Credit Demand and Financial Constraints in Non-Financial Recessions: Evidence from the COVID-19 Pandemic*

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Abstract

We use a comprehensive Swedish credit registry together with data on government subsidies for short-term work to study how the COVID-19 recession affected corporate credit demand and financial constraints. We find that firms responded to the COVID-19 shock by scaling down production, which reduced working-capital financing needs and thereby credit demand. As credit supply meanwhile remained stable and financial accelerator effects were weak, the financial constraints of non-financial firms were relaxed during the recession. The short-term work subsidies played an important role in this outcome, as they enabled firms to swiftly reduce labor input following the onset of the recession.

Keywords: Financial constraints; credit demand; working capital; credit lines; COVID-19.

JEL: D22; D24; G21; G32; H32.

*The opinions expressed in this article are the sole responsibility of the authors and should not be interpreted as reflecting the views of Sveriges Riksbank.

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1 Introduction

What happens to corporate credit demand and financial constraints in non-financial recessions?[1] We study this question in the context of the COVID-19 recession using a dataset comprising every corporate loan extended by Swedish banks, every debt security issued by Swedish non-financial firms, as well as comprehensive firm-level data on government subsidies for short-term work. Our analysis shows that firms responded to the decline in output demand induced by the COVID-19 shock by scaling down production, which reduced working-capital financing needs and thereby credit demand. As the supply of credit meanwhile remained stable and financial accelerator effects were weak, the financial constraints of non-financial firms were *relaxed* as a consequence of the recession.

We reach these conclusions on the basis of the following empirical findings. Firstly, we show that firms more adversely affected by the COVID-19 shock—measured by the decline in value added in the industry in which a firm operates—significantly reduced credit line utilization relative to less affected firms during the recession. This finding is robust to controlling for firm size, bond market access, location and main-bank fixed effects, probability of default, and unused credit-line capacity at the outset of the recession. Hence, the negative correlation between exposure to the COVID-19 shock and credit line utilization rates cannot be explained by more exposed firms being less creditworthy, having exhausted their credit lines prior to the recession, or being clients of specific banks.

Secondly, we show that the decline in utilization rates for more exposed firms were not caused by efforts on the part of banks to restrict their ability to access their credit lines. On the contrary, we estimate the relationship between firms' COVID-19 exposure and the probability that their credit lines were withdrawn during the recession to be precisely zero; the same holds when we consider changes in committed amounts on credit lines as dependent variable. Hence, banks were not more prone to either terminate credit lines or reduce their limits for firms more exposed to the COVID-19 shock. Our results also speak against the possibility that banks used more informal

[1] We define non-financial recessions as recessions in which shocks emanating from financial markets do not play a central role. Hence, the COVID-19 recession is a typical non-financial recession, whereas the Great Recession is a recent example of a financial recession.

means, such as explicit or implicit threats, to discourage firms from using their credit lines: had this been the case, the relationship between COVID-19 exposure and credit line utilization would have been stronger for firms more likely to be subject to such threats on account of weak bargaining positions—for example small, young, and less creditworthy firms—but we find no evidence of cross-sectional heterogeneities in these dimensions. Taken together, these results strongly suggest that the cause of the fall in utilization rates was a decline in credit demand.

Thirdly, we find that firms more exposed to the COVID-19 shock were significantly more likely to reduce labor input by furloughing workers as part of the the government's short-term work program. The magnitude of the relationship is substantial: the most affected firms were over 56 percentage points more likely to participate in the program than the least affected firms. Importantly, there is no evidence that financially weaker firms were more prone to participate, which suggests that cost-saving capacity reductions is the optimal response to declines in output demand even for financially unconstrained firms. We then use an instrumental-variables approach to document that program participants significantly reduced credit line utilization relative to non-participants; this shows that the decline in credit demand occurred because firms responded to the COVID-19 shock by scaling down production. Moreover, according to Banerjee and Duflo's (2014) definition of credit constraints—which states that a firm is not credit constrained if it uses subsidized credit to repay non-subsidized credit—this implies that firms' financial constraints on average were relaxed during the recession.[2]

Finally, given our claim that credit demand declined, what explains the sharp *increase* in bank lending to non-financial firms that occurred early in the recession? We show that it was the result of substitution of bank loans for market funding in response to the turmoil that bond markets were undergoing at the time. That is, firms that would normally have issued bonds or commercial paper instead went to the banks to raise funds in the form of loans; hence, the increase in bank loans for firms with bond market access was almost fully offset by a corresponding decline in their market funding and does not indicate an increase in overall credit demand.

The findings presented in this paper run counter to an almost universally shared

[2]While Banerjee and Duflo's (2014) definition concerns firms' behavior when receiving subsidized *credit*, its logic carries over to cases in which firms repay non-subsidized credit upon receipt of grants or forgivable loans.

expectation at the outset of the COVID-19 recession, according to which corporate credit demand would increase sharply, driven by firms seeking to curb revenue declines through increased borrowing. This, in turn, would worsen firms' financial constraints and exacerbate the economic downturn, unless measures were taken to ensure that the surge in credit demand could be met. Consequently, policymakers around the world implemented large support programs aimed at alleviating firms' financial constraints by means of subsidized credit.

For example, the Federal Reserve launched the Main Street Lending Program (MSLP) in May—a $600 billion lending facility aimed at small and medium-sized businesses that were in sound financial condition before the onset of the pandemic—arguing that "the disruptions to economic activity [...] have heightened the needs for businesses to obtain financing in order to manage cash flows and sustain themselves until economic conditions normalize." Yet in September, four months after the start of the program, the outstanding volume of MSLP loans amounted to only $2 billion, or 0.3 percent of the total lending capacity. Similar programs undertaken by other governments and central banks have typically had similar effects—for example, the volume of loans issued within the most closely corresponding Swedish program amounted to SEK 2.2 billion, or 1.5 percent of the approved program limit, as of September. Our analysis suggests that an important reason for these outcomes is that the anticipated increase in corporate credit demand never materialized.[3]

Against the background of widespread expectations of increases in corporate credit demand, how should the decline in credit demand be understood? We argue that working capital is the missing link. Working capital consists of assets generated by the delay between a firm's outlays for variable inputs—labor and intermediate goods and services—and the receipt of revenues for sold output. Because firms typically pay for inputs before they are paid for their output, the size of a firm's working capital is increasing in the amount of output it produces. Hence, a negative shock to the demand for a firm's output, to which the firm optimally responds by scaling down production, reduces the size of its working capital and thereby its financing needs (see Jermann

[3]This does not rule out that there existed other reasons for why many extraordinary loan programs had low take-up rates. For example, Hanson et al. (2020) note several problems in the design of the MSLP that may have reduced take-up. Our argument is that even optimally designed programs likely would had seen low take-up rates, since the necessary demand was lacking.

and Quadrini, 2012, for a macroeconomic model incorporating these features). Importantly, this is true whether or not the firm is financially constrained, which means that one should not expect firms to be willing to use internal cash or raise external finance, even at favorable terms, to finance idle input factors that could otherwise be laid off.

In practice, however, firms may not be able to adjust inputs to optimal levels in the short run; for example, labor laws may prevent firms from laying off workers on short notice, or firms may have entered into long-term contracts with suppliers that commit them to a given expenditure level. Moreover, input adjustment costs may make it optimal for firms to maintain spending in the face of temporary declines in output demand—the phenomenon of labor hoarding is one example of this. Hence, while the primary pressure on a firm facing a sudden reduction in output demand is to cut costs—which reduces working-capital funding needs—there exists countervailing factors that, if sufficiently strong, may force firms to borrow to bridge revenue declines. Our results, then, imply that such factors were not strong enough to offset the effects of firms' cost-cutting efforts during the COVID-19 recession; hence, working-capital financing needs, and thereby credit demand, declined.

As government subsidies for short-term work appear to have played an important role in the outcomes documented in this paper, it is fair to ask whether our results have relevance beyond the present setting. We think they do. Firstly, most developed countries implemented some form of short-term work subsidy or other wage-compensation scheme during the COVID-19 recession.[4] The presence of short-term work subsidies in Sweden therefore make our findings more, not less, relevant for understanding the behavior of firms in other countries during the COVID-19 recession. Secondly, as our analysis sheds light on the various factors that determine firms' credit demand and financial constraints in non-financial recessions, they are also useful for thinking about recessions in which short-term work subsidies are not in place. In particular, our results imply that one should not expect credit demand to increase in recessions unless (i) firms cannot swiftly reduce labor input because of employment-protection laws, or (ii) labor-hoarding motives are strong. Thus, in the absence of short-term work sub-

[4]See OECD (2020) for an overview of short-term work and other wage-compensation programs during the COVID-19 recession. While these programs often differed in their design and implementation—for example, the Paycheck Protection Program launched by the U.S. government was, unlike most corresponding European programs, administered via banks in the form of forgivable loans—their fundamental economic purposes and effects were mostly the same.

sidies, our findings are likely to be more relevant for a country like the United States, where at-will employment is common, than for Sweden, where the laying off of employees is typically a slower and more cumbersome process.

This paper adds to a growing literature studying bank lending and financial constraints in the COVID-19 recession (see, e.g., Greenwald, Krainer and Paul, 2020; Balduzzi et al., 2020; Li, Strahan and Zhang, 2020; and Beck and Keil, 2021). The paper most closely related to ours is the contemporaneous work by Chodorow-Reich et al. (2020), which studies bank liquidity provision through credit lines in the United States during the COVID-19 recession. A closer comparison of our findings with theirs is therefore instructive. Firstly, like us Chodorow-Reich et al. find that banks' total corporate lending increased sharply following the onset of the COVID-19 recession. Similarly, they find that the increase was entirely driven by lending to large firms, whereas total lending to SMEs responded very little early in the the recession. Unlike us, however, they find that the increase in lending to large firms cannot be fully explained by substitution of bank loans for market funding.

Secondly, whereas we find a negative correlation between COVID-19 exposure and credit line utilization rates in all firm-size classes, Chodorow-Reich et al. find a positive correlation among large firms and zero correlation among SMEs, which they interpret as evidence of an inability of small firms to access their credit lines in bad times. They propose precautionary liqudity hoarding as the main explanation for the higher drawdowns among large firms with higher COVID-19 exposure, which agrees with the findings in Granja et al. (2020) and Acharya and Steffen (2020). Moreover, Chodorow-Reich et al. find that the increase in drawdowns occurred in March, whereas credit line borrowing, as well as total loans, actually decreased in all firm-size classes between March and June—the quarter in which the massive decline in GDP occurred—which is consistent with our findings and supports the precautionary-liquidity interpretation. Hence, the main difference between Sweden and the United States in this regard appears to be the strength of the precautionary motive during the COVID-19 recession.[5]

Thirdly, Chodorow-Reich et al. find that firms reduced credit line borrowing upon

[5]By way of anecdotal evidence, bankers have reported to us that some large Swedish firms also drew down credit lines and parked the funds in bank accounts early in the recession. However, this phenomenon was evidently not widespread enough to noticeably affect credit aggregates or cross-sectional patterns in credit line borrowing.

receiving PPP funds, just like we show that Swedish firms did when receiving short-term work subsidies. Our interpretations of the respective findings differ, however: whereas Chodorow-Reich et al. posit that firms sought subsidized public credit when they were prevented from accessing their private credit lines, we interpret firms' repayment of private credit upon receipt of public subsidies as evidence of non-binding financial constraints, following Banerjee and Duflo (2014). In sum, the comparison points to many similarities in results, but also several apparent discrepancies. A further exploration of the extent to which institutional differences can account for the latter would be interesting, but is beyond the scope of the present paper.

More generally, a large literature studies the role of credit lines in firms' liquidity management, and in particular, the question of whether or not credit lines provide liquidity insurance to firms that are hit by adverse liquidity shocks (see, e.g., Sufi, 2009; Nikolov, Schmid and Steri, 2019; and Santos and Viswanathan, 2020). Our findings suggest that this is not the primary issue when it comes to understanding firms' behavior in the COVID-19 recession. This is because the current recession was not caused by a liquidity shock, but by a real shock with enormous implications for firms' optimal production plans; hence, credit-line access has at most been an issue for firms unable to undertake capacity-reduction measures. A clear distinction between liquidity shocks and real shocks—and their differing implications for credit demand and financial constraints—is thus central to understand firms' responses to the COVID-19 shock.

Apart from this, our paper contributes to the literature studying firm behavior more broadly in the COVID-19 recession (e.g., Bartik et al., 2020; Bartlett and Morse, 2020; Kim, Parker and Schoar, 2020). We also add to the literature on short-term work subsidies in recessions. Our focus is quite different from previous work in this area, though, in that we consider the implications of short-term work subsidies for firms' financial constraints, whereas existing papers mostly study their costs and benefits when it comes to saving jobs in recessions (e.g., Giupponi and Landais, 2018, and Cahuc, Kramarz and Nevoux, 2018).

The rest of this paper is structured as follows. Section 2 describes our data resources and outlines the empirical framework. Section 3 presents the results of the empirical analysis. Section 4 concludes.

2 Data and Empirical Approach

2.1 Data sources

Our empirical analysis is based on three data sets, which we merge unambiguously by means of the unique identifier (*organisationsnummer*) belonging to every Swedish firm. Taken together, the three data sets provide a comprehensive and granular account of Swedish firms' bank loans, market funding, and use of short-term work subsidies, and thus enable us to describe firms' responses to the COVID-19 shock in detail.

The first data set is the credit register KRITA, collected and maintained by Statistics Sweden on behalf of Sveriges Riksbank, the central bank of Sweden. KRITA is the Swedish part of ECSB's pan-European credit register AnaCredit—which it follows closely in terms of data structure and variable definitions—and contains detailed monthly data on the universe of loans extended by 18 Swedish monetary financial institutions to Swedish companies. The reporting institutions jointly account for 95 percent of the outstanding volume of bank loans to Swedish companies, which makes KRITA close to a census of corporate loans in Sweden.[6] For each loan reported in KRITA, we observe a broad set of loan characteristics—such as on- and off-balance amounts, loan maturity, interest rate, loan type, loan purpose, collateral type and value, and amortization scheme—as well as information about the borrowing firm, including its size, industry, location, legal form, and group affiliation. KRITA data are available from December 2018 and onwards, but some variables used in our empirical analysis do not have complete coverage across reporting institutions in the earliest months of the database, so to ensure full coverage we set October 2019 as the starting point of our sample.

The second data set is the debt securities database SVDB, also collected and maintained by Statistics Sweden on behalf of Sveriges Riksbank. SVDB contains detailed monthly data on all debt securities issued by Swedish companies, both domestically and abroad. More specifically, SVDB is a census of all debt securities issued in Sweden, and while the aim of Statistics Sweden is full coverage also of securities issued

[6] The reporting requirement for monetary financial institutions is defined to make the reporting institutions account for 95 percent of Swedish corporate lending. More specifically, the requirement is determined by ranking lenders according to size, from largest to smallest, and then moving down the list until the included lenders jointly account for 95 percent of the total. Hence, the lenders not included in KRITA are mostly local savings banks.

by Swedish companies in other countries, the latter part of the data collection is not registry-based and may thus fail to include some securities. For each security, we observe the identity of the emitting company and the outstanding amount, as well as a number of contract characteristics, including the currency in which the debt is denominated and the initial and remaining maturity.

Finally, we use a confidential firm-level data set on government subsidies to firms that implemented short-term work schemes during the COVID-19 pandemic, provided to us by the Swedish Agency for Economic and Regional Growth, the agency responsible for administrating the program. These data comprise information on all applications for short-term work subsidies received by the agency, including the identity of the applying firm, the number of employees covered by the application, the amount applied for, and the agency's decision about whether or not to grant the application.

2.2 Sample properties

Our target population is the universe of Swedish non-financial incorporated firms (*aktiebolag*), except for firms whose ultimate owner is a public-sector entity. We construct our loan-level sample based on all firms belonging to the target population who has a loan in KRITA with a committed amount of at least 25,000 SEK (approximately 2,600 USD at the exchange rate prevailing at the outset of the pandemic). We include four types of loans—revolving credit lines, non-revolving credit lines, and term loans with short and long maturities, respectively—and when we speak of 'bank loans' in what follows, we refer to these four loan types taken together.[7] We exclude loans with a committed amount of less than 25,000 SEK. The resulting sample of bank loans consists of around 2.4 million loan-month observations, corresponding to 277,668 unique loans extended by eleven lenders to 117,406 borrowers.[8] The average total volume of committed and outstanding loans amounts to 1,690 and 1,286 billion SEK, respectively, over the sample period October 2019 to September 2020.

[7]We split term loans into short- and long-maturity loans based on initial maturity, with one year as cutoff. The most important loan types omitted from the sample are financial leases and factoring. Note, however, that we do not drop credit lines and term loans secured by receivables from the sample—what we drop are exposures arising from direct purchases of invoices on the part of banks.

[8]The reduction from 18 lenders in the KRITA database to eleven lenders in our sample occurs for two reasons. Firstly, one lender is the public entity Kommuninvest, which only lends to companies owned by municipalities and counties, which we drop from the sample. Secondly, we merge lenders belonging to the same banking group, which further reduces the number of lenders from 17 to 11.

The debt securities sample comprises 5,181 debt instruments issued by 325 borrowers and a total of 3,516 borrower-month observations over the sample period October 2019 to September 2020. 158 of the 325 bond issuers in our sample have a match in the loan data, whereas the remaining 167 issuers relied on bond markets only during our sample period.[9] The average volume of outstanding debt securities issued by the sample firms amounts to 1,075 billion SEK over the sample period.

The data on short-term work subsidies, finally, consists of 84,417 applications, submitted by 73,225 firms between April 2020 and November 2020. 83 percent of the applications were granted and 17 percent rejected; about half of the rejections were due to insufficient information provided by the borrower and the other half due to the applicant not fulfilling the requirements for the program. The granted applications concern a total of 582,657 employees—roughly ten percent of the Swedish labor force—and 31.6 billion SEK. The smallest granted application covers one employee and less than 1,000 SEK, while the largest covers almost 15,000 employees and around one billion SEK.

2.3 Empirical approach

The purpose of the empirical analysis is to estimate how non-financial firms' demand for credit, and in particular credit for working-capital purposes, is affected by sudden declines in output demand. The COVID-19 recession is an ideal setting for studying this question, since it was caused by a shock that (i) generated substantial cross-sectional variation in output demand across firms and industries, (ii) was almost completely unexpected, (iii) is plausibly orthogonal to the pre-pandemic trends of firms and industries, and (iv) has not been accompanied by distress in the banking sector. The stability of the banking system during the recession is particularly important, since it mitigates concerns that credit-supply effects may confound our results.[10]

We focus on credit line borrowing as the main outcome of interest. The reason for this is twofold. Firstly, credit lines are the main source of external funding for working-capital purposes, and has been the focus of the recent literature studying the role of

[9]Thanks to the unique identifier belonging to each Swedish firm, we can be certain that any firm in SVDB that fails to match with a firm in the loan-level data has bonds but not bank loans outstanding, and vice versa. Note, however, that bank loans refer to the loan types included in our sample, which implies that bond issuers may still have other types of loans.

[10]For example, Chodorow-Reich and Falato (2021) show that banks in poor financial health are significantly more inclined to demand prompt repayment of loans after covenant violations.

Table 1: Bank loans by loan type and firm size

	Firm-level shares		Aggregate shares			
	Total	Drawn	Total	Drawn	No. obs.	No. firms
A. Micro firms						
Credit lines (revolving)	0.60	0.35	0.28	0.12	603,581	52,201
Credit lines (non-revolving)	0.01	0.01	0.02	0.01	8,444	728
Term loans ($<$ 1 year)	0.02	0.03	0.04	0.05	25,024	2,749
Term loans ($\geq$ 1 year)	0.37	0.61	0.66	0.82	592,953	35,273
B. Small firms						
Credit lines (revolving)	0.52	0.25	0.23	0.10	175,577	14,181
Credit lines (non-revolving)	0.01	0.02	0.02	0.02	9,906	536
Term loans ($<$ 1 year)	0.04	0.06	0.07	0.08	19,708	1,635
Term loans ($\geq$ 1 year)	0.43	0.68	0.68	0.80	384,242	11,893
C. Medium-sized firms						
Credit lines (revolving)	0.43	0.22	0.20	0.10	57,974	4,314
Credit lines (non-revolving)	0.02	0.02	0.05	0.03	6,293	295
Term loans ($<$ 1 year)	0.05	0.07	0.08	0.09	14,288	858
Term loans ($\geq$ 1 year)	0.50	0.69	0.67	0.78	198,078	4,881
D. Large firms						
Credit lines (revolving)	0.24	0.13	0.27	0.07	55,365	2,323
Credit lines (non-revolving)	0.03	0.03	0.05	0.04	9,966	376
Term loans ($<$ 1 year)	0.08	0.09	0.09	0.12	23,623	1,064
Term loans ($\geq$ 1 year)	0.66	0.75	0.58	0.77	204,541	5,572

This table shows the share of each loan type in total loans, reported separately for each firm-size class. 'Firm-level shares' are cross-sectional mean shares, whereas 'aggregate shares' refer to the share of each loan type in the total amount of lending to firms in given size class. The number of observations and firms are the number of loan-months and unique firms, respectively, in each loan-type category; hence, a firm is counted several times—i.e., is included in the count on several rows—if it has loans of different kinds.

financial constraints in the COVID-19 recession (see, e.g., Chodorow-Reich et al., 2020, and Greenwald, Krainer and Paul, 2020). The importance of credit lines for the financing of Swedish non-financial firms—in particular for smaller firms and when it comes to short-term funding—is evident in Table 1, which shows the share of different types of loans in total bank borrowing for the firms in our data, reported separately for each firm-size class. For example, revolving credit lines account for 60 percent of the amount of committed bank lending to the average micro-sized firm, and while the cross-sectional mean share of revolving credit lines decreases monotonically over size classes, it is the second largest loan type even for large firms (the only larger loan type being term loans with maturities longer than one year, which for large firms predominantly consists of loans secured by residential and commercial real estate).

Secondly, since a credit line gives the borrower the right to freely draw credit up to a pre-specified limit, changes in its utilization rate provide a direct indication of changes in the borrower's demand for credit. It should be noted, however, that several papers have argued that banks may prevent firms from tapping their credit lines when faced with adverse liquidity shocks, which could invalidate the interpretation of utilization rates as a measure of credit demand (Sufi, 2009; Chodorow-Reich et al., 2020). The possibility for banks to restrict access can be ensured either by extending credit lines with short maturities, or by using loan covenants which, when violated, allow the lender to demand prompt repayment. Indeed, Sufi (2009) has documented that banks tend to reduce the committed amounts of credit lines following covenant violations. To ensure that our results are not driven by efforts on the part of the banks to restrict firms' ability to draw on their credit lines, we include committed amounts and an indicator for terminated credit lines in the set of outcome variables.

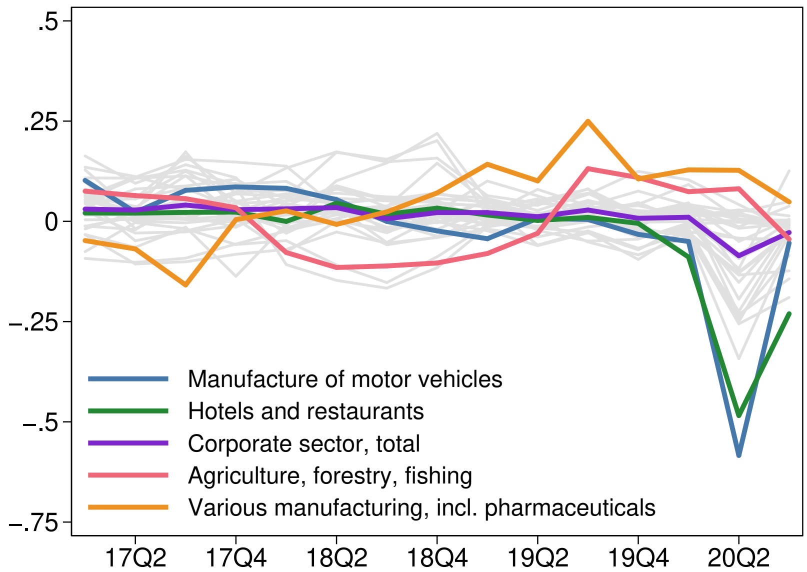
2.4 Econometric models

Our baseline specification is a difference-in-differences model estimated by means of the following first-differenced regression equation:

$$\Delta Y_{i,t} = \alpha + \beta \cdot Exposure_{i(j)} + \gamma \cdot \mathbf{X_{i,t-4}} + \varepsilon_{i,t}, \tag{1}$$

where $\Delta Y_{i,t}$ is the change in outcome Y for firm i between periods $t-4$ and t; $Exposure_{i(j)}$ is a measure of industry j's exposure to the COVID-19 shock; and $\mathbf{X_{i,t-4}}$ is a vector of control variables measured for firm i in period $t-4$. Periods $t-4$ and t correspond to February and June 2020, respectively, which mark the beginning and end of the first phase of the recession caused by the pandemic. Standard errors are cluster-adjusted at the level of two-digit SNI/NACE industries to account for the fact

Figure 1: Sector-level GDP growth (quarterly, year-on-year)



that treatment is assigned at the level of industries (Abadie et al., 2017). Note that the unit of observation in (1) is the firm; hence, we aggregate all loan-level variables to the firm-period level, as described below.

The industry-level exposure measure, $Exposure_{i(j)}$, is constructed as follows. Firstly, we compute the quarterly year-on-year growth in industry j's value added between 2019Q2 and 2020Q2.[11] We then subtract the average of each industry's corresponding Q2–Q2 growth rates between 2015 and 2019 to remove any pre-pandemic trends in industry growth. Finally, we standardize the measure and reverse its sign, so that larger values correspond to larger declines in an industry's value added during the pandemic. The removal of pre-pandemic industry trends from the exposure measure follows Chodorow-Reich et al. (2020). In practice, the adjustment makes little difference, as the correlation between the adjusted and unadjusted growth rates is close to 0.99. The almost perfect correlation between the two measures reflects the fact that the COVID-19 shock is orthogonal to pre-pandemic trends in industry growth and of

[11] The industries are defined based on the most disaggregated industry classification for which quarterly value-added figures are published in the Swedish national accounts. This classification is based on two-digit SNI/NACE codes, but in many cases several two-digit industries are combined into one, which results in a total of 33 different industries. The same industry classification is the basis of Figure 1.

a magnitude that dwarfs the shocks that hit industries in more normal times. The series of quarterly sector-level GDP growth over the period 2017Q1–2020Q3 is plotted in Figure 1.

The set of controls, $\mathbf{X_{i,t-4}}$, consists of the following variables. The first is a dummy indicating whether or not the firm has access to bond markets; a firm is defined as having bond market access if the firm itself, its parent company, or any other firm belonging to the same corporate group had bonds outstanding at some point between 2017 and 2020. The second is a firm-size dummy, equal to one if the firm is an SME, and zero otherwise.[12] The third control variable is the utilization rate on the firm's credit lines in February, computed as the weighted average utilization rate across all the firm's credit lines, with weights given by the committed amount on each facility. Fourthly, we include the the probability of default (PD) assigned to the firm by UC AB, the leading Swedish credit bureau.[13] Finally, we include main-bank and county fixed effects, respectively; the firm's main bank is defined as the bank with the largest amount of committed lending to the firm as of February, while the county is defined based on the location of the firm's headquarters.

To explore cross-sectional heterogeneities in the effect of the COVID-19 shock on the outcomes of interest, we use the following variation on the baseline specification:

$$\Delta Y_{i,t} = \alpha + \beta_1 \cdot Exposure_{i(j)} + \beta_2 \cdot T_i + \beta_3 \cdot Exposure_{i(j)} \cdot T_i + \gamma \cdot \mathbf{X_{i,t-4}} + \varepsilon_{i,t}, \qquad (2)$$

where T_i is a sample-split variable that takes the value one if firm i belongs to a given category of firms, and zero otherwise. The sample-split variables will be introduced along with the results of the cross-sectional heterogeneity analysis in section 3.3.

[12]The firm-size classification in KRITA is based on the European Commission's definition, according to which SMEs are "enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million." Since this definition occasionally generates strongly misleading size classifications—for example, some firms classified as micro-sized in KRITA have loans amounting to several billion SEK—we apply a reclassification scheme, the details of which are provided upon request.

[13]The credit bureau estimates firm-specific PDs using a scoring model and granular input data from four main sources: balance sheet and profit-and-loss data from firms' financial accounts; data on injunctions for settlement of payments that firms have defaulted on; information on the private financial status of firms' board members; and demographic information, such as age and industry. The PDs are consistent and universal appraisals of Swedish firms' one-year failure risks and widely used to evaluate counterparty risks in inter-firm trade, as well as by Swedish banks' when screening and monitoring customers.

2.5 Dependent variables

Our first dependent variable is the change in the utilization rate on a firm's revolving credit lines between February and June:

$$\Delta CL\ drawn_{i,t} = \frac{CL\ drawn_{i,t}}{CL\ committed_{i,t}} - \frac{CL\ drawn_{i,t-4}}{CL\ committed_{i,t-4}}, \tag{3}$$

where $CL\ drawn_{i,t}$ and $CL\ committed_{i,t}$ are the sums of all drawn and committed amounts, respectively, across firm i's revolving credit lines in period t. The change in the utilization rate on a firm's credit lines is, as discussed above, a proxy for the change in its credit demand, and in particular its demand for credit for working-capital purposes. Note that this variable can only be computed for firms having credit lines with non-zero committed amounts in both $t-4$ and t, i.e., in both February and June.

The second dependent variable is a dummy equal to one if a firm's revolving credit lines were terminated during the COVID-19 recession, and zero otherwise; more specifically, the dummy is equal to one if a firm has a revolving credit line with non-negative committed amount in period $t-4$, but not in period t. The third dependent variable is the change in the committed amount on a firm's revolving credit lines, computed using the symmetric growth rate formula:

$$\Delta CL\ committed_{i,t} = \frac{CL\ committed_{i,t} - CL\ committed_{i,t-4}}{0.5 \cdot (CL\ committed_{i,t} + CL\ committed_{i,t-4})}, \tag{4}$$

where $CL\ committed_{i,t}$ is defined as before. These dependent variables are, as mentioned above, included to assess whether banks actively tried to restrict credit line access for firms that were particularly exposed to the COVID-19 shock.

Our next set of outcome variables consists of changes in the quantity of various measures of credit, again computed using the symmetric growth rate formula:

$$\Delta X_{i,t} = \frac{X_{i,t} - X_{i,t-4}}{0.5 \cdot (X_{i,t} + X_{i,t-4})}, \tag{5}$$

where $X_{i,t}$ is the sum of all credit of type X extended to firm i in period t. We set $\Delta X_{i,t}$ to zero in case X_i is zero in both $t-4$ and t. The credit measures considered are: drawn amounts on revolving credit lines; drawn amounts on revolving credit lines plus term loans with short maturities (working capital loans); drawn amounts on non-revolving credit lines plus term loans with long maturities (investment loans); working capital loans plus investment loans (total loans); and bank loans plus market funding (total credit). These outcome variables are included to provide a more complete picture of firms' borrowing patterns in the COVID-19 recession; in particular, they allow us to assess whether changes in credit line borrowing patterns were offset by countervailing changes in other kinds of borrowing.

The final dependent variables is a dummy equal to one if a firm received government subsidies for short-term work at some point between April and June, and zero otherwise. The short-term work dummy thus captures whether a firm responded to the COVID-19 shock by undertaking government-subsidized capacity-reduction measures aimed at bringing costs in line with the lower output demand.

2.6 Descriptive statistics for the estimation sample

Since our focus is on credit line borrowing, we estimate the models specified in (1) and (2) based on a sample consisting of the subset of firms in the full sample that had a revolving credit line with positive committed amount in February 2020; this is the case for 67,359 of the 103,078 firms that had any type of loan with positive committed amount in February. A further 3,357 firms have missing data on probability of default, which is an important control variable. To keep the sample consistent across specifications, we drop firms with missing PDs from the main estimation sample, but we provide evidence below that this is unlikely to have a meaningful impact on the results. Applying these sample selection screens generates a final estimation sample comprising 64,002 firms. Descriptive statistics for all variables used in the estimation of (1) and (2) are provided in Table 2.

Several features of the data are worth noticing in Table 2. Firstly, 25 percent of the firms in the credit line sample received government subsidies for short-term work between April and June. Secondly, the total amount of outstanding loans declined by 19 percent for the average firm during the pandemic, driven primarily by a reduction in drawdowns on revolving credit lines. Thirdly, the average credit line utilization rate at the outset of the recession was 25 percent, which implies that firms on average had ample unused capacity on their credit lines. Finally, the vast majority of sample firms are SMEs, and less than one percent have access to bond markets.

Table 2: Descriptive statistics for estimation sample

	Mean	Median	SD	Pct. 25	Pct. 75	No. obs.
$Short\text{-}term\ work_i$ (0/1)	0.248	0.000	0.432	0.000	1.000	64,002
$\Delta CL\ utilization_{i,t}$	-0.058	0.000	0.267	-0.064	0.000	62,659
$\Delta CL\ committed_{i,t}$	0.013	0.000	0.159	0.000	0.000	62,659
$\Delta CL\ drawn_{i,t}$	-0.198	0.000	0.908	-0.151	0.000	62,659
$CL\ terminated_{i,t}$ (0/1)	0.021	0.000	0.143	0.000	0.000	64,002
$\Delta WC\ loans_{i,t}$	-0.209	0.000	0.921	-0.187	0.000	64,002
$\Delta Inv\ loans_{i,t}$	-0.027	0.000	0.394	0.000	0.000	64,002
$\Delta Total\ loans_{i,t}$	-0.190	0.000	0.840	-0.195	0.000	64,002
$\Delta Total\ credit_{i,t}$	-0.190	0.000	0.839	-0.194	0.000	64,002
B. Explanatory variables and sample-split variables						
$Exposure_{i(j)}$	0.000	-0.059	1.000	-0.852	0.403	64,002
$Bond\ access_i$ (0/1)	0.006	0.000	0.079	0.000	0.000	64,002
SME_i (0/1)	0.970	1.000	0.171	1.000	1.000	64,002
$CL\ utilization_{i,t-4}$	0.254	0.000	0.355	0.000	0.552	64,002
$PD_{i,t-4}$	0.015	0.005	0.039	0.002	0.013	64,002

This table reports descriptive statistics for all variables used in the estimation of (1) and (2). Variable definitions are provided in the text.

3 Results

This section presents the results of the empirical analysis. We begin by describing the aggregate developments on Swedish corporate credit markets during the COVID-19 recession using our micro data on bank loans and debt securities, and then proceed to the analysis of the determinants of the cross-sectional variation in credit demand, based on the difference-in-differences models specified in (1) and (2).

3.1 Aggregate developments on corporate credit markets

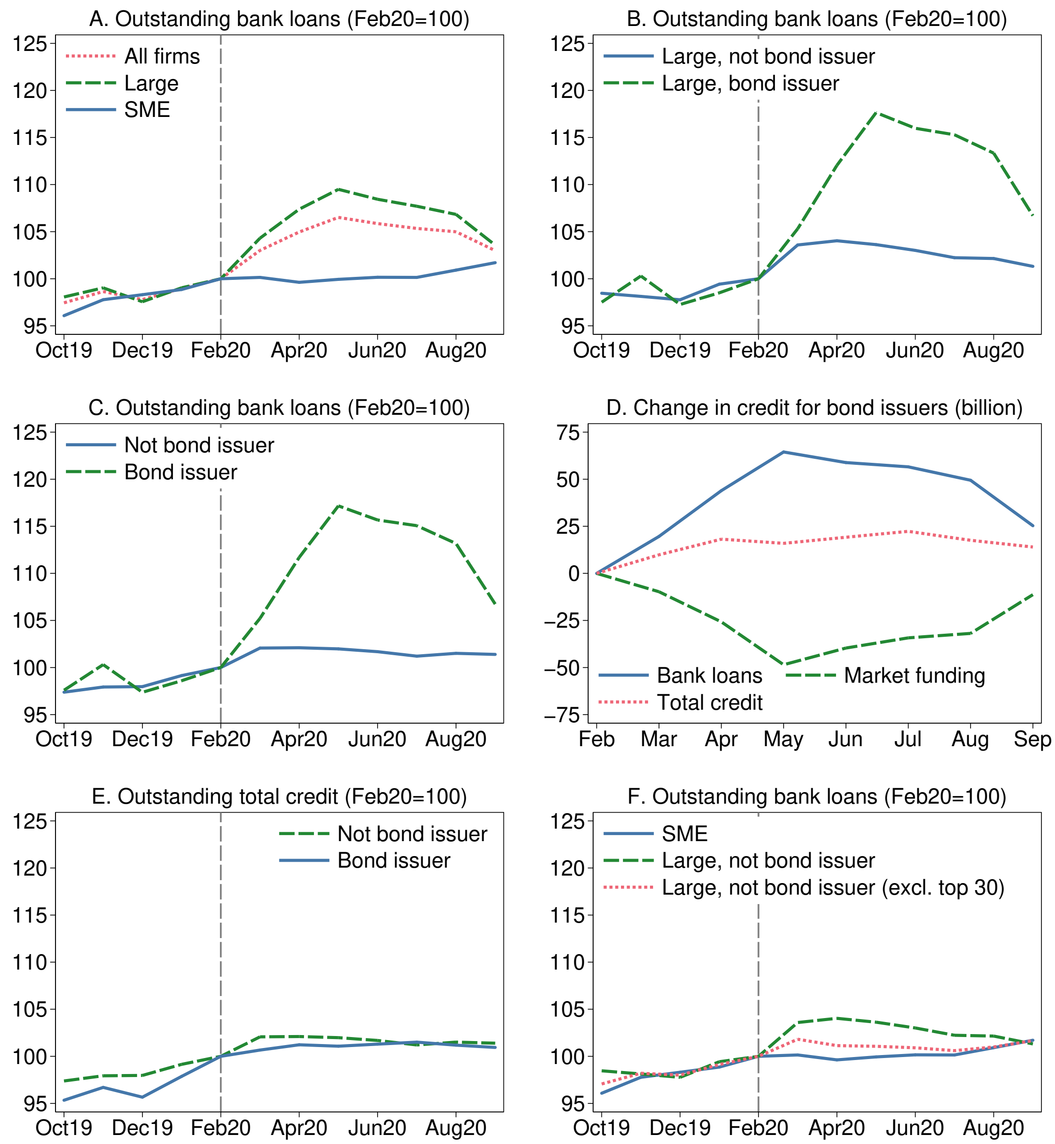
Figure 2 summarizes the aggregate developments on Swedish corporate credit markets between October 2019 and September 2020. To begin with, Panel A shows that bank lending increased markedly following the onset of the pandemic—between February and June, the outstanding volume of bank loans increased by around six percent, or 19 percent at an annualized rate. This increase is entirely accounted for by large firms, whose outstanding bank loans increased by more than eight percent between February and June; lending to SMEs, on the other hand, remained virtually unchanged throughout the same period. In Panel B, we show that the increase in lending to large firms, in turn, is primarily driven by large firms with bond market access. Bank lending to these firms increased by around 16 percent between February and June, or 56 percent at an annualized rate. Loans to large firms without bond market access, on the other hand, grew by a more modest three percent over the same period. The figure in Panel C makes the same point by plotting the growth in bank loans for all firms with and without bond market access, respectively.

What explains the divergence in bank lending to firms with and without bond market access? In Panel D, we show that firms with bond market access substituted bank borrowing for bond issuance in response to the bond market turmoil that occurred early in the pandemic.[14] The figure shows that bank loans and bonds developed as mirror images during the pandemic, with the former increasing and the latter decreasing. The increase in bank loans was slightly larger than the decrease in bond funding, however, which resulted in an increase in total credit (loans plus bonds) of just over one percent for firms with bond market access. This is almost exactly equal to the increase in bank loans for firms without bond market access, as shown in Panel E, which implies that growth in total credit to firms with and without bond market access developed very similarly during the pandemic.

Finally, it may be noted from the figures in Panels A and B that bank lending grew somewhat more between February and June for large firms without bond market access than for SMEs (three percent increase versus no change). In Panel F, we document that this difference is largely accounted for by a small number of very large firms that are classified as not having bond market access; if we sort firms without bond mar-

[14] See Wollert (2020) for a description of Swedish bond markets during the COVID-19 pandemic.

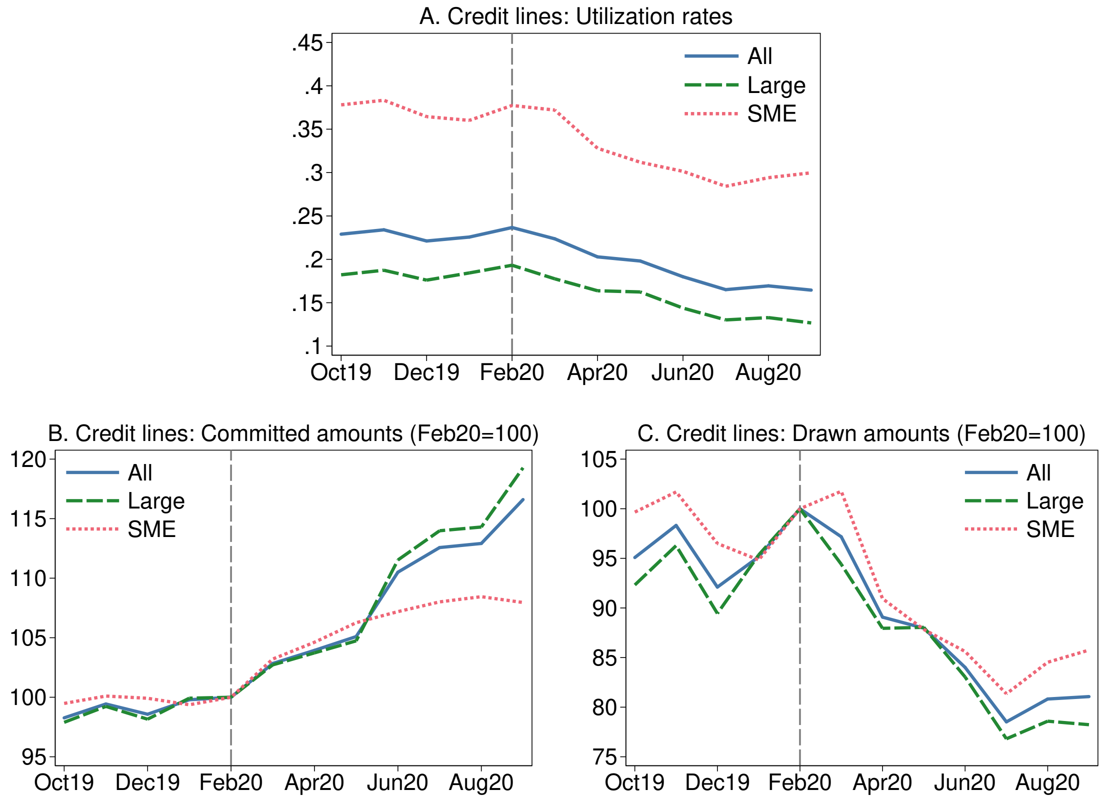
Figure 2: Aggregate developments on Swedish corporate credit markets



ket access by the size of their outstanding bank loans in February and exclude the 30 largest firms—each of which has bank loans amounting to two billion SEK or more—the growth in lending to the remaining firms in the group of large firms without bond market access becomes very similar to the growth in lending to SMEs (one percent increase versus no change).

In sum, Figure 2 shows that corporate borrowing largely followed its pre-crisis

Figure 3: Aggregate developments in credit line borrowing



path during the first phase of the COVID-19 recession. Hence, the aggregate developments on corporate credit markets suggest that neither credit supply nor credit demand shifted sharply following the onset of the crisis. Moreover, the data do not point to sharp divergences in credit conditions between large and small firms, nor between firms with and without bond market access. However, a large share of bank lending to Swedish non-financial firms consists of term loans used for real-estate investments. As such loans are not directly indicative of firms' demand for working-capital credit—which is what policy discussions on firms' access to finance during the COVID-19 recession has been about—we turn next to the aggregate developments in credit line borrowing.

Panel A of Figure 3 plots aggregate utilization rates on revolving credit lines for three groups of firms: all firms, SMEs, and large firms.[15] Note first that at the outset of the

[15]The aggregate utilization rate is defined as the aggregate amount of credit line borrowing in a given

recession, the aggregate utilization rate on credit lines was 24 percent percent for all firms, whereas the corresponding figures for SMEs and large firms were 38 and 19 percent, respectively. The generally higher utilization rates on credit lines among smaller firms is consistent with the evidence in the credit-line literature (see, e.g., Sufi, 2009, and Chodorow-Reich et al., 2020). Then, between February and June, utilization rates fell markedly in all size classes. Across all firms, the aggregate utilization rate fell by five percentage points, from 24 percent in February to 18 percent, in June; the corresponding declines for SMEs and large firms were eight and five percentage points, respectively. Measured as percent changes, the declines in utilization rates amount to 24, 20, and 26 for all firms, SMEs, and large firms, respectively.

In Panels B and C, we show that the decline in aggregate utilization rates occurred for two reasons. Firstly, the aggregate drawn amounts on credit lines fell by around 15 percent in all groups of firms between February and June. Secondly, during the same period banks increased the limits, or committed amounts, on firms' credit lines by around 10 percent; through May, the increases were roughly similar for SMEs and large firms, but from June and onwards the increase has been markedly higher for large firms. The fact that banks increased committed amounts on credit lines during the recession strongly suggests that they were not actively trying to restrict firms' ability to use them—at least not in the aggregate—which is not surprising given that the banking system has remained healthy throughout the pandemic. Hence, the likely explanation for the fall in credit line utilization rates is that firms' demand for credit for working-capital purposes declined during the recession.

3.2 Determinants of the cross-sectional variation in credit demand

To better understand credit-line usage during the recession, we now turn to an analysis of the cross-sectional variation in utilization rates. Our main interest is to examine the firm-level relationship between the severity of the COVID-19 shock and the change in firms' credit line utilization rates. We conduct the analysis based on the empirical model in (1), starting with a simple bivariate specification and then introducing the control variables consecutively. We assess the economic magnitude of the coefficients in terms of the differences between firms operating in the industries most and least af-

group of firms, divided by the aggregate committed amounts on credit lines for firms in the same group.

fected by the COVID-19 shock. More specifically, we multiply the estimated coefficients for $Exposure_{i(j)}$ by the difference between its maximum and minimum values—4.52 and –2.14, respectively—which captures the change in credit line utilization rates between February and June for the most affected firms relative to the least affected firms.

The results are presented in Table 3. Consider first column (1), in which the estimation results for the bivariate specification are presented. The coefficient on $Exposure_{i(j)}$ is –0.010 and statistically significant, which implies that a one standard deviation larger decline in industry value-added during the second quarter of 2020 is associated with a one percentage point reduction in credit line utilization rates between February and June; hence, in terms of economic significance, the firms most affected by the COVID-19 shock reduced credit line utilization by 6.7 percentage points relative to the least affected firms.

In columns (2)–(4), we augment the regression with, in turn, county and main-bank fixed effects, a dummy for whether a firm has access to bond markets, and an SME dummy. The inclusion of these control variables has no effect on the coefficient of interest. Hence, the baseline coefficient is not the result of omitted variable bias stemming from differences in firm size, bond market access, location, or credit supply across industries differently exposed to the COVID-19 shock. In columns (5)–(6), we add two additional controls: firstly, a firm's credit line utilization rate at the outset of the recession, and secondly, the firm's probability of default. These control variables contribute to a slight decline the magnitude of the coefficient of interest, which nevertheless remains economically and statistically significant: in the estimation with the full set of control variables, reported in column (6), the coefficient for $Exposure_{i(j)}$ is –0.007. This demonstrates that the baseline result cannot be explained by more exposed firms being less creditworthy in general, or by having exhausted their credit lines already at the outset of the recession.

The results documented in Table 3 show that firms more exposed to the COVID-19 shock reduced credit line utilization relative to less exposed firms during the recession. This reduction can, as discussed above, be interpreted as a decline in credit demand, provided that it was not caused by banks restricting firms' ability to actually use their pre-committed credit lines. To assess whether banks engaged in such efforts against firms more severely exposed to the COVID-19 shock, we estimate the baseline model

Table 3: Determinants of cross-sectional variation in credit line utilization

	Dependent variable: $\Delta CL\ utilization_{i,t}$					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$Exposure_{i(j)}$	-0.010	-0.010	-0.010	-0.010	-0.006	-0.007
	[0.004]	[0.004]	[0.004]	[0.004]	[0.003]	[0.003]
$Bond\ access_i$			0.006	0.016	0.015	0.014
			[0.012]	[0.013]	[0.012]	[0.013]
SME_i				0.014	-0.003	-0.008
				[0.007]	[0.006]	[0.006]
$CL\ utilization_{i,t-4}$					-0.363	-0.382
					[0.005]	[0.006]
$PD_{i,t-4}$						0.673
						[0.042]
Most vs. least exposed firms	-0.067	-0.067	-0.067	-0.067	-0.040	-0.047
Main bank FE	No	Yes	Yes	Yes	Yes	Yes
County FE	No	Yes	Yes	Yes	Yes	Yes
Number of observations	62,659	62,659	62,659	62,659	62,659	62,659
R-squared	0.001	0.003	0.003	0.003	0.232	0.241

This table reports estimation results for the regression model specified in equation (1) with $\Delta CL\ utilization_{i,t}$ as dependent variable. 'Most vs. least exposed firms' refers to the estimated difference in the dependent variable between firms operating in the industries most and least affected, respectively, by the COVID-19 shock. t-statistics, calculated using standard errors clustered at the level of two-digit SNI/NACE industries, are reported in square brackets.

with a dummy for terminated credit lines and the change in committed amounts on credit lines, respectively, as outcome variables. The results are reported in columns (1) and (2) of Table 4. In both cases, the coefficient on $Exposure_{i(j)}$ is a precisely estimated zero, which demonstrates that banks were not more prone to either terminate credit lines (extensive margin) nor reduce their committed amounts (intensive margin) for firms that were more exposed to the COVID-19 shock. Hence, the results in Table 3 are unlikely to be explained by supply-side factors.

Table 4: Results for other outcome variables

	(1) CL $terminated_{i,t}$	(2) $\Delta CLcommitted_{i,t}$	(3) ΔCL $drawn_{i,t}$	(4) ΔWC $loans_{i,t}$	(5) ΔInv $loans_{i,t}$	(6) $\Delta Total$ $loans_{i,t}$	(7) $\Delta Total$ $credit_{i,t}$
$Exposure_{i(j)}$	0.000	0.001	-0.022	-0.019	0.005	-0.006	-0.007
	[0.002]	[0.001]	[0.010]	[0.011]	[0.003]	[0.009]	[0.009]
$Bond\ access_i$	0.005	0.025	0.034	0.121	-0.027	0.082	0.030
	[0.011]	[0.020]	[0.052]	[0.058]	[0.039]	[0.050]	[0.048]
SME_i	-0.027	-0.031	-0.078	-0.062	0.028	-0.097	-0.093
	[0.006]	[0.008]	[0.028]	[0.028]	[0.024]	[0.029]	[0.029]
$CL\ utilization_{i,t-4}$	0.011	-0.004	-0.916	-0.925	-0.011	-0.732	-0.731
	[0.005]	[0.002]	[0.022]	[0.023]	[0.007]	[0.023]	[0.023]
$PD_{i,t-4}$	0.094	-0.093	1.658	1.486	-0.322	0.980	0.980
	[0.026]	[0.015]	[0.128]	[0.109]	[0.047]	[0.124]	[0.124]
Most vs. least exposed firms	—	—	-0.147	-0.127	—	—	—
Number of obs.	64,002	62,659	62,659	64,002	64,002	64,002	64,002
R-squared	0.010	0.004	0.121	0.121	0.006	0.092	0.092

This table reports estimation results for the regression model specified in equation (1). The dependent variable in each regression is listed in the respective column headers. Main-bank and county fixed effects are included in all specifications. 'Most vs. least exposed firms' refers to the estimated difference in the dependent variable between firms operating in the industries most and least affected, respectively, by the COVID-19 shock. t-statistics, calculated using standard errors clustered at the level of two-digit SNI/NACE industries, are reported in square brackets.

This does not, however, imply that banks do not actively manage their outstanding credit lines. On the contrary, firms that entered the recession with low creditworthiness—manifested in high probabilities of default—were significantly more likely to have their credit lines terminated during the recession, or, in case their credit lines survived, to have the committed amounts significantly reduced. On the other hand, the results in columns (1) and (2) also show that the banks' propensity to terminate credit lines or reduce committed amounts is unrelated to the level of utilization rates at the outset of the recession; put differently, firms were not penalized for actually using their credit lines.[16] This finding speaks against a more subtle concern regarding

[16]More precisely, the estimated coefficients are statistically significant, but economically insignificant. For example, a ten percentage points higher utilization rate is associated with a 0.04 percent reduction of

our baseline result, namely, that firms might abstain from using their credit lines to handle adverse liquidity shocks because they fear having them revoked if they do. We provide further evidence on this point in section 3.3 below.

Next, to confirm that reduced drawdowns account for the decline in utilization rates documented in Table 3—which is implied by the results already presented—we estimate (1) with the change in drawn amounts on credit lines as outcome variable. The coefficient on $Exposure_{i(j)}$, reported in column (3) of Table 4, is –0.023 and statistically significant; hence, the firms most affected by the COVID-19 shock reduced drawn amounts on revolving credit lines by 14.7 percentage points relative to the least affected firms.

In columns (4)–(7), we consider the four broader measures of credit defined in section 2.5. To begin with, the results for working-capital loans, reported in column (4), are very similar to the results for drawn amounts on credit lines, which implies that increases in short-maturity term loans did not offset the decrease in credit line borrowing for firms exposed to the COVID-19 shock; an unsurprising finding, given that very few firms have short-maturity term loans at all (see Table 1). Next, the results reported in column (5) show that investment loans, unlike working-capital loans, are unaffected by the COVID-19 shock. This, together with the fact that investment loans constitute the majority of the volume of firms' outstanding bank loans, implies that the effect of the COVID-19 shock on total loans should be small. In column (6), we confirm that this is indeed the case; the coefficient on $Exposure_{i(j)}$ is –0.006 and statistically insignificant. The differing responses of working-capital loans and investment loans to the COVID-19 shock underscores the importance of distinguishing between different loan types when studying how credit demand is affected by a sudden decline in output demand.

In column (7), we show that the coefficient on $Exposure_{i(j)}$ does not change if one considers total credit instead of total bank loans as dependent variable, which is expected given that only a few hundred firms have access to bond markets. However, it is interesting to compare the coefficients on the dummy for bond market access across columns. In particular, by considering the results in columns (3)–(5), we learn that the substitution of bank loans for market funding, documented graphically in Figure 2, primarily took the form of short-maturity term loans. To see this, note that the coeffi-

the committed amount.

cients are statistically insignificant in the regressions with credit lines and investment loans as dependent variables, but large and statistically significant when the dependent variable is working-capital loans (recall that the latter is defined as the sum of short-maturity term loans and outstanding amounts on revolving credit lines).

In sum, the hypothesis that the COVID-19 shock caused a decline in credit demand finds support in the aggregate time-series depicted in Figure 3, as well as in the cross-sectional analysis reported in Tables 3 and 4.

3.3 Cross-sectional heterogeneities in the effects of the COVID-19 shock?

We have presented several pieces of evidence showing that efforts on the part of banks to formally restrict firms' ability to access credit lines cannot explain the negative relationship between the COVID-19 shock and utilization rates. Most importantly, we have shown that banks were not more prone to terminate credit lines or reduce limits for firms more exposed to the shock. One may still argue, however, that more exposed firms wanted to draw on their credit lines, but were discouraged from doing so by implicit or explicit threats from the banks; more specifically, even if banks did not revoke or reduce limits on credit lines, they could have let firms know that they would be punished for using them to deal with liquidity problems during the recession.

A testable implication of the preceding argument is that the negative relationship between the COVID-19 shock and utilization rates should be stronger for firms more likely to be subject to such threats. We assess whether this is the case by testing for cross-sectional heterogeneities in the effects of the COVID-19 shock, using the triple-differenced regression specification in (2). We consider three dimensions of heterogeneity: size, age, and creditworthiness. The idea is that if banks were trying to restrict firms' credit line access by informal means—i.e., in ways other than revocations or limit reductions—then smaller, younger, and less creditworthy firms would have been the most likely targets, on account of their weaker bargaining positions vis-à-vis banks. We construct the age and creditworthiness splits by dividing the sample at the medians of $Firm\ age_{i,t-4}$ and $PD_{i,t-4}$, respectively, whereas the size split is obtained by dividing firms into SMEs and large firms based on the variable SME_i.

The results of the cross-sectional heterogeneity analyses are presented in Table 5. The coefficient estimates in the first row correspond to β_1 and those in the second row

Table 5: Cross-sectional heterogeneity in the effects of the COVID-19 shock

	Sample-split variable (T_i)		
	(1)	**(2)**	**(3)**
	SME	Young	Low credit-worthiness
$Exposure_{i(j)} \cdot \mathbb{1}\{T_i = 0\}$	-0.015	-0.005	-0.006
	[0.005]	[0.003]	[0.002]
$Exposure_{i(j)} \cdot \mathbb{1}\{T_i = 1\}$	-0.006	-0.008	-0.007
	[0.003]	[0.003]	[0.004]
p-value for difference	0.117	0.241	0.609
Number of observations	62,659	62,659	62,659
R-squared	0.241	0.241	0.236

This table reports estimation results for the regression model specified in (2). The first row reports the coefficient estimates for β_1 and the second row the estimates for the linear combination of β_1 and β_3. 'p-value for difference' refers to the p-value from a t-test where the null hypothesis is that the interaction term, β_3, is zero. All regressions reported in the table include the full set of control variables used in Tables 3 and 4, with the exception that where one of the controls is used to define T_i, that variable is excluded from the set of controls. t-statistics, calculated using standard errors clustered at the level of two-digit SNI/NACE industries, are reported in square brackets.

to the linear combination of β_1 and β_3, while the reported p-value is from a t-test where the null hypothesis is that the interaction term, β_3, is zero. Hence, the first row provides the estimated relationships between the COVID-19 shock and utilization rates for larger, older firms, and more creditworthy firms, and the second row the corresponding relationships for smaller, younger, and less creditworthy firms. In all three columns, the reported p-value indicates that there is no statistically significant difference in the relationship between the COVID-19 shock and utilization rates across the groups of firms being compared. Hence, under the assumption that banks discriminate between weak and strong borrowers when issuing explicit or implicit threats, the results in Table 5 suggest that banks did in fact not pressure firms to not draw on their credit lines during the COVID-19 recession. These results therefore provide additional evidence that our baseline results are not driven by informal restrictions on firms' ability to access pre-committed credit lines.

3.4 The COVID-19 shock and cost-saving capacity reductions

The empirical analysis has up until this point demonstrated that the COVID-19 shock generated a decline in corporate credit demand, driven by a fall in firms' demand for credit for working-capital purposes. This finding suggests that the decline in output demand caused by the COVID-19 shock led firms to successfully undertake cost-saving capacity reductions, which reduced the size of their working capital, and thereby their financing needs. In what follows, we provide direct empirical evidence supporting this interpretation.

We proxy firms' propensity to reduce working capital through cuts in labor input by means of a dummy indicating whether or not they furloughed workers as part of the government's short-term work program. This program enabled firms to reduce the working hours of an employee by up to 80 percent, with the cost shared between the government (75 percent), the firm (5-12.5 percent depending on the extent of the reduction in hours), and the employee (12.5-20 percent); at most, firms could reduce their wage costs by 72.5 percent. Firms could initially apply for short-term work subsidies covering six months of wage payments, with the possibility of a subsequent three-month extension (the program was later extended into 2021 under modified conditions). The great majority of firms were eligible to apply; the main exceptions being insolvent firms, firms undergoing reconstruction, and sole proprietorship.[17]

There are two reasons for why program participation is a strong proxy for what we want to capture. Firstly, firms that strove to reduce labor input because of declines in output demand had a strong incentive to participate in the short-term work program, as this enabled them to engage in labor hoarding at very low cost and with great flexibility.[18] Moreover, as eligibility criteria were weak, almost all firms in our sample that wanted to participate could do so. Hence, the vast majority of labor-saving efforts undertaken by Swedish firms in response to the COVID-19 shock should be captured by the program-participation indicator. Secondly, it is mainly labor-generated working capital that gives rise to demand for bank credit, since bank credit frequently

[17]For further details on the Swedish short-term work program, as well as a comparison of the Swedish program with those implemented in other countries, see International Labour Organization (2020*a*,*b*).

[18]The flexibility of the program refers to the fact that firms were allowed to recall furloughed workers earlier than planned. Firms did therefore not need to abstain from furloughing because of uncertainties about how long the recession would turn out to be.

funds labor input but only rarely funds intermediate goods and services, which are instead predominantly purchased on trade credit (see, e.g., Klapper, Laeven and Rajan, 2012; Murfin and Njoroge, 2015; and Amberg et al., 2020). A measure of labor-saving efforts—like the program-participation indicator—thus captures changes in those parts of working capital that primarily determine firms' demand for bank credit. Put differently, we expect a firm's demand for bank credit to fall after declines in output demand as long as it is able to adjust the size of its workforce with sufficient flexibility.

Our hypothesis, then, is that firms more severely affected by the COVID-19 shock decreased labor input by participating in the short-term work program, which, in turn, reduced the size of their working capital and thereby their credit demand. We test this hypothesis in two steps. Firstly, we estimate the relationship between the severity of the COVID-19 shock and firms' propensity to participate in the short-term work program using the following empirical model:

$$STW_i = \alpha + \beta \cdot Exposure_{i(j)} + \gamma \cdot \mathbf{X_{i,t-4}} + \varepsilon_{i,t}, \tag{6}$$

where STW_i is a dummy equal to one if the firm participated in the short-term work program between April and June, and the other variables are defined as before. Secondly, we use specification (6) as the first-stage regression in a two-stage least squares estimation, where the second-stage regression is given by

$$\Delta Y_{i,t} = \alpha + \beta \cdot \widehat{STW}_i + \gamma \cdot \mathbf{X_{i,t-4}} + \varepsilon_{i,t}, \tag{7}$$

where $\widehat{STW}_i$ are the fitted values from the estimation of (6), $\Delta Y_{i,t}$ is one of the credit-growth measures used in the preceding analysis, and $\mathbf{X_{i,t-4}}$ consists of the full set of control variables. Hence, we use (7) to estimate the relationship between short-term work participation and credit demand, while instrumenting participation by the severity of the COVID-19 shock. That is, we aim to capture how corporate credit demand was affected by the changes in working capital induced by firms' responses to the COVID-19 shock.

The results from the estimation of (6) are reported in Table 6. The first column concerns the estimation of the bivariate specification, which yields a statistically significant coefficient on $Exposure_{i(j)}$ of 0.085. This implies that a one standard deviation

Table 6: Determinants of participation in the short-term work program

	Dependent variable: STW_i					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$Exposure_{i(j)}$	0.085	0.084	0.084	0.084	0.083	0.083
	[0.017]	[0.017]	[0.017]	[0.017]	[0.016]	[0.016]
$Bond\ access_i$			-0.01	-0.053	-0.053	-0.053
			[0.034]	[0.021]	[0.020]	[0.020]
SME_i				-0.066	-0.063	-0.062
				[0.033]	[0.032]	[0.032]
$CL\ utilization_{i,t-4}$					0.045	0.047
					[0.015]	[0.016]
$PD_{i,t-4}$						-0.096
						[0.069]
Most vs. least exposed firms	0.566	0.559	0.559	0.559	0.553	0.553
Main bank FE	No	Yes	Yes	Yes	Yes	Yes
County FE	No	Yes	Yes	Yes	Yes	Yes
Number of observations	64,002	64,002	64,002	64,002	64,002	64,002
R-squared	0.038	0.046	0.046	0.047	0.048	0.048

This table reports estimation results for the regression model specified in equation (6). 'Most vs. least exposed firms' refers to the estimated difference in the dependent variable between firms operating in the industries most and least affected, respectively, by the COVID-19 shock. t-statistics, calculated using standard errors clustered at the level of two-digit SNI/NACE industries, are reported in square brackets.

larger decline in industry value-added during the second quarter of 2020 is associated with an 8.5 percentage point higher likelihood of receiving government subsidies for short-term work; hence, the firms most affected by the COVID-19 shock were 56.6 percentage points more likely to participate in the program than the least affected firms. In columns (2)–(6), we consecutively add control variables in the same way as for the utilization-rate estimations in Table 3, with virtually no impact on the coefficient of interest.

The strong relationship between the COVID-19 shock and program participation demonstrates the priority and urgency of cost-saving capacity reductions for firms facing sudden declines in output demand. Importantly, the results in Table 6 also show that there is no clear relationship between a firm's financial strength and its propensity to reduce labor input during the recession; for example, an SME without bond market access was about equally likely to participate in the short-term work program as a large firm with bond market access. Hence, our results do not support the view that binding financial constraints forced firms to operate at a suboptimally small scale during the recession; instead, downsizing appears to have been an optimal response to the lower output demand induced by the COVID-19 shock.[19]

Next, we assess how the furloughing of workers through the short-term work program affected firms' credit demand using the two-stage least squares specification in (7). Column (1) reports the estimation results for the specification with $\Delta CL\ utilization_{i,t}$ as dependent variable. The coefficient on $\widehat{STW_i}$ shows that firms participating in the short-term work program on average reduced credit line utilization rates by eight percentage points relative to non-participants. The results reported in columns (2) and (3) demonstrate that this is entirely the result of a decline in drawn amounts on credit lines, as committed amounts did not change for program participants relative to non-participants. Moreover, we show in column (4) that program participants were not more likely to have their credit lines terminated during the recession. Taken together, these results strongly suggest that the decline in credit line utilization rates of program participants is accounted for by a fall in credit demand.

The results reported in Tables 6 and 7 thus support the proposition that firms responded to the COVID-19 shock by decreasing labor input, which in turn reduced the size of their working capital and thereby led to a decline in credit demand. In fact, drawing on Banerjee and Duflo's (2014) definition of credit constraints—according to which a firm is not credit constrained if it uses subsidized credit to repay non-subsidized credit—our results suggest that the COVID-19 shock on average *relaxed* firms' financial constraints, since firms reduced credit line utilization rates upon receiving subsidies

[19]This conclusion is reinforced by casual observation of firms' behavior during the recession. In particular, Swedish media has reported widely on the fact that several very large firms applied for and received short-term work subsidies, despite having large cash reserves and good access to external finance. For example, the car manufacturer Volvo—whose cash holdings at the outset of the recession amounted to over 50 billion SEK, or around one percent of annual Swedish GDP—received short-term work subsidies amounting to more than one billion SEK.

Table 7: Short-term work participation and credit line utilization

	2SLS estimates (instrument: $Exposure_{i(j)}$)			
	(1)	**(2)**	**(3)**	**(4)**
	ΔCL *utilization*$_{i,t}$	ΔCL *drawn*$_{i,t}$	ΔCL *committed*$_{i,t}$	CL *terminated*$_{i,t}$
$\widehat{STW}_i$	-0.079	-0.267	0.008	-0.005
	[0.034]	[0.115]	[0.010]	[0.020]
$Bond\ access_i$	0.01	0.020	0.026	0.005
	[0.013]	[0.053]	[0.020]	[0.011]
SME_i	-0.013	-0.095	-0.030	-0.027
	[0.006]	[0.029]	[0.008]	[0.006]
$CL\ utilization_{i,t-4}$	-0.378	-0.903	-0.004	0.011
	[0.006]	[0.024]	[0.002]	[0.006]
$PD_{i,t-4}$	0.666	1.633	-0.093	0.093
	[0.043]	[0.130]	[0.015]	[0.027]
Number of observations	62,659	62,659	62,659	64,002
F-statistic	25.798	25.798	25.798	26.083
R-squared	0.237	0.118	0.004	0.011

This table reports estimation results for the IV regression model, the first stage of which is specified in equation (6) and the second stage in equation (7). t-statistics, calculated using standard errors clustered at the level of two-digit SNI/NACE industries, are reported in square brackets.

for short-term work. Our analysis thus demonstrates that firms' financial constraints on average were relaxed during the COVID-19 recession, as a result of a decline in credit demand combined with a stable supply of credit and weak financial accelerator effects.

4 Conclusions

The COVID-19 pandemic swept across the globe in the spring of 2020 and resulted in drastic declines in economic activity, in many countries at an unprecedented scale. A widespread concern early in the recession was that the downturn would be exacerbated by sharply tightened financial constraints for non-financial firms, due to a combination of (i) increases in credit demand, driven by firms seeking to curb revenue declines by means of increased borrowing, and (ii) worsened access to external finance, as a consequence of adverse financial accelerator effects. Contrary to such expectations, this paper has demonstrated that the financial constraints of Swedish non-financial firms were relaxed during the COVID-19 recession, as a result of a decline in credit demand combined with a stable supply of credit and weak financial accelerator effects. The decline in credit demand, in turn, was shown to have occurred because firms responded to the decline in output demand induced by the COVID-19 shock by scaling down production, which reduced working-capital financing needs. Our findings thus challenge the view that financial constraints are necessarily tighter in recessions.

Looking ahead, we want to note two key aspects of our findings. Firstly, they point to the importance of working capital for our understanding of corporate credit demand and financial constraints in recessions. To further develop the modelling of working capital in financial-frictions models is thus a fruitful avenue for future work. Secondly, the extent to which capital market imperfections amplify shocks in macroeconomic models with financial frictions have been shown to depend strongly on how financial contracts are modelled. Our results align with models exhibiting weak financial accelerator effects—such as those in Carlstrom, Fuerst and Paustian (2016) and Dmitriev and Hoddenbagh (2017).

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