Causal Evidence on Firms' Investment Expectations and Revisions in Response to the Global Pandemic

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25 August 2021

Abstract

This paper studies firms' investment expectations and their revisions in response to the COVID-19 pandemic outbreak. Combining a survey of Swiss firms with a quasi-experimental research design finds that the pandemic caused firms to reduce their 2020 investment plans by over one-eight. The pandemic reinforced pre-crisis constraints in that companies facing poor economic conditions or a lack of financial resources cut their plans more than others. Although realization certainty before the crisis did not predict revisions, increased uncertainty during the crisis depressed firms' expected investments through real options effects. Government-guaranteed loans helped preserve plans to expand production capacity, and the forward-guiding easing of containment measures reduced uncertainty, resulting in smaller revisions overall.

JEL Classification: D22, D8, E22, G30
Keywords: Firms' expectations, investments, uncertainty, financial constraints, COVID-19, pandemic

For helpful comments and suggestions, I thank Klaus Abberger, Daniel Kopp, Samad Sarferaz, and Michael Siegenthaler. An earlier version of this paper appeared in CEPR Covid Economics, Vetted and Real-Time Papers (2021) No. 73 under the title "Firms' Investment Decisions in Response to the COVID-19 Pandemic: Causal Evidence From Switzerland."
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1 Introduction

The fast spread of the coronavirus disease 2019 (COVID-19) in early 2020 prompted governments around the globe to take strict measures to contain the pandemic and protect their populations. In many countries, public and social life was essentially shut down through ordered mass quarantines ("lockdowns"). Businesses were forced to close, curfews were imposed, and contact restrictions were put in place. The measures lead to an unprecedented disruption of economic activity, with no clear indication of when or how quickly the situation would return to normal.

This situation presented many companies with an existential challenge, forcing them to make a wide range of important decisions in a rapidly evolving environment characterized by unparalleled uncertainty and determined by questions that only the virus could answer.[1] These circumstances are likely to have affected firms' investment decisions in particular, which are inherently costly, long-term, and often irreversible. For this reason, the economic crisis associated with the COVID-19 pandemic provides an ideal setting to study how firms create and adjust their investment plans.

This paper examines how the global pandemic influenced firms' investment expectations and how policy measures affected their investment revisions. The analysis aims to understand three different aspects. First, it explores how the pandemic changed firms' investment expectations and identifies those firms that have made particularly significant changes to their 2020 investment plans in response to the crisis. Second, it examines the influence of governments' policy measures to mitigate the economic impact of the crisis on firms' investment revisions. Third, it seeks to uncover the mechanism underlying these revisions.

The motivation to understand how firms adjust their investment expectations is twofold. From an academic perspective, heterogeneity in investment decisions, which due to their dynamic nature, depend on firms' expectations of future economic conditions, can help uncover the channels through which macroeconomic shocks are transmitted to the real economy. From a policy perspective, knowledge about which interventions affect firms' expectations and how firms respond to them can support the future design of more targeted and effective policies.

The empirical investigation uses firm-level data from a Swiss investment survey. Twice a year, this survey collects detailed information on firms' investment activities in the recent past and their investment expectations in the near future. It covers firms in the manufacturing, construction, and services sectors and accounts for 58% of total employment (FTE) in Switzerland. Using the survey, I construct a firm-level panel data set composed of 1,200 firms covering 2014–2020. These survey data have several desirable properties. First, they include not only realized investments but also planned investments. Second, the investment data are both qualitative and quantitative. Third, repeatedly surveying many firms over a long period has created a panel with Large-N and

[1] Following a statement by Jerome Powell, Chairman of the Federal Reserve System, in his opening remarks at the "Fed Listens" event on 21 May 2020 (see Powell, 2020).

Large-T properties. Forth, the survey covers a wide range of firms, from small to large, and across all industries in Switzerland, except agriculture. Fifth, apart from data on investments, the survey collects information on several factors influencing firms' investment activity, including firm-specific uncertainty. Finally, the survey in autumn 2020 included additional questions to gather information specifically about firms' exposure to the pandemic and the importance of federal and corporate measures to mitigate its economic impact.

The empirical strategy takes advantage of a design feature of the survey data. Both in autumn 2019 and spring 2020, I observe firms' 2020 investment plans, which allows me to calculate investment revisions as the between-survey change in expected investments for 2020. For identification, I then exploit the fact that the survey in spring 2020 was launched immediately before and conducted throughout the first wave of the pandemic. This setup allows me to adopt a difference-in-differences approach to analyze how firms revised their investment plans in response to the COVID-19 pandemic. In particular, I identify the COVID-induced effect on firms' investments by comparing the revisions of the 2020 investment plans of companies that completed the survey in spring 2020 before the crisis with those of companies that responded during the crisis. This strategy assumes that the difference in investment revisions between firms responding before and during the crisis is due entirely to the pandemic. I choose 16 March as the cut-off date, when the Swiss federal government decreed a partial lockdown and introduced far-reaching containment measures. These policy decisions turned out to have catalyzed the economic dimension of the crisis.

My results show that the pandemic severely depressed firms' investment expectations. In response to the pandemic, firms reduced their plans to invest in gross fixed capital formation in 2020 by 14 percentage points. This result is driven by investments in equipment and machinery, which firms reduced by as much as a fifth. Conversely, I find no effects of the pandemic on investments in construction or research and development. At the same time, the pandemic did not influence whether companies invested in replacing worn-out or failing equipment, but it lowered the probability of investing in expanding production capacity by as much as 40%.

Not all companies decided to revise their investment plans alike. Firm characteristics and pre-crisis conditions are important predictors of changes in firms' investment plans in response to the crisis. I find that service providers (-18.3 percentage points) reduced their investment plans slightly more than manufacturing firms (-17.3 percentage points). On the other hand, the pandemic did not affect the investment expectations of construction companies. While small and medium-sized enterprises have cut their investment plans by as much as a quarter, the pandemic did, on average, not cause larger firms to revise their investment decisions. Moreover, older and exporting firms show a stronger reaction by reducing their planned investments by more than younger and non-exporting firms. The extent to which companies revise their investment plans also depends on their geographic exposure to the virus. Firms in regions more exposed to the virus cut their investments more. The pandemic further reinforced pre-crisis weaknesses and

constraints. Firms that assessed their business situation in 2019 on average as poor cut their investment plans by 43 percentage points. Conversely, firms in a good state before the crisis did not change their investment expectations. I find a similar pattern for firms whose investment expectations in 2019 were constrained by a lack of external funding. Financially constrained firms cut their plans by more during the crisis than firms facing no constraints. However, certainty about realizing their 2020 investment plans before the crisis does not predict firms' revisions during the crisis.

Revisions in investment expectations were largely due to firms postponing their investment plans. 58% considered delaying investment projects important to address the economic impact of the pandemic. Slightly less than half of the firms surveyed assigned the same importance to waive investments. Those firms that canceled their investment plans revised their 2020 investment expectations by an average of 4 percentage points more than firms that deferred them. In contrast, the 37% of participants for whom starting new investment projects was important to cope with the pandemic did not change their investment plans. The few firms that increased their investments due to the pandemic stand out as particularly innovative. They have a large share of human capital in their production or service provision, employ a large number of well-trained workers, and – already before the crisis – have largely digitized both internal and external processes, with employees doing most of their work with information and communications technologies and using the internet as a channel for both procurement and sales.

The COVID-19 pandemic triggered an unprecedented policy response, bringing public and social life to a standstill and largely restricting economic activity. To assess how these "lockdown" policies have influenced firms' investment expectations, I decompose the policy response of the Swiss government into three different components: the government-imposed temporary closure of production or service provision, workers' ability to do their work from home, and a profession's need for physical proximity to others. I find strong evidence for an inverse relationship between firms' investment revisions and their exposure to the lockdown policies. Forced plant closures caused the largest cuts in investments. Increasing the share of completely closed firms during the lockdown in spring 2020 by one percentage point decreases 2020 investment plans by 15.5 percentage points on average. Further, a profession's need for physical proximity has a slightly stronger effect on firms' investment revisions than its ability to work from home. This is consistent with the Swiss government's lockdown policies focusing on reducing physical contact between people rather than having them work from home.

To ease the economic consequences of the pandemic, the Swiss government adopted a comprehensive package of support measures and emergency aid. One key component of this package was the COVID-19 bridging loan program, which aimed at providing companies with sufficient liquidity to cover their current overheads despite turnover reductions associated with the pandemic. Participation in the program was sizeable, as 20% of all firms participated in this program, comprising a guaranteed loan volume of 2.4% of annual GDP (Fuhrer et al., 2021). I find evidence

that loan demand was driven by weak ex-ante financial conditions, firms' exposure to the lockdown policies, and their expectations about the duration of the crisis. In particular, less liquid, more indebted, and less profitable firms had a higher probability of participating in the program. Revisions of investment plans increase with the size of the credits taken. Firms that did not take COVID-19 credits reduced their investment plans by about ten percentage points on average, while firms that took a loan of more than CHF 0.5 million reduced their plans by as much as fifty percentage points. Conversely, firms that took a smaller loan did not revise their investment plans. This could indicate that these smaller loans have not only helped to bridge liquidity bottlenecks but also to sustain firms' investment plans. Indeed, the government-guaranteed loans program helped preserve plans to extend the production capacity of those firms that participated in the program, as the pandemic caused firms not participating to abandon their investments intended to expand capacity.

Investigating the mechanism underlying these investment revisions, I find empirical evidence for real options theory (Bernanke, 1983; Pindyck, 1988; Caballero, 1991), according to which uncertainty increases the option value for "wait-and-see" behavior, leading firms to postpone their irreversible investments. The pandemic caused firms uncertain about realizing their irreversible investment plans to decrease their 2020 investments by 20 percentage points more than firms more certain about their planned investments. I consider the magnitude of the effect substantial, reflecting the surge in uncertainty at the onset of the COVID-19 crisis. Shrouded in a veil of uncertainty, firms at large abandoned their investment plans which they could not have easily reversed. Conversely, the forward-guiding easing of the lockdown policies reduced uncertainty, leading to smaller revisions overall.

These results contribute to a recent, international, and rapidly growing literature that examines the economic consequences of the COVID-19 pandemic, focusing on firm-level expectations and behavior using survey data.[2] Only a handful of these contributions to date have examined firms' investment decisions. Balduzzi et al. (2020) field a survey in Italy and document that most firms planned to cut their investments during the crisis. Similarly, Buchheim et al. (2020) study managerial mitigation strategies in the wake of the pandemic and find that firms in bad shape before the crisis were first to cut employment and investment during the crisis. Using data from the same survey and linking it to firm-level uncertainty, Lautenbacher (2020) finds no evidence that firms postponed investment following the COVID-related changes in uncertainty. These papers use qualitative data on firms' investment responses or investment plans collected during the crisis. My analysis complements these earlier studies by using quantitative investment data from a survey that captured firms' investment plans not only after the crisis but also long

[2] Bartik et al. (2020) provide broad and descriptive evidence on the effect of the pandemic on small businesses in the US. Brülhart et al. (2020) provide similar evidence for self-employed in Switzerland. Using another survey on Swiss firms, Zoller-Rydzek and Keller (2020) show that firms' decrease in business activity is driven by a decline in foreign demand. Baker et al. (2020) document an enormous increase in survey-based uncertainty of firms at the onset of the crisis in the US and the UK. Balleer et al. (2020) study price-setting behavior in German firm-level survey data.

before. This panel dimension allows me to quantify changes in firms' investment expectations and convincingly identify the causal effect of the pandemic on various types of investment using difference-in-differences estimations. To the best of my knowledge, my paper is the first to quantify firms' investment revisions in response to the COVID-19 pandemic.

My results further add to the literature that examines the determinants of firms' investment decisions from a microeconomic perspective. They highlight the importance of firms' financial situation and profitability during the recent crisis and thus align with the extensive literature documenting the adverse effect of binding financial constraints on firms' investments (see, for example, Bernanke et al., 1996; Fazzari et al., 1988). Moreover, by linking firms' investments to subjective uncertainty, my results provide empirical evidence for real options theory. Using survey data on Italian manufacturing firms, Guiso and Parigi (1999) show that uncertainty reduces investments and that the effect of uncertainty is more substantial for firms that cannot quickly reverse their investment decisions. Many empirical contributions have since corroborated this initial evidence for real options theory. Using the same survey as this paper, Binding and Dibiasi (2017) and Dibiasi et al. (2018) document that Swiss firms' investment decisions are consistent with real options. My work contributes to this literature by reinforcing the empirical evidence for real options in firms' investment decisions. Unlike Lautenbacher (2020), it finds this evidence also for the COVID-19 pandemic.

Finally, by analyzing the effect of the lockdown policies on firms' investment expectations, my paper builds on the broad literature that studies the formation of expectations by economic agents and the effects of these expectations on their decisions. There is growing evidence that inattention to macroeconomic policies and conditions is widespread among firms (Coibion et al., 2018, 2020a; Andrade et al., 2021) and households (Bachmann and Elstner, 2015; D'Acunto et al., 2019). Utilizing randomized control trials, Coibion et al. (2020b) find that new information about policy responses during the COVID-19 pandemic had little effect on the economic expectations of US households. My results for Swiss firms differ in that companies were attentive to fiscal containment measures, and their investment expectations responded to the forward guidance as the government announced to lift the lockdown policies gradually. This powerful effect of the expectations channel, consistent with standard macroeconomic models, can be reconciled with empirical evidence of rational inattention in the sense that economic agents are likely to focus their attention and turn to their government for guidance and support during crises and periods of high uncertainty.

The remainder of this paper is organized as follows. Section 2 provides an overview of the first wave of the COVID-19 pandemic in Switzerland in spring 2020. Section 3 describes the data. Section 4 lays out the empirical strategy. Section 5 presents the results. Section 6 provides robustness analyses. Section 7 concludes.

2 The COVID-19 pandemic in Switzerland

Aside from its impact on public health, the fast spread of the coronavirus disease 2019 (COVID-19) in early 2020 triggered economic crises all around the globe, including Switzerland. The disease first caught public attention on 8 January 2020, after a Swiss newspaper reported multiple cases of mysterious lung disease in Wuhan's central Chinese metropolis (Neue Zürcher Zeitung, 2020). The virus was confirmed to have spread to Switzerland on 25 February 2020 when a person tested positive for COVID-19 for the first time. After that, the virus spread quickly around the country, and the daily numbers of confirmed COVID-19 cases grew exponentially, as shown in Figure 1.

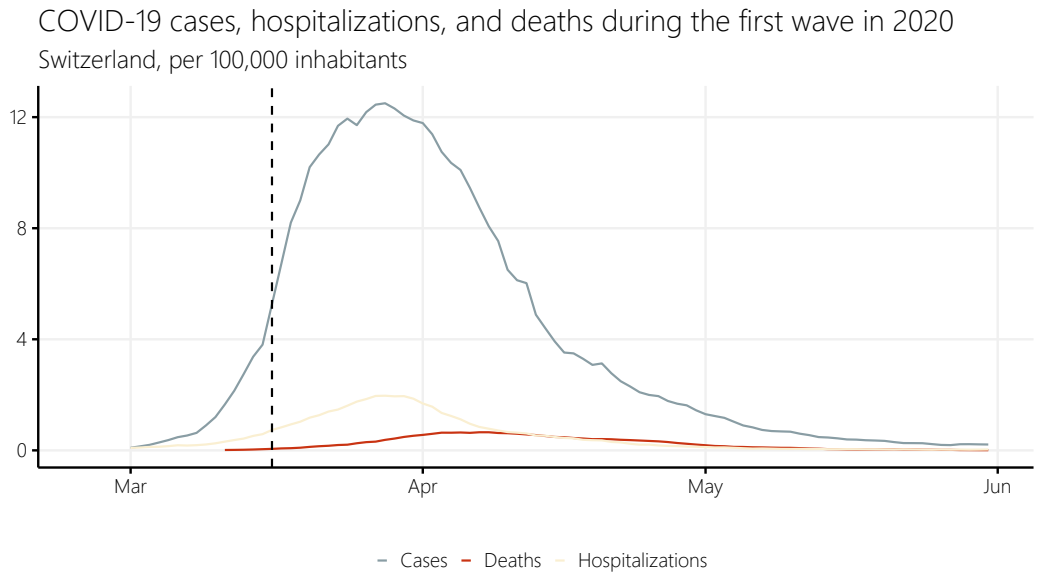

Figure 1: This chart shows daily numbers of confirmed COVID-19 cases by diagnosis date, hospitalizations due to COVID-19 by admission date, and deaths by date of death from COVID-19 on a daily basis for Switzerland for the duration of the investment survey in spring 2020 (i.e., from 25 February to 31 May 2020). Counts are shown as 7-day right-aligned moving averages per 100,000 inhabitants. The vertical dashed line marks the declaration of the "extraordinary situation" by the Swiss Federal Council on 16 March 2020.

On 28 February 2020, the Federal Council classified the state of affairs in Switzerland as a "special situation" under the Epidemics Act[3] and prohibited, among other things, events involving more than 1,000 people.[4] The Swiss Federal Office of Public Health launched an information campaign

[3]The Epidemics Act is a federal law of the Swiss Confederation on the control of transmissible human diseases. It was adopted in its current form by the Federal Assembly on 28 September 2012, after being examined by the Federal Council on 3 December 2010. The law was submitted to a popular vote in an optional referendum. With a turnout of just under 47 percent, the law was adopted on 22 September 2013, with 60 percent vote in favor. It is effective since 1 January 2016. The "special" and "extraordinary" situations it sets out and the additional powers for the executive branch that they entail were first proclaimed during the COVID-19 pandemic.

[4]In Appendix A, I provide a more detailed overview of the first wave of the COVID-19 pandemic in Switzerland. Table A.1 shows a timeline of selected events and measures taken by the Swiss federal government. Figure A.1 shows the stringency of COVID-19 policy measures in Switzerland and its neighboring countries.

on 1 March. On 13 March, the Federal Council prohibited events with more than 100 people and closed public schools as of 16 March.

Only a few days later, on 16 March, the Federal Council reclassified Switzerland's situation fundamentally and declared a national state of emergency ("extraordinary situation" in terms of the Epidemics Act).[5] Faced with the rapidly evolving epidemiological situation, the Swiss government decreed a partial lockdown and introduced nationwide measures to protect the public. These entailed mobility restrictions, social distancing rules, and shop closures. Non-essential retail outlets and many service providers (such as restaurants, bars, entertainment and leisure facilities) were to close. Only a few essential industries, such as grocery stores, pharmacies, banks, and post offices, were exempt from the measures and allowed to remain open. All public and private events were prohibited. Besides, the government called on the public to avoid unnecessary contact and keep their distance from others. Wherever possible, work activities were to be carried out from home. Where this was impossible and hygiene measures could not be respected, work activities had to be stopped. Beyond, border controls were introduced, and entry bans were imposed.

The announcement of the "extraordinary situation" and the adoption of far-reaching measures proved to be a focal point adding an economic dimension to the crisis, which had hitherto been epidemiological in the first place. Private consumption declined sharply.[6] Business activity was widely restricted, and firms' outlook for the future was severely clouded. Many companies suffered a significant or even complete loss of sales and faced liquidity problems. Employees were put on short-time work or laid off altogether. At the time, GDP was projected to contract by more than 5% over the whole year (KOF, 2020; SECO, 2020).

To mitigate the economic consequences of the pandemic, the Federal Council adopted a comprehensive package of measures on 20 March 2020. This package included the extension and simplification of short-time work, as well as liquidity assistance for companies in the form of "COVID-19 credits." Under the latter, companies affected by the COVID-19 crisis could take advantage of bridging loans guaranteed by the federal government to secure their liquidity.[7] Participation in the COVID-19 loan program was sizeable, as 20% of all firms participated in this program, comprising a guaranteed loan volume of 2.4% of annual GDP (Fuhrer et al., 2021).

The measures announced on 16 March were effective immediately and until 19 April at first. On 8 April[8], the Federal Council extended the measures by one week until 26 April. At the same

[5] For further information, see the press release by the Swiss Federal Council (2020b).

[6] In Seiler (2020), I use public data from debit card transactions to measure COVID-induced changes in consumer spending and estimate the resulting weighting bias in Swiss consumer price inflation.

[7] Bridging loans should provide companies with sufficient liquidity to cover their current overheads despite turnover reductions associated with the pandemic. The program aimed to provide companies affected by the COVID-19 crisis with quick and uncomplicated loans of up to 10% of their annual turnover (or up to a maximum of CHF 20 million) and with a maturity of five years. The federal government fully guaranteed amounts of up to CHF 500,000. Amounts over of CHF 500,000 (called "COVID-19 plus loan") were guaranteed by the federal government at 85% and required additional checks by the banks.

[8] For further information, see the press release by the Swiss Federal Council (2020c).

time, it decided to gradually ease the measures before the end of April. However, it would not decide on the steps to ease the measures until its next meeting on 16 April.

On 16 April, one month into the lockdown and in light of an encouraging epidemic development, the Federal Council presented its roadmap to ease the lockdown measures.[9] The reopening of the economy and public life should take place in three stages. In an initial stage, scheduled for 27 April, hairdressers, beauty salons, DIY stores, flower shops, and garden centers were allowed to reopen. Also, from 27 April, hospitals were again allowed to perform all operations. In a second stage, scheduled for 11 May, compulsory schools and retail shops were allowed to reopen. In a third stage, scheduled for 8 June, secondary schools and universities, museums, zoos, and libraries were to reopen.

These three stages were effectively met. By announcing its schedule for gradually easing the lockdown policies until June, the Federal Council aimed explicitly to give both households and companies a clear perspective out of the crisis, thereby creating planning security. Such certainty was lacking during the one-month lockdown, which contributed to the unprecedented rise in uncertainty. Between 16 March and 16 April, it was generally unknown how long the imposed measures would be maintained and how long the overall lockdown would last. Both the measures and their relaxation depended on how the pandemic developed – the virus set the pace. As a result, prospects for the future were limited and uncertainty exceptionally high.

These circumstances constitute an ideal setting to study how firms adjust their investment expectations in response to a substantial exogenous shock and explore the role of different policy measures in these revisions.

3 Data

To examine the effects of the pandemic on firms' investment expectations, I use firm-level data from the investment survey[10] conducted by the KOF Swiss Economic Institute at ETH Zurich. Since 2012 in spring and autumn, this survey is conducted bi-annually among a large panel of private Swiss firms collecting detailed information on investment decisions and plans. Currently, it consists of 13,287 firms. The average response rate between 2012 and 2020 amounts to 29%. The sampled firms cover all industries, except agriculture, and account for 58% of total employment (FTE) in Switzerland. Appendix B shows the questionnaire and describes the survey in greater detail.

[9] For further information, see the press release by the Swiss Federal Council (2020d).

[10] Recent studies using the investment survey have analyzed the effects of exchange rate uncertainty (Bannert et al., 2015; Binding and Dibiasi, 2017), economic policy uncertainty (Dibiasi et al., 2018), or the low-interest-rate environment (Föllmi et al., 2021) on firms' investment activity.

3.1 The regular investment survey

The investment survey is focused on quantitative information on planned and realized investments. For this purpose, every survey asks firms about their investments for several years. In autumn, firms report on their investments for the past, current, and following year. In spring, they report on their investments for the current year and the two previous years. Thus, for a firm participating every spring and autumn, the survey collects six investment figures for any given year at different points in time, as illustrated by Figure 2. The area highlighted in yellow represents an example of the six investment amounts collected for 2019, the first in the 2018 autumn survey and the last in the 2021 spring survey. Some of the investment data are *actual* (i.e., realized) investments made in the past; some refer to *planned* (i.e., expected) investments in the future.

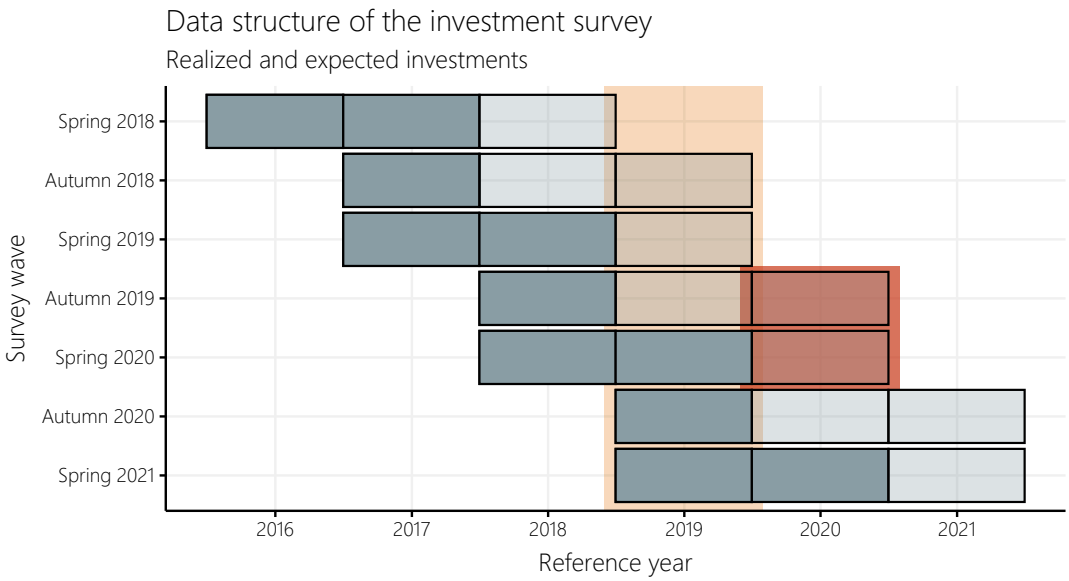

Figure 2: Reporting and data structure of the quantitative questions from the investment survey conducted by the KOF Swiss Economic Institute at ETH Zurich. Dark shaded areas represent realized investments. Light areas represent expected investments. The area highlighted in yellow represents the six investment amounts collected for 2019 as an example. The area highlighted in red represents the change in investment expectations of particular interest, namely the change in expected investment for 2020 between the survey in autumn 2019 and spring 2020.

The survey asks firms to report their investments in equipment and machinery[11], construction[12], and research and development (R&D)[13]. It defines gross fixed capital formation (GFCF) as

[11] Investments in equipment and machinery include machinery, mechanical equipment, conveying and warehouse equipment, office machines incl. IT (hardware and software), equipment and furniture, vehicles used for business purposes, and services to maintain, improve or renew facilities.

[12] Investments in construction include new construction, reconstruction, and renovation of industrial and commercial buildings.

[13] Investments in research and development include all expenditures for research and development projects that serve the company's own business, such as personnel costs and materials and equipment to support research and development, as well as costs for purchased research and development services or costs for the purchase of patents.

the sum of the three categories. Beyond these investment categories, the survey asks whether investments replace capital, extend production capacity, streamline production, or protect the environment. Firms may choose one or more of these purposes.

The reporting and data structure reveals changes in firms' investment plans at three points in time over one and a half years. For the analysis, one change in investment expectations is of particular interest, highlighted in red in Figure 2. Namely, the survey allows quantifying the revisions of firms' investment plans during the COVID-19 pandemic. For the year 2020, we observe a company's expected investments both in autumn 2019 ($I_{i,t=2020,s=\text{autumn 2019}}$) and spring 2020 ($I_{i,t=2020,s=\text{spring 2020}}$). The revision of the investment plan of firm i for the year $t = 2020$ then results from the between-wave change in planned investments, i.e.

$$\Delta I_{i,t=2020} = \log(I_{i,t=2020,s=\text{spring 2020}}) - \log(I_{i,t=2020,s=\text{autumn 2019}}). \tag{1}$$

Investment revisions defined in this way will serve as the main dependent variables in the regression analyses. Since the logarithm of zero is not defined, about 12.7% of all firm-year observations are discarded. Conditioning the sample to firms with positive investment does not induce a sample selection bias in my analysis, as shown in Section 6.

Figure 3 shows the distribution of investment variables for all firm-year observations in the sample. The upper panel shows firms' expected investments for year t as reported in the autumn survey the year before ($I_{i,t,s=\text{autumn } t-1}$). The middle panel shows firms' expected investment for year t as reported in the spring survey of the current year ($I_{i,t,s=\text{spring } t}$). The lower panel shows revisions in firms' investment expectations, $\Delta I_{i,t=2020}$, as defined in Equation (1). Investment figures are in logarithms, and revisions are log-differences of them.

Whether reported in the current year or the previous year, expected investments are very similar, on average. Investments in construction are the largest, with 13.4 log points (660,000 CHF) and a standard deviation of 2.6. The average investment in equipment and machinery is 12.8 log points (360,000 CHF) with a standard deviation of 2.4. Investments in research and development amount to 12.0 log points (160,000 CHF) with a standard deviation of 2.6. Investment revisions are, on average, small and close to zero. They amount to -0.9% for equipment, -0.4% for construction, and -0.8% for R&D.

Furthermore, the panel contains most observations of firms' investment revisions for equipment and machinery (almost twice as many as for construction and more than three times as many as for R&D). Because of the small number of observations for these other categories, models in subsequent analyses can sometimes be estimated precisely only for investments in equipment. Therefore, in what follows, I will often focus on the impact of the pandemic on investment decisions for equipment and machinery.

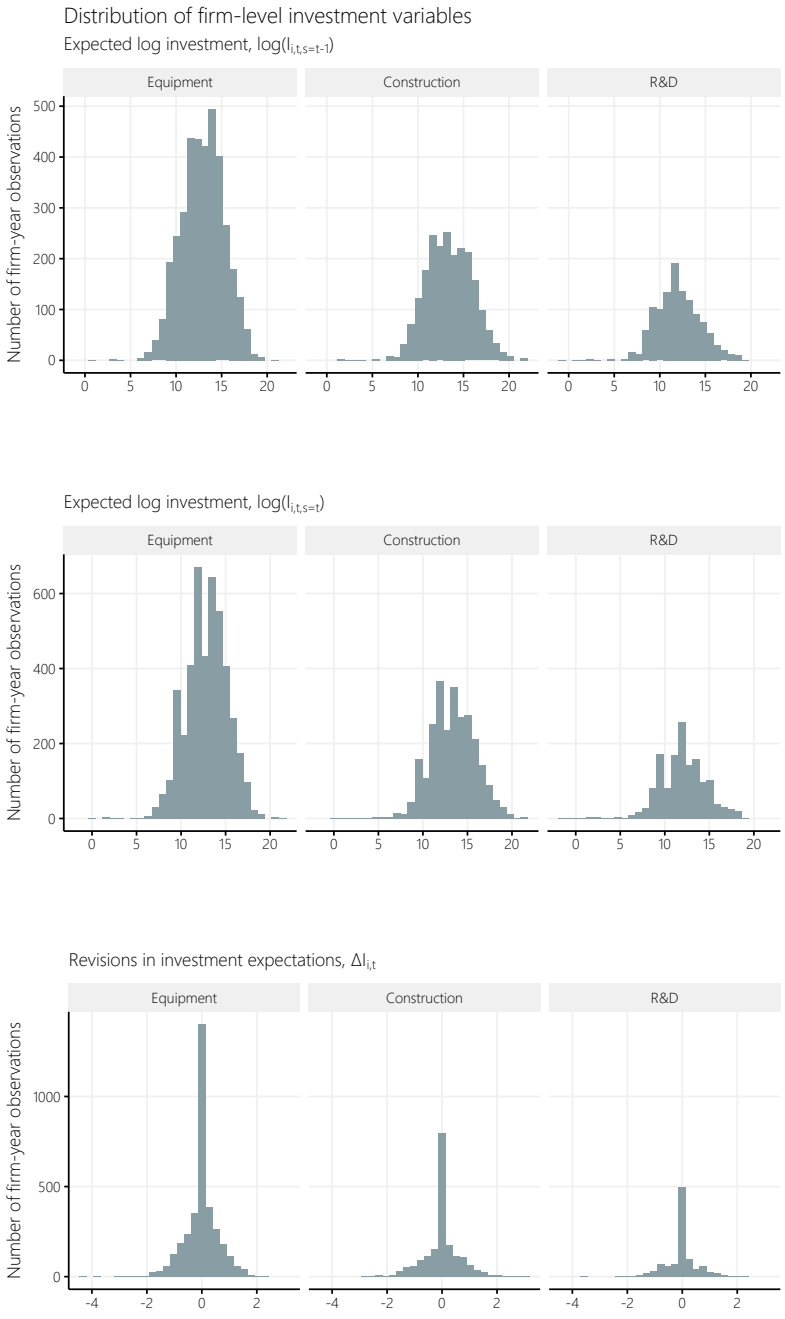

Figure 3: Distribution of investment variables for all firm-year observations in the sample from 2014 to 2020. The upper panel shows firms' expected investments for year t as reported in the autumn survey the year before ($I_{i,t,s=\text{autumn } t-1}$). The middle panel shows firms' expected investment for t as reported in the spring survey of the current year ($I_{i,t,s=\text{spring } t}$). The lower panel shows revisions in firms' investment expectations, $\Delta I_{i,t=2020}$, as defined in Equation (1). Investment figures are in logarithms, revisions are log-differences of them.

Firm-level uncertainty and irreversibility of investments

In addition to investment figures, the investment survey also collects information on the factors that determine companies' investment decisions. These include, in particular, investors' perceived uncertainty. The economic theory highlights different channels through which uncertainty affects investment, with one of the most prominent channels revolving around "real options."[14] Real options theory (Bernanke, 1983; Pindyck, 1988; Caballero, 1991) describes firms' investment choices as a series of options. If uncertainty increases, firms resort to "wait-and-see" behavior until more information becomes available to inform their decision. Until then, firms postpone their investment plans. Alternatively, when uncertainty is high, the option value of delaying investments is high. Real options, however, are not universal. They require investment to be irreversible for uncertainty to affect investment. After all, reversible investment does not lead to the loss of an option.

I infer firm-level uncertainty and irreversibility of investments directly from the investment survey. I identify uncertainty at the firm level using a survey question in every wave of the investment survey since spring 2015. This question concerns how confident firms are about realizing their future investment plans.[15] It asks firms to classify their implementation certainty on a 4-item Likert scale as "very certain," "fairly certain," "fairly uncertain," or "very uncertain." For the analysis, I convert this survey question into a measure of firms' uncertainty by encoding the categorical answer choices into a binary variable ranging from 0 (corresponding to "very certain" or "fairly certain") to 1 (corresponding to "very uncertain" or "fairly uncertain").

$$\text{Uncertain}_{i,t} = \begin{cases} 1 & \text{if firm } i \text{ in } t \text{ is fairly/very uncertain} \\ 0 & \text{———"———} \text{ fairly/very certain} \end{cases} \tag{2}$$

To infer the degree of irreversibility of firms' investments, the investment survey since spring 2015 contains a question inspired by Guiso and Parigi (1999). It asks about the second-hand market conditions for existing equipment and machinery. Firms can choose from four options: (1) there exists a second-hand market, and it is relatively easy to find a buyer in a short time willing to pay a reasonable price; (2) there exists a second-hand market, but it takes time to find a buyer and selling prices are not very rewarding; (3) even though there exists a second-hand market, it is very difficult to find a buyer and selling prices can be very low; and (4) there does not exist a second-hand market for the existing machinery and production plants.

[14] Overall, the effects of uncertainty on investment decisions explained by these channels are ambiguous. Theoretical channels that explain negative investment effects from uncertainty include borrowing constraints due to higher risk premia (Gilchrist et al., 2014; Christiano et al., 2014; Arellano et al., 2019), and a loss of confidence caused by ambiguity aversion (Hansen et al., 1999; Ilut and Schneider, 2014). Theoretical channels that explain positive investment effects from uncertainty include growth options (Bar-Ilan and Strange, 1996; Stein and Stone, 2013; Kraft et al., 2018) and the Oi-Hartman-Abel effect (Oi, 1961; Hartman, 1972; Abel, 1983).

[15] In autumn, the survey collects data on the certainty of realizing the investment plans for the next year. In spring, the survey collects data on the certainty of realizing the investment plans for the current year.

For the analysis, I transform the 4-item Likert scale of the survey question into a binary variable of irreversibility. The variable takes a value of 1 in the case where a firm reports that there does not exist a second-hand market ("full irreversibility"), or it is very difficult to find a buyer and selling prices can be very low at the existing market ("high irreversibility"):

$$\text{Irreversible}_{i,t} = \begin{cases} 1 & \text{if firm } i \text{ in } t \text{ reports high or full irreversibility} \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

Most notably, the resulting firm-specific and time-varying measure of uncertainty has several advantages over the proxies commonly used in the literature.[16] Unlike dispersion-based proxies, it is a first-order measure. Survey-based uncertainty measures are usually proxied by the dispersion of firms' expectations about the future. This approximation is based on the assumption that, in times of high uncertainty, firms' assessments of the future are more disperse than in times of low uncertainty, when most decision-makers' assessments are roughly the same. Dispersion-based measures, however, suffer from a significant weakness: Beyond uncertainty, survey data dispersion is also influenced by the heterogeneity of firms and their genuine disagreement (Girardi and Reuter, 2016).

Also, the object underlying dispersion-based measures of uncertainty is often not precisely determined. This is different for my measure of uncertainty (and irreversibility), which refers to firms' investment uncertainty (irreversibility) specifically. Most of the earlier studies that have examined the effect of uncertainty on firms' investments have either employed uncertainty measures with very specific objects not directly related to investments (e.g., output price uncertainty (Hartman, 1972; Abel, 1983; Abel and Eberly, 1997), demand uncertainty (Caballero, 1991), or profit uncertainty (Abel and Eberly, 1994) or combined an array of different variables of firms' expectations at the cost of a lack of transparency and determinacy. My study contributes to this long-standing literature in that it more explicitly identifies firms' investment uncertainty.

Conversely, the source of uncertainty captured by the measure remains undetermined by choice. This invites firms to consider a broad and individual range of factors that influence their investment decisions. At the same time, firms will only consider sources that are relevant to them. By contrast, survey-based proxies for uncertainty only ever draw from a bounded set of factors. For instance, an uncertainty measure derived from demand expectation only identifies those factors as sources of uncertainty that also influence demand.

[16] Uncertainty cannot be observed directly. Therefore, the economic literature has developed several different strategies to operationalize uncertainty through a broad range of proxy measures. Proxies for macro-level uncertainty include the volatility of the stock market (Bekaert et al., 2013), disagreement among professional forecasters (Boero et al., 2008; Bachmann et al., 2013; Baker et al., 2016), mentions of "uncertainty" in newspapers and other text sources (Baker et al., 2016; Hassan et al., 2019; Handley and Li, 2020), and prediction errors derived from econometric models (Bloom, 2009; Fernández-Villaverde et al., 2011; Jurado et al., 2015). Proxies for firm-level uncertainty include the dispersion of firms' expectations (Guiso and Parigi, 1999) and ex-post forecast errors (Bachmann et al., 2013).

3.2 The COVID-19 special survey in 2020

The empirical analysis further uses additional survey information specifically gathered to study the effects of the pandemic on firms' investment expectations. These special questions, added to the regular investment survey in autumn 2020, asked firms directly about their exposure to the pandemic, the importance of federal and corporate measures to mitigate the economic impact of the pandemic, and various metrics from their 2019 financial statements to capture their pre-crisis financial situation. Appendix B shows the questionnaire in detail.

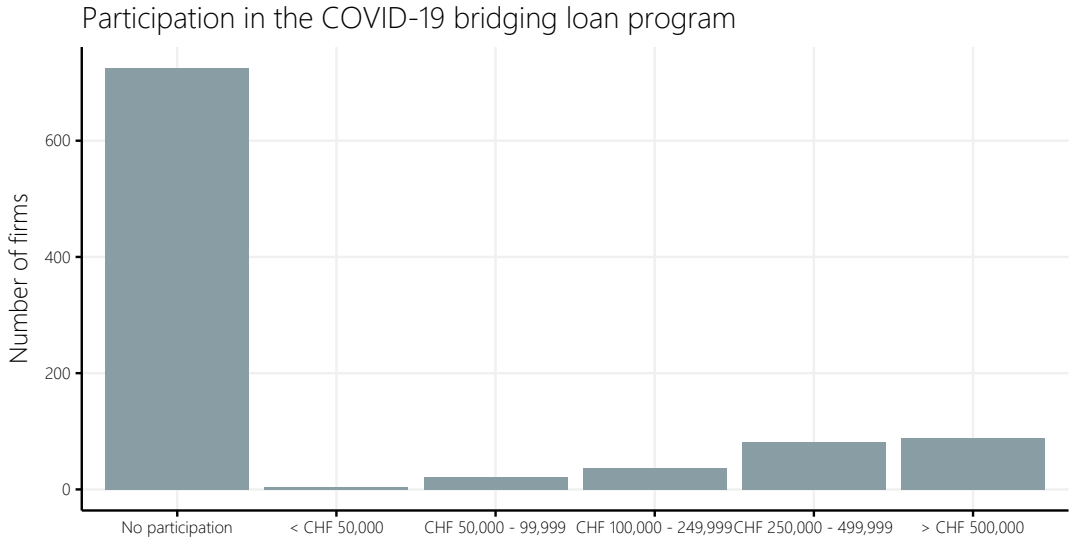

Figure 4: Distribution of firms' participation in the COVID-19 bridging loan program over the pooled sample. Firms are asked if they have obtained a "COVID-19 credit", and if so, to which amount. 60% of firms did not obtain a COVID-19 credit. 0.3% obtained a credit smaller than CHF 50,000. 2% obtained a credit between CHF 50,000 and CHF 100,000. 3% obtained a credit between CHF 100,000 and CHF 250,000. 7% obtained a credit between CHF 250,000 and CHF 500,000. 7% obtained a "COVID-19 credit plus" larger than CHF 500,000.

Importantly, the survey also asked respondents whether they participated in the COVID-19 bridging loan program and, if so, to which amount they have obtained a "COVID-19 loan." The COVID-19 bridging loan program aimed at providing companies with sufficient liquidity to cover their current overheads despite turnover reductions associated with the pandemic. Figure 4 shows the distribution of the reported participation by all the firm-year observations in the sample.

Of all the firms in our sample, 233 participated in the loan program (19.4%). 725 firms reported that they did not participate (60.4%). Of all the firms participating, 37.8% obtained a "COVID-19 loan plus" of an amount larger than CHF 500,000. When analyzing the influence of government policy measures on investment revisions below, I will use the answers to this question in one key specification to examine the effect of this supporting policy on firms' investment expectations.

3.3 Sample summary and descriptive statistics

Using the investment surveys conducted since autumn 2013, I construct a firm-level panel data set providing yearly data on firms' investment revisions for 2014–2020. In the final data set, I only retain companies whose 2020 investment revisions can be calculated, i.e., firms that reported investment figures for 2020 both in autumn 2019 and spring 2020. Besides, I exclude all paper survey participants and only retain the answers of those who completed the survey online.[17] This allows me to determine the exact time of response, which will prove necessary for identification as part of the empirical strategy (see Section 4).

The final data set covers 1,200 different firms. Table 1 reports the summary statistics of the most important variables used in the paper. 27% of the firms employ more than 250 employees (FTE). About 33% of all firms are in the manufacturing sector; the share of firms in the service sector is 57%. Investment revisions are, on average, small and close to zero. They amount to 1.8% for GFCF, −0.9% for equipment, −0.4% for construction, and −0.8% for R&D.

Overall, these survey data have several properties that are desirable for my research design. First, they include not only realized investments but also planned investments. Investment expectations are fundamental to study investment decisions and reveal the factors influencing them. However, because this information is difficult to access, only a few studies to date have used data on planned investments (e.g., Guiso and Parigi, 1999; Binding and Dibiasi, 2017; Bachmann et al., 2017). More easily accessible are actual investment data based on annual accounting results (e.g., Leahy and Whited, 1996; Bloom et al., 2007; Kang et al., 2014; Gulen and Ion, 2016).
Second, besides qualitative data, the survey also collects quantitative data on firms' investments. Previous studies that have surveyed firms' investment plans (e.g., Gennaioli et al., 2016; Coibion et al., 2018; Altig et al., 2020) have done so in a qualitative manner (e.g., "do you expect investments to rise, fall, or stay the same in the next 12 months?"), which makes it difficult to extract quantitative measures of investment expectations (Bachmann and Elstner, 2015). In contrast, I collect quantitative answers from firms about the amount of both the investments they have made in the past and the investments they plan to make in the future.
Third, repeatedly surveying many firms over a long period has created a panel with Large-N and Large-T properties. This feature allows me to study the evolution of firms' investment plans along the entire decision-making process: I observe firms' initial expectations one year in advance, watch them change and materialize over time, and capture the final investment decision that firms eventually make.
Forth, the survey covers a wide range of firms, from small to large, and across all industries in Switzerland, except agriculture. Often, quantitative investment surveys either consider only

[17] In Appendix B, I compare online and paper survey respondents by selected firm characteristics. This comparison shows that the participants who answer the survey online are, on average, larger firms, more frequently located in the eastern and southern parts of Switzerland, and export more. To ensure that the exclusion of paper survey respondents does not affect my main results, I perform a robustness check in Appendix D in which I include them into the estimation sample. The results of this check are qualitatively consistent with my main results.

large firms[18] or cover only one sector of the economy[19].

Finally, in addition to investment data, the survey collects information on various factors that influence firms' investment activity, including firm-specific uncertainty. This allows exploring how firm-specific and time-varying factors influence firms' investment decisions.

Table 1: Summary statistics for firm-year observations from the period 2014-2020.

Variable	N	Mean	Std. Dev.	Minimum	Q1	Median	Q3	Maximum
Investment variables								
Investment revisions (GFCF)	3,841	0.02	0.73	−11.51	−0.18	0	0.24	6.91
Investment revisions (equipment)	3,481	−0.01	0.59	−4.40	−0.22	0	0.23	2.38
Investment revisions (construction)	1,868	−0.004	0.66	−2.71	−0.22	0	0.22	3.00
Investment revisions (R&D)	1,011	−0.01	0.56	−3.56	−0.14	0	0.15	2.30
Covid: postpone	950	0.32	0.47	0	0	0	1	1
Covid: cancel	954	0.24	0.43	0	0	0	0	1
Covid: launch	949	0.15	0.35	0	0	0	0	1
Purpose replacement	4,113	0.25	0.43	0	0	0	1	1
Purpose extension	2,290	0.35	0.48	0	0	0	1	1
Purpose streamlining	2,919	0.23	0.42	0	0	0	0	1
Purpose environment	1,892	0.27	0.44	0	0	0	1	1
Uncertain, current year	4,921	0.14	0.35	0	0	0	0	1
Uncertain, next year	5,252	0.14	0.35	0	0	0	0	1
Irreversible	4,891	0.35	0.48	0	0	0	1	1
Firm characteristics								
Manufacturing firm	6,452	0.33	0.47	0	0	0	1	1
Construction firm	6,452	0.06	0.24	0	0	0	0	1
Service firm	6,452	0.57	0.50	0	0	1	1	1
Large firm	6,452	0.27	0.44	0	0	0	1	1
Old firm	3,647	0.41	0.49	0	0	0	1	1
Exporter	4,684	1.33	0.47	1	1	1	2	2
Pre-crisis conditions								
Business situation 2019	340	0.20	0.55	−1	0	0.07	0.71	1
External financial constraints	946	0.08	0.28	0	0	0	0	1
Internal financial constraints	946	0.18	0.39	0	0	0	0	1
Liquidity assessment	948	0.66	0.58	−1	0	1	1	1
Debt ratio	640	0.41	0.34	−3.50	0.14	0.43	0.67	1
Profit margin	501	0.05	0.11	−0.65	0.0001	0.01	0.07	0.64
COVID-related variables								
COVID cases	1,200	3.25	6.19	0	0	0.65	4.36	83.09
COVID deaths	1,200	0.24	0.61	0	0	0	0.19	5.45
Partial closure	864	0.33	0.47	0	0	0	1	1
Complete closure	682	0.15	0.36	0	0	0	0	1
Working from home	5,933	0.57	0.19	0.23	0.40	0.59	0.76	0.89
Workers' proximity	6,444	0.32	0.15	0	0.24	0.34	0.40	0.71
COVID-19 credit program	958	0.24	0.43	0	0	0	0	1

Notes: This table provides summary statistics of the main variables used in the paper for firm-year observations ("N") over the period from 2014 to 2020. "Investment revisions" represent revisions in firms' investment expectations for gross fixed capital formation (GFCF), equipment, construction, and research & development (R&D) as defined in Equation (1). "Covid: postpone" takes the value 1 if a firm considered postponing investments important in mitigating the economic impact of the pandemic and 0 otherwise. Similar applies to "Covid: cancel" and "Covid: launch." The variable "Purpose replacement" takes the value 1 if a firm's investment serves replacement in the current year, when it didn't invest in replacements the year before, and 0 otherwise. Similar applies to "Purpose extension," "Purpose streamlining," and "Purpose environment." The variable "Uncertain, current year" takes the value 1 in case a firm is fairly or very uncertain about its current year investment and 0 otherwise. Similar applies to "Uncertain, next year." The variable "Irreversible" is binary and takes the value 1 in case a firm reports that there does not exist a second-hand market for its existing production plants, or if there exists a second-hand market but it is very difficult to find a buyer and selling prices can be very low at the existing market. The variable "Manufacturing firm" takes the value 1 in case that a firm is a manufacturing firm (NACE 10–38) and 0 otherwise. The variable "Construction firm" takes the value 1 in case that a firm is a construction firm (NACE 41–43) and 0 otherwise. The variable "Service firm" takes the value 1 in case that a firm operates within the service sector (NACE 45–96) and 0 otherwise. The variable "Large firm" takes the value 1 in case a firm has more than 250 FTE and 0 otherwise. The variable "Old firm" takes the value 1 in case a firm was founded more than 70 years ago and 0 otherwise. The variable "Exporter" takes the value 1 when the export share of a firm's production was more than 5% and 0 otherwise. The variable "Business situation" captures a firm's average business situation in 2019 and ranges from −1 (poor) to 1 (good). The variable "External financial constraints" takes the value 1 if the lack of external funding hindered a firm's investment plans by the end of 2019 and 0 otherwise. The same holds true for "Internal financial constraints." The variable "Liquidity assessment" equals −1 if a firm assessed its liquidity situation in the end of 2019 as "bad" or "very bad", 0 if it assessed it as "satisfactory", and 1 if it assessed it as "good" or "very good." The variable "Debt ratio" is defined as a firm's total debt divided by total assets by the end of 2019. The variable "Profit margin" is defined as a firm's earnings before interest and taxes divided by sales revenue. The variable "COVID cases" captures the daily confirmed COVID-19 cases per 100,000 population by canton. The variable "COVID deaths" captures the daily COVID-related deaths per 100,000 population by canton. The variable "Working from home" captures a profession's ability to work from home and refers to the inverse home office index constructed by Rutzer and Niggli (2020). The variable "Workers' proximity" captures a firm's dependence on the physical proximity of its workers to others and refers to the Swiss lockdown index constructed by Faber et al. (2020). "COVID-19 credit program" is a binary variable that takes the value 1 if a firm participated in the COVID-19 bridging loan program and 0 otherwise.

[18] For instance, Bloom et al. (2007) study the investment behavior of a sample of 672 publicly traded UK firms.

[19] Investment surveys are usually limited to the manufacturing sector, e.g., Guiso and Parigi (1999); Fuss and Vermeulen (2008); Bachmann et al. (2017); Bachmann and Zorn (2020).

4 Empirical strategy

4.1 Identification

I use a quasi-experimental research design to determine the causal effect of the COVID-19 pandemic on firms' investment plans. In particular, I identify the COVID-induced effect on firms' investments by comparing the revisions of the 2020 investment plans of companies in spring 2020 that responded before the crisis with those of companies that responded during the crisis using difference-in-differences estimations.

I divide firms accordingly into two groups. Firms that completed the investment survey in spring 2020 before 16 March belong to the group that responded before the crisis (control group). All others are part of the group that responded during the crisis (treatment group). Hence, I construct a binary variable that considers a firm as exposed to the COVID-19 pandemic as follows:

$$\text{COVID}_i = I[t_i \geq 16 \text{ March } 2020] = \begin{cases} 1 & \text{if } t_i \geq 16 \text{ March } 2020 \\ 0 & \text{if } t_i < 16 \text{ March } 2020 \end{cases} \tag{4}$$

I choose 16 March as the cut-off date, when the Federal Council declared the "extraordinary situation" and decreed far-reaching measures to contain the further spread of the virus and protect the public.

Credible identification of the effect of the COVID-19 crisis on firms' investments hinges on this choice of the treatment date. From an epidemiological point of view, it is clear that the crisis was already well advanced before 16 March. However, only the policy response of that day proved to catalyze the economic dimension of the crisis. This claim – and with it the validity of the identification strategy – essentially rests on two assumptions. First, there were no fundamental economic reactions to the crisis before 16 March. Second, the public did not anticipate the policy measures announced on 16 March. I provide evidence to support both assumptions in Figure 5 and Figure 6.

Figure 5 displays daily averages of the current business situation as reported by the firms[20] themselves in the KOF business tendency survey, in which firms are asked to assess their overall business situation as either "good," "satisfactory," or "poor." The term "business situation" is deliberately holistic, chosen as an umbrella term to reflect firms' overall economic conditions and essential business determinants such as turnover, profits, costs, and liquidity. The advantage of a soft question like this is that it can be asked in all economic sectors, and the participants themselves choose the factors most relevant for them. It thus gives a quite differentiated view of

[20] Business tendency surveys track firms over time and monitor a variety of relevant business determinants. Although it is not conducted with the same set of firms, the KOF business tendency survey covers all sectors represented in the investment survey. The figure shows the current business situation for the overlap of firms participating in both surveys in spring 2020, which is 453 firms.

economic development and can be regarded as a coincidence indicator.

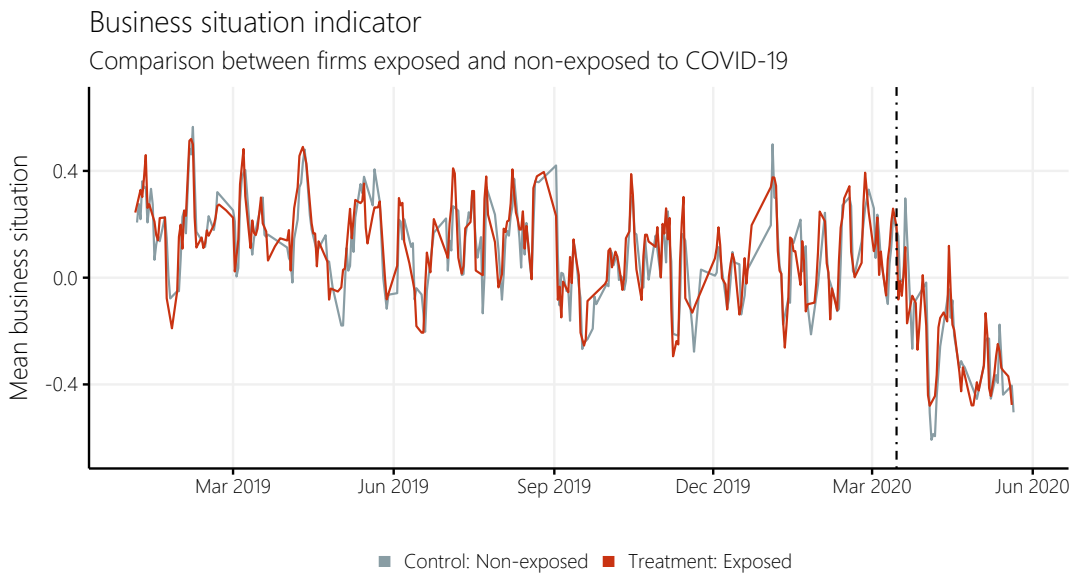

Figure 5: Daily averages of the current business situation as reported in the KOF business tendency surveys, separately for firms in the treatment and control group. The KOF business tendency survey asks firms to assess their current overall business situation as either "good," "satisfactory," or "poor," where "good" is coded as 1, "satisfactory" as zero, and "poor" as -1. To increase readability, I display the centered moving average of the daily means with a window length of 7 days. The vertical dotted line marks the declaration of the "extraordinary situation" by the Swiss Federal Council on 16 March 2020.

Figure 5 corroborates two points. First, there is no significant difference in firms' assessment of their current business situation depending on whether they belong to the treatment or control group. Both before and after 16 March, the two lines are virtually identical. Second, the policy measures announced on 16 March had a substantial impact on firms' business situation. This holds for both groups of firms. More importantly, while most firms have assessed their business situation as "good" or "satisfactory" before the crisis, it started to deteriorate significantly only after 16 March in the wake of the pandemic. Since 16 March 2020, firms have, on average, classified their business situation rather as "poor" than "good."

Figure 6 underscores that people did not anticipate the policy measures announced on 16 March. It shows daily data on the intensity of internet search queries for economic, policy- and disease-related terms on Google in Switzerland between 1 January and 31 May 2020. The increasing importance of the internet as a primary source of information makes internet search queries indicative of people's interests and concerns (Choi and Varian, 2012; Bontempi et al., 2016). The data can be retrieved from Google's website, allowing users to query the relative popularity of search terms for selected geographical regions and periods. Notably, interest in search terms over time is reported as an index. The values indicate the search interest relative to the highest point in the diagram for the selected region in the specified period. The value 100 represents the

highest popularity of the search terms. A value of 50 means that the term is half as popular, and 0 means that not enough data was available for this term.

Figure 6 displays the relative frequencies of search queries with some of the most relevant economic, disease- and policy-related keywords. It underpins three things. First, the public had been aware of the coronavirus disease since late January 2020 (first panel). The increasing spread of the virus in the immediate vicinity and the first cases in Switzerland have significantly increased the frequency of searches in late February and early March. Second, immediate economic reactions to the early spread of the virus seem to have failed to materialize (second panel). Relevant search terms that indicate a negative economic sentiment only peak immediately after 16 March. Third, the public did not anticipate the measures taken on 16 March (third panel). Before introducing the Swiss lockdown, virtually no search queries would hint at that policy response. Hence, when the companies in the control group participated in the survey, neither the extent of the crisis nor the Swiss government's measures seem to have been in any way foreseeable.

Figure 5 and Figure 6 support the validity of my identification strategy, according to which 16 March marks the beginning of the COVID-induced economic crisis in Switzerland. The announcement of the "extraordinary situation" proved to be a focal point that added an economic dimension to the crisis, which had hitherto been epidemiological exclusively. Thus, 16 March is a plausible cut-off date for classifying survey respondents in spring 2020 into treatment and control groups.[21] This allows me to calculate the revisions of firms' investment plans separately for the two groups of firms and to interpret any difference between them causally as COVID-induced effect.

4.2 Methodology and regression model

Formally, I investigate the influence of the COVID-19 shock on firms' investment plan revisions by estimating variants of the following difference-in-differences (DD) regression model:

$$\Delta I_{i,t} = \gamma_j + \delta_k + \alpha_1 T_t + \alpha_2 \text{COVID}_i + \alpha_3 T_t \cdot \text{COVID}_i + \beta \mathbf{X_{i,t}} + \varepsilon_{i,t} \tag{5}$$

The DD model compares the change in investment plans of companies that completed the survey in spring 2020 during the pandemic with the change in investment plans of companies that in spring 2020 responded before the pandemic.

The dependent variable in this model, $\Delta I_{i,t}$, is the nominal log change in the investment plans of firm i for year t between the autumn survey in $t-1$ and the spring survey in t, as defined in

[21] In Section 6, I provide robustness checks of the main analysis by altering the treatment date. In particular, I choose 28 February (declaration of the "special situation"), 1 March, and 5 March (first COVID-related death in Switzerland) as alternative treatment dates. In a further specification, I exclude all firms participating in the survey between 1 March and 16 March and assign the respondents after 16 March to the treatment group. This specification aims to make the estimation independent of any choice of the treatment date. In all alternative specifications, the main results remain significant and qualitatively unchanged.

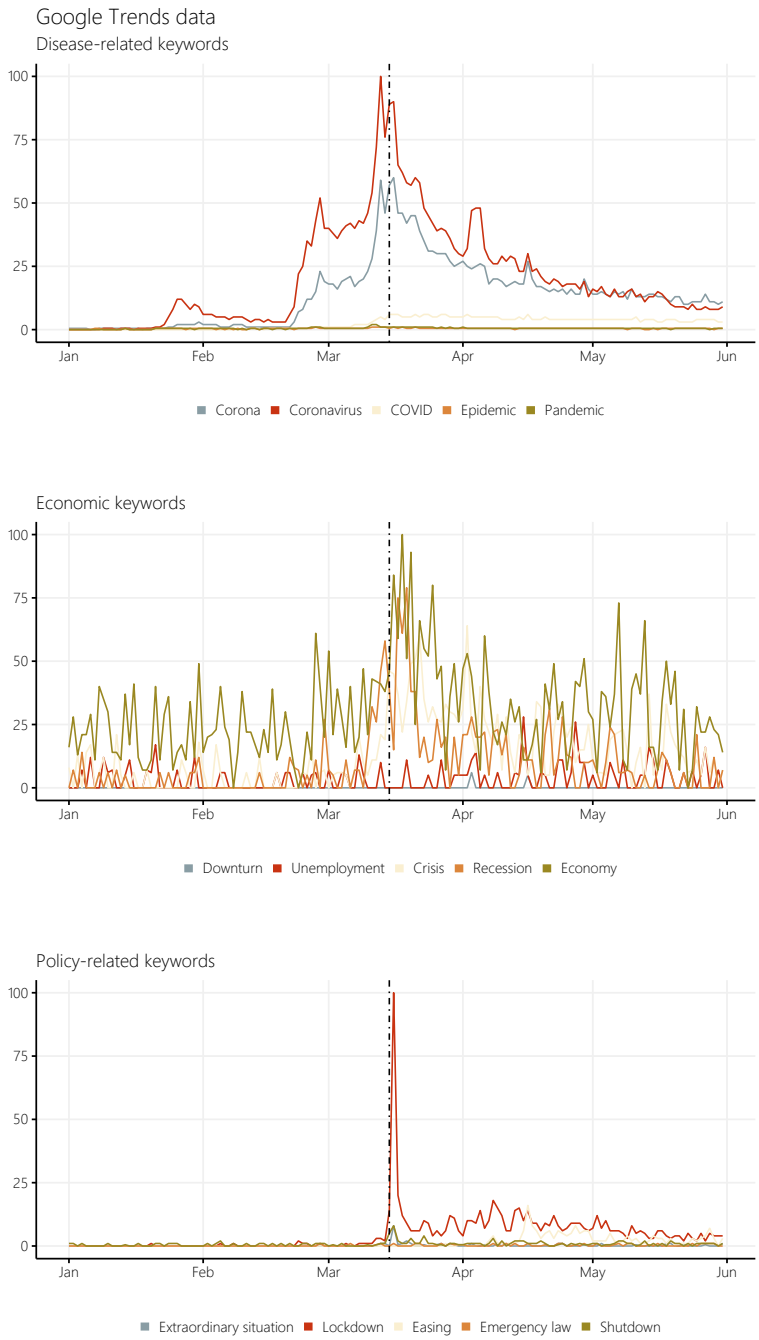

Figure 6: Daily Google Trends data for disease-related (upper panel), economic (middle panel) and policy-related search terms (lower panel) in Switzerland from 1 January until 31 May 2020. The values indicate the search interest relative to the highest point in the diagram for the selected region in the specified period. The value 100 represents the highest popularity of the search terms. A value of 50 means that the term is half as popular and a value of 0 means that not enough data was available for this term. I used German search terms, which are for the disease-related keywords: Corona, Coronavirus, COVID, Epidemie, Pandemie; for the economic keywords: Abschwung, Arbeitslosigkeit, Krise, Rezession, Wirtschaft; and for the policy-related keywords: Ausserordentliche Lage, Lockdown, Lockerung, Notrecht, Shutdown. The vertical dotted line marks the declaration of the "extraordinary situation" by the Swiss Federal Council on 16 March 2020.

Equation (1). Since the logarithm of zero is undefined, 12.7% of all firms are discarded because they have zero investment. Conditioning the sample to firms with positive investment does not induce a selection bias in the analysis, as shown in Section 6.

COVID_i is a binary, time-invariant dummy variable equal to 1 for all firms which completed the spring survey in 2020 after 16 March, and 0 otherwise, see Equation (4). This variable captures the difference between the treatment group that reported their investment plans in spring 2020 after the COVID shock and the control group. T_t is an indicator for the reference year of investment plan revisions. It is equal to 1 in 2020, indicating changes in investment plans for 2020, and 0 otherwise.

The main coefficient of interest is the interaction of these two variables, i.e., the coefficient α_3 of the difference-in-differences term $T_t \cdot \text{COVID}_i$, which captures the effect of the COVID shock on firms' investment plans for 2020. It shows the extent to which firms during the pandemic changed their investment plans for the current year differently than the rest of the firms.

The model contains a large set of fixed effects that control for a variety of unobserved factors. First, it includes industry fixed effects, γ_j, built on the NACE Rev. 2 division level. These fixed effects absorb all factors that equally affect all firms i within the same industry j. Second, it contains region fixed effects, δ_k, built on seven NUTS-II regions. These fixed effects absorb all time-invariant differences between the regions k. The vector $\mathbf{X_{i,t}}$ controls for further firm characteristics, including expected current year investments ($I_{i,t,s=\text{spring } t}$) and the number of employees. Finally, $\varepsilon_{i,t}$ is the error term.

The DD model reveals the causal effect of the COVID-19 pandemic under the identifying assumption that firms' investment revisions would have displayed common trends absent the COVID shock. Although this assumption is not testable, examining whether companies revised their investment plans similarly in the pre-COVID period can help assess its plausibility. Further, I examine whether the firms in the treatment and control groups differ structurally from each other. This is of particular interest because the identification strategy relies on a time-dependent criterion. Depending on firms' response time in spring 2020, it divides the sample into early ("control group") and late responders ("treatment group").[22] Hence, if early and late responders differ systematically, the DD model runs the risk of not only identifying the COVID effect on firms' investment revisions but mixing it with the differences between early and late responders.

Table 2 provides a detailed breakdown of the sample into treatment and control groups by firm characteristics and the main variables used in the analysis. The treatment group consists of 649 firms, the control group of 551.

Regarding investment revisions, they do not differ significantly between treatment and control groups in the pre-COVID era (2014–2019). They are close to zero, on average. This holds for

[22] In fact, firms in the control group consistently completed past investment surveys earlier than firms in the treatment group, by about one week on average.

Table 2: Group-specific firm characteristics

Variable	Control group (2014–2019)	Treatment group (2014–2019)		Control group (2020)	Treatment group (2020)	
Firm size						
Small	0.42	0.40		0.44	0.46	
Medium	0.33	0.33		0.31	0.31	
Large	0.24	0.27		0.25	0.23	
Number of FTE	343.62	379.90		314.40	300.61	
Region						
Zurich	0.21	0.21		0.21	0.19	
Schweizer Mittelland	0.18	0.17		0.18	0.17	
Lake Geneva Region	0.08	0.13	***	0.09	0.14	***
Eastern Switzerland	0.22	0.17	**	0.20	0.17	
Ticino	0.06	0.09	***	0.06	0.09	**
North-West Switzerland	0.13	0.11	*	0.14	0.12	
Central Switzerland	0.12	0.12		0.12	0.12	
Export orientation						
Exporter	1.29	1.34	**	1.27	1.30	
Sector						
Manufacturing	0.34	0.33		0.32	0.31	
Construction	0.07	0.05	*	0.08	0.05	*
Service	0.56	0.58		0.58	0.59	
Observations	1852	2000		551	649	

Notes: This table provides a detailed breakdown of the sample into treatment and control groups by firm characteristics (firm size, region, export orientation, and sector). It distinguishes between treatment and control groups for 2020 and the time before. Unless otherwise stated, numbers are relative frequencies. The stars indicate if the means are significantly different at conventional significance levels (***p < 0.01, **p < 0.05, *p < 0.1). The underlying p-values result from comparing treatment and control groups before 2020 and in 2020 with a two-sample t-test assuming unequal variance.

investment in GFCF as well as the three investment categories. Firms revised their investment plans similarly before the pandemic, which lends credibility to the identifying common trends assumption. Conversely, the groups differ significantly in how they have revised their investment plans for 2020. Treated firms have reduced their 2020 investment plans by about 15% on average, while all other firms' revisions were slightly positive. This suggests that these differences in investment revisions are rooted in the grouping criterion – the COVID-19 pandemic.

Firms in the treatment and control groups do not seem to differ structurally from each other regarding firm characteristics. Treated firms are of similar size as firms in the control group (381 versus 344 FTE employees). About 40% are small firms (employing fewer than 50 employees), about a third are medium-sized firms, and about a quarter are large firms (employing more than 250 employees). Treatment and control groups both reported investment plans of similar reversibility, and they were equally certain about their realization. Only in 2020, the uncertainty of treated firms has surged.

Beyond, firms from the construction sector are slightly under-represented in the treatment group. This, however, holds true both in the pre-COVID period and in 2020. The same goes for regional differences in response behavior. Firms from the Lake Geneva region and Ticino appear more

frequently among late responders than companies based in German-speaking cantons.

Overall, these observations suggest that early and late responders do not differ systematically so that the DD model identifies the COVID effect properly. In the following result sections, I will examine these COVID-induced effects on firms' investment decisions in detail.

5 Results

This section presents my main empirical results. A natural starting point is the descriptive evidence from the survey, in which firms qualitatively report the expected change in their investment plans for 2020 (Section 5.1). Then, I turn to a more formal analysis of the pandemic's effects on investment decisions using the DD model outlined in the previous section. I first explore how the pandemic changed firms' investment expectations in the aggregate (Section 5.2) before I identify which firms revised their 2020 investment plans in response to the pandemic (Section 5.3). In Section 5.4, I examine the influence of government policy measures on firms' investment revisions. Finally, in Section 5.5, I uncover the mechanism underlying these revisions, focusing on the role of uncertainty and real options effects.

5.1 Descriptive evidence

In this first descriptive approach, I examine how firms expected their investment plans to change in 2020 compared to 2019 and how their expectations changed between the two surveys in autumn 2019 and spring 2020. Both surveys asked firms to assess their expected change in investment qualitatively.[23] Firms could answer a 3-item Likert scale and report that they expected their investments to increase, remain unchanged (or remain at zero), or decrease. As the survey in autumn 2019 was conducted 3–6 months before the declaration of the "extraordinary situation," it is unaffected by the COVID shock. I focus on the sample of firms for which I observe expected investment changes for 2020 in both surveys and present firms' answers in Figure 7 through Sankey diagrams. A Sankey diagram allows studying flows. On either side of the diagram, the three answer choices are represented as vertical bars, the height of which conveys the share of firms that have opted for each answer choice. The flows between them are represented by arrows whose width is proportional to the number of firms that have changed their investment plans accordingly. I present Sankey diagrams separately for firms that in spring 2020 responded before ("control") and during the pandemic ("treatment").

[23] The surveys asked firms to assess their expected change in investment separately for investment in equipment and machinery, investment in construction, and investment in research and development. Since most firms invest in equipment and machinery, I focus on these results in what follows. The results for investment in construction and research and development are shown in Section C.1. They are qualitatively comparable to the results for investment in equipment and machinery.
The exact wording of the survey question is as follows: "Relative to 2019, in the year 2020, our investment in Switzerland is likely to □ increase, □ remain unchanged (or remain at zero) or □ decrease."

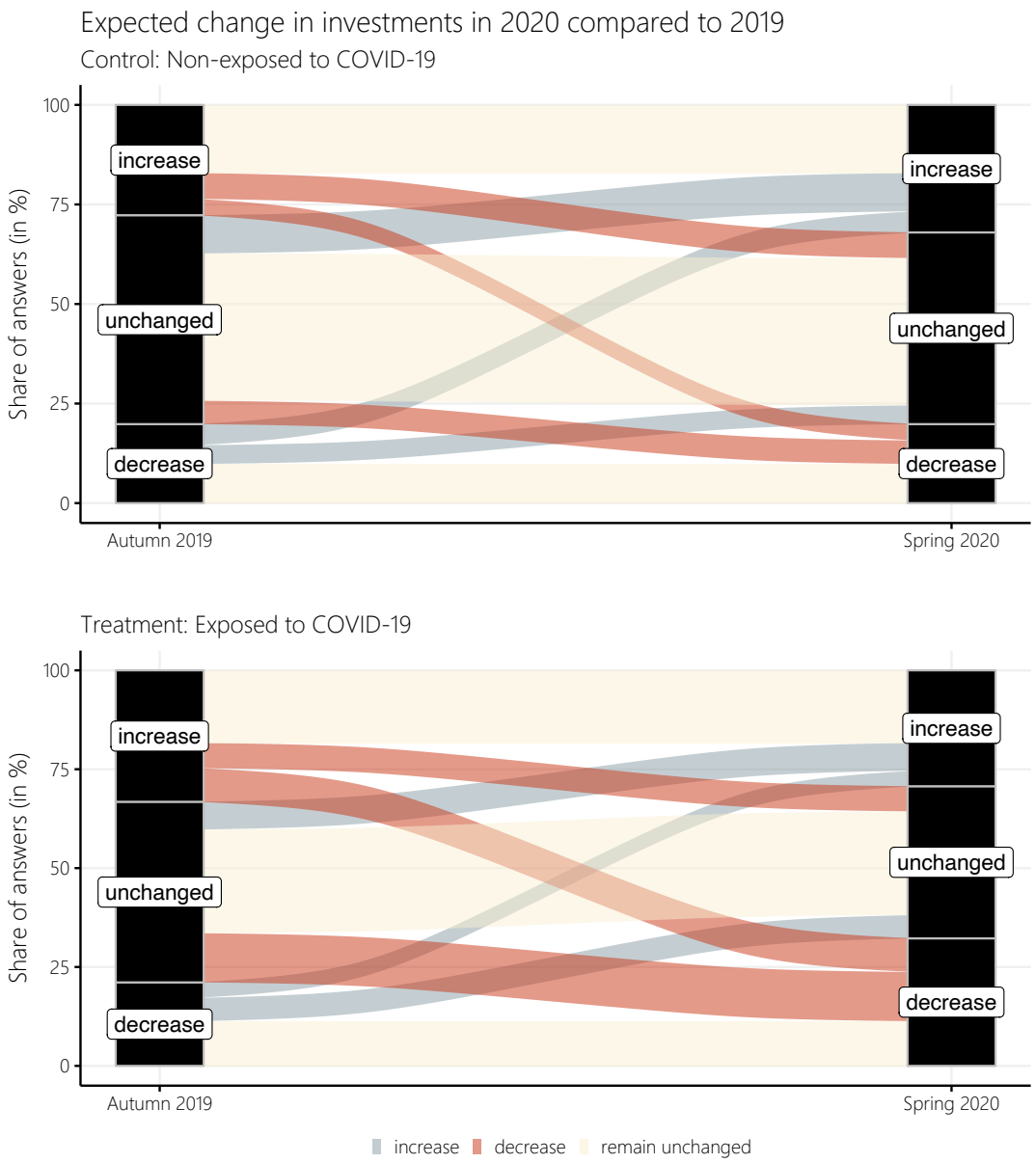

Figure 7: Sankey diagrams of firms' expected changes in investment in equipment and machinery in 2020 relative to 2019, as collected in the investment surveys in autumn 2019 and spring 2020. Flows are shown separately for firms in the control (upper panel) and treatment groups (lower panel).

Figure 7 provides evidence that during the pandemic, more firms expected their investments in 2020 to decrease relative to their expectations in late 2019. In autumn 2019, companies in both groups were spread similarly across the three answer choices (see bars on the left-hand side). About 30% each wanted to increase their investments in 2020, about half wanted to leave them unchanged, and about 20% wanted to reduce them. As is shown in the upper panel of Figure 7, the distribution remains similar in spring 2020 for firms responding before the pandemic, and the flows of responses between the two surveys are balanced. In fact, slightly more firms planned to increase (19.6%) than to decrease (16.4%) their investments relative to their expectations in autumn 2019.

A completely different picture emerges after the COVID shock, as shown in the lower panel of Figure 7. During the pandemic, 27.2% of companies have revised their investment plans downwards compared to their plans in autumn. Only 16.7% have increased them. In total, 32.4% of the treatment group companies intend to reduce their investments in 2020 relative to 2019, 29.1% intend to increase them, and 38.5% intend to leave them unchanged.

5.2 The overall impact of the pandemic on firms' investment plans

The descriptive evidence presented in the previous section is suggestive, but by itself, it does not allow us to determine whether firms reduced their investment plans in 2020 due to the COVID shock. In this section, I use the empirical strategy presented in Section 4 to determine the causal effect of the pandemic on firms' investment plans and the extent to which firms have changed their expectations in response.

As a first step, I consider the evolution of firms' investment revisions that in spring 2020 were exposed to the pandemic in Figure 8. This series (labeled "treatment" in the figure) shows that the average revision between years was fairly stable at around 5% in the period before the pandemic from 2014 to 2019. After the pandemic hit, demarcated by a vertical line in the figure, revisions have fallen sharply into negative territory. Firms have reduced their investment plans for 2020 by more than 14%.

Naturally, firms could have revised their investment plans even in the absence of the pandemic. Any negative surprise between the two surveys in autumn 2019 and spring 2020 could have led firms to cancel or postpone their investments. The simplest way to control for such events is to plot the investment revisions of the group of firms that completed the survey in spring 2020, just before the pandemic. Hence, Figure 8 also shows how firms have revised their investment plans that were not yet exposed to the pandemic ("control").

Two lessons emerge from the use of this control. First, the control series follows the treatment series extremely closely in the pre-COVID period. The remarkable similarity and stability of the two series lend credibility to my identification strategy in verifying the parallel trend assumption. The two trends in the pre-COVID period are very similar, and in the absence of the pandemic,

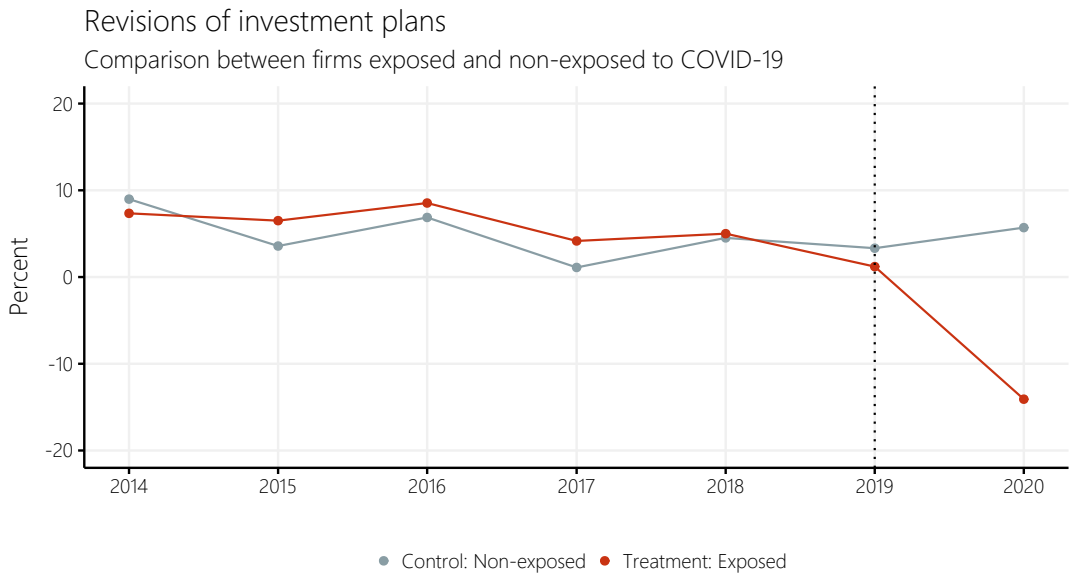

Figure 8: Effect of the COVID-19 pandemic on firms' investment plans: difference-in-differences evidence.
This figure compares the revision of firms' investment plans that in spring 2020 were exposed to the COVID-19 pandemic (treatment series) with those that were not exposed (control series) from 2013 to 2020. Exposure is defined by the response time in the survey wave of spring 2020: Companies that responded before 16 March belong to the control group. Companies that responded after 16 March belong to the treatment group. The vertical line in the year 2019 denotes the last year before the pandemic. Investment revisions for each year are defined as the percentage change between the investment amounts expected in the previous autumn and those expected in the current spring.

average investment revisions in 2020 would probably have been the same for both the treatment and control groups. Second, the control group series follows the pre-COVID trend also in 2020. It even increases slightly to 5.7%, while the treatment series is negative by more than twice as much.

Table 3 summarises the visual evidence described above by presenting estimates of the difference-in-differences model specified in Section 4.2. Here and throughout the paper, standard errors are clustered on the level of the individual firm. Control variables are included, but coefficients are not reported. The four columns consider (1) total investments (gross fixed capital formation, GFCF) and three subcategories thereof: (2) investment in equipment and machinery, (3) investment in construction, and (4) investment in research and development (R&D).

Column 1 in Table 3 is the estimation counterpart of Figure 8. It shows that revisions are large and precisely estimated. In response to the COVID-19 pandemic, firms have reduced their total investment plans for 2020 by 14 percentage points.

This result is essentially driven by investments in equipment, for which I find a significant and strongly negative coefficient in column 2. Treated firms reduce their investment plans by 17 percentage points compared to other firms. I consider the magnitude of this effect substantial and economically relevant. Meanwhile, I find no significant effects on investments in construction

Table 3: DD estimates of the effect of the pandemic on investment revisions

	Investment revisions ($\Delta I_{i,t}$)			
	GFCF	Equipment	Construction	R&D
	(1)	(2)	(3)	(4)
T_t	−0.017	0.018	−0.049	0.077
	(0.041)	(0.034)	(0.064)	(0.062)
COVID_i	−0.023	0.003	0.0003	−0.026
	(0.029)	(0.023)	(0.038)	(0.043)
$T_t \times \text{COVID}_i$	−0.137**	−0.171***	0.046	−0.070
	(0.055)	(0.052)	(0.081)	(0.084)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	3,662	3,316	1,788	963
R^2	0.032	0.033	0.039	0.091
Adjusted R^2	0.010	0.008	-0.004	0.021
Residual Std. Error	0.726 (df = 3577)	0.589 (df = 3231)	0.665 (df = 1711)	0.554 (df = 893)
F Statistic	1.426*** (df = 84; 3577)	1.313** (df = 84; 3231)	0.904 (df = 76; 1711)	1.300* (df = 69; 893)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

(column 3) or research and development (column 4). While the difference-in-differences interaction term is slightly positive for the former, it is slightly negative for the latter. Both models, however, are not precisely estimated. In what follows, I will, therefore, focus on the impact of the pandemic on investment decisions for equipment and machinery.

The fact that the pandemic has reduced firms' investment expectations for 2020 does not yet clarify whether companies have merely postponed their investment plans or canceled them altogether. Postponing or canceling investment projects differ in their severity and reversibility. It is more expensive to reactivate a canceled project than to accelerate a postponed one. At the same time, firms are likely to retain more capital investment when they cancel projects than when they delay them. To gain further insight into firms' revisions, the COVID special survey asked companies to assess the importance they placed on postponing, abandoning, and launching investment projects to mitigate the economic impact of the pandemic. 58% assigned moderate to high importance to postponing investment projects. Less than half of the surveyed firms assigned the same priority to cancel investments. For 37% of participants, launching new investment projects was important in managing the pandemic.

Table 4 analyzes investment revisions separately for the groups of firms that postponed (column 1), canceled (column 2), and launched new (column 3) investment projects. Those firms that canceled their investment plans revised their 2020 investment expectations on average by four percentage points more than firms that postponed them. Revisions in the case of postponements amounted to −26 percentage points, while in the case of cancellations, they amounted to almost −30 percentage points. In contrast, I find no significant revisions for the participants for whom

Table 4: DD estimates of the effect of the pandemic on firms postponing, canceling or launching investments

	Revisions in investment in equipment ($\Delta I_{i,t}$)		
	Postpone investments	Cancel investments	Launch investments
	(1)	(2)	(3)
T_t	0.039	0.021	0.034
	(0.066)	(0.067)	(0.103)
COVID_i	−0.054	−0.049	−0.088
	(0.045)	(0.062)	(0.090)
$T_t \times \text{COVID}_i$	−0.260***	−0.296***	−0.157
	(0.095)	(0.110)	(0.140)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	957	705	422
R^2	0.114	0.132	0.168
Adjusted R^2	0.045	0.051	0.038
Residual Std. Error	0.586 (df = 887)	0.588 (df = 644)	0.588 (df = 364)
F Statistic	1.650*** (df = 69; 887)	1.633*** (df = 60; 644)	1.292* (df = 57; 364)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

launching new investment projects were important in managing the pandemic.[24]

To gain further insight into which investment projects were postponed or abandoned due to the COVID shock, I examine how the pandemic influenced firms' investment motives. The investment survey asks firms whether their investments serve one or more of the following purposes: replacement, the extension of their production capacity, streamlining production, or fulfilling environmental protection and regulations by trade law. With this information, I construct an indicator that equals one if a firm allocates its investment to a purpose it did not intend in the previous survey and zero otherwise. Using logistic regressions, I examine the probability of planning specific investment projects in response to the pandemic.

Table 5 shows the estimated logit coefficients. Column 1 demonstrates that the odds of investing in replacement in response to the pandemic are estimated to be highest and not different from zero. Hence, the pandemic did not influence whether companies make replacements. This is not surprising because replacement investments are essential and more or less inevitable. Replacements may be required to replace worn-out or failing equipment. They arise from the continuous depreciation of fixed capital assets and are necessary to ensure a smooth production process and maintain operations. Moreover, they are relatively risk-free compared to the other purposes because they do not change the size of the enterprise and do not increase the capital commitment.

[24] In Table C.1 in the appendix, I find that the few firms that increased their investments in response to the pandemic stand out as particularly innovative: They have the largest share of human capital in their production or service provision, employ a large number of well-trained workers, and – already before the crisis – have largely digitized both internal and external processes, with employees doing most of their work with information and communications technologies and using the internet as a channel for both procurement and sales.

Table 5: DD estimates of the effect of the pandemic on investment motives

	Purpose of investments			
	Replacement	Extension	Streamlining	Environment
	logistic	*logistic*	*logistic*	*logistic*
	(1)	(2)	(3)	(4)
T_t	-1.114^{***}	-0.466^{***}	-0.252	0.016
	(0.175)	(0.178)	(0.186)	(0.205)
COVID_i	0.269^{***}	0.217^{**}	0.376^{***}	0.247^{*}
	(0.088)	(0.111)	(0.112)	(0.134)
$T_t \times \text{COVID}_i$	0.083	-0.504^{**}	-0.228	-0.267
	(0.223)	(0.247)	(0.247)	(0.268)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	3,836	2,151	2,474	1,646
Log Likelihood	-2,007.085	-1,293.797	-1,321.133	-938.672
Akaike Inf. Crit.	4,186.171	2,753.594	2,806.266	2,045.345

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

This is different from investments for extensions. They have the effect of increasing both capital and capacity, which changes revenues and total costs of the firm. Therefore, a company will invest in expanding its facilities only if it has a positive outlook for the future. For example, if it expects growth, resulting in favorable sales and profit expectations, or if the interest rate level for external financing is rising. Such prospects were not given for most of the firms under the pandemic, as confirms column 2. The COVID shock has decreased the odds of investing in expansions significantly by 39.6%. Alternatively, the odds for expansions are only three-fifth compared to the odds before the crisis. Similarly, the odds of investing for streamlining (column 3) or environmental protection (column 4) have decreased with the pandemic. Both point estimates are negative but not significant.

5.3 The heterogeneous responses across firms

Having documented the impact of the pandemic on aggregate investment plans in the previous section, we are now in a position to address whether revisions to investment plans differed across firms. Likely, the pandemic did not affect all firms equally. For one, because firms inherently differ on a range of multiple firm characteristics and pre-crisis conditions. For another, because firms were affected very differently by the geographic component of the shock generated by the COVID-19 pandemic. I begin this section by examining investment revisions differentiated by firm characteristics and firms' pre-crisis conditions and then studying the influence of their

exposure to the virus.

Investment revisions by firm characteristics

To find out which companies have revised their investment plans more than others, I decompose the results of the previous section by firm characteristics in this part of the analysis. In particular, I divide firms into groups according to different firm characteristics (sector, size, age, and export orientation) and re-estimate Equation (5) to see how the average treatment effects differ across these groups. Figure 9 presents the resulting conditional treatment effects.[25]

Panel A shows the regression results by sectors.[26] This top panel of Figure 9 clarifies that the contraction of planned investments is most pronounced in the construction sector. Although imprecisely estimated, construction companies have revised their plans on average by roughly −22 percentage points. Revisions are similarly negative and significantly estimated in the services and manufacturing sectors. Service providers (−18.3 percentage points) reduced their investment plans slightly more strongly than manufacturing firms (−17.3). By contrast, firms operating in other industries, for instance in the life sciences, have, on average, increased their investments following the COVID shock. Figure C.3 in the appendix shows the sectoral decomposition per industry (NACE Rev. 2 divisions) in greater detail.

Panel B shows that small and medium-sized enterprises (SMEs, defined as firms with fewer than 250 employees) have reduced their investment plans significantly due to the crisis. Their average investment revision is −21.5 percentage points. On average, they reduced their plans by more than larger firms. The average revision of large firms (−2.1 p.p.) is not significantly different from zero.

A similar contrast emerges between companies that have been around for several generations and younger firms, as shown by Panel C. Companies older than 70 years have sharply cut their investment plans (−34.2 p.p.). Younger firms have responded less strongly (−7.5 p.p.).

Finally, Panel D reveals that the COVID shock has caused both exporting and non-exporting firms to reduce their investment plans significantly. The negative revision of investment plans is larger for exporting (−20.5 p.p.) than for non-exporting (−15.9 p.p.) firms.

Investment revisions by firms' pre-crisis conditions

To explore how firms' pre-crisis conditions affected their investment revisions in response to the pandemic, I further decompose the results by a set of indicators describing the state of the firms

[25] The corresponding regression tables are shown in Section C.3.

[26] Sector definitions are based on the following industry codes (NACE Rev. 2 division level). Manufacturing: NACE 10-33. Construction: 41-43. Services: 45-96. Life sciences is a subgroup of the manufacturing sector and consists of pharmaceuticals (21), biotech research (7211), agrochemicals (202), and electrical and mechanical medical technology (2660, 325).

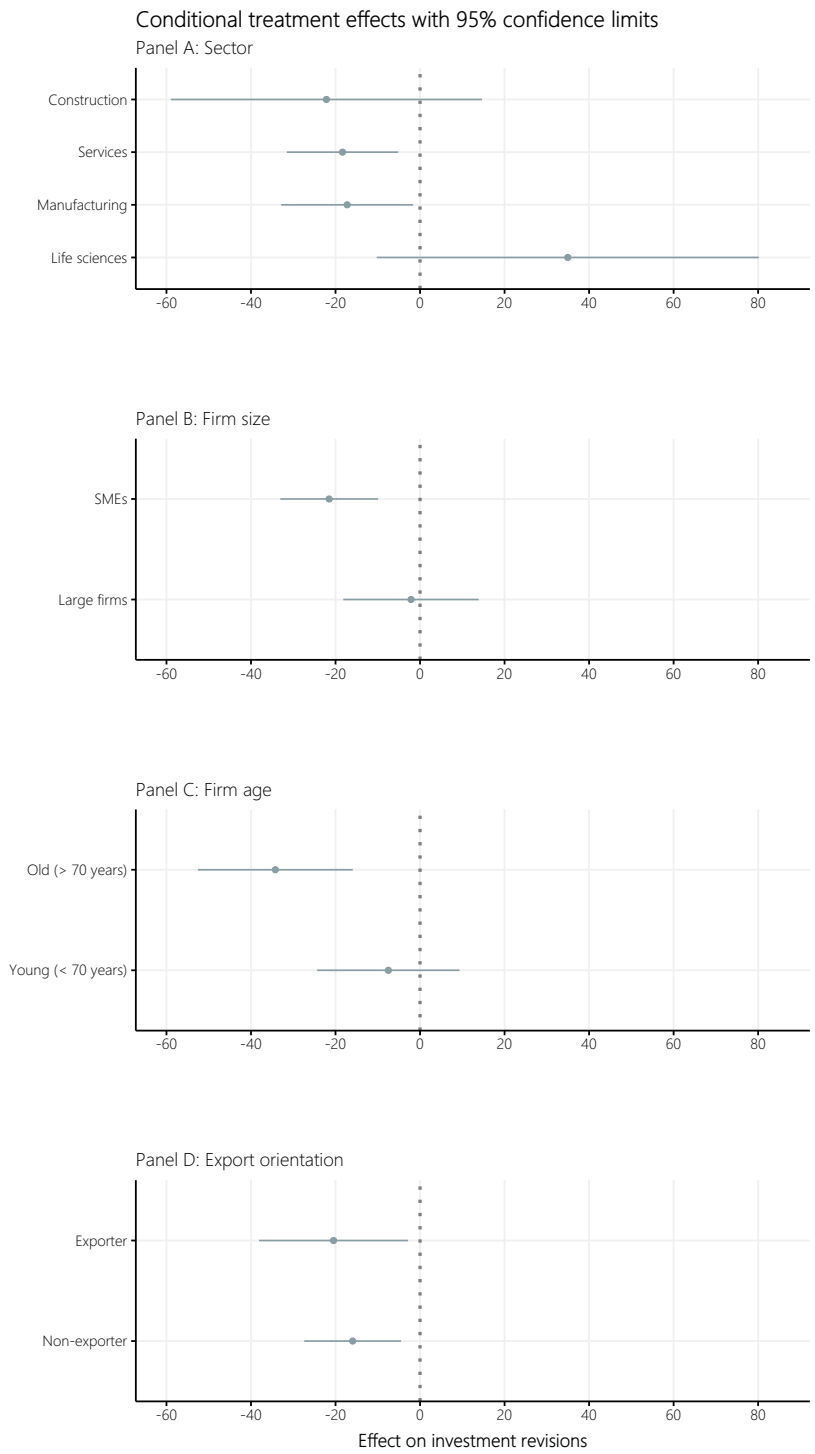

Figure 9: Conditional treatment effects of the COVID-19 pandemic on firms' investment plans: difference-in-differences evidence. The figure shows regression results by sectors (Panel A), firm size (Panel B), firm age (Panel C), and export orientation (Panel D).

by the end of 2019: firms' average business situation in 2019[27], their lack of financial resources to make investments[28], and their certainty about realizing their 2020 investment plans. Figure 10 presents the resulting conditional treatment effects and demonstrates that the pandemic amplified pre-crisis weaknesses and constraints.[29]

Panel A shows the regression results by firms' business situation. Pre-crisis business conditions are a relevant predictor for firms' investment revisions. Firms that have assessed their situation in 2019 rather as poor than good revised their investment plans by −43 percentage points. Conversely, firms in a good state before the crisis did not significantly change their investment plans.

Panels B and C show the influence of firms' financial constraints in revising their investment plans, distinguishing between a lack of external funds (Panel B) and internal funds (Panel C) for making investments. Panel B shows that firms that report that a lack of external funding hindered their investment plans revised their plans more during the crisis (by −42 p.p.) than firms that were not constrained (by −14 p.p.). In contrast, Panel C shows that the revisions of firms that complained of a lack of internal funds for investment are not significantly different from zero, while unconstrained firms significantly reduced their plans (by −17 p.p.).

Beyond, as shown in Panel D, we find no significant investment revisions for firms uncertain about their 2020 investment plans in autumn 2019. By contrast, firms that were fairly or very certain about realizing their plans in 2020 cut them by −19 percentage points.

Regional variation and exposure to the virus

I conclude by examining the geographic component of the shock generated by the COVID-19 pandemic. A key metric of the COVID-19 crisis is the spread of and exposure to the virus. In Switzerland, the virus has spread very differently from region to region, as shown in Figure 11. This figure displays the cumulative number of confirmed COVID-19 cases by canton per 100,000 inhabitants by the end of the spring survey (30 May 2020). While there were particularly many cases in the Southern parts of Switzerland (Ticino and Lake Geneva Region), the pandemic was significantly less advanced in the cantons of Central or Eastern Switzerland.

This regional heterogeneity in the intensity of the pandemic may translate into heterogeneous responses of the companies depending on whether they are located in areas of high or low viral

[27] The KOF business tendency survey asks firms to assess their overall business situation as either "good," "satisfactory," or "poor." The term "business situation" is deliberately holistic, chosen as an umbrella term to reflect firms' overall economic conditions and essential business determinants such as turnover, profits, costs, and liquidity. Although it is not conducted with the same set of firms, the KOF business tendency survey covers all sectors represented in the investment survey. The overlap of firms participating in both surveys is 453 firms.

[28] The COVID special survey asked firms to what extent a lack of external (internal) funding has hindered their investment plans by the end of 2019. They were able to differentiate their answer on a 4-point Likert scale ("not," "rather little," "rather strongly," or "very strongly"). I consider a firm's investment plans as constrained by a lack of external (internal) funding if it answered with "rather strongly" or "very strongly."

[29] The corresponding regression tables are shown in Section C.3.

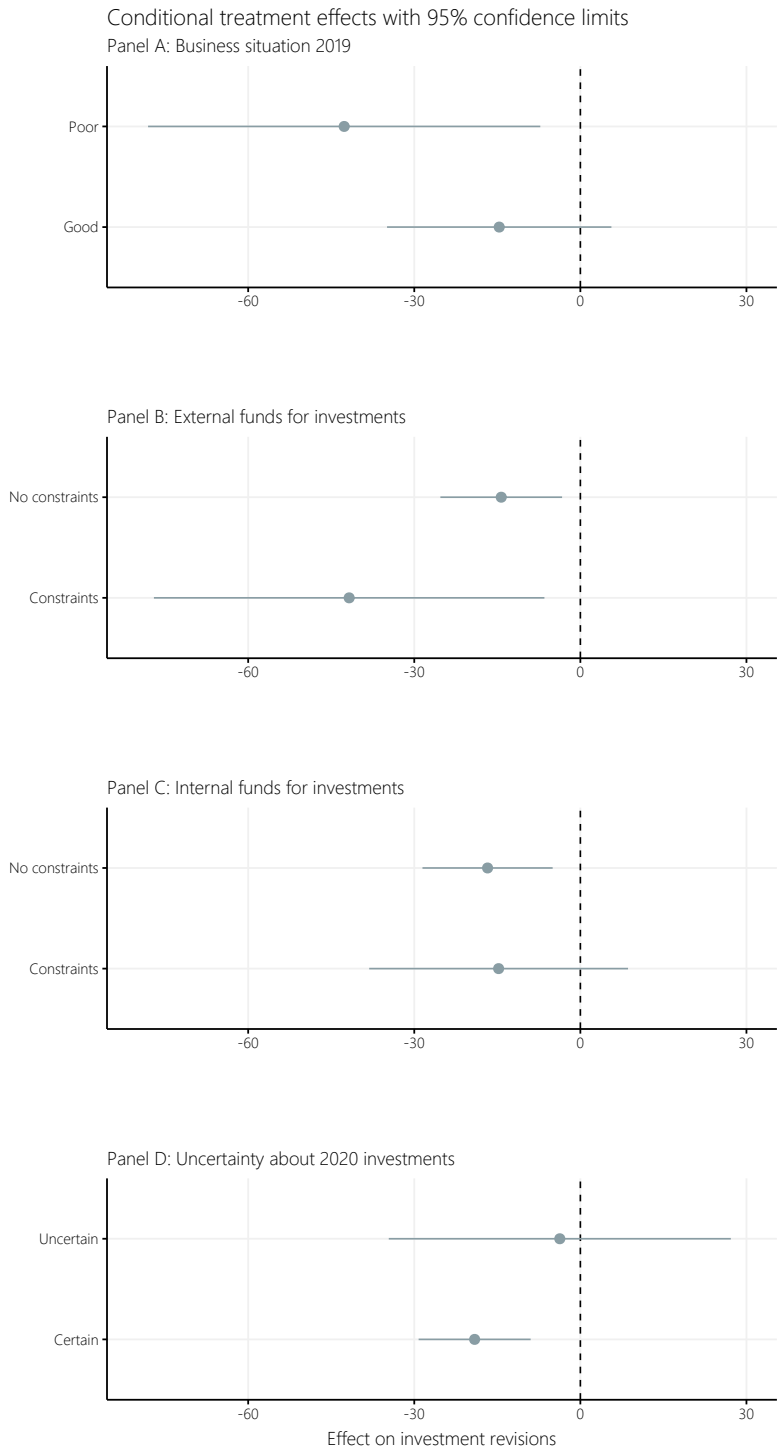

Figure 10: Conditional treatment effects of the COVID-19 pandemic on firms' investment plans: difference-in-differences evidence. The figure shows regression results by firms' business condition in 2019 (Panel A), lack of external funding in hindering their investment plans (Panel B), lack of internal funding in hindering their investment plans (Panel C), and firms' uncertainty about their 2020 investment plans in autumn 2019 (Panel D).

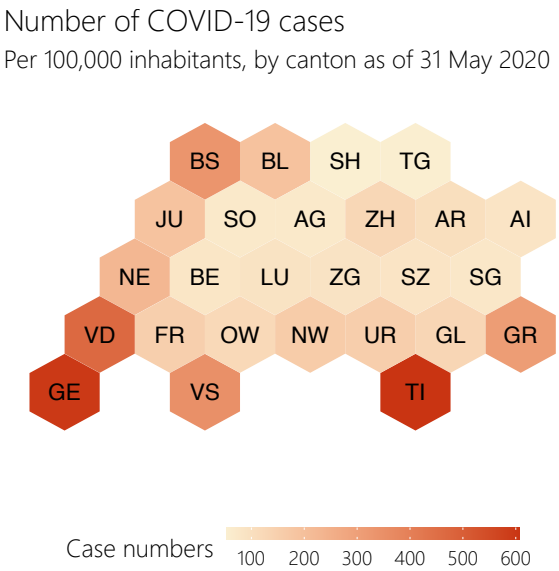

Figure 11: Cumulative number of confirmed COVID-19 cases by canton per 100,000 inhabitants by the end of the investment survey in spring 2020 (31 May 2020).

intensity. For example, a locally higher virus incidence may prompt households to become more cautious, in turn affecting nearby firms negatively (e.g., fewer visits to shops or restaurants). In the same vein, firms in regions with higher virus intensity may be inclined to take stronger operational measures to manage the economic consequences of the pandemic than firms in regions with lower virus intensity. Therefore, investment revisions may be related to the regional differences in the spread of the virus, reflecting the local severity of the pandemic. Investment revisions could thus – in a figurative sense – be seen as firms' infections with the virus itself.

To disentangle the average treatment effect of the COVID shock on firms' investment plans from the regional variation in the spread of the virus, I estimate conditional treatment effects by regions[30] and plot the estimation results in Figure 12. Comparing firms' investment revisions in Figure 12 with the regional COVID case counts in Figure 11 reveals striking correspondences. Firms in Ticino (−52.7 p.p.), North-West Switzerland (−57.2 p.p.), and Lake Geneva Region (−21.4 p.p.) have revised their 2020 investment plans the most. Conversely, companies in Eastern (−3.4 p.p.) and Central (−3.0 p.p.) Switzerland did not revise their investment plans significantly from zero. Taken together, local virus intensity was a relevant driver of investment revisions.

[30] The corresponding regression table is shown in Section C.3.

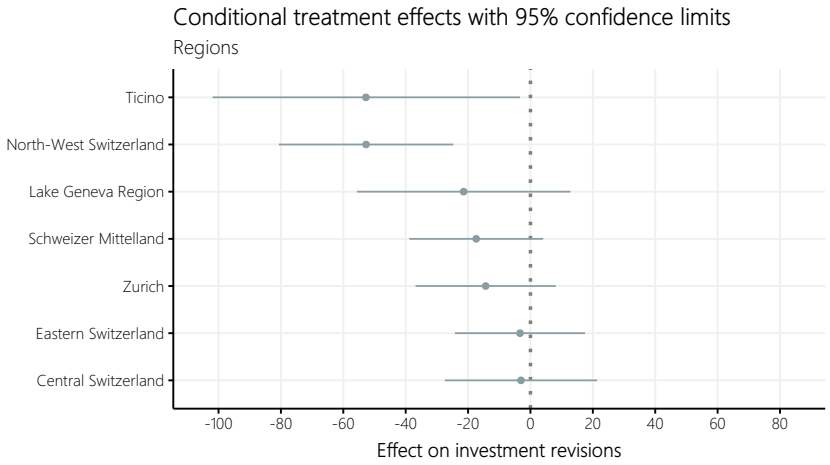

Figure 12: Conditional treatment effects of the COVID-19 pandemic on firms' investment plans: difference-in-differences evidence. The figure shows regression results by regions. Regions consist of the following cantons, illustrated in Figure 11: Ticino: TI; North-West Switzerland: AG, BL, BS; Lake Geneva Region: GE, VD, VS; Schweizer Mittelland: BE, FR, JU, NE, SO; Zurich: ZH; Eastern Switzerland: AI, AR, GL, GR, SG, SH, TG; Central Switzerland: LU, NW, OW, SZ, UR, ZG.

5.4 The influence of government policy measures on investment revisions

The fast spread of the coronavirus in early 2020 prompted governments around the globe to take strict measures to contain the pandemic and protect their populations, bringing public and social life to a standstill and largely restricting economic activity. In turn, further measures were taken to mitigate the economic impact of the pandemic and minimize the disruption caused by the containment measures themselves. In this section, I examine how these government policy measures affected firms' investment expectations. First, I examine how firms' exposure to the containment measures (i.e., the "lockdown" policies) influenced their investment revisions. Then, I focus on a key component of the package of measures to cushion the economic impact of the pandemic, namely the COVID-19 bridging loans program. This program aimed at providing companies with sufficient liquidity to cover their ongoing fixed costs despite their COVID-related loss of sales. Specifically, I address the question of whether the bridging loan program improved the financial situation of participating firms to the extent that their investment revisions differed from firms that did not participate in the program.

Firms' exposure to the lockdown policies

To assess how the "lockdown" policies[31] have influenced firms' investment expectations, I decompose the policy response of the Swiss government into three different components: the government-imposed temporary closure of production or service provision, workers' ability to do their work from home, and a profession's need for physical proximity to others.

The first component corresponds to the core of the measures taken by the Swiss government. The lockdown policies involved, first and foremost, the closure of numerous facilities open to the general public, namely all shops and markets, restaurants, bars, entertainment and leisure facilities, and establishments providing personal services with physical contact (such as hairdressers or cosmetic studios). Grocery stores and health care facilities were among those exempted. As a result of these closures, many companies had to partially or even completely shut down their production or service provision temporarily. To assess the extent to which firms were affected by the government-imposed shutdown, I use their statements in the COVID special survey. When asked how their company was affected by the forced closure during the spring 2020 lockdown, they could indicate whether their company was at times completely closed, partially closed (but never completely), or fully operational at all times.

The second component of the lockdown policies corresponds to the home office recommendation by the Federal Office of Public Health. Where possible, employees were supposed to work from home. Accordingly, many companies have taken steps to relocate jobs from the office to home. However, not all jobs can be done from home, and professions differ significantly regarding whether their tasks can be carried out fully or at least partially from home. Occupations that can easily operate from home include, for example, software developers, economists, or lawyers. In contrast, veterinarians or construction workers cannot work from home. To estimate the share of firms' employees with the option to work from home, I use the home office index constructed by Rutzer and Niggli (2020).[32] Based on the method used in Dingel and Neiman (2020), they use several survey questions from the Occupational Information Network (O*NET) such as whether an occupation requires "operating vehicles, mechanized devices, or equipment" or daily "work outdoors" to classify a profession's suitability for home office. The index ranges from zero to one. A value of zero means that workers can work from home. A value of one means that workers cannot do their tasks from home.

The third component of the lockdown policies corresponds to the aim of the Swiss government to reduce physical contact between people. The Federal Council called on the population to avoid unnecessary contacts, keep their distance, and follow the hygiene measures. This call affected occupational groups to varying degrees, as some occupations rely more on physical proximity to people than others. It also differs subtly from the home office recommendation. On the one hand,

[31] Section 2 and Appendix A describe the lockdown policies in more detail. For further information, see Swiss Federal Council (2020a,b).

[32] Their index is available at the industry level (NACE Rev. 2 division level).

truck drivers or farmers remained largely unrestricted by the requirement to keep their distance but could not possibly work from home. On the other hand, other professions, such as music teachers, could work from home but were still constrained by the physical proximity required to perform their job. To measure a firm's dependence on the physical proximity of its workers to others, I use the Swiss lockdown index constructed by Faber et al. (2020), which is based on the O*NET survey questions about physical proximity requirements. The index classifies an occupation as restricted if it involves a small physical distance from other people.[33] The index ranges from zero to one. A value of zero means that the occupation does not rely on physical proximity. A value of one means that physical proximity is essential.

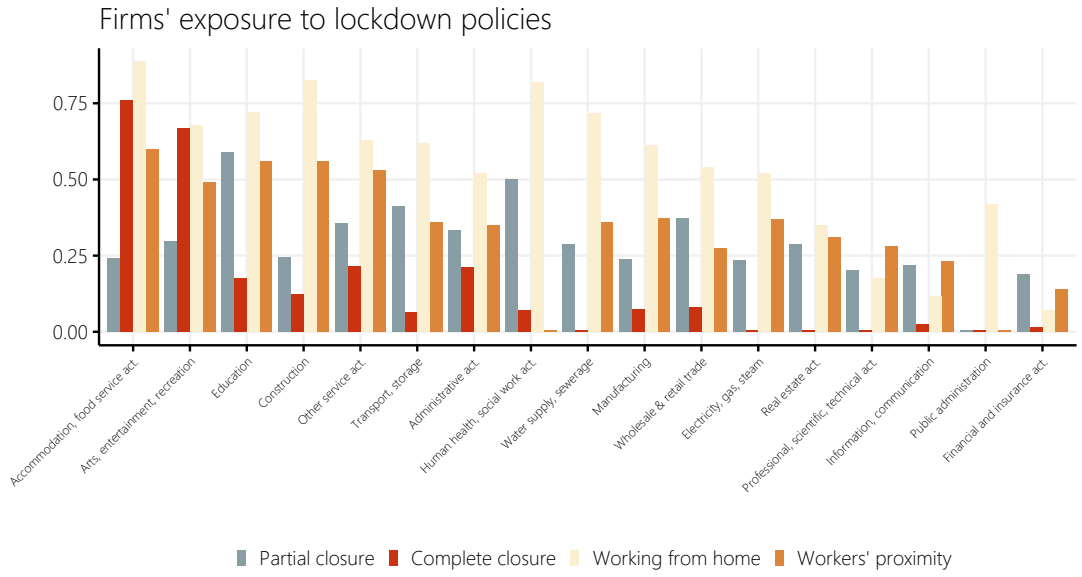

Figure 13: Firms' average exposure to the lockdown policies (partial or complete closure, working from home, and workers' need for physical proximity to others) by industry. "Partial closure" (and "complete closure") shows the share of firms by industry that were partially (completely) closed during the spring 2020 lockdown and is taken from the COVID special survey. "Working from home" shows the average share of firms' employees who cannot work from home and is taken from Rutzer and Niggli (2020). "Workers' proximity" shows the average share of firms' employees in an industry which rely on physical proximity to other people and is taken from Faber et al. (2020).

Figure 13 visualizes firms' exposure to the lockdown policies (partial or complete closure, working from home, and workers' need for physical proximity to others) by industry. The closer a value is to one, the more firms in the corresponding sector were restricted by the respective measure. Not surprisingly, the hospitality industry was among the most restricted sectors, where working from home is hardly possible. Many establishments were completely closed, and employees are in close contact with other people. Conversely, "information, communication", "public administration," and "financial and insurance activities" were the least restricted by the measures.

[33] Additionally, they account for essential industries that were exempt from the government's measures by coding workers in these industries as unrestricted. Their index is available at the industry level (NACE Rev. 2 division level).

All of these measures are exogenous in the sense that neither the state-imposed closures could be circumvented, nor could an occupation's ability to work from home or its workers' dependence on physical proximity be easily (or rapidly) altered. I use these measures to assess how firms' investment revisions depend on their exposure to different lockdown policies and report regression results in Table 6.

Table 6: Effect of lockdown policies on investment revisions

	Dependent variable:				
	Revisions in investment in equipment ($\Delta I_{i,t}$)				
	(1)	(2)	(3)	(4)	(5)
$T_t \times \text{COVID}_i$	−0.111*	−0.131**	−0.201***	−0.183***	−0.155**
	(0.059)	(0.067)	(0.053)	(0.050)	(0.070)
Partial closure	−0.025				
	(0.029)				
Complete closure		−0.155**			−0.104*
		(0.066)			(0.054)
Working from home			−0.117**		−0.165*
			(0.056)		(0.099)
Workers' proximity				−0.131**	0.125
				(0.066)	(0.150)
Industry fixed effects	Yes	Yes	No	No	No
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	2,566	1,962	3,211	3,479	1,880
R^2	0.033	0.053	0.015	0.014	0.019
Adjusted R^2	0.002	0.014	0.012	0.010	0.012
Residual Std. Error	0.579 (df = 2484)	0.574 (df = 1882)	0.588 (df = 3199)	0.584 (df = 3467)	0.575 (df = 1865)
F Statistic	1.057 (df = 81; 2484)	1.343** (df = 79; 1882)	4.399*** (df = 11; 3199)	4.329*** (df = 11; 3467)	2.573*** (df = 14; 1865)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

I find strong evidence that firms' investment revisions depend on their exposure to the lockdown policies. In general, the more constrained a firm was in its production or service provision, the more it reduced its 2020 investment plans, with forced plant closures causing the largest cuts. Columns 1 and 2 in Table 6 show that firms' investment revisions decrease with them being at times partially or completely closed, respectively, relative to being fully operational at all times. Increasing the share of completely closed firms during the lockdown in spring 2020 by one percentage point decreases 2020 investment plans by 15.5 percentage points on average. In comparison, the ability of employees to do their work from home had a smaller effect on firms' investment plans, as shown in column 3. A one percentage point higher share of employees who cannot do their work from home reduces investment expectations by slightly more than ten percentage points. Instead, a profession's need for physical proximity has a slightly stronger effect on firms' investment revisions than its ability to do work from home (see column 4). This is consistent with the Swiss government's lockdown policies focusing on reducing physical contact between people rather than having them work from home.

Effect of government-guaranteed loans on investment revisions

To address the economic consequences of the pandemic, the Swiss government adopted a comprehensive package of support measures and emergency aid. One key component of this package was the COVID-19 bridging loan program. The bridging credit facilities aimed to provide companies with sufficient liquidity to cover their current overheads despite turnover reductions associated with the pandemic. The program aimed to provide companies affected by the COVID-19 crisis with quick and uncomplicated loans of up to 10% of their annual turnover (or up to a maximum of CHF 20 million) and with a maturity of five years. Amounts up to CHF 500,000 (called "COVID-19 credits") were fully guaranteed by the federal government and paid out quickly (usually within one business day). Amounts above CHF 500,000 (called "COVID-19 credits plus") were guaranteed by the federal government at 85% and required additional checks by the banks. Participation in the COVID-19 bridging loan program was sizeable, as 20% of all firms participated in this program comprising a guaranteed loan volume of 2.4% of annual GDP (Fuhrer et al., 2021).

This section will first examine what factors drove firms' participation in the COVID-19 bridge loan program before analyzing the effect of this supporting policy measure on firms' investment expectations in more detail.

To explore firms' participation, I consider three broad dimensions of loan demand: firms' initial conditions, their exposure to the lockdown policies, and firms' expectations about the duration of the crisis. To disentangle these different determinants of loan demand, I consider a standard logit model. The dependent variable is a binary firm-specific variable that indicates a firm's participation in the loan program. I take this information from the COVID special survey, in which firms reported whether or not they participated in the program (including the amount of COVID-19 credit drawn if they participated). Each model includes industry-fixed effects, region-fixed effects, and fixed effects for the survey response date.

Table 7 reports the main regression results. Columns 1 to 10 provide estimates focusing on one determinant each. Column 11 cross-checks these estimates in a multivariate specification. The coefficients of a logit regression represent the log of the odds ratio, which is hard to interpret quantitatively. My discussion of the regression results hence focuses on the sign and the significance of the coefficient, which determine the direction of the effect.

First, I find that participation in the loan program is affected significantly by a firm's pre-crisis business condition in general (column 1) and its ex-ante financial situation in particular (columns 2 to 5). Firms reporting a poor business situation in 2019 are more likely to participate in the program than firms with average conditions throughout 2019. In contrast, participation rates are significantly lower among firms in good shape before the crisis. There is further evidence that the loan program reached less liquid firms, as participation is higher among firms reporting

Table 7: Participation in the COVID-19 bridging loan program

	Participation in the COVID-19 briding loan programme (yes/no)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Business situation 2019: poor	0.721***										−0.674
	(0.228)										(0.578)
Business situation 2019: good	−1.015***										−2.210***
	(0.208)										(0.451)
External financial constraints		0.805***									0.862**
		(0.057)									(0.347)
Liquidity: poor			0.971***								−1.316
			(0.173)								(0.980)
Liquidity: good			−1.165***								0.182
			(0.096)								(0.446)
Debt ratio				1.741***							1.369**
				(0.198)							(0.649)
Profit margin					−9.227***						−12.299***
					(1.346)						(4.123)
Complete closure						2.487***					0.848
						(0.166)					(0.659)
Partial closure						1.584***					1.454***
						(0.101)					(0.416)
Working from home							3.243***				−0.850
							(0.204)				(1.387)
Workers' proximity								1.903***			5.634**
								(0.236)			(2.442)
Uncertainty									0.190***		−0.004
									(0.046)		(0.202)
Expected crisis duration										0.603***	0.715***
										(0.031)	(0.115)
Employees (log)	−0.289***	−0.197***	−0.139***	−0.253***	−0.180***	−0.153***	−0.159***	−0.098***	−0.139***	−0.270***	−0.701***
	(0.051)	(0.026)	(0.026)	(0.034)	(0.040)	(0.026)	(0.021)	(0.019)	(0.028)	(0.029)	(0.127)
Constant	1.340***	−1.141***	0.534*	−0.185	0.643*	−0.922***	−1.916***	−0.990***	−0.023	−2.288***	−3.509***
	(0.503)	(0.275)	(0.276)	(0.340)	(0.370)	(0.277)	(0.165)	(0.142)	(0.298)	(0.314)	(1.167)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey date fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,570	4,951	4,944	3,410	2,687	5,003	4,645	5,015	3,842	4,887	544
Log Likelihood	-573.011	-1,955.830	-1,910.341	-1,315.358	-895.577	-1,884.762	-2,305.782	-2,610.294	-1,582.231	-1,699.917	-140.202
Akaike Inf. Crit.	1,442.021	4,283.660	4,194.682	2,988.716	2,143.153	4,143.524	4,837.564	5,446.588	3,532.462	3,769.834	466.405

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

a bad liquidity situation by the end of 2019 than firms satisfied with their liquidity.[34] Additionally, I find empirical support that the program reached more indebted and less profitable firms. My estimates show that firms with a lower ex-ante debt ratio have a higher probability of participating.[35] Conversely, firms with a higher ex-ante profit margin have a lower probability of taking up COVID-19 credits.[36]

Second, firms more restricted by the lockdown policies generally show higher participation (columns 6 to 8). I defined these explanatory variables in the previous Section 5.4. Firms that, during the lockdown in spring 2020, had to shut down their production or service provision have a higher participation rate, and the probability is higher for firms that were at times completely closed (compared to firms that were at times partially closed). This finding is also true for firms whose employees were less likely to work from home or whose work requires physical proximity to other people.

[34] "Poor liquidity" captures firms assessing their liquidity at the end of 2019 as poor or very poor. "Good liquidity" captures firms assessing their liquidity at the end of 2019 as good or very good. Both variables are evaluated relative to firms considering their liquidity at the end of 2019 as satisfactory. This information comes from the COVID special survey and is matched at the firm level.

[35] We asked firms to report their debt ratio by the end of 2019 in the COVID special survey. We defined the debt ratio as total debt divided by total assets.

[36] We asked firms to report their profit margin ("return on sales") by the end of 2019 in the COVID special survey. We defined the profit margin as earnings before interest and taxes divided by sales revenue.

Third, I find that firms' outlook and expectations about the duration of the crisis are positively related to their participation in the loan program (columns 9 and 10). Firms uncertain about their 2020 investment plans are more likely to participate in the program than firms assessing the realization of their investment expectation as certain. Similarly, the probability of participating in the program increases with the time the company anticipates will be needed to overcome the crisis.[37]

Finally, we note throughout all specifications that the loan program reached more small companies, which might have been financially more vulnerable as they are less likely to obtain outside finance during a crisis than larger firms.

I will now turn to the impact of the government-guaranteed bridging loans program on firms' investment revisions. Table 8 applies our baseline estimation (see Equation (5)) to three groups of firms: those that did not take COVID-19 credits (column 1), those that took COVID-19 credits in amounts up to CHF 500,000 (column 2), and those that took "COVID-19 credits plus" (in amounts greater than CHF 500,000).

Table 8: DD estimates of the effect of the pandemic on investment revisions by amount of COVID-19 credit

	Dependent variable:		
	Revisions in investment in equipment ($\Delta I_{i,t}$)		
	No credit	$\leq$ CHF499,999	$\geq$ CHF500,000
	(1)	(2)	(3)
T_t	−0.009	0.042	0.049
	(0.028)	(0.106)	(0.100)
COVID_i	0.022	0.183*	−0.050
	(0.041)	(0.110)	(0.097)
$T_t \times \text{COVID}_i$	−0.106*	−0.272	−0.488***
	(0.059)	(0.213)	(0.152)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	2,213	353	340
R^2	0.039	0.159	0.189
Adjusted R^2	0.004	0.022	0.077
Residual Std. Error	0.551 (df = 2136)	0.750 (df = 303)	0.593 (df = 298)
F Statistic	1.131 (df = 76; 2136)	1.165 (df = 49; 303)	1.691*** (df = 41; 298)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

The estimation results show that the size of the investment revisions increases with the size of the credits taken: The larger the COVID-19 credit taken, the greater the reduction in 2020 investment plans. Firms that did not take COVID-19 credits reduced their investment plans

[37] We asked firms in the COVID special survey by when they expected their company to have completely overcome the COVID-19 crisis. Their answers could range from less than 6 months, 6-12 months, 1-2 years, 2-3 years, to more than 3 years.

by about ten percentage points on average. This is significantly less than the revision of 17 percentage points we identified earlier in Table 3 across all firms. Conversely, firms that took a "COVID-19 credit plus" reduced their 2020 investment plans by as much as 50 percentage points. COVID-19 credits were originally not allowed to be used to make investments. The data suggest that firms that borrowed heavily suffered from such severe liquidity constraints that, in addition to the loans they received, they also postponed or abandoned their investment plans to meet the challenges of the crisis. The situation is different for ordinary COVID-19 credits of up to CHF 500,000. The estimation results show a negative point estimate but no significant revisions to investment plans. This could indicate that these smaller loans have not only helped to bridge liquidity bottlenecks but also to sustain firms' investment plans.

To further investigate this issue, I examine how the COVID-19 bridging loan program influenced firms' investment motives. To do so, I repeat the estimation from Table 5 for two groups of firms: those that did not take a COVID-19 credit and those that did take a COVID-19 credit. Using logistic regressions, I estimate the probability of planning specific investment projects in response to the pandemic.

Table 9: DD estimates of the effect of the pandemic on investment motives by participation in the COVID-19 bridging loan program

	Purpose of launched investments							
	Replacement		Extension		Streamlining		Environment	
	logistic		*logistic*		*logistic*		*logistic*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_t	-1.262^{***}	-1.156^{**}	-0.406^{*}	-1.605^{*}	0.137	−0.335	0.192	0.065
	(0.238)	(0.460)	(0.226)	(0.823)	(0.242)	(0.547)	(0.267)	(0.656)
COVID_i	0.328^{***}	−0.144	0.237^{*}	−0.726	0.427^{***}	0.705^{*}	0.169	0.259
	(0.116)	(0.325)	(0.143)	(0.512)	(0.155)	(0.404)	(0.173)	(0.503)
$T_t \times \text{COVID}_i$	0.344	0.349	-0.729^{**}	0.898	−0.441	0.499	−0.083	0.023
	(0.299)	(0.649)	(0.328)	(1.024)	(0.326)	(0.803)	(0.345)	(1.051)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,452	413	1,437	187	1,718	286	1,142	192
Log Likelihood	-1,207.812	-198.283	-794.623	-94.710	-790.019	-146.421	-599.365	-94.550
Akaike Inf. Crit.	2,571.623	504.565	1,737.246	287.420	1,734.039	394.842	1,352.730	285.100

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

The results in Table 9 reveal two main findings. First, the point estimates of all investment motives of firms that participated in the COVID-19 loan program are not significantly different from zero. This supports the hypothesis that firms did not use government-guaranteed loans to finance investment projects. Second, we find a significant and negative effect in the case of investments in extensions among firms that did not participate in the COVID-19 loan program. Column 3 demonstrates that firms that were exposed to the pandemic and did not take up a COVID-19 credit are significantly less likely to invest in extensions. In other words, the odds of investing in extensions are 48% lower for said companies. At the same time, the comparable point estimate for firms that participated in the program is positively though not significantly different from zero. We had already found a negative effect for this investment motive in Table 5, noting that the COVID shock has decreased the odds of investing in expansions significantly by

39.6%. This recent result extends the earlier finding in that the pandemic negatively affected the investment plans to expand the production capacity of those firms that did not take COVID-19 credits, but not of those that participated in the COVID-19 loan program. Put differently: the government-guaranteed loans program helped preserve plans to extend the production capacity of those firms participating in the program.

5.5 Uncertainty, irreversible investments, and forward-guiding easing of the lockdown policies

Having documented the impact of the pandemic on firms' investment expectations and the influence of government policy measures on their investment revisions in the previous sections, we now turn to the question of what drove these revisions. To uncover the mechanism underlying them, I focus on the role of uncertainty as a determinant of investment revisions in this section.

The outbreak of COVID-19 and the ensuing global pandemic has led to a massive surge in uncertainty. Figure 14 shows how three selected measures of uncertainty evolved in Switzerland over the past twenty years. These measures include a newspaper-based measure, subjective uncertainty in business expectation surveys, and stock market volatility, all figuring prominently in the long literature on economic uncertainty (see Bloom, 2014; Baker et al., 2020). They confirm an enormous increase in uncertainty coinciding with the COVID-19 pandemic in spring 2020.[38] Measured by the news and survey-based indicators, the uncertainty shock is larger than the one associated with the Great Recession of 2008-09 and unprecedented to date.

The idea that investment decisions are sensitive to investors' perceived uncertainty is not new. Many economic decisions involve an intertemporal element in that the moment of decision-making and its realization are separated in time. Because the future is unknown, companies face uncertainty when making decisions. In the presence of uncertainty, they resort to expectations to inform their decisions and guide their actions. This holds in particular for investment decisions, which are often costly, long-term, and irreversible. While there is always uncertainty about the future, a sharp increase in uncertainty – such as during the COVID-19 pandemic – is thought to impair firms' ability to form reliable expectations. A veil of uncertainty blocks their view of the future, making it harder to make forward-looking decisions.

The economic theory highlights different channels through which uncertainty affects investment decisions. One of the most prominent channels revolves around "real options." Real options theory (Bernanke, 1983; Pindyck, 1988; Caballero, 1991) describes firms' investment choices as a series of options. If uncertainty increases, firms resort to wait-and-see behavior until more

[38] Significant uncertainties surrounded non-economic, economic, and policy aspects of the pandemic alike, for instance: the infectiousness and lethality of the virus; the time needed to develop and deploy effective vaccines; the duration and effectiveness of containment strategies and their immediate impact on economic activity; the design of policies in the event of further waves of the pandemic; the policy decisions on which sectors and workers receive government support; the speed of normalization once containment measures are relaxed, or and the long-term impacts of the pandemic on productivity and growth.

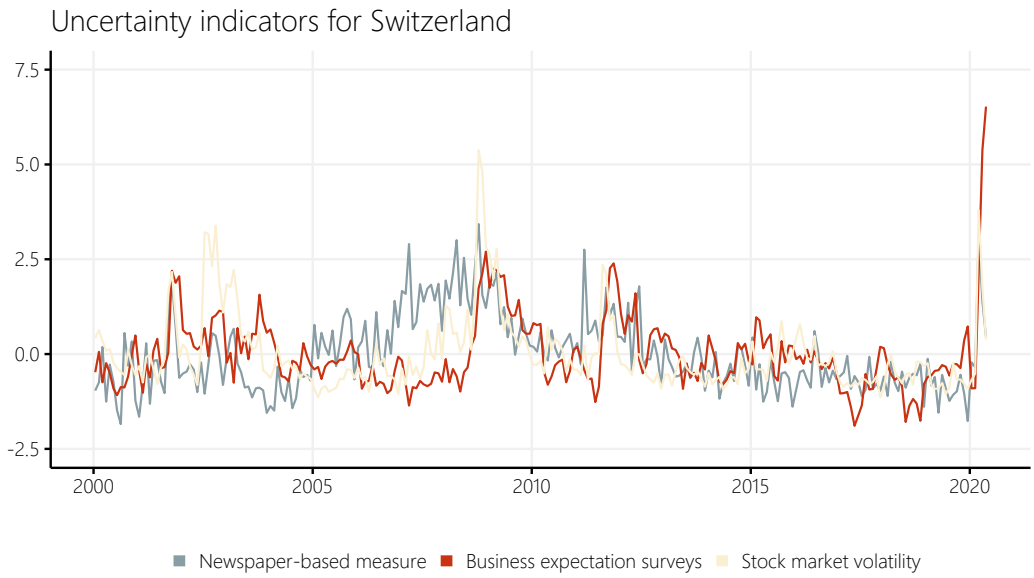

Figure 14: This figure shows three selected measures of uncertainty for Switzerland from 2000 to 2020. The newspaper-based measure represents a part of the economic policy uncertainty indicator developed by Baker et al. (2016). It counts Swiss newspaper articles that contain words related to "uncertainty." It is based on newspaper articles from "Blick," "Neue Zürcher Zeitung," and "Tages-Anzeiger." The measure of subjective uncertainty in business expectation surveys is based on the KOF business tendency surveys. It depicts disconformity in firms' expectations constructed along the lines proposed by Theil (1952). Stock market volatility is based on the Volatility Index on the Swiss Market Index (VSMI). All indicators are standardized to mean one and unit variance.

information becomes available to inform their decision. Until then, firms postpone their investment plans. Put differently, when uncertainty is high, the option value of delaying investments is high. Real options, however, are not universal. They require investment to be irreversible for uncertainty to affect investment. After all, reversible investment does not lead to the loss of an option.

Further theoretical channels that explain negative investment effects from uncertainty include borrowing constraints due to higher risk premia (Gilchrist et al., 2014; Christiano et al., 2014; Arellano et al., 2019) and a loss of confidence caused by ambiguity aversion (Hansen et al., 1999; Ilut and Schneider, 2014). By contrast, there are also theoretical channels that highlight positive investment effects from uncertainty. These include growth options (Bar-Ilan and Strange, 1996; Stein and Stone, 2013; Kraft et al., 2018) and the Oi-Hartman-Abel (Oi, 1961; Hartman, 1972; Abel, 1983) effect.

Overall, the evidence offered by economic theory on the relationship between uncertainty and investment is ambiguous. Therefore, its sign needs to be determined on empirical grounds. To investigate this relation formally during the COVID-19 pandemic, I present estimation results in Table 10. In these estimations, I use as measures of uncertainty and irreversibility firms' responses taken directly from the investment survey, which I have described in Section 3. As the survey

questions on uncertainty and irreversibility were only introduced in spring 2015, estimations are based on a reduced sample of 2,977 firm-year observations.

Table 10: DD estimates of the effect of uncertainty on (irreversible) investments

	Dependent variable:		
	Revisions in investment in equipment ($\Delta I_{i,t}$)		
	(1)	(2)	(3)
$\text{Uncertain}_{i,t}$	-0.061^{***}	-0.043^{**}	-0.007
	(0.014)	(0.017)	(0.032)
$\text{Irreversible}_{i,t}$		-0.054	-0.072
		(0.037)	(0.065)
$T_t \times \text{COVID}_i$			-0.149^{*}
			(0.085)
$\text{Uncertain}_{i,t} \times \text{Irreversible}_{i,t}$		-0.051^{*}	-0.091^{*}
		(0.028)	(0.048)
$T_t \times \text{COVID}_i \times \text{Uncertain}_{i,t} \times \text{Irreversible}_{i,t}$			-0.207^{*}
			(0.117)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	2,977	2,944	2,944
R^2	0.037	0.038	0.047
Adjusted R^2	0.010	0.010	0.015
Residual Std. Error	0.586 (df = 2894)	0.586 (df = 2859)	0.584 (df = 2847)
F Statistic	1.362^{**} (df = 82; 2894)	1.363^{**} (df = 84; 2859)	1.471^{***} (df = 96; 2847)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

Column 1 in Table 10 shows that firms considering the realization certainty of their investment plans as "fairly uncertain" or "very uncertain" reduce them by six percentage points relative to firms that did not report any uncertainty. The effect is statistically significant at a 1% level.

When I test for the presence of real options and hence control for irreversibility in column 2, I find a negative effect of uncertainty on the revision of irreversible investment plans. The coefficient of the interaction term between uncertainty and irreversibility is negative and statistically significant. More precisely, firms indicating uncertainty decrease irreversible investment by 5.1 percentage points more (or increase irreversible investment by 5.1 percentage points less) than firms that do not indicate uncertainty. This effect is in line with standard real options theory. The magnitude of the effect is substantial and economically relevant, even though it is slightly smaller than the one found in earlier studies using the same survey data. Dibiasi et al. (2018) show that policy uncertainty caused by an unexpected outcome of a popular vote in Switzerland decreased irreversible investments of Swiss firms by 13 percentage points. Binding and Dibiasi (2017) find that exchange rate uncertainty decreased irreversible investment by 9.8 percentage points in the same spirit.

Given the unprecedented increase in uncertainty during the recent crisis, I expect to uncover larger real options effects when focusing on treated firms during the COVID-19 pandemic. Indeed, when I interact the real options terms ($\text{Uncertain}_{i,t} \cdot \text{Irreversible}_{i,t}$) with the difference-in-differences interaction term ($T_t \cdot \text{COVID}_i$) in column 3 of Table 10, I find a strongly negative and significant effect during the pandemic. This effect suggests that the COVID-19 pandemic has caused firms being "fairly uncertain" or "very uncertain" about their investments to decrease

their plans for irreversible investments by 20 percentage points more than firms that were certain about their irreversible investments. This result is consistent with real options theory, and its magnitude reflects the vast increase in uncertainty in the recent crisis. Shrouded in a veil of uncertainty during the lockdown, firms abandoned their investment plans which were not easily reversible at a large scale.

The high level of uncertainty during the lockdown led companies to revise and reduce their 2020 investment plans. Conversely, the announcement of the end of the lockdown and, in particular, the forward-looking easing of the measures lowered uncertainty, reducing the negative effect of the pandemic on firms' investment expectations. One month into the lockdown, the improved epidemiological situation created opportunities for the government to relax its containment measures. In doing so, the authorities explicitly declared that restoring planning security for businesses was one of their main objectives in lifting the lockdown policies.[39] Therefore, when disclosing the first easing measures on 16 April, the Federal Council announced a well-articulated 3-phase plan for gradually reopening the economy. The plan outlined three relaxation steps to take effect from 27 April until mid-June, provided the epidemiological situation continued to ease and remain under control. This forward-guiding easing of the containment measures was unique in international comparison (IMF, 2021) and helped reduce uncertainty.

Figure 15 shows proportionately how much uncertainty firms associate with the realization of their 2020 investment plans. At the same time, it distinguishes firms' uncertainty in four phases of the 2020 investment survey: before the pandemic ("Pre-COVID"), during the lockdown ("Lockdown"), when the easing steps were announced ("Announcement"), and from the time the first easing steps came into effect ("Relaxation"). As seen before, uncertainty had increased markedly with the outbreak of the pandemic. The proportion of companies that were fairly to very certain about their investment plans decreased from 87.7% before the pandemic ("Pre-COVID") to 66.5% during the lockdown. Conversely, the proportion of companies uncertain about their plans even before the pandemic increased from 12.3% to 33.4%. With the announcement of the easing steps, the share of firms that assess the realization of their investment plans as "very uncertain" has decreased again by more than half, falling from 10.3% during the lockdown to 5.1%. At the same time, the share of companies that are fairly certain about their plans has risen from 48.6% to 56.4%. This confirms that the government's forward guidance successfully reduced business uncertainty, not only when the relaxations came into effect but already when they were announced.

The increased realization certainty was accompanied by smaller investment revisions. I show this by repeating the baseline estimation from Equation (5) for the four previously determined phases of the 2020 investment survey. Specifically, I determine the change in investment plans of companies exposed to the pandemic (relative to the investment plans of firms non-exposed to

[39] At the beginning of its media release, the Federal Council explains: "In order to create planning certainty, it [the Federal Council] is also announcing how it plans to implement further easing steps by the beginning of June" (Swiss Federal Council, 2020d).

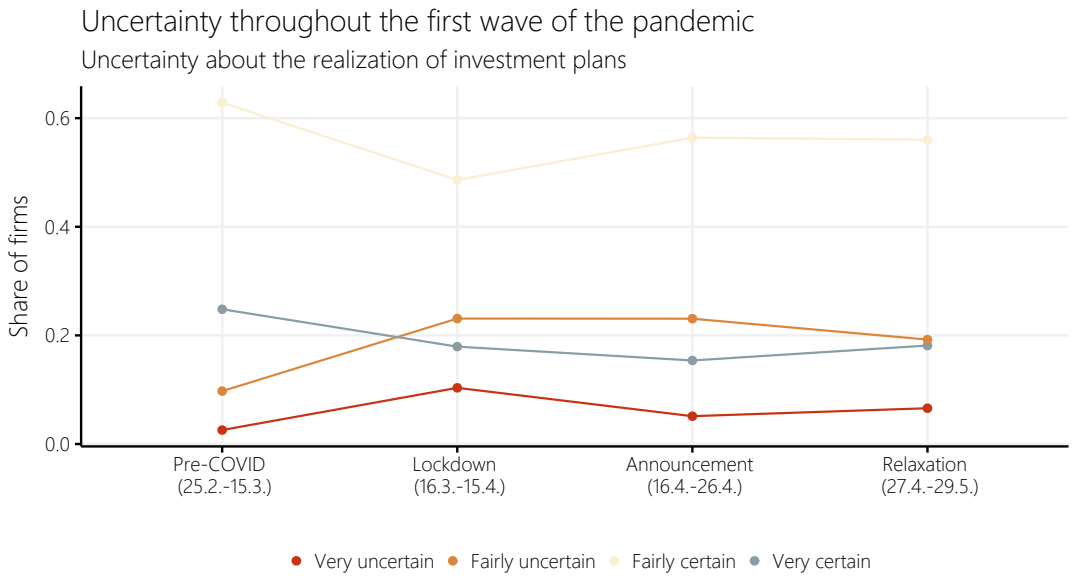

Figure 15: This chart shows the share of companies that described the realization of their 2020 investment plans throughout the survey in spring 2020 as "very uncertain," "fairly uncertain," "fairly certain," and "very certain." It distinguishes four phases: before the pandemic ("Pre-COVID," from 25 February until 15 March 2020), during the lockdown ("Lockdown," from 16 March until 15 April 2020), when the easing steps were announced ("Announcement," from 16 April until 26 April 2020), and from the time the first easing steps came into effect ("Relaxation," from 27 April until 29 May 2020).

COVID-19) that responded to the survey during the lockdown, when the easing measures were announced, and after the first easing measures went into effect. Figure 16 shows the estimation coefficients with the corresponding 95% confidence intervals. During the lockdown, firms revised their investment plans by nearly 20 percentage points. The announcement of the easing measures, in turn, reduced these revisions by almost five percentage points. From 16 April, when the easing plan was announced, to the inception of the first relaxations on 27 April 2020, firms reduced their investment expectations by an average of 14.8 percentage points. Due to the small sample during this period, the point estimate cannot be estimated significantly. However, it hardly differs from the significantly estimated revisions in the last phase, when the first easing measures had taken effect (-15.0 percentage points).

This corroborates the empirical evidence that companies' investment expectations are closely linked to and driven by uncertainty: When uncertainty is high (as during the lockdown), firms reduce their investment plans. If uncertainty decreases (as when the end of the lockdown was announced), investment increases, or the initial revisions turn out to be less negative. Moreover, these findings provide evidence that the authorities' forward guidance in easing the lockdown policies was successful to the extent that it created planning certainty, leading to smaller revisions of firms' investment plans overall.

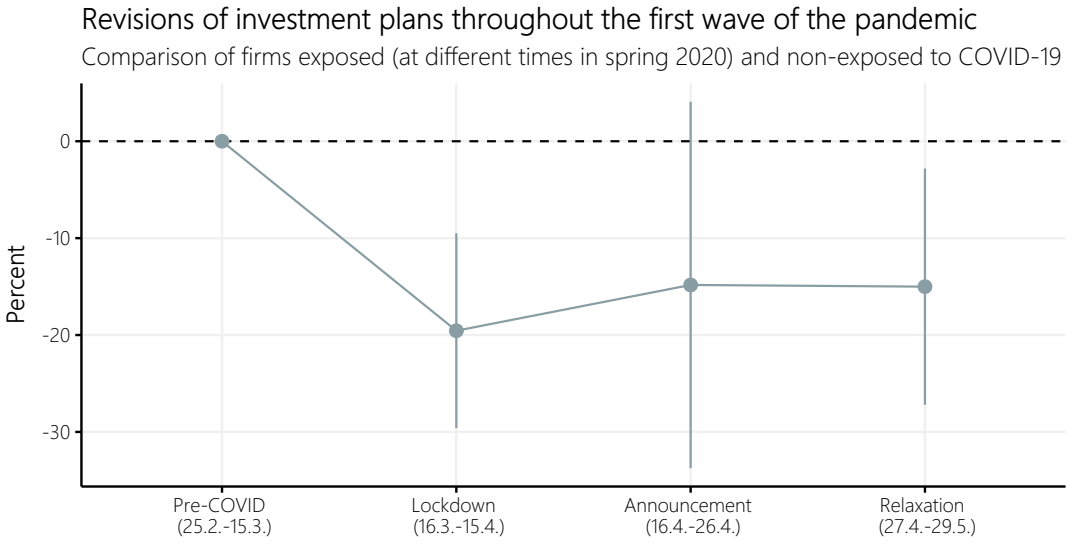

Figure 16: This chart shows average revisions of firms' investment plans throughout the survey in spring 2020 together with the corresponding 95% confidence intervals. It distinguishes four phases: before the pandemic ("Pre-COVID," from 25 February until 15 March 2020), during the lockdown ("Lockdown," from 16 March until 15 April 2020), when the easing steps were announced ("Announcement," from 16 April until 26 April 2020), and from the time the first easing steps came into effect ("Relaxation," from 27 April until 29 May 2020).

6 Placebo and main sensitivity checks

The difference-in-differences estimates rely on the assumption of a common trend absent the COVID-19 pandemic. To examine whether this assumption is plausible, this section studies whether the DD estimation identifies a spurious effect before COVID-19. To this end, I generalize the DD model to the following placebo DD model:

$$\Delta I_{i,t} = \gamma_i + \delta_{j,t} + \sum_{\substack{k=2015,\ldots,2020 \\ k\neq 2019}} \beta_{1k} T_k + \beta_2 \text{COVID}_i + \sum_{\substack{k=2015,\ldots,2020 \\ k\neq 2019}} \beta_{3k} T_k \cdot \text{COVID}_i + \varepsilon_{i,t} \tag{6}$$

The placebo model estimates the difference-in-differences interaction term, capturing the COVID effect for every period (but one) before and during the pandemic. It excludes one period to avoid perfect multicollinearity. I chose to omit the interaction term for 2019 from the regression, the last year before the pandemic. The model then estimates placebo treatment effects for each year relative to 2019. The estimated series of coefficients on the variable of interest, β_{3k}, is a placebo test for whether the treatment affected the outcome between the two groups. The coefficients are plotted together with their 95% confidence intervals in Figure 17. In contrast to Figure 8, which plots average investment revisions for the treatment and control groups and shows the unconditional outcome evolution over time, this figure depicts a *conditional* outcome

distribution.

Figure 17 illustrates the pandemic's substantial negative effect identified by the DD model in the period between 2019 and 2020. Plans to invest in equipment and machinery are substantially revised downwards. On the other hand, we do not observe a significant effect of the pandemic in the years leading up to it. This supports the validity of the central identifying assumption that the groups of firms would have displayed a common trend in the outcome absent the pandemic.

Apart from these placebo checks, I perform several sensitivity and robustness checks, only two of which are discussed in the main body of this paper. All other sensitivity checks can be found in Appendix D.

First, I show that the results do not depend on my choice of the treatment date, which classifies survey respondents in spring 2020 into treatment and control groups. Table 11 provides robustness checks of the baseline DD estimation (Table 3) by altering the treatment date. In particular, I choose 28 February (declaration of the "special situation"), 1 March, and 5 March (first COVID-related death in Switzerland) as alternative treatment dates. In a further specification, I exclude all firms participating in the survey between 1 March and 16 March and assign the respondents after 16 March to the treatment group. This specification aims to make the estimation independent of any specific choice of the treatment date.

Table 11: Robustness of baseline DD to alternative treatment dates

	Dependent variable:			
	Revisions in investment in equipment ($\Delta I_{i,t}$)			
	28 Feb	01 Mar	05 Mar	Gap (01 Mar - 16 Mar)
	(1)	(2)	(3)	(4)
T_t	−0.012	−0.010	−0.004	−0.009
	(0.045)	(0.044)	(0.038)	(0.044)
COVID_i	0.011	0.011	0.001	0.005
	(0.026)	(0.026)	(0.024)	(0.028)
$T_t \times \text{COVID}_i$	−0.087	−0.091*	−0.114**	−0.143**
	(0.055)	(0.055)	(0.052)	(0.059)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	3,318	3,318	3,318	2,709
R^2	0.029	0.030	0.031	0.038
Adjusted R^2	0.004	0.004	0.005	0.008
Residual Std. Error	0.590 (df = 3233)	0.590 (df = 3233)	0.590 (df = 3233)	0.602 (df = 2625)
F Statistic	1.169 (df = 84; 3233)	1.172 (df = 84; 3233)	1.217* (df = 84; 3233)	1.255* (df = 83; 2625)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

In the alternative specifications, the main results remain significant and qualitatively unchanged. In response to the pandemic, firms reduce their investment plans by 9 to 14 percentage points. This shows that my results are not driven by any specific treatment date and lends further plausibility to my choice of identification assigning firms into exposed and non-exposed to the COVID shock.

Second, I provide evidence that the baseline DD results do not depend on the exclusion of zero

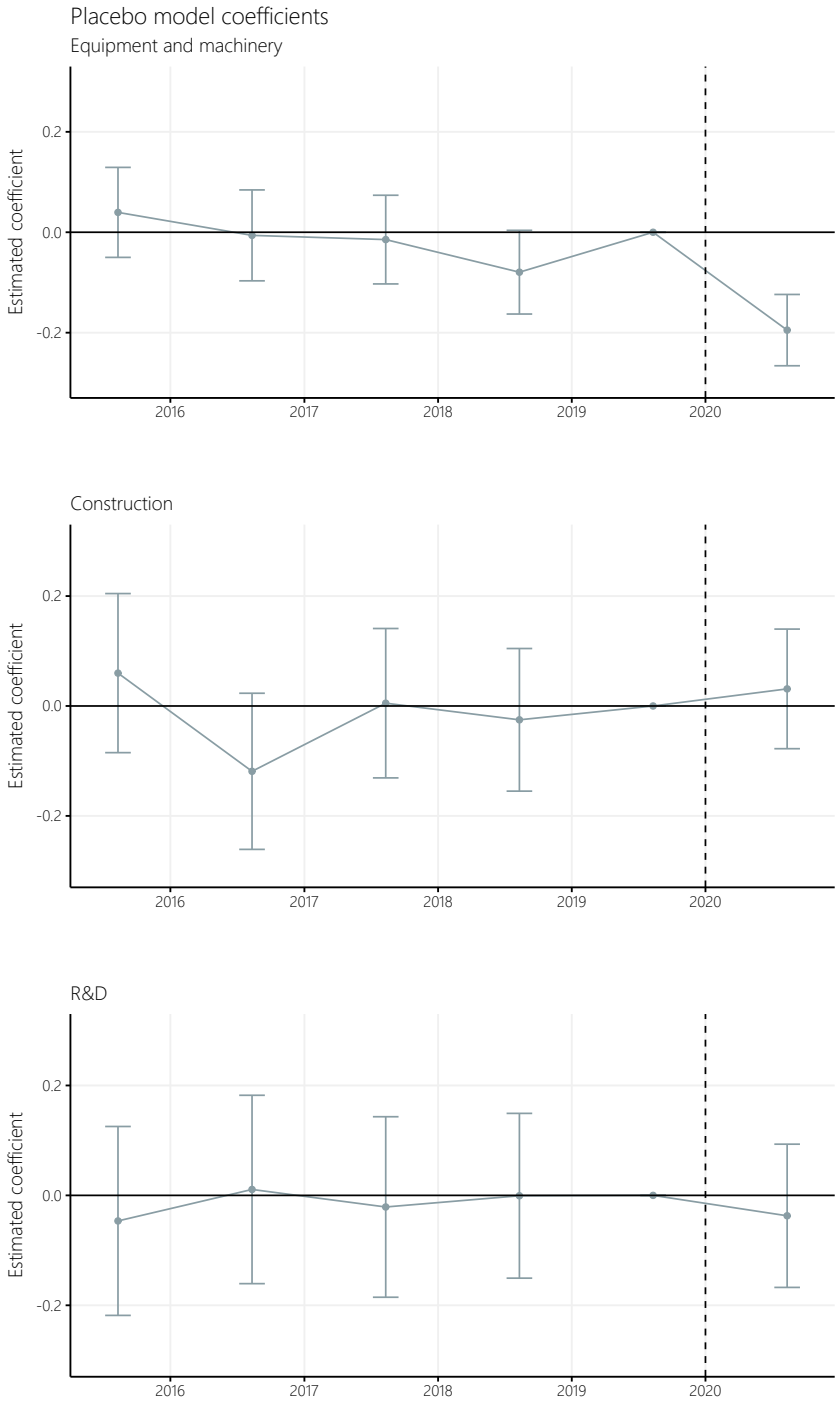

Figure 17: Placebo coefficients of the DD model. The figure depicts the series of placebo coefficients and the associated 95% confidence intervals. The placebo model estimates the interaction term for every period before and after the COVID-19 shock. Because I omit the interaction term for 2019 from the regression, each year's treatment effects are estimated relative to 2019, the year before the COVID-19 shock. The estimation sample covers the 2014–2020 period.

investments. One major concern with my estimates is that revisions from or to zero are discarded from the estimation sample because I define investment revisions as log differences. This is a particular worry for investment in construction as well as R&D because many firms do have zero expenditures on these types of investments in many years. This could be particularly relevant at the current edge.

To address this issue, I define an alternative outcome variable. In particular, I construct an ordered categorical variable equal to 1 if investment plans for any given year t increase (including increases from zero) between the autumn survey in $t-1$ and the spring survey in t, equal to -1 if they decrease (including decreases to zero) and equal to 0 if they remain unchanged. Using this variable as the outcome of an ordered logit model similar to the baseline DD model, Table 12 shows the results of this alternative estimation specification.

Table 12: Robustness of baseline DD to zero investments

	Investment revisions (categorical)		
	Equipment	Construction	R&D
	ordered logistic	*ordered logistic*	*ordered logistic*
	(1)	(2)	(3)
T_t	−0.049	−0.056	0.050
	(0.093)	(0.097)	(0.120)
COVID_i	−0.088	−0.020	0.140
	(0.066)	(0.071)	(0.091)
$T_t \times \text{COVID}_i$	−0.242*	−0.138	−0.397**
	(0.128)	(0.135)	(0.165)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	4,436	4,318	3,738
Note:			*p<0.1; **p<0.05; ***p<0.01

The estimated coefficient on investment in equipment and machinery (column 1) is again negative and statistically significant. Keeping all other variables constant, the odds of investing in equipment and machinery are −21.5% for firms which are exposed to the pandemic. I further find a negative effect of the pandemic for R&D investments (column 2). The odds of investing in research and development are −32.8% for firms exposed to the pandemic. This result suggests that many companies may have canceled their investments in R&D completely during the crisis instead of just reducing them. Albeit negative, the effect on construction is not statistically significant (column 3).

7 Conclusion

This paper has studied how the COVID-19 pandemic affected firms' investment expectations. It aimed to understand three different aspects. First, it explored how the pandemic changed firms' investment expectations and identified the firms that revised their 2020 investment plans in response to the crisis. Second, it examined the influence of governments' policy measures to mitigate the economic impact of the crisis on firms' investment revisions. Third, it sought to uncover the mechanism underlying these revisions.

Combining a survey of Swiss firms with a quasi-experimental research design has found that the pandemic caused firms to reduce their 2020 investment plans by over one-eighth. Yet, the pandemic did not affect firms equally. It reinforced pre-crisis constraints in that companies facing worse economic conditions or a lack of financial resources already before the crisis cut their plans more than others. Although realization certainty before the crisis did not predict revisions, increased uncertainty during the crisis depressed firms' expected investments through real options effects. Government-guaranteed loans helped preserve plans to expand production capacity, and the forward-guiding easing of the policy measures reduced uncertainty, resulting in smaller revisions overall.

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Appendix

Causal Evidence on Firms' Investment Expectations and Revisions in Response to the Global Pandemic

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In this appendix, I present additional figures, tables and analyses that are not featured in the main body of the paper. The appendices refer to the corresponding sections in the main text.

Disclaimer: The views expressed in this paper are those of the author and do not necessarily reflect the views of the European Central Bank.
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A The COVID-19 pandemic in Switzerland

This appendix refers to Section 2 in the main body of the paper. Section A.1 presents a timeline of selected events and measures taken by the Swiss federal government in the first wave of the COVID-19 pandemic in spring 2020. Section A.2 shows the stringency of COVID-19 policy measures for Switzerland and its neighboring countries during the first wave of the pandemic.

A.1 Timeline of selected events and measures during the first wave of the COVID-19 pandemic in Switzerland

29 January	The Federal Department of Home Affairs defined qualified suspicion of disease and (positive and negative) detection on severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as reportable.
28 February	The Swiss Federal Council categorizes the situation in Switzerland as *special* in terms of the Epidemics Act. Events with more than 1,000 people are prohibited effective immediately. Directly affected were, among others, sporting events, concerts, or the Basel Carnival. Cantonal authorities decided regionally on events with less than 1,000 people.
1 March	The Federal Office of Public Health launched a campaign with hygiene recommendations to protect against SARS-CoV-2.
13 March	The government announces the closure of the schools from Monday, 16 March. Events with more than 100 people are prohibited. Restaurants, bars, and discos are limited to 50 people. Ski resorts had to suspend operations.
15 March	The parliament decided not to proceed with the ongoing spring session.
16 March	Federal President declares the *extraordinary situation*, allowing the Federal Council to order uniform measures in all cantons. All public and private events are prohibited. Shops, restaurants, and leisure facilities must close. The lockdown also applies to schools and businesses where the recommended distance cannot be maintained (e.g. hairdressers and cosmetics studios). Only grocery stores and health facilities remain open. Border controls at the borders with Germany, Austria, and France were introduced, and entry bans were imposed, albeit with exceptions. Border checks at the Italian border were already introduced at an earlier stage. Up to 8,000 members of the armed forces were deployed to assist the cantons at hospitals and with logistics and security.
20 March	The Federal Council announced a comprehensive package of measures worth 32 billion Swiss francs to mitigate the economic consequences of the spread of the coronavirus. These include liquidity support for companies ("COVID-19 bridging loans"), expansion and simplification of short-time work, and compensation for loss of earnings for self-employed.
8 April	The Federal Council extended the measures taken on 16 March by one week (until 26 April) and announced to relax them in stages, starting before the end of April
16 April	Four weeks into the lockdown, the Federal Council announced the roadmap for easing its measures taken. The reopening of the economy and social life is to take place in three stages, see 27 April, 11 May and 6 June.

27 April	First step: hairdressers, DIY stores, and garden centers may resume operations with protection concepts.
11 May	Second step: Shops, restaurants, public markets, and museums may reopen. Primary and secondary schools can again teach on-site.
6 June	Third step: Events with up to 300 people are permitted again. Mountain railways, camping sites, zoos, and leisure facilities may open. Secondary, vocational, and higher education establishments may resume teaching.
15 June	The borders to all states within the EU/EFTA area will be opened completely. Among other things, shopping tourism to Germany or Austria is permitted again.
19 June	Return from the extraordinary to the special situation. The cantons will have a greater say and more room for maneuver. In public spaces, the minimum distance is reduced from 2 to 1.5 meters. Restaurants will be allowed to move their tables closer together, while at the same time, the Swiss midnight curfew will be lifted. Meetings and events for up to 1,000 people are again permitted. Masks are compulsory at rallies. The recommendation to work from home if possible is repealed.

Table A.1: Timeline of selected events and measures taken by the Swiss federal government in the onset of the COVID-19 pandemic. Compiled from the ordinances and media releases of the Swiss Federal Council, see https://www.admin.ch/gov/en/start/documentation.html.

A.2 Stringency of COVID-19 policy measures

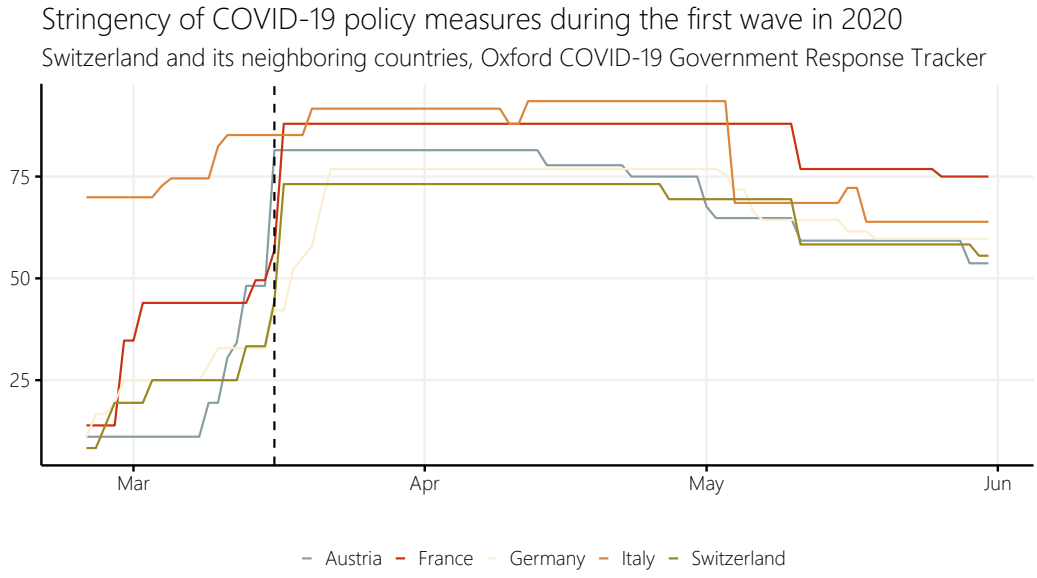


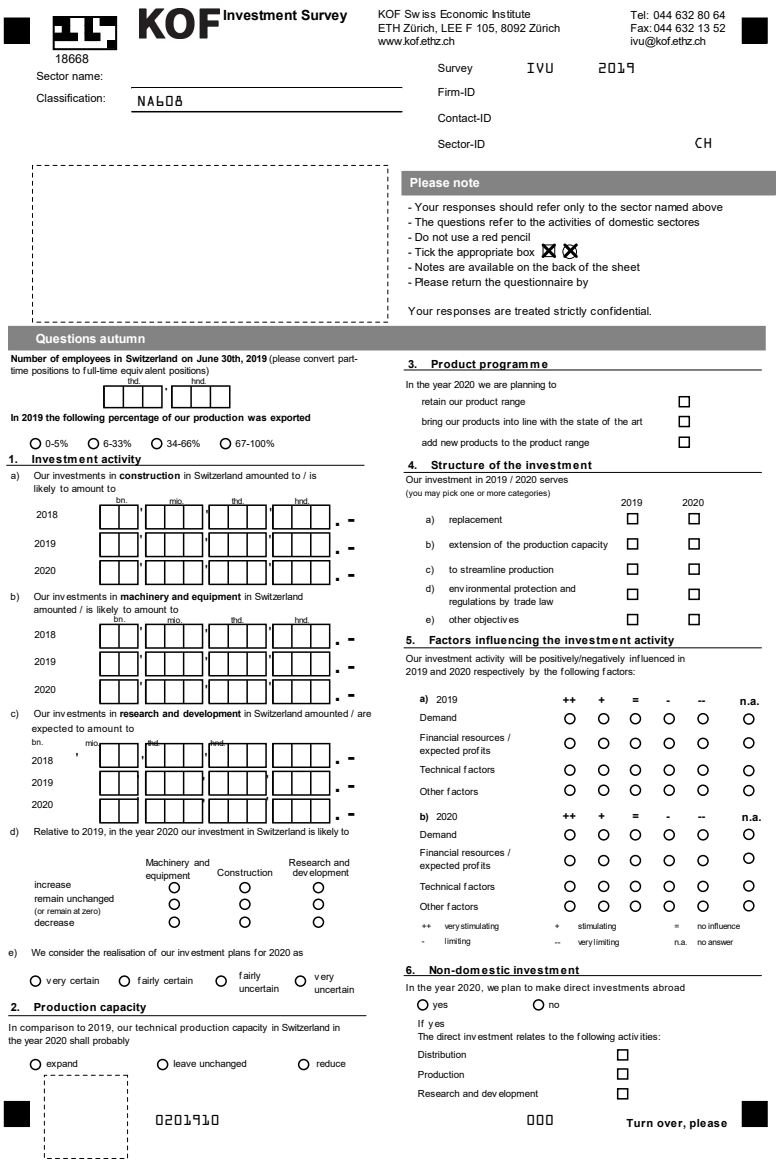
Figure A.1: This chart shows the Oxford COVID-19 Government Response Tracker for Switzerland and its neighboring countries during the first wave of the pandemic in 2020. The index is a composite measure including lockdown policies, such as school and workplace closure. Its value ranges from 0 (no measures) to 100 (full lockdown). The vertical dashed line marks the declaration of the "extraordinary situation" by the Swiss Federal Council on 16 March 2020.

B Data

This appendix refers to Section 3 in the main body of the paper. Section B.1 shows the questionnaires of the regular investment surveys in autumn and spring. The example questionnaires from autumn 2019 and spring 2020. Section B.2 shows the questionnaire of the COVID-19 special survey in autumn 2020. Section B.3 provides more details on the regular investment survey.

B.1 Questionnaires of the regular investment surveys

Autumn 2019 investment survey



KOF Investment Survey

KOF Swiss Economic Institute
ETH Zürich, LEE F 105, 8092 Zürich
www.kof.ethz.ch

Tel: 044 632 80 64
Fax: 044 632 13 52
ivu@kof.ethz.ch

18668

Sector name:

Classification: NACE

Survey IVU 2019

Firm-ID

Contact-ID

Sector-ID CH

Please note

- Your responses should refer only to the sector named above
- The questions refer to the activities of domestic sectors
- Do not use a red pencil
- Tick the appropriate box ☒
- Notes are available on the back of the sheet
- Please return the questionnaire by

Your responses are treated strictly confidential.

Questions autumn

Number of employees in Switzerland on June 30th, 2019 (please convert part-time positions to full-time equivalent positions)

thd. hnd.

In 2019 the following percentage of our production was exported

○ 0-5% ○ 6-33% ○ 34-66% ○ 67-100%

1. Investment activity

a) Our investments in **construction** in Switzerland amounted to / is likely to amount to

	bn.	mio.	thd.	hnd.	
2018					.-
2019					.-
2020					.-

b) Our investments in **machinery and equipment** in Switzerland amounted / is likely to amount to

	bn.	mio.	thd.	hnd.	
2018					.-
2019					.-
2020					.-

c) Our investments in **research and development** in Switzerland amounted / are expected to amount to

	bn.	mio.	thd.	hnd.	
2018					.-
2019					.-
2020					.-

d) Relative to 2019, in the year 2020 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and development
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

e) We consider the realisation of our investment plans for 2020 as

○ very certain ○ fairly certain ○ fairly uncertain ○ very uncertain

2. Production capacity

In comparison to 2019, our technical production capacity in Switzerland in the year 2020 shall probably

○ expand ○ leave unchanged ○ reduce

0201910

3. Product programme

In the year 2020 we are planning to

- retain our product range ☐
- bring our products into line with the state of the art ☐
- add new products to the product range ☐

4. Structure of the investment

Our investment in 2019 / 2020 serves
(you may pick one or more categories)

		2019	2020
a)	replacement	☐	☐
b)	extension of the production capacity	☐	☐
c)	to streamline production	☐	☐
d)	environmental protection and regulations by trade law	☐	☐
e)	other objectives	☐	☐

5. Factors influencing the investment activity

Our investment activity will be positively/negatively influenced in 2019 and 2020 respectively by the following factors:

a) 2019	++	+	=	-	--	n.a.
Demand	○	○	○	○	○	○
Financial resources / expected profits	○	○	○	○	○	○
Technical factors	○	○	○	○	○	○
Other factors	○	○	○	○	○	○

b) 2020	++	+	=	-	--	n.a.
Demand	○	○	○	○	○	○
Financial resources / expected profits	○	○	○	○	○	○
Technical factors	○	○	○	○	○	○
Other factors	○	○	○	○	○	○

++ very stimulating + stimulating = no influence
- limiting -- very limiting n.a. no answer

6. Non-domestic investment

In the year 2020, we plan to make direct investments abroad

○ yes ○ no

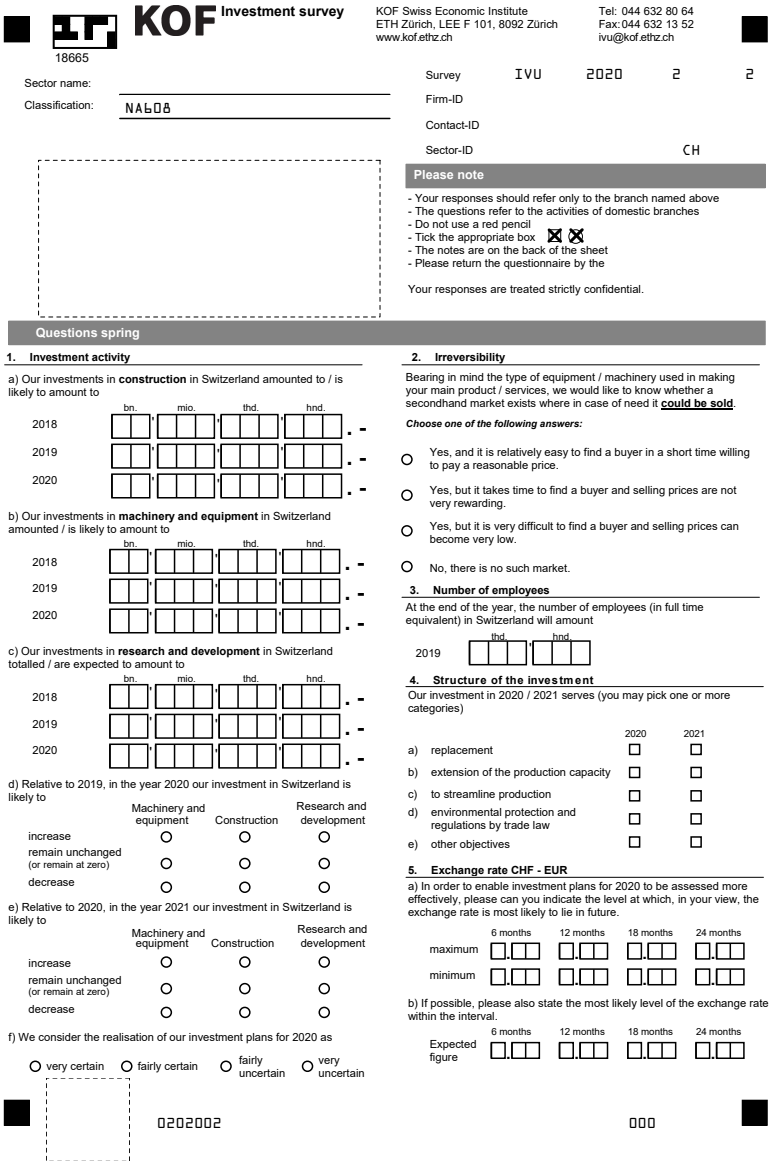
If yes
The direct investment relates to the following activities:

- Distribution ☐
- Production ☐
- Research and development ☐

000

Turn over, please

Spring 2020 investment survey



KOF Investment survey

18665

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Tel: 044 632 80 64
Fax: 044 632 13 52
ivu@kof.ethz.ch

Sector name:

Classification: NAGO8

Survey IVU 2020 2 2

Firm-ID

Contact-ID

Sector-ID CH

Please note

- Your responses should refer only to the branch named above
- The questions refer to the activities of domestic branches
- Do not use a red pencil
- Tick the appropriate box ☒ ☒
- The notes are on the back of the sheet
- Please return the questionnaire by the

Your responses are treated strictly confidential.

Questions spring

1. Investment activity

a) Our investments in **construction** in Switzerland amounted to / is likely to amount to

bn. mio. thd. hnd.

2018 . -

2019 . -

2020 . -

b) Our investments in **machinery and equipment** in Switzerland amounted / is likely to amount to

bn. mio. thd. hnd.

2018 . -

2019 . -

2020 . -

c) Our investments in **research and development** in Switzerland totalled / are expected to amount to

bn. mio. thd. hnd.

2018 . -

2019 . -

2020 . -

d) Relative to 2019, in the year 2020 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and development
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

e) Relative to 2020, in the year 2021 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and development
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

f) We consider the realisation of our investment plans for 2020 as

○ very certain ○ fairly certain ○ fairly uncertain ○ very uncertain

2. Irreversibility

Bearing in mind the type of equipment / machinery used in making your main product / services, we would like to know whether a secondhand market exists where in case of need it **could be sold**.

Choose one of the following answers:

○ Yes, and it is relatively easy to find a buyer in a short time willing to pay a reasonable price.

○ Yes, but it takes time to find a buyer and selling prices are not very rewarding.

○ Yes, but it is very difficult to find a buyer and selling prices can become very low.

○ No, there is no such market.

3. Number of employees

At the end of the year, the number of employees (in full time equivalent) in Switzerland will amount

thd. hnd.

2019

4. Structure of the investment

Our investment in 2020 / 2021 serves (you may pick one or more categories)

		2020	2021
a)	replacement	☐	☐
b)	extension of the production capacity	☐	☐
c)	to streamline production	☐	☐
d)	environmental protection and regulations by trade law	☐	☐
e)	other objectives	☐	☐

5. Exchange rate CHF - EUR

a) In order to enable investment plans for 2020 to be assessed more effectively, please can you indicate the level at which, in your view, the exchange rate is most likely to lie in future.

	6 months	12 months	18 months	24 months
maximum	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐
minimum	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐

b) If possible, please also state the most likely level of the exchange rate within the interval.

	6 months	12 months	18 months	24 months
Expected figure	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐

02020O2 OOO

B.2 Questionnaire of the COVID-19 special survey

Exposure to the COVID-19 pandemic

1. **To what extent is the physical presence of workers at the work place necessary for your production or service provision?**
   - ☐ Physical presence required in most cases
   - ☐ Both shares of possible home work and physical presence requirement

□ Home work possible in most cases

2. **To what extent was your production or service provision affected by the state-imposed lockdown in spring 2020?**
   - □ Our company was completely closed at times
   - □ Our company was at times partially, but never completely closed
   - □ Our company was at all times fully operational

Importance of federal and corporate measures to mitigate the economic impact of the COVID-19 pandemic

3. **What was the importance of the following federal measures to mitigate the economic impact of the COVID-19 pandemic for your company?**
   - (a) **Introduction of short-time work** no □—□—□—□ high
   - (b) **Liquidity support and bridging credits** no □—□—□—□ high
   - (c) **Compensation for loss of earnings** no □—□—□—□ high

4. **What was the importance of the following corporate measures to mitigate the economic impact of the COVID-19 pandemic for your company?**

   Financial measures

   - (a) **Take up new credits** no □—□—□—□ high
   - (b) **Increase of existing credits** no □—□—□—□ high
   - (c) **Sale of assets** no □—□—□—□ high
   - (d) **Request for rent reduction** no □—□—□—□ high

   Strategic decisions

   - (e) **Implementation/expansion of home office** no □—□—□—□ high
   - (f) **Development of new supply chains** no □—□—□—□ high
   - (g) **Development of new distribution channels** no □—□—□—□ high
   - (h) **Change of the marketing strategy** no □—□—□—□ high
   - (i) **Rationalisation of product lines** no □—□—□—□ high
   - (j) **Waive investment projects** no □—□—□—□ high
   - (k) **Postpone investment projects** no □—□—□—□ high
   - (l) **Initiate investment projects** no □—□—□—□ high
   - (m) **Increase of prices** no □—□—□—□ high
   - (n) **Decrease of prices** no □—□—□—□ high

Cost control

(o) **Closure of plants** no □—□—□—□ high
(p) **Reduction of personnel** no □—□—□—□ high
(q) **Reduction of wage growth** no □—□—□—□ high
(r) **Reduction of inventoryl** no □—□—□—□ high

Financial situation following the COVID-19 pandemic

5. **A key element of the federal government's measures to mitigate the economic consequences of the pandemic is liquidity support and bridging loans ("COVID-19 credits"). Have you obtained a "COVID-19 credit", and if so, to which amount?**
   □ We have not obtained a "COVID-19 credit"
   □ < CHF 49,999
   □ CHF 50,000 - 99,999
   □ CHF 100,000 - 249,999
   □ CHF 250,000 - 499,999
   □ ≥ CHF 500,000 ("COVID-19 credit plus")

6. **By when do you expect to have repaid any "COVID-19 credit" you may have obtained**
   □ We have already repaid the "COVID-19 credit"
   □ 1 year
   □ 1 - 3 years
   □ 3 - 5 years
   □ ≥ 5 years

7. **In 2019 was your:**
   (a) Sales revenue: _____
   (b) Wage total: _____
   (c) Total expenditure: _____
   (d) Total assets: _____
   (e) Debt ratio: _____
   (f) Profit margin: _____

8. **To what extent does a lack of external funding hinder the investment plans of your company?**
   (a) **December 2019** not □—□—□—□ very strongly
   (b) **Today** not □—□—□—□ very strongly

9. **To what extent does a lack of internal funding hinder the investment plans of your company?**
   (a) **December 2019** not □—□—□—□ very strongly
   (b) **Today** not □—□—□—□ very strongly

Assessments and expectations

10. How do you assess the following aspects of your business at the end of 2019, today, and at the end of 2021?

Demand

(a) **December 2019** very good □—□—□—□—□ very bad
(b) **Today** very good □—□—□—□—□ very bad
(c) **December 2021** very good □—□—□—□—□ very bad

Liquidity

(a) **December 2019** very good □—□—□—□—□ very bad
(b) **Today** very good □—□—□—□—□ very bad
(c) **December 2021** very good □—□—□—□—□ very bad

Profitability

(a) **December 2019** very good □—□—□—□—□ very bad
(b) **Today** very good □—□—□—□—□ very bad
(c) **December 2021** very good □—□—□—□—□ very bad

Indebtedness

(a) **December 2019** very good □—□—□—□—□ very bad
(b) **Today** very good □—□—□—□—□ very bad
(c) **December 2021** very good □—□—□—□—□ very bad

Competition

(a) **December 2019** very good □—□—□—□—□ very bad
(b) **Today** very good □—□—□—□—□ very bad
(c) **December 2021** very good □—□—□—□—□ very bad

11. Measured by your company's turnover as a percentage of the sales expected before the crisis, how do you assess the course of the crisis and the recovery from it for your company? Example: A turnover of 80% in Q2 2020 means that your turnover in Q2 was 20% below your expected turnover for the corresponding quarter

Turnover (in percent)

(a) Q2 2020: _____

(b) Q4 2020: _____

(c) Q2 2021: _____

(d) Q4 2021: _____

12. When do you expect your company to have completely overcome the COVID-19 crisis?

- ☐ Our company has not experienced a crisis
- ☐ Our company has already overcome the crisis
- ☐ $<$ 6 months
- ☐ 6 - 12 months
- ☐ 1 - 2 years
- ☐ 2 - 3 years
- ☐ $\geq$ 3 years

B.3 More details on the regular investment survey

This appendix gives more details on the regular investment survey conducted by the KOF Swiss Economic Institute at ETH Zurich.

The survey is conducted bi-annually since 2012 among a large panel of private Swiss firms. It takes place in the spring and autumn of each year and is available in all three official languages of Switzerland (German, French and Italian) and English. Respondents may choose to fill out the questionnaire on paper or directly on the internet.

The panel of firms is a (with respect to firm size) disproportionately stratified sample drawn from the national census of enterprises. To deal with attrition, new companies are regularly drawn from the census and included in the survey. Currently, it consists of 13,287 firms. The firms in the sample cover all industries excluding agriculture (NACE 10–96) and within each industry three size classes with complete coverage of large firms. The limits for the three size classes, which are defined by employment in full-time equivalents (FTE), are determined by "optimal stratification," taking firms' size distribution within industries into account (see Cochran, 2007). Overall, the sample accounts for 58% of total employment (FTE) in Switzerland.

The investment survey serves to identify investment tendencies at an early stage. For this purpose, it consists of many qualitative and quantitative questions on investment plans and objectives, on the structure of investments, or the factors influencing investment activity. Investments are defined as gross fixed capital formation (GFCF). The survey distinguishes between investments in construction, machinery and equipment, as well as research and development. As part of the quality assurance of the data, all quantitative survey responses are subjected to plausibility checks. These involve rough checks to detect apparent errors in response behavior. For example, responses often vary in increments of thousands or millions across survey waves. Such inconsistencies can be easily identified and corrected thanks to the reporting and data structure. None of the main results critically depend on these corrections, but they tend to be more precisely estimated. As a robustness check, Table D.4 in Appendix D shows estimates of

the main specification without these corrections and after excluding all outliers below the 5th and above the 95th percentiles.

The analysis is based on data from all surveys conducted since 2013, focusing on data from the survey waves in autumn 2019 and spring 2020 to investigate the revisions in firms' investment plans in response to the Covid-19 pandemic. Table B.1 summarises information on survey participants and response rates to the investment surveys in autumn 2019 and spring 2020. Columns 1 and 2 show the number of firms contacted in each wave. Columns 3 and 4 show the response rates. Column 5 gives the number of firms remaining in the joint sample. Column 6 reports the sectoral distribution in the final data set.

Table B.1: Survey participants and response statistics

	Contacted firms		Response rates		Joint sample	
	Autumn 2019	Spring 2020	Autumn 2019	Spring 2020	*N*	%
Manufacturing	4328	4232	25%	23%	424	35%
Construction	1158	1135	23%	22%	75	6%
Services	8129	7886	26%	24%	701	58%
Overall	13615	13253	25%	23%	1200	100%

Survey participants and response rates to the investment surveys in autumn 2019 and spring 2020. Columns 1 and 2 show the number of firms contacted in each wave. Columns 3 and 4 show the response rates. Column 5 gives the number of firms remaining in the joint sample, i.e., the firms which reported investment figures for 2020 in both waves via the online survey. Column 6 reports the sectoral distribution in the final data set.

The survey in autumn 2019 was conducted from 30 September to 31 December 2019. From 13,650 contacted firms, 3,340 valid questionnaires were received, corresponding to a response rate of 24.5%. Of the participating firms, 30.7% are in manufacturing, 7.7% in construction, and 61.2% in the services sector.
In spring 2020, the survey was conducted from 25 February to 31 May 2020. From the 13,287 firms contacted, 3,103 valid questionnaires were received, corresponding to a response rate of 23.4%. Firms in the manufacturing, construction, and services sectors account for 31.0%, 7.9%, and 60.6%, respectively, of the participants in this wave.

Average response rates are similar across sectors and the final data set is balanced with respect to the distribution among the firms initially contacted. 33% of firms belong to the manufacturing sector (NACE Rev. 2 divisions 10–33). 6% of the firms in the sample are in construction (NACE 41–43), and 57% belong to the service sector (NACE 45–96). Regarding size, 27% of all firms are large firms (more than 250 FTE), 28% are medium-sized firms (between 50 and 249 FTE), and 45% of all firms in the sample have less than 50 employees. The median firm size is 74 employees. Unlike other surveys, the investment survey also includes micro-sized companies with only one employee.

Identification of non-response bias in survey data Wallace and Mellor (1988) outline methods to identify non-response bias in survey data. One proposition is to compare the profile of early respondents to the profile of late respondents, with the underlying assumption that late respondents are similar to non-respondents. In this table, I compare the first N respondents to the last N respondents of every spring survey. I select several N to avoid accidental outcomes. For each N, I test the equality of means between the two groups for several characteristics. I use a two-sided t-test allowing for unequal variances to test for equality of means. As shown in the table, no significant differences exist.

Table B.2: Identification of non-response bias in survey data

Variable	N	Mean (First N)	SD (First N)	Mean (Last N)	SD (Last N)	p-value
Employees (FTE)	10	103.40	159.79	153.55	274.43	0.358
	25	98.99	139.20	150.12	241.33	0.087
	50	112.02	166.69	136.58	234.51	0.247
	100	138.39	243.88	137.83	227.06	0.974
$\text{Irreversible}_{i,t}$	10	0.36	0.49	0.40	0.50	0.711
	25	0.35	0.48	0.46	0.50	0.097
	50	0.38	0.49	0.37	0.48	0.824
	100	0.34	0.47	0.34	0.48	0.837
$\text{Uncertain}_{i,t}$	10	-0.95	0.85	-0.71	1.11	0.290
	25	-0.92	0.92	-0.65	1.16	0.073
	50	-0.98	0.92	-0.83	1.08	0.133
	100	-0.98	0.94	-0.90	1.04	0.239
$\log(I_{i,t,s=\text{spring t}})$	10	12.99	1.49	12.29	2.31	0.154
	25	12.95	1.60	12.50	2.31	0.146
	50	12.75	1.73	12.38	2.35	0.116
	100	12.39	2.09	12.56	2.36	0.366
$\Delta I_{i,t}$	10	0.06	0.42	0.00	0.65	0.747
	25	-0.04	0.50	-0.05	0.64	0.933
	50	0.02	0.56	-0.01	0.54	0.661
	100	0.01	0.55	-0.06	0.52	0.138

Difference between online and paper survey respondents This table provides a detailed breakdown of the sample into online and paper survey respondents by firm characteristics (size, location, export orientation, and industry). Unless otherwise stated, numbers are relative frequencies. The stars indicate if the means are significantly different at conventional level (***p < 0.01, **p < 0.05, *p < 0.1). The underlying p-values result from a comparison of online and paper survey respondents with a two-sample t-test assuming unequal variance.

Table B.3: Characteristics of online versus paper survey respondents

Variable	Online respondents (2014–2020)	Paper respondents (2014–2020)	
Firm size			
Small	0.41	0.48	***
Medium	0.32	0.35	
Large	0.26	0.17	***
Number of FTE	354.40	312.06	
Region			
Zurich	0.21	0.22	
Schweizer Mittelland	0.18	0.16	
Lake Geneva Region	0.10	0.14	**
Eastern Switzerland	0.20	0.16	**
Ticino	0.08	0.06	**
North-West Switzerland	0.12	0.13	
Central Switzerland	0.12	0.13	
Export orientation			
Exporter	1.31	1.25	**
Sector			
Manufacturing	0.33	0.32	
Construction	0.06	0.07	
Service	0.57	0.59	
Observations	2403	2645	

C Results

This appendix refers to Section 5 in the main body of the paper. In this appendix, I present additional results including tables and figures that are not featured in the main body of the paper. The subappendices refer to the corresponding sections in the main text.

C.1 Descriptive evidence

In Section 5.1, I've presented descriptive evidence on how firms expected their investment in equipment and machinery to change in 2020 compared to 2019 and how their expectations changed between the two surveys in autumn 2019 and spring 2020. In this appendix, I present similar evidence for investment in construction (Figure C.1) and research and development (Figure C.2). They are qualitatively similar to the results for investments in equipment and machinery, as they also show that during the pandemic more companies expected their investments to decrease in 2020 compared to their expectations in late 2019.

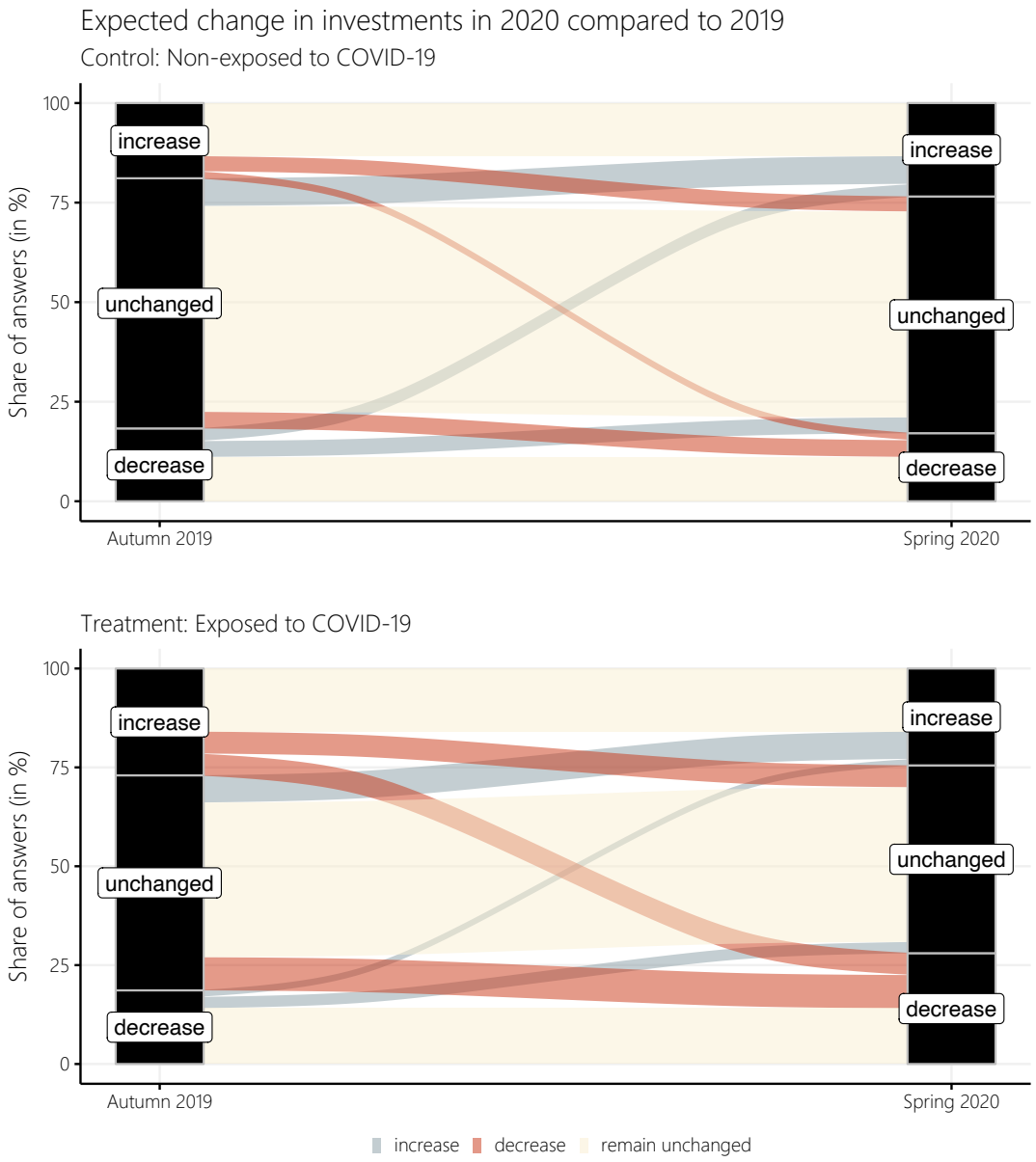

Figure C.1: Sankey diagram of firms' planned changes in investment in construction in 2020 relative to 2019 as collected in the Investment Surveys in autumn 2019 and spring 2020. Flows are shown separately for firms in the control (upper panel) and treatment group (lower panel).

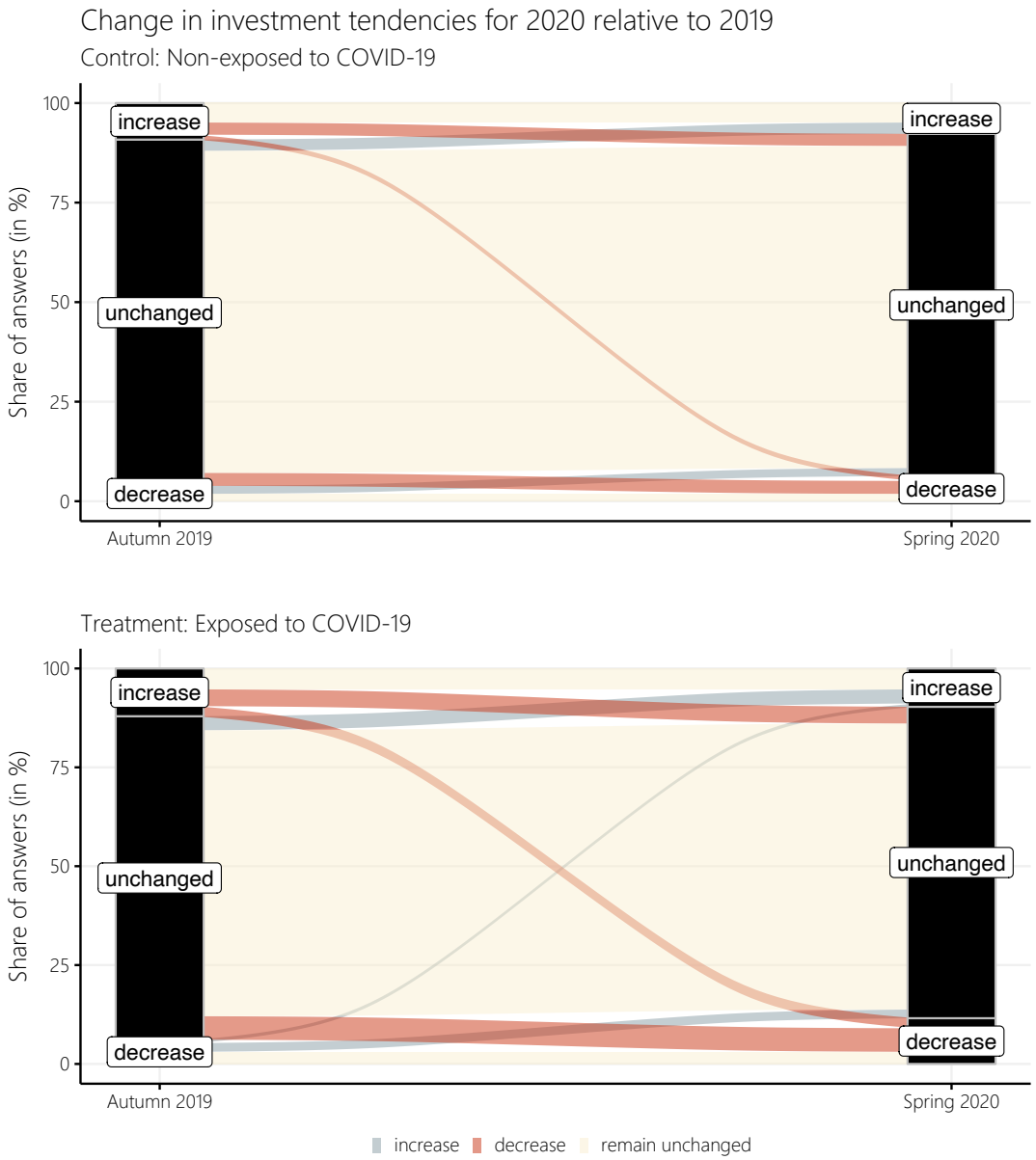

Figure C.2: Sankey diagram of firms' planned changes in investment in research and development in 2020 relative to 2019 as collected in the Investment Surveys in autumn 2019 and spring 2020. Flows are shown separately for firms in the control (upper panel) and treatment group (lower panel).

C.2 The overall impact of the pandemic on firms' investment plans

While my results in Section 5.2 document that the COVID shock has on average depressed investment projects, the negative relationship between the home office index and investment revisions gives us an idea of which firms revised their investment plans significantly less and

which (few) firms were actually able to increase their 2020 investment plans in response the COVID-19 crisis. These could be firms whose human capital accounts for a large share in their production or service provision, that employ many well-trained employees, and that have – already before the crisis – digitized both internal and external processes to a high degree. I group these firms under the term "innovative firms." Innovative firms may have been more agile and found it easier to adapt to the rapidly evolving conditions during the lockdown in spring 2020. Similarly, innovative firms may have had it easier to adopt digital processes (e.g., teleworking, digital procurement, or distribution) and thus been more independent from the government-imposed lockdown measures.

To test this hypothesis, I examine how firms' investment revisions depend on various innovation features. Table C.1 reports the corresponding regression results. In these estimations, I interact the difference-in-differences term from Equation (5) with the indicators for innovation. This information comes from the KOF Innovation Survey 2018 and is matched at the firm level. Specifically, I use an indicator for (i) the education level of employees[40], (ii) personnel expenses[41], (iii) the use of information and communication technologies (ICT)[42], and (iv) the relevance of e-commerce[43].

Table C.1: DDD estimates of the effect of the COVID-19 shock on investment revisions

	Dependent variable:			
	Revisions in investment in equipment ($\Delta I_{i,t}$)			
	High education level	High personnel cost share	High ICT use	E-Commerce
	(1)	(2)	(3)	(4)
$T_t \times \text{COVID}_i$	-0.208^{***}	-0.216^{***}	-0.347^{***}	-0.331^{***}
	(0.072)	(0.079)	(0.095)	(0.100)
$T_t \times \text{COVID}_i \times$ Education	0.920^{***}			
	(0.217)			
$T_t \times \text{COVID}_i \times$ Personnel cost		0.281^{*}		
		(0.150)		
$T_t \times \text{COVID}_i \times$ ICT			0.396^{**}	
			(0.194)	
$T_t \times \text{COVID}_i \times$ E-Commerce				0.576^{**}
				(0.265)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	2,055	2,034	1,477	1,006
R^2	0.040	0.035	0.051	0.069
Adjusted R^2	0.005	-0.0001	0.006	0.009
Residual Std. Error	0.584 (df = 1982)	0.575 (df = 1961)	0.559 (df = 1409)	0.538 (df = 944)
F Statistic	1.155 (df = 72; 1982)	0.999 (df = 72; 1961)	1.135 (df = 67; 1409)	1.147 (df = 61; 944)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

The results in Table C.1 suggest that the investment plans of more innovative firms were indeed more resilient to the COVID shock than those of less innovative companies. Firms that employ many well-educated employees reduced their investment plans by 92.0 percentage points less than

[40] The education level of employees is high if, by the company's own account, the share of graduates (university or *Fachhochschule*) in total employment exceeded 50% at the end of 2018, and low otherwise.

[41] The personnel cost share is high if, by the company's own account, the share of personnel costs in turnover exceeded 50% in 2018, and low otherwise.

[42] The use of ICT is high if, by the company's own account, the share of employees who use a computer (e.g., PC, workstation, terminal, laptop), the internet, the intranet, and mobile broadband (3G, 4G) in their work averaged between 61-100% in 2018, and low otherwise.

[43] E-commerce is relevant if, by the company's own account, the firm made purchases or sales via the internet and the respective share of purchases/sales of goods and services exceeded 50% of total purchases/sales in 2018, and irrelevant otherwise.

firms with fewer qualified employees (Column 1). Comparably, firms with high personnel costs revised their investment plans by 28.1 percentage points less (Column 2). Companies with a high education level of their employees and high personnel expenditure are likely to be less bound to a specific location, which means that the majority of these companies were able to carry out their activities even during the lockdown and were thus less restricted by the pandemic and the policy measures. A corporate culture in which the use of information and communication technologies was already common practice before the pandemic (Column 3) further favors this hypothesis. Companies whose employees did not or could not use ICT in their day-to-day business cut their investments by 39.6 percentage points more. Besides, companies that were already using the internet as both a procurement and sales channel before the crisis (Column 4) revised their investment plans for the current year by significantly less. Companies without corresponding channels reduced their plans to invest by more than 50 percentage points more.

C.3 The heterogeneous responses across firms

C.3.1 Investment revisions by firm characteristics

Table C.2 is the regression counterpart of Figure 9, Panel A. It shows conditional treatment effects by sectors.

Table C.2: Conditional treatment effects, by sector (Panel A)

	Dependent variable:			
	Revisions in investment in equipment ($\Delta I_{i,t}$)			
	Construction	Services	Manufacturing	Life sciences
	(1)	(2)	(3)	(4)
T_t	0.020	−0.036	0.048	−0.147
	(0.129)	(0.033)	(0.038)	(0.133)
COVID_i	−0.019	0.012	0.039	−0.028
	(0.125)	(0.049)	(0.058)	(0.138)
$T_t \times \text{COVID}_i$	−0.221	−0.183***	−0.173**	0.350
	(0.187)	(0.067)	(0.080)	(0.228)
Industry fixed effects	No	No	No	No
Region fixed effects	Yes	Yes	Yes	Yes
Observations	194	1,755	1,247	107
R^2	0.031	0.017	0.030	0.160
Adjusted R^2	-0.028	0.011	0.021	0.062
Residual Std. Error	0.578 (df = 182)	0.599 (df = 1743)	0.581 (df = 1235)	0.469 (df = 95)
F Statistic	0.529 (df = 11; 182)	2.761*** (df = 11; 1743)	3.436*** (df = 11; 1235)	1.640* (df = 11; 95)
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure C.3 shows the sectoral decomposition per industry (NACE, Rev. 2 divisions) in greater detail.

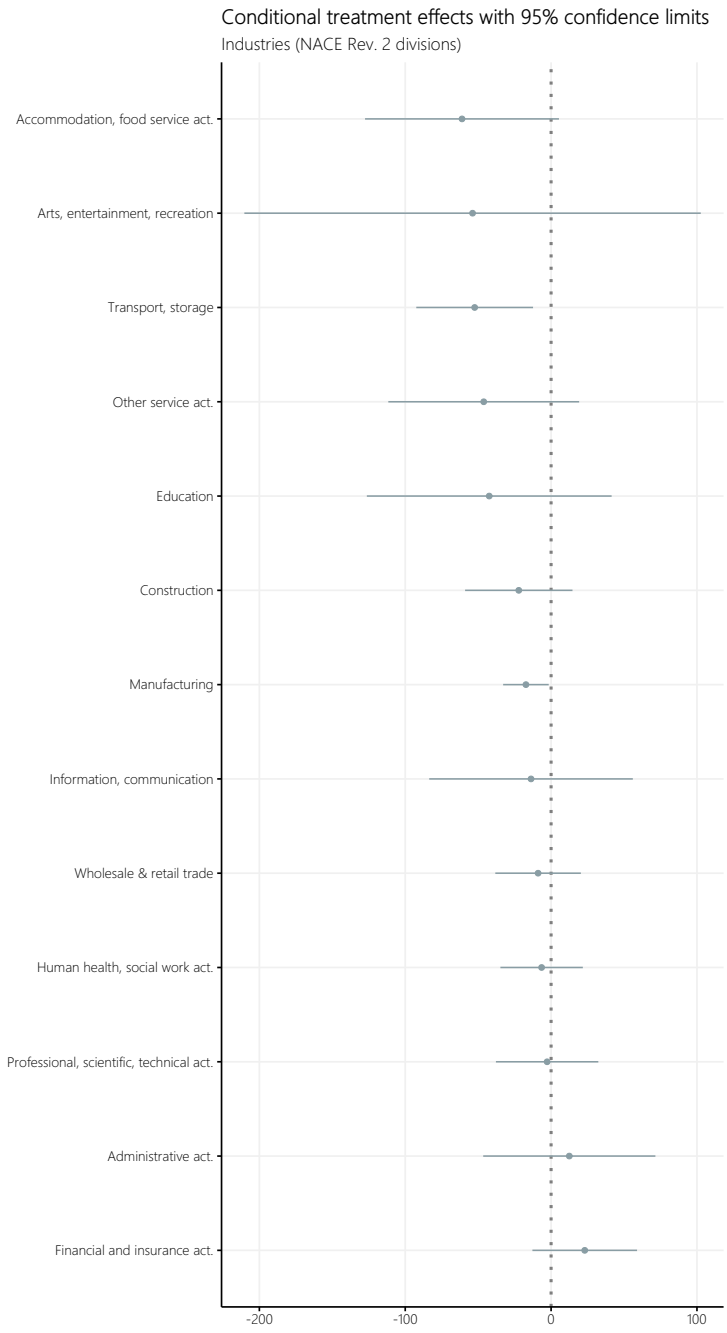

Figure C.3: Conditional treatment effects of the COVID-19 pandemic on firms' investment plans: difference-in-differences evidence. The figure shows regression results by industries (NACE Rev. 2 divisions).

Table C.3 is the regression counterpart of Figure 9, Panel B. It shows conditional treatment effects by firm size.

Table C.3: Conditional treatment effects, by firm size (Panel B)

	Dependent variable:	
	Revisions in investment in equipment ($\Delta I_{i,t}$)	
	SMEs	Large firms
	(1)	(2)
T_t	−0.001	0.0005
	(0.031)	(0.043)
COVID_i	0.028	−0.023
	(0.043)	(0.060)
$T_t \times \text{COVID}_i$	−0.215***	−0.021
	(0.059)	(0.082)
Industry fixed effects	Yes	Yes
Region fixed effects	Yes	Yes
Observations	2,458	860
R^2	0.051	0.062
Adjusted R^2	0.018	-0.008
Residual Std. Error	0.619 (df = 2375)	0.483 (df = 799)
F Statistic	1.564*** (df = 82; 2375)	0.883 (df = 60; 799)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table C.4 is the regression counterpart of Figure 9, Panel C. It shows conditional treatment effects by firm age.

Table C.4: Conditional treatment effects, by firm age (Panel C)

	Dependent variable:	
	Revisions in investment in equipment ($\Delta I_{i,t}$)	
	Old (> 70 years)	Young (< 70 years)
	(1)	(2)
T_t	0.106**	−0.035
	(0.047)	(0.043)
COVID_i	0.085	−0.030
	(0.071)	(0.064)
$T_t \times \text{COVID}_i$	−0.342***	−0.075
	(0.093)	(0.086)
Industry fixed effects	Yes	Yes
Region fixed effects	Yes	No
Observations	937	1,201
R^2	0.069	0.052
Adjusted R^2	0.011	0.001
Residual Std. Error	0.550 (df = 881)	0.602 (df = 1138)
F Statistic	1.192 (df = 55; 881)	1.016 (df = 62; 1138)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table C.5 is the regression counterpart of Figure 9, Panel D. It shows conditional treatment effects by export orientation.

Table C.5: Conditional treatment effects, by export (Panel D)

	Dependent variable:	
	Revisions in investment in equipment ($\Delta I_{i,t}$)	
	Exporter	Non-exporter
	(1)	(2)
T_t	0.049	−0.016
	(0.046)	(0.032)
COVID_i	0.064	0.035
	(0.068)	(0.042)
$T_t \times \text{COVID}_i$	−0.205**	−0.159***
	(0.090)	(0.058)
Industry fixed effects	Yes	Yes
Region fixed effects	Yes	No
Observations	1,062	2,031
R^2	0.058	0.052
Adjusted R^2	-0.004	0.014
Residual Std. Error	0.592 (df = 995)	0.579 (df = 1952)
F Statistic	0.930 (df = 66; 995)	1.380** (df = 78; 1952)
Note:		*p<0.1; **p<0.05; ***p<0.01

C.3.2 Investment revisions by pre-crisis conditions

Table C.6 is the regression counterpart of Figure 10. It shows conditional treatment effects by several pre-crisis conditions: firms' average business situation in 2019, their lack of financial resources to make investments, and their certainty about realizing their 2020 investment plans.

Table C.6: Effect of pre-crisis conditions on investment revisions

	Investment revisions ($\Delta I_{i,t}$)							
	Business situation		External funding		Internal funding		Uncertainty	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_t	−0.150	0.040	0.002	−0.045	0.012	0.081	0.006	0.098
	(0.109)	(0.053)	(0.027)	(0.107)	(0.028)	(0.072)	(0.025)	(0.086)
COVID_i	0.300**	−0.016	0.005	0.203*	0.010	0.117	0.022	−0.054
	(0.132)	(0.062)	(0.039)	(0.106)	(0.042)	(0.077)	(0.036)	(0.109)
$T_t \times \text{COVID}_i$	−0.427**	−0.147	−0.143**	−0.418**	−0.168**	−0.148	−0.191***	−0.037
	(0.188)	(0.111)	(0.061)	(0.165)	(0.067)	(0.117)	(0.055)	(0.147)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	No	No	Yes	No	No	No	No
Observations	244	835	2,528	224	2,253	510	2,852	426
R^2	0.230	0.083	0.039	0.236	0.041	0.131	0.037	0.157
Adjusted R^2	0.078	0.011	0.007	0.084	0.007	0.017	0.008	-0.006
Residual Std. Error	0.548 (df = 203)	0.596 (df = 773)	0.588 (df = 2445)	0.538 (df = 186)	0.590 (df = 2174)	0.565 (df = 450)	0.579 (df = 2768)	0.661 (df = 356)
F Statistic	1.514** (df = 40; 203)	1.149 (df = 61; 773)	1.207 (df = 82; 2445)	1.551** (df = 37; 186)	1.202 (df = 78; 2174)	1.145 (df = 59; 450)	1.291** (df = 83; 2768)	0.964 (df = 69; 356)
Note:								*p<0.1; **p<0.05; ***p<0.01
								Control variables are included but coefficients not reported.
								Cluster-robust standard errors in parenthesis.

C.3.3 Regional variation and exposure to the virus

Table C.7 is the regression counterpart of Figure 12. It shows conditional treatment effects by regions.

Table C.7: Conditional treatment effects, by region

	Dependent variable:						
	Revisions in investment in equipment ($\Delta I_{i,t}$)						
	Ticino	North-West Switzerland	Lake Geneva Region	Schweizer Mittelland	Zurich	Eastern Switzerland	Central Switzerland
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T_t	−0.234	0.214**	0.091	0.073	−0.024	−0.134**	−0.014
	(0.205)	(0.086)	(0.125)	(0.061)	(0.063)	(0.059)	(0.070)
COVID_i	0.107	0.203**	0.113	0.030	−0.032	−0.087	−0.005
	(0.205)	(0.094)	(0.141)	(0.078)	(0.083)	(0.075)	(0.089)
$T_t \times \text{COVID}_i$	−0.527**	−0.527***	−0.214	−0.174	−0.144	−0.034	−0.030
	(0.249)	(0.142)	(0.174)	(0.109)	(0.114)	(0.106)	(0.124)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	No	No	No	No	No	No	No
Observations	189	441	337	591	677	679	404
R^2	0.217	0.126	0.207	0.087	0.102	0.099	0.185
Adjusted R^2	0.032	0.012	0.068	-0.006	0.024	0.025	0.075
Residual Std. Error	0.673 (df = 152)	0.598 (df = 389)	0.611 (df = 286)	0.555 (df = 536)	0.604 (df = 622)	0.575 (df = 627)	0.504 (df = 355)
F Statistic	1.172 (df = 36; 152)	1.102 (df = 51; 389)	1.493** (df = 50; 286)	0.940 (df = 54; 536)	1.313* (df = 54; 622)	1.344* (df = 51; 627)	1.683*** (df = 48; 355)

Note: *p<0.1; **p<0.05; ***p<0.01

D Placebo and main sensitivity checks

This appendix refers to Section 6 in the main body of the paper. In this appendix, I present additional sensitivity checks that are not featured in the main body of the paper.

D.1 Percentage investment revisions

One primary concern with my main specification is that revisions from or to zero are discarded from the estimation sample because the log of zero is undefined. This table presents robustness checks in which I use an alternative outcome variable. In particular, instead of defining investment revisions as log differences, I calculate them as percentage changes. Although the point estimates differ, the results of this plausibility check are qualitatively consistent with the main results (see Table 3).

Table D.1: Robustness of baseline DD to percentage investment changes

	Investment revisions ($\Delta I_{i,t}$)		
	Equipment	Construction	R&D
	OLS	*OLS*	*OLS*
	(1)	(2)	(3)
T_t	3.838	14.068	18.883*
	(5.126)	(12.661)	(10.084)
COVID_i	−0.643	5.130	−2.330
	(3.404)	(6.291)	(5.833)
$T_t \times \text{COVID}_i$	−12.701*	−19.108	−6.899
	(7.087)	(15.354)	(14.091)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	3,482	2,043	1,108
R^2	0.028	0.035	0.087
Adjusted R^2	0.004	-0.004	0.023
Residual Std. Error	85.101 (df = 3396)	122.252 (df = 1963)	89.174 (df = 1034)
F Statistic	1.153 (df = 85; 3396)	0.891 (df = 79; 1963)	1.358** (df = 73; 1034)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

D.2 $\log(1 + x)$ transformation

One primary concern with my main specification is that revisions from or to zero are discarded from the estimation sample because the log of zero is undefined. This table presents robustness checks in which I use an alternative outcome variable. In particular, instead of defining investment revisions as log differences, I calculate them as $\log(1 + x)$ differences. Although the point estimates differ, the results of this plausibility check are qualitatively consistent with the main results (see Table 3).

Table D.2: Robustness of baseline DD to log(1+x) transformation

	Investment revisions ($\Delta I_{i,t}$)		
	Equipment	Construction	R&D
	OLS	*OLS*	*OLS*
	(1)	(2)	(3)
T_t	−0.144	−0.110	−0.049
	(0.166)	(0.208)	(0.160)
COVID_i	−0.008	0.212	0.054
	(0.130)	(0.171)	(0.132)
$T_t \times \text{COVID}_i$	−0.490**	−1.001***	−0.307
	(0.233)	(0.300)	(0.225)
Industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	4,225	4,121	3,573
R^2	0.026	0.028	0.027
Adjusted R^2	0.006	0.008	0.003
Residual Std. Error	3.521 (df = 4138)	4.485 (df = 4034)	3.102 (df = 3486)
F Statistic	1.306** (df = 86; 4138)	1.371** (df = 86; 4034)	1.120 (df = 86; 3486)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

D.3 Inclusion of paper survey respondents

This table presents robustness checks in which I include paper survey respondents into the estimation sample. In my main specification, I exclude all paper survey participants and only retain the answers of those participants who completed the survey online. At the cost of fewer observations, this allows me to determine the exact time of response, which proves necessary for identification as part of the empirical strategy (see Section 4). Although the point estimates differ, the results of this plausibility check are qualitatively consistent with the main results (see Table 3).

Table D.3: Robustness of baseline DD to the inclusion of paper survey respondents

	Investment revisions ($\Delta I_{i,t}$)			
	GFCF	Equipment	Construction	R&D
	OLS	*OLS*	*OLS*	*OLS*
	(1)	(2)	(3)	(4)
T_t	0.006	−0.005	0.004	0.056
	(0.040)	(0.032)	(0.055)	(0.055)
COVID_i	−0.015	0.011	−0.002	−0.011
	(0.027)	(0.021)	(0.035)	(0.041)
$T_t \times \text{COVID}_i$	−0.180***	−0.146***	−0.030	−0.057
	(0.052)	(0.044)	(0.071)	(0.076)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	4,872	4,393	2,314	1,225
R^2	0.028	0.026	0.026	0.080
Adjusted R^2	0.010	0.007	-0.009	0.021
Residual Std. Error	0.767 (df = 4786)	0.600 (df = 4307)	0.683 (df = 2233)	0.591 (df = 1150)
F Statistic	1.604*** (df = 85; 4786)	1.379** (df = 85; 4307)	0.737 (df = 80; 2233)	1.351** (df = 74; 1150)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

D.4 Exclusion of manual data plausibility checks

This table presents robustness checks in which I use data that were not subjected to manual plausibility checks. As part of the quality assurance of the data, all quantitative survey responses are usually subjected to plausibility checks. These involve rough checks to detect obvious errors in response behavior. For example, responses often vary in increments of thousands or millions across survey waves. Such inconsistencies can be easily identified and corrected thanks to the reporting and data structure. None of the main results critically depend on these corrections, but they tend to be more precisely estimated. As a robustness check, this table shows estimates of the main specification without these corrections and after excluding all outliers below the 5th and above the 95th percentiles. Although the point estimates differ, the results of this plausibility check are qualitatively consistent with the main results (see Table 3).

Table D.4: Robustness of baseline DD to exclusion of manual data plausibility checks

	Investment revisions ($\Delta I_{i,t}$)			
	GFCF	Equipment	Construction	R&D
	(1)	(2)	(3)	(4)
T_t	0.042	0.033	−0.028	0.039
	(0.031)	(0.034)	(0.050)	(0.071)
COVID_i	−0.023	−0.005	−0.041	−0.009
	(0.021)	(0.023)	(0.035)	(0.049)
$T_t \times \text{COVID}_i$	−0.109**	−0.143***	0.028	0.030
	(0.044)	(0.048)	(0.067)	(0.090)
Constant	0.026*	−0.009	0.029	−0.029
	(0.015)	(0.016)	(0.027)	(0.037)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	3,499	3,176	1,707	914
R^2	0.004	0.005	0.001	0.002
Adjusted R^2	0.003	0.004	-0.001	-0.001
Residual Std. Error	0.541 (df = 3495)	0.569 (df = 3172)	0.615 (df = 1703)	0.619 (df = 910)
F Statistic	4.774*** (df = 3; 3495)	5.557*** (df = 3; 3172)	0.522 (df = 3; 1703)	0.549 (df = 3; 910)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

D.5 Weighted regressions

This table presents robustness checks in which I weight each firm with the number of its employees (FTE). Although the point estimates differ, the results of this plausibility check are qualitatively

consistent with the main results (see Table 3).

Table D.5: Robustness of baseline DD to employee-weighted regressions

	Investment revisions ($\Delta I_{i,t}$)			
	GFCF	Equipment	Construction	R&D
	OLS	*OLS*	*OLS*	*OLS*
	(1)	(2)	(3)	(4)
T_t	0.062	0.030	0.054	0.082
	(0.047)	(0.041)	(0.050)	(0.061)
COVID_i	−0.009	−0.058	0.075	0.084
	(0.051)	(0.047)	(0.089)	(0.065)
$T_t \times \text{COVID}_i$	−0.159*	−0.014	−0.092	−0.111
	(0.084)	(0.083)	(0.106)	(0.084)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	3,664	3,318	1,788	963
R^2	0.082	0.075	0.067	0.216
Adjusted R^2	0.061	0.052	0.026	0.157
Residual Std. Error	10.278 (df = 3580)	8.450 (df = 3234)	11.661 (df = 1712)	6.424 (df = 894)
F Statistic	3.850*** (df = 83; 3580)	3.173*** (df = 83; 3234)	1.642*** (df = 75; 1712)	3.630*** (df = 68; 894)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

D.6 Falsification test

This table presents the results of a falsification test. In a causal analysis, it is common to test a very unlikely claim to be causally related to the intervention. In my case, I test whether firms' investment revisions for 2019 – rather than 2020 – are influenced by the COVID-19 pandemic. Investment in 2019 should not have been affected by the pandemic if it were to be truly exogenous. My model does not explain investment revisions for 2019. This adds a layer of confidence to my results, even if falsification analysis is not a perfect tool for validating causality.

Table D.6: Robustness of baseline DD to the falsification test

	Investment revisions ($\Delta I_{i,t}$)			
	GFCF	Equipment	Construction	R&D
	(1)	(2)	(3)	(4)
T_t	−0.059	0.017	0.023	−0.016
	(0.050)	(0.035)	(0.060)	(0.062)
COVID_i	−0.023	0.012	−0.025	−0.045
	(0.034)	(0.027)	(0.044)	(0.049)
$T_t \times \text{COVID}_i$	−0.014	−0.068	0.004	0.058
	(0.063)	(0.050)	(0.077)	(0.083)
Industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	2,783	2,528	1,354	679
R^2	0.030	0.031	0.043	0.076
Adjusted R^2	0.001	-0.001	-0.011	-0.017
Residual Std. Error	0.733 (df = 2700)	0.559 (df = 2445)	0.639 (df = 1280)	0.518 (df = 616)
F Statistic	1.021 (df = 82; 2700)	0.969 (df = 82; 2445)	0.793 (df = 73; 1280)	0.812 (df = 62; 616)

Note: *p<0.1; **p<0.05; ***p<0.01
Control variables are included but coefficients not reported.
Cluster-robust standard errors in parenthesis.

List of abbreviations

BCS	Business and Consumer Surveys
CH	Confoederatio Helvetica
CHF	Swiss Franc
COVID-19	Coronavirus disease 2019
DD	Difference-in-differences
DDD	Difference-in-differences-in-differences
DIY	Do it yourself
EC	European Commission
ETH	Eidgenössische Technische Hochschule
FTE	Full time equivalent
GDP	Gross domestic product
GFCF	Gross fixed capital formation
ICT	Information and communication technology
IT	Information technology
KOF	Swiss Economic Institute (Konjunkturforschungsstelle)
NACE	Nomenclature générale des activités économiques dans les Communautés Européennes
NUTS	Nomenclature des unités territoriales statistiques
O*NET	Occupational Information Network
PC	Personal computer
R&D	Research and development
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SME	Small and medium-sized enterprise
UK	United Kingdom
US	United States of America
VSMI	Volatility Index on the Swiss Market Index