible.

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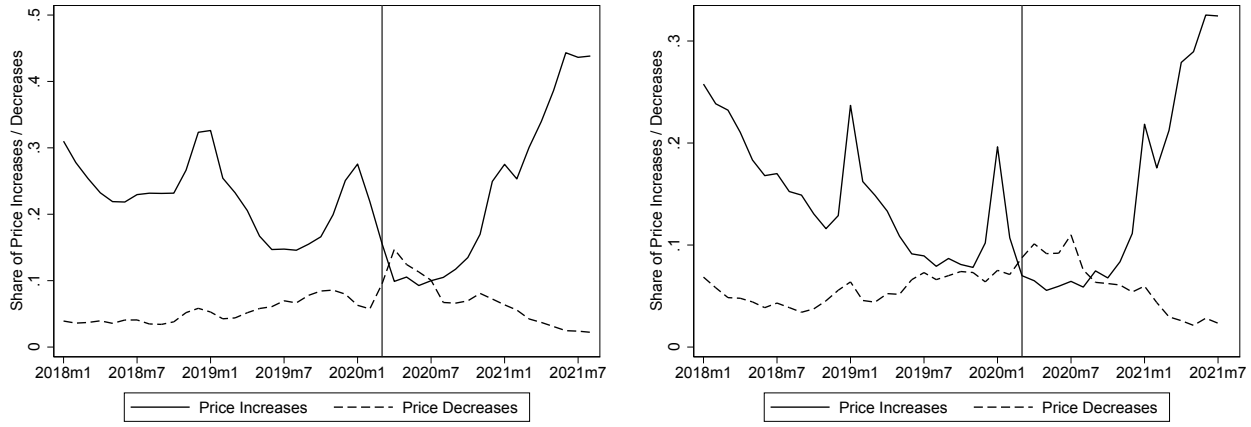
Main Figures

Figure 1 – Frequency of Planned and Realized Price Changes over Time

(a) Planned Price Changes

(b) Realized Price Changes

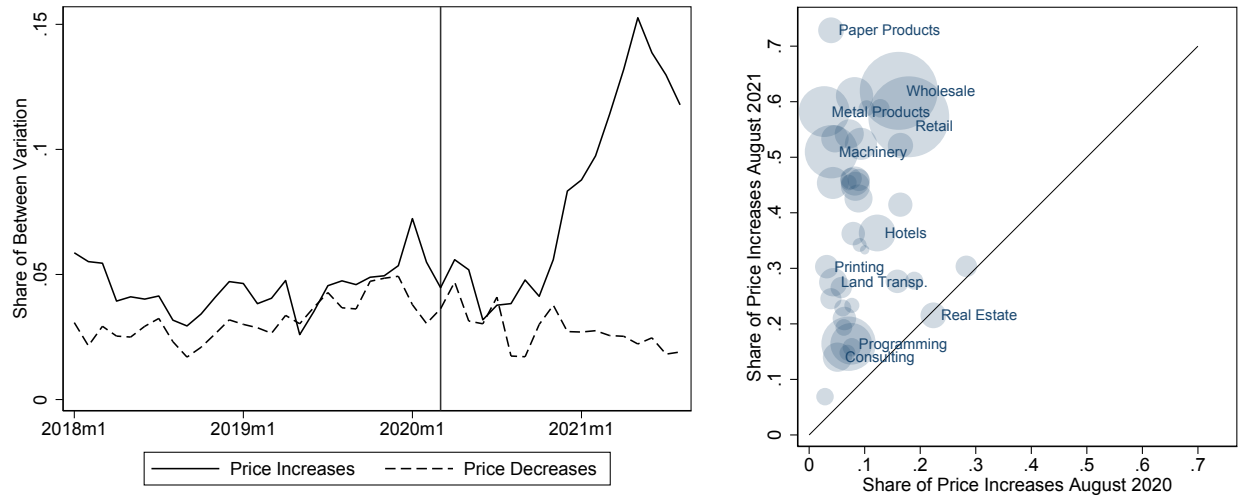


Notes: The panels depict the frequency of planned (left) and realized (right) price changes in the ifo-BCS, respectively. The sample covers the manufacturing, retail/wholesale, and services industries. The sample period starts in 2018:M01 and runs through 2021:M08 for planned price changes and through 2021:M07 for realized price changes reported in the following month. The vertical line refers to March 2020, i.e., the month, when the Covid-19 pandemic reached Germany.

Figure 2 – Between-Industry Variation in Price Adjustment

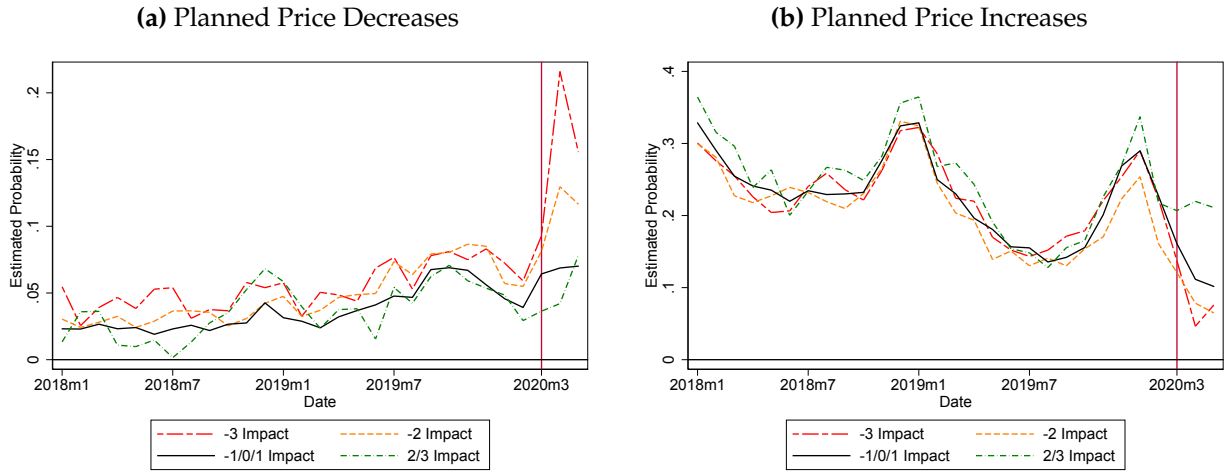
(a) Share Explained by Between-Variation

(b) Frequency of Planned Price Increases



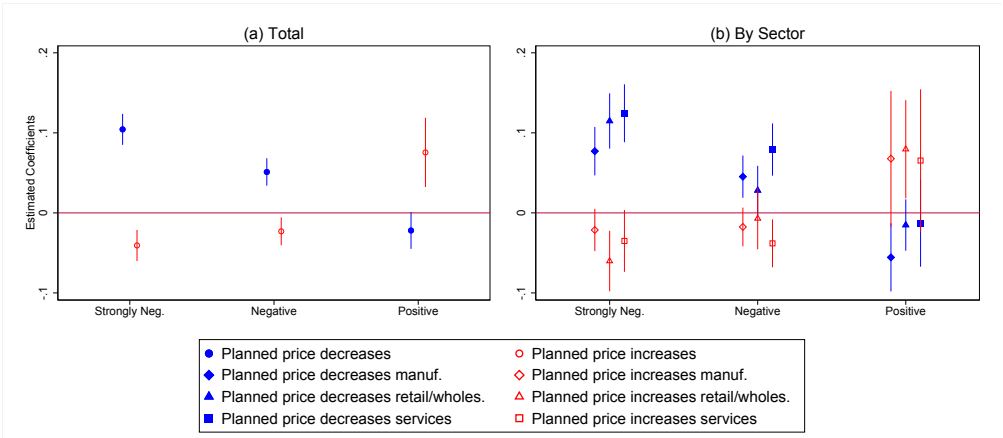
Notes: The left panel plots the share of variance explained by between-industry variation in planned price increases and decreases over the sample period, based on two-digit NACE industries and at least five observations per sector. The vertical line depicts 2020:M03. The right panel compares the average frequency of planned price increases across two-digit industries in 2020:M08 and 2021:M08. The size of each bubble represents the relative number of firms in each sector. The black line is the 45 degree line.

Figure 3 – Planned Price Adjustment before and during the Covid-19 Pandemic



Notes: This figure shows the time series of the frequency of planned price decreases (left) and price increases (right) for each grouped *Covid-19 impact* category as of 2020:M04, net of controls. Firms are grouped according to their *Covid-19 impact* in April 2020. In every month, the difference between each line relative to firms with weak or no impact corresponds to the estimated coefficient δ_i, $i = -3, -2, \{2, 3\}$ from Equation (2). The frequency-weighted average of all lines in a given month equals the month's sample average. The vertical red line refers to March 2020, i.e., the month, when the Covid-19 pandemic reached Germany. Sample: 2018:M01–2020:M05.

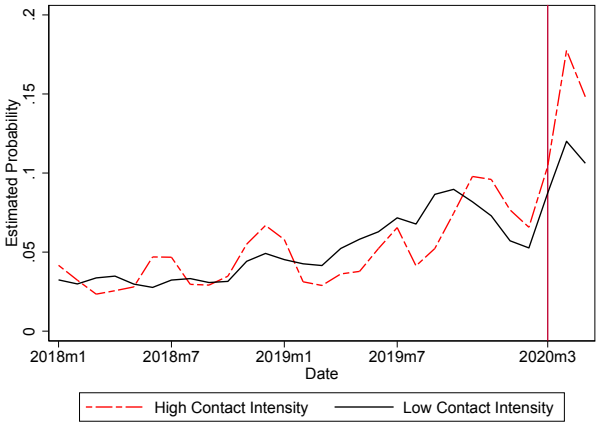
Figure 4 – Effects of *Covid-19 Impact* on Planned Price Adjustment



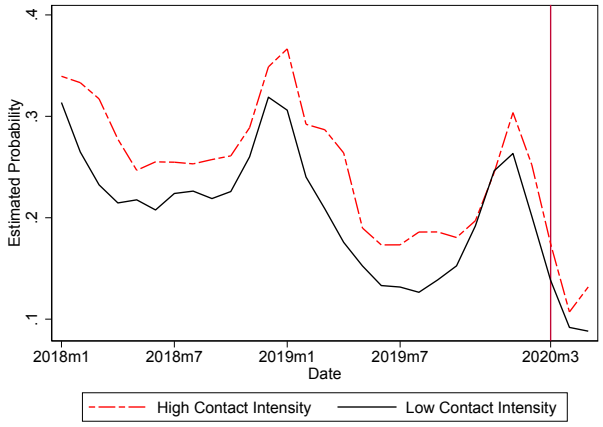
Notes: This figure reports estimates from linear regressions of indicators for planned price decreases/increases on indicators for *Covid-19 impact* categories in the pooled sample (left) and separately by sector (right), based on Equation (3). *Covid-19 impact* measures the impact of Covid-19 on the current business situation on a seven-point scale from -3 ("negative") to $+3$ ("positive") in the ifo-BCS, which we group and label "Strongly Negative" (-3), "Negative" (-2), and "Positive" ($+2$ and $+3$), and the base category "Weak/No Impact" (-1, 0, or $+1$). Control variables include separate indicators for positive and negative responses to the questions about business situation, business expectations, and orders, all lagged by three months. In addition, we control for firm fixed effects and month-year fixed effects at the levels of two-digit NACE industries. Online Appendix C provides translations of all corresponding survey questions. 95%-confidence bounds are based on standard errors clustered at the firm level. Sample: 2018:M01–2020:M05. Columns 3 and 6 of Table A.3 in the Online Appendix present the corresponding numerical estimates.

Figure 5 – Effects of Health Risk Exposure on Planned Price Adjustment

(a) Planned Price Decreases



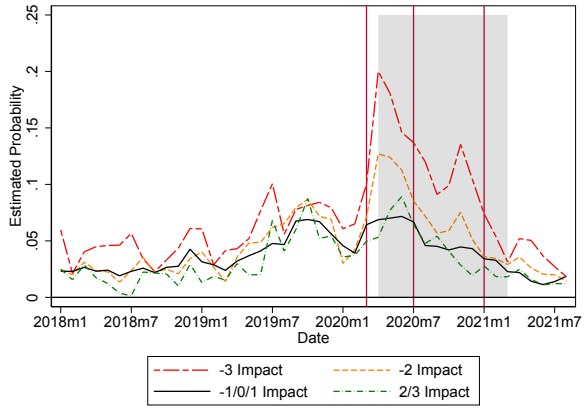
(b) Planned Price Increases



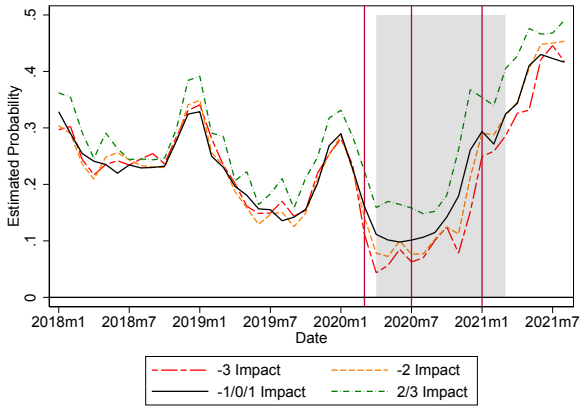
Notes: The figure shows the time series of the frequency of planned price decreases (left) and planned price increases (right) by health risk exposure, net of controls. "High health risk exposure" refers to the group of firms in industries with above-median O*NET contact intensity and below-median capacity to work from home by Alipour et al. (2021). The remaining firms are classified as "Low health risk exposure". The vertical red line refers to March 2020, i.e., the month, when the Covid-19 pandemic reached Germany. See notes to Figure 3 for details on the construction of these figures. Sample: 2018:M01–2020:M05.

Figure 6 – Planned Price Adjustment until August 2021

(a) Planned Price Decreases

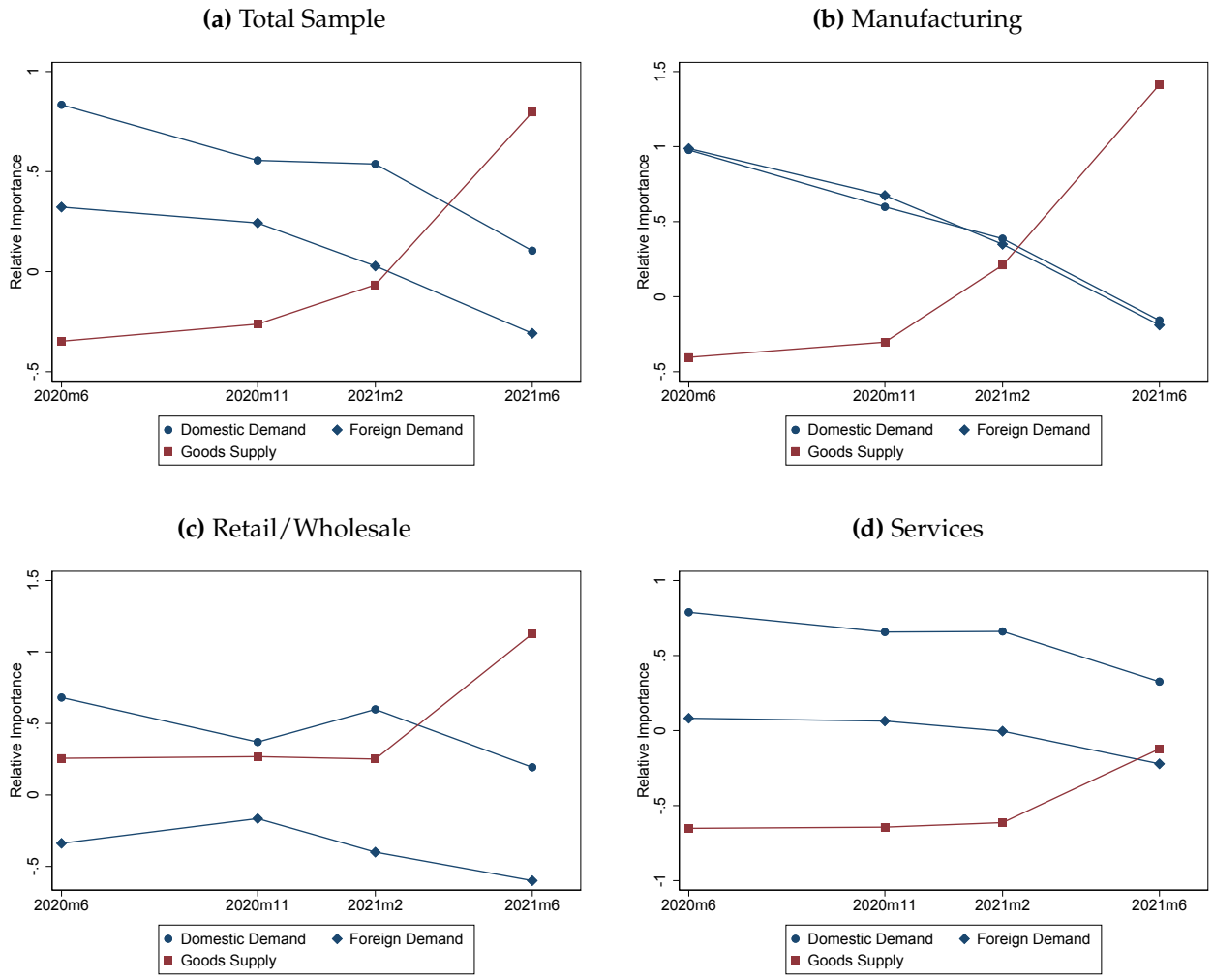


(b) Planned Price Increases



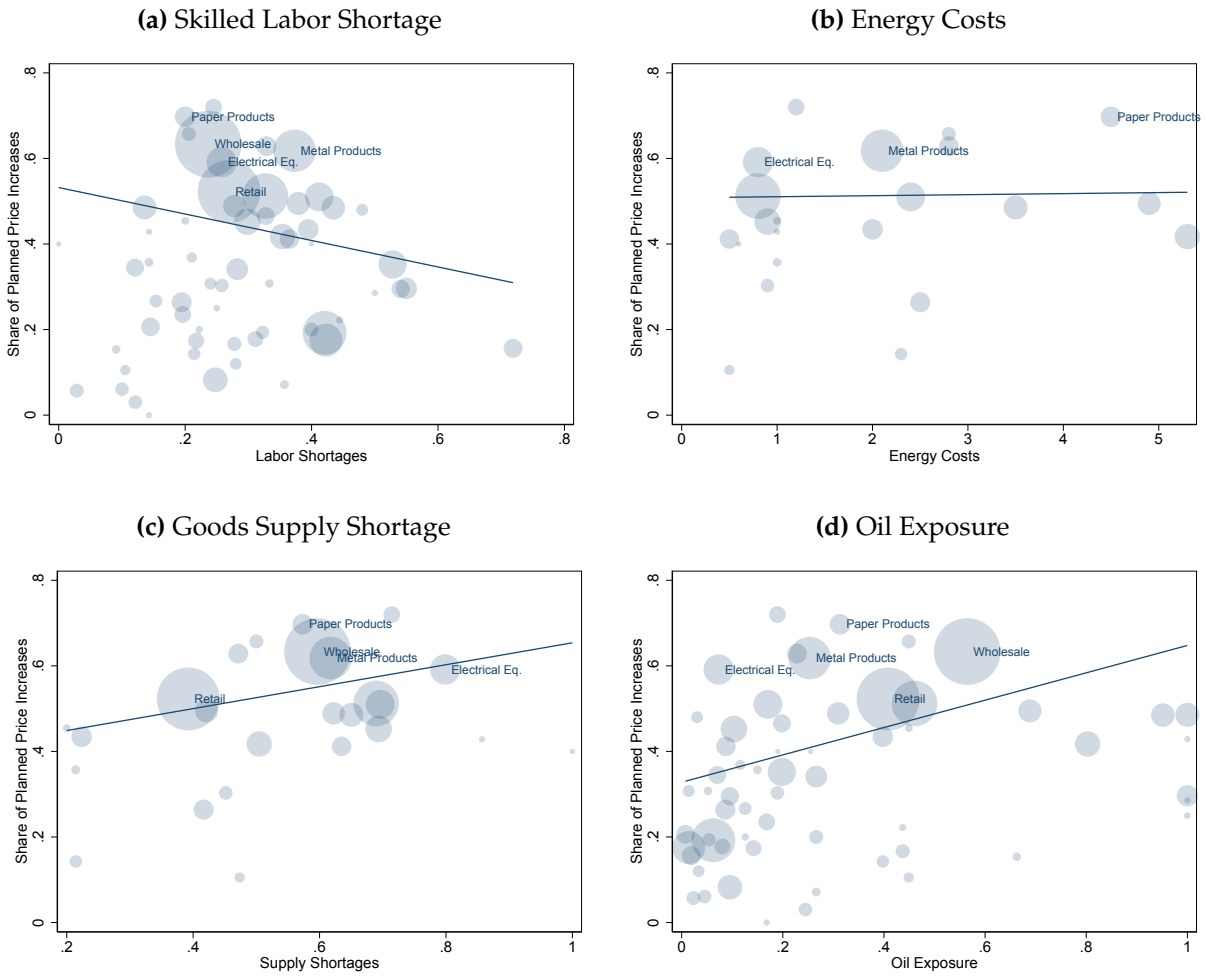
Notes: This figure shows the time series of the frequency of planned price decreases (left) and price increases (right) for each grouped *Covid-19 impact* category net of controls. Firms are grouped according to their average value of *Covid-19 impact* between April 2020 and March 2021, rounded to the next integer. In every month, the difference between each line relative to firms with weak or no impact corresponds to the estimated coefficient δ_i, $i = -3, -2, \{2, 3\}$ from Equation (2). The frequency-weighted average of all lines in a given month equals the month's sample average. The vertical red lines refer to March 2020, i.e., the month, when the Covid-19 pandemic reached Germany, and July 2020 and January 2021, when the value added tax was temporarily decreased and reverted to the original level, respectively. Sample period: 2018:M01–2021:M08.

Figure 7 – Subjective Reasons for Adverse Economic Effects of Covid-19



Notes: This figure shows the relative subjective importance of domestic and foreign demand as well as goods supply as reasons for the adverse economic effects of Covid-19 on firm business activity. Supplementary questions in the ifo-BCS ask firms to assess the adverse effects due to Covid-19 of financing conditions, demand (domestic and foreign, separately), labor input, supply-chain disruptions, and government containment regulations. Online Appendix C provides the corresponding translated survey questions. Possible answers categories range from "no effect" (+1) to "large adverse effect" (+5). To capture their relative importance at the firm level at a given point in time, we compare each subjective reason relative to the firm mean of all those remaining, and then average across firms. Thus, positive values reflect relatively more important reasons. Subjective reasons data are available in June 2020, November 2020, February 2021, and June 2021. Panel (a) covers the total sample, Panels (b) through (d) the manufacturing, retail/wholesale, and services industries, respectively.

Figure 8 – Planned Price Increases on Sector Level in July 2021



Notes: This figure shows the share of planned price increases in relation to goods supply shortage, skilled labor supply shortage, oil price exposure, and energy costs at the two-digit NACE industry level in July 2021. Goods supply shortage is the share of firms in a given sector that reports to be constrained by lack of material/intermediates. Skilled labor supply shortage is the share of firms in a given sector that reports to be constrained by lack of skilled labor. Both measures derive from Q7 in Online Appendix C. Oil price exposure is the share of oil and oil-related (measured as the input share of cokery and oil products times the share of oil input in that sector) inputs in total production from the 2016 input-output matrix. We winsorize the oil exposure share in four sectors at 1. Energy costs is the total share of energy in gross production value. Both statistics are obtained from the Federal Statistical Office. Goods supply shortages are only available for manufacturing and retail/wholesale sectors. Energy costs are only available for the manufacturing sectors. The linear fit shown is from Table A.7 in the Online Appendix.

Main Tables

Table 1 – Health Risks Effects of the Covid-19 Pandemic on Planned Price Adjustment

	Planned Price Decrease		Planned Price Increase	
	(1)	(2)	3)	(4)
Crisis	0.057***	0.069***	-0.091***	-0.099***
	(0.0073)	(0.012)	(0.011)	(0.0100)
High Health Risk	-0.000067		0.043*	
	(0.0079)		(0.025)	
Contact Intensive (Eichenbaum et al. 2020b)		0.0094		0.095***
		(0.0093)		(0.012)
High Health Risk × Crisis	0.050***		-0.014	
	(0.015)		(0.021)	
Contact Intensive (Eichenbaum et al. 2020b) × Crisis		0.011		0.011
		(0.027)		(0.016)
Observations	121099	121111	121099	121111
Industry FE	No	No	No	No
Controls	Yes	Yes	Yes	Yes

Notes: This table reports estimates from difference-in-differences regressions based on Equation (4). Firms are classified into a high and low health risks group based on three different measures: Columns (1) and (3) group firms to "high health risk exposure" if they operate in industries with above-median contact intensity as described in Footnote 21 and below-median industry-specific capacity to work from home by Alipour et al. (2021). In Columns (2) and (4), firms are sorted according to the heuristic classification by Eichenbaum et al. (2020) to "high contact goods and services". Control variables include separate indicators for positive and negative responses to the questions about business situation, business expectations, and orders, all lagged by three months. Online Appendix C provides translations of all corresponding survey questions. Standard errors in parentheses are clustered at the firm level. Sample: 2018:M01–2020:M05. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.