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The Impact of Credit Supply on Firm Performance: Micro-Evidence from Slovenia

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Abstract

In this paper, I estimate the impact of credit supply on real economic outcomes measured by firm investment, sales and employment. Using detailed credit register data, I identify the credit supply shocks as a series of bank-time fixed effects while controlling for loan demand factors with firm-time fixed effects. I find a positive impact of credit supply on investment, sales and number of employees for a sample of Slovenian firms in the period 2000–2020. Further, credit supply shocks have a greater impact on the performance of smaller firms as these are usually more bank-dependent and thus the cut of bank lending affects them more. I also find that credit supply has a larger impact in times of crisis, such as during the 2009–2013 economic/banking crisis and in 2020, when the COVID-19 pandemic erupted.

JEL Classification Codes: G01, G21, G28

Keywords: credit supply, micro-evidence, credit register, investment

Povzetek

V članku je predstavljena analiza vpliva ponudbenih kreditnih šokov na poslovanje slovenskih podjetij v letih 2000–2020. Ponudbeni kreditni šoki so definirani v širšem smislu in vključujejo vse dejavnike, ki vplivajo na ponudbo posojil bank. To so lahko eksogeni dejavniki, npr. sprememba denarne in makrobonitetne politike, nova regulativa (npr. višje kapitalske zahteve) ali katerikoli drugi zunanji šok, na katerega se banke odzovejo s prilagajanjem ponudbe posojil. Na drugi strani ponudbeni šoki vključujejo tudi endogene spremembe v bilancah bank, npr. raven kapitaliziranosti ali obremenjenost s slabimi posojili, ki lahko vplivajo na posojilno dejavnost bank.

Rezultati kažejo pozitiven vpliv ponudbe posojil bank na poslovanje podjetij, saj ta vodi do večje rasti prodaje, investicij in števila zaposlenih. Kreditni šoki imajo večji vpliv na poslovanje manjših podjetij, njihov vpliv pa se poveča v času krize, npr. med finančno krizo (2009-2013) in v letu 2020, ki je bilo zaznamovano s pandemijo covida-19.

1 Introduction

Credit supply shock can have an important impact on economic activity. This was one of the main topics after the global financial crisis, when the bank lending channel was significantly impaired and firm performance in terms of investment and employment fell considerably. A shortage of capital on banks' balance sheets led to a sizeable deleveraging by banks in order to meet rising capital requirements. The limited availability of bank financing for firms and households in turn amplified the initial economic shock through the banking system (see Amiti and Weinstein, 2018, and Jimenez et al., 2017b).

In this paper, I estimate the impact of credit supply shocks on firm performance measured by growth of investment, sales and employment. Credit supply shocks are identified following the Khwaja and Mian (2008) approach and can be understood as any factor that impacts banks' lending decisions. These may be exogenous factors, such as changes in monetary policy or macroprudential policy, new regulation, or any other external shock to which banks respond by adjusting their supply of loans. In addition, supply shocks also capture endogenous changes on banks' balance sheets, such as the level of capitalisation or non-performing loans, that are expected to affect the lending activity of banks.

The impact of credit supply shocks is estimated for Slovenian firms in the period 2000–2020. Slovenia is an interesting case study for at least two reasons. First, Slovenia experienced a deep recession that started with the global financial crisis and then continued as a banking crisis until 2013. Banks were heavily burdened with non-performing loans and their capitalisation stood at low levels, which together with lower investment opportunities led to strong deleveraging by banks.[1] Second, the Slovenian credit register covers a long time period, which enables an estimation of the loan supply and its effects through the whole cycle, including important historical events such as the accession to the European Union in 2004, the adoption of the euro in 2007, the severe economic and banking crisis in 2009–2013, and the COVID-19 pandemic in 2020.

The results show a positive impact of credit supply on firm performance. Higher loan supply increases firm investment, sales and number of employees. As expected, credit supply shocks have a greater impact on the performance of smaller firms as these are usually more bank-dependent and thus the cut of bank lending affects them more. I also find that credit supply has a larger impact in times of crisis, such as during the 2009–2013 economic/banking crisis and in 2020, when the COVID-19 pandemic erupted.

My paper is closest to Alfaro et al. (2021). Alfaro et al. (2021) study the impact of credit supply shocks on firm performance in Spain. Their findings suggest that credit supply shocks have a sizeable direct and downstream propagation, through suppliers, on employment, investment and output, and that this was especially the case during the 2008–2009 crisis. I apply the same methodology, relying on credit register data

[1] See Sivec and Volk (2021) and Brezigar-Masten et al. (2015) for a discussion of the Slovenian banking system during the Global Financial Crisis.

that enable the identification of the credit supply shocks while controlling for the demand side factors with firm-time fixed effects. In addition to the findings by Alfaro et al. (2021), I study also the non-linearity of the impact of credit supply, depending on firm size and two crisis periods: the 2009–2013 financial crisis and the 2020 COVID-19 crisis.

The results of my paper complement empirical findings on the effects of credit supply shocks on real economic outcomes. Amiti and Weinstein (2018) show that idiosyncratic granular bank supply shocks explain 30-40 percent of aggregate loan and investment fluctuations in Japan in the period 1990 to 2010. Gilchrist and Zakrajšek (2012) construct a credit spread index for the US and decompose it to a component capturing firm-specific information and a residual – the excess bond premium. They show that an increase in the latter results in a contraction in the supply of credit with significant adverse consequences for the real economy. Most of the studies in the field focus on the period around the Global Financial Crisis, when interest in understanding the propagation of credit supply shocks increased significantly and, at the same time, the crisis offered exogenous variation, enabling identification through impact studies. For examples of these studies, see Jimenez et al. (2020), Greenstone et al. (2020), Bentolila et al. (2018) and Cingano et al. (2016).

The rest of the paper is structured as follows. Section 2 presents methodology and data. Section 3 is the main section, where all the results are presented, including robustness checks. Finally, Section 4 concludes the paper and discusses policy implications.

2 Methodology and Data

The methodology closely follows the approach in Alfaro et al. (2021), where the authors estimate the effect of credit supply shocks on firm performance in Spain. The analysis is composed of two parts. First, I identify the credit supply, which is then in the second step used as the key variable of interest in explaining the growth of investment, sales and number of employees in firms.

The key challenge in identifying credit supply shocks is to disentangle them from demand shocks. Credit supply changes are correlated with credit demand changes and both are endogenous to economic conditions. For instance, when the economic outlook worsens and there are fewer investment opportunities, firms demand for loans decreases. At the same time, bank capital might erode, which leads to lower willingness and ability of banks to lend. Therefore, it is highly likely that an economy experiences a decline of credit demand and supply at the same time (see Peydro (2010) for an extensive discussion).

To tackle the above issue, I apply the methodology proposed by Khwaja and Mian (2008) (see Jimenez et al. (2010), Jimenez et al. (2017), Bonaccorsi di Patti and Sette (2016) and Behn et al. (2016) for other studies using the same methodology). Khwaja and Mian (2008) bypass the issue of simultaneous changes in loan demand and supply by exploiting the loan-level data. In their setting, the loan-level data are

data on borrowers with (at least) two banking relations with (at least) two banks.[2] The idea is simple: if a borrower's loan demand is constant across the two banks in a given time period, then introducing a borrower-specific dummy will capture the loan demand. Analogously, a bank-specific dummy will explain the supply side effects under the assumption of constant supply of loans to all the firms a bank is lending to. Putting this together, I estimate the following model:

$$\Delta L_{fbt} = \alpha_{ft} + \beta_{bt} + \varepsilon_{fbt} \qquad (1)$$

where ΔL_{fbt} is growth of loans of firm *f* taken in bank *b* in year *t.* α_{ft} are firm-time fixed effects that capture all the factors affecting loan growth that do not vary between banks. The most important among these are loan demand and firm riskiness. Similarly, β_{bt} explains supply-side effects, capturing banks' ability and willingness to lend.

In the second step, I estimate the effect of loan supply shock on firm performance:

$$\Delta Y_{ft} = \gamma \bar{\beta}_{ft} + \theta * controls_{ft} + \varepsilon_{ft} \qquad (2)$$

where Y_{ft} is a measure of firm performance, defined as growth of (1) investment,[3] (2) sales or (3) number of employees. $\bar{\beta}_{ft}$ is the firm-specific credit supply shock, calculated as the weighted average of supply shocks estimated in the previous equation, where loan amount is used as weight (c_{fbt}):

$$\bar{\beta}_{ft} = \sum_b \frac{c_{fbt-1}}{\sum_b c_{fbt-1}} \hat{\beta}_{bt} \qquad (3)$$

In all the estimates, I control for other firm characteristics that are expected to impact firm performance. The list of controls thus includes ($controls_{ft}$): firm-fixed effects, firm size measured by the logarithm of total assets, profitability measured by ROA, indebtedness measured by debt-to-asset ratio, efficiency measured by asset-to-turnover ratio, share of loans on firm balance sheet, growth of trade credit, average credit rating[4] assigned by the bank, number of relations a firm has with banks and the estimated demand effects (α_{ft}).

To estimate the above models, I use data from the credit register of Banka Slovenije and from AJPES, which collects data on firms' balance sheet and income statement items. The credit register is an exceptionally rich database containing detailed information at a bank-borrower level that is not publicly available. An important advantage of the Slovenian credit register is that it covers a long time period, which enables an estimation of the loan demand and supply through the whole cycle. In particular, I use data for the period 2000–2020, in which Slovenia joined the European Union in 2004, adopted the euro in 2007, went through a severe economic and banking crisis in 2009–2013 and was, like other countries, affected by the COVID-19 pandemic in 2020. Both models are estimated on an annual basis,[5] including firms that take out loans with at least two banks. This restriction is needed to identify demand and supply shocks and limits the sample to 20% of the total number of firms borrowing from banks. This share is admittedly low, but it includes on average larger firms, meaning

[2] For robustness, I apply the methodology of Degryse et al. (2019), which includes also firms that borrow from only one bank.

[3] Investments are approximated by growth of tangible assets.

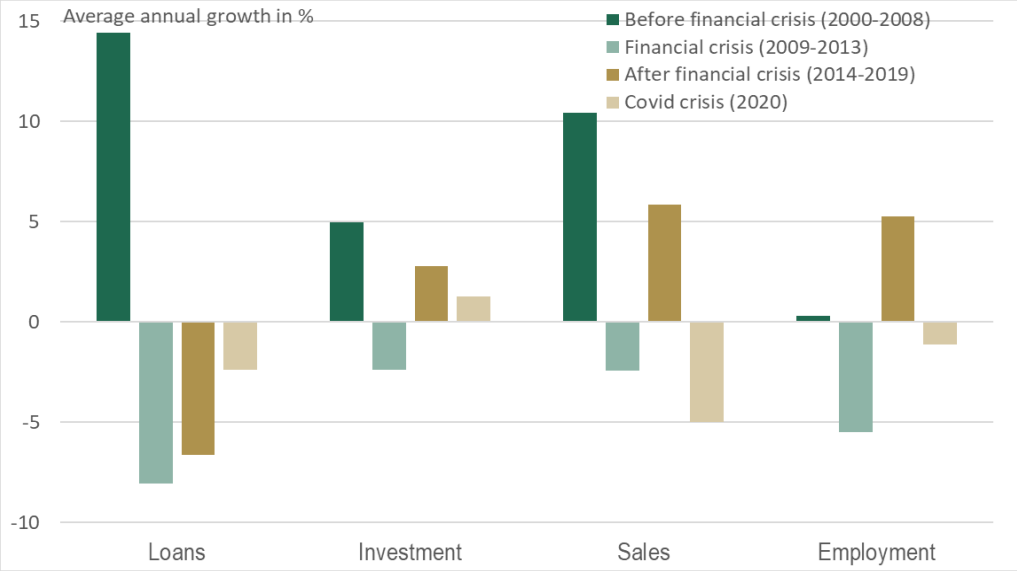
[4] Credit rating represents bank-own assessment of firm creditworthiness. Banks assign credit ratings on a five-point rating scale from A (best) to E (worst). For the purpose of estimation, I translate these into values from 0 (for rating A) to 4 (for rating E).

[5] The credit register contains data on a monthly frequency, but since firm balance sheet and income statement data, which I use in the second step, are available only annually, I estimate also the supply shocks on an annual basis. Loan growth in equation (1) is defined as $\Delta L_{fbt} = \ln(L_{fbt}) - \ln(L_{fbt-1})$, where I take average loan amount in each year.

that despite the restriction I cover around 80% of the total loan amount to firms.[6] Further, I exclude firms with non-performing loans as those could bias the estimates.[7]

Figure 1 shows the evolution of the key variables of interest, split into four periods. Lending to corporates grew extensively in the pre-crisis period, with an average annual growth of close to 15%. This followed from a strong credit demand as the Slovenian economy recorded high growth rates, especially after the EU accession in 2004, and was supported by sizeable bank borrowing from abroad. The latter was, in addition to weak capitalisation and rising stock of non-performing loans (NPL), also one of the main reasons for strong deleveraging in the crisis period, as banks were unable to raise funds from abroad due to interbank market freeze. Later, in the post-crisis period, lending still contracted on average as a result of bank restructuring and still existing NPL burden. Conversely, firm investment, sales and employment grew sizeably in the period after the financial crisis. This followed from firm restructuring, with a higher share of equity financing, also from abroad, and a greater role of internal funding sources. The COVID-19 crisis in 2020 mostly affected sales, which fell by 5%.

Figure 1: **Growth in loans, investment, sales and employment**



Source: Bank of Slovenia, own calculations.

3 Results

This section reports the results on the impact of credit supply shocks on firm performance. I first check how the estimated credit supply shock propagates to total firm borrowing, which is then followed by the main set of results, where I estimate the impact of credit supply shocks on investment, sales and employment.

[6] 98.7% of firms borrowing from banks are SMEs and 1.3% are large firms. In terms of their loan exposure, the structure is 44.5% SMEs and 55.5% large firms. After restricting the sample to firms that take loans out from multiple banks, the proportions are similar: 97.8% (42.5% in terms of exposure) represent SMEs and 2.2% (57.5%) represent large firms.

[7] More specifically, I exclude all the firm that are more than 90 days overdue in repaying a loan or are assigned a credit rating D or E by a bank. The reason for the exclusion is twofold. First, non-paid interest is added to the loan amount, which means an artificial increase of the loan amount. Second, many of the firms with non-performing status are in bankruptcy.

The Slovenian economy can be characterised as bank-based, as firms largely rely on bank funding to finance their business activity. In such an environment, bank lending conditions can have an important impact on the availability of credit to firms. I verify this by estimating a model following equation (2), where the dependent variable is growth of loans at the firm level. The main coefficient of interest is that for credit supply shock. This amounts to 0.945 and is highly statistically significant (the standard error is 0.059). This tells us that credit supply conditions indeed matter a lot for firm access to bank funding, as they translate to growth of firm loans in an almost 1:1 fashion. Having a strong impact on access to credit, it could be expected that credit supply shocks also matter for real firm outcomes. I check this below, where I show the impact of credit supply shocks on investment, sales and employment.

Table 1 shows the estimated impacts of credit supply shock on investment, sales and number of employees. It contains six sets of estimates: (1) is a basic estimate of the impact of credit supply shocks, where I control for all other factors described in the previous section, while estimates (2)–(6) explore the non-linearity of the impact of credit supply shock depending on the firm size, dependency on bank financing and over three periods – the financial crisis (2009–2013), after the crisis (2014–2019) and 2020, when the COVID-19 pandemic started.

Table 1: **Credit supply impact on firm investment, sales and number of employees**

	(1)	(2)	(3)	(4)	(5)	(6)
				Investment		
Supply shock	0.621***	1.234***	0.628***	0.586***	0.687***	0.551***
Supply shock × ln(Assets)		-0.086***				
Supply shock × Share of loans			-0.033			
Supply shock × Financial crisis				0.123*		
Supply shock × After crisis					-0.152**	
Supply shock × Covid crisis						0.816***
Number of observations	133,925	133,925	133,925	133,925	133,925	133,925
R-square	0.312	0.312	0.312	0.312	0.312	0.312
				Sales		
Supply shock	0.496***	0.778***	0.489***	0.395***	0.704***	0.406***
Supply shock × ln(Assets)		-0.040***				
Supply shock × Share of loans			0.032			
Supply shock × Financial crisis				0.395***		
Supply shock × After crisis					-0.478***	
Supply shock × Covid crisis						1.029***
Number of observations	137,592	137,592	137,592	137,592	137,592	137,592
R-square	0.307	0.307	0.307	0.307	0.307	0.307
				Number of employees		
Supply shock	0.203***	0.344***	0.154***	0.137***	0.319***	0.169***
Supply shock × ln(Assets)		-0.020***				
Supply shock × Share of loans			0.246***			
Supply shock × Financial crisis				0.238***		
Supply shock × After crisis					-0.268***	
Supply shock × Covid crisis						0.393***
Number of observations	131,631	131,631	131,631	131,631	131,631	131,631
R-square	0.324	0.324	0.324	0.324	0.324	0.324

Source: Bank of Slovenia, AJPES, own estimates.
Note: The table reports the estimated coefficients of the impact of credit supply shock on the growth of investment, sales and number of employees. The estimates are for the period 2000–2020 and include only firms with multiple relations with banks. The supply shocks are estimated with equation (1) and, for the purpose of estimating its impact on firm performance, aggregated according to equation (3). *Financial crisis* is defined as a dummy variable, which equals one between 2009 and 2013, while *After crisis* and *Covid crisis* take the value of one in the period 2014–2019 and 2020 respectively. In addition to the variables shown in the table, all the estimates include also the following controls: firm fixed effects, logarithm of total assets, returnon assets, debt-to-assets, share of bank loans on firm balance sheet, asset turnover ratio, growth of trade credit, average credit rating assigned by banks, number of relations a firm has with banks and demand effects from equation (1). Significance: * (p<0.10), ** (p<0.05), *** (p<0.01). Standard errors are clustered at industry-year level.

The results show a positive impact of credit supply on firm performance. The first column in Table 1 shows a highly significant positive effect of loan supply on firm investment, sales and number of employees. The effect is the largest on investments,

where one percentage point higher loan supply leads to 0.62% higher growth of investments on an annual basis. This impact is also economically relevant, as a one standard deviation higher loan supply increases investment growth by 5 percentage points, which is 80% of the average investment growth in the estimation period.

Column (2) in Table 1 shows an interaction of credit supply shock with firm size, measured by a logarithm of total assets. The negative sign of the coefficient (e.g. -0.086 for investment) indicates that the impact of loan supply on firm performance decreases with firm size. This result was expected, as smaller firms are more financially constrained and can hardly access external financial sources other than banking loans (see a seminal paper by Fazzari et al. (1988) for a deeper discussion). As a result, their business performance is more sensitive to changes in access to bank financing. The result is robust across all the three measures of firm performance.

The specification in column (3) checks if the impact of credit supply shock is more relevant for firms that are more dependent on bank financing. This is measured by the share of banking loans on a firm balance sheet in the previous year. The results do not show any difference in the impact of credit supply on investment and sales but do reveal a strong positive impact on employment. The growth of number of employees is therefore more sensitive to changes in credit supply for firms with larger dependency on bank-based financing.

Next, I check if the impact of credit supply on firm performance changes during a period of crisis. For this purpose, I interact the loan supply shock with a dummy variable for two crisis periods. The first of these, for which the results are displayed in column (4), is the deep economic and banking crisis in Slovenia which lasted from 2009 to 2013. It ended in 2013 with large-scale state capitalisation and a transfer of a significant portion of non-performing loans to the Bad Asset Management Company (BAMC) (see Bank of Slovenia (2015) for a more comprehensive discussion). The second crisis period in our sample is the COVID-19 pandemic, for which the dummy variable equals one in 2020 (column (6)). The coefficients on interaction terms in columns (4) and (6) show a greater impact of credit supply on firm performance during the crisis period. As firms struggle to finance their business with internal funding sources, loan supply plays an even greater role for firm performance in deteriorated economic conditions. The greater impact of loan supply in 2020 is also a consequence of several policy measures taken to contain the effects of the pandemic crisis.[8]

Column (5) shows the impact of credit supply on firm performance changes between 2014 and 2019. This is a period when the Slovenian economy was recovering from the financial crisis, including with a deep restructuring of firm financing, with a larger share of equity financing and higher reliance on internal funding sources to finance their growth. In line with this, we find a lower impact of credit supply in that period for all the three measures of firm performance.

3.1 Robustness checks

This section presents four sets of robustness checks. First, I estimate the impact of the credit supply shock with one year lag to avoid possible endogeneity issues with contemporaneous setup. Second, I add lagged dependent variable as a regressor to

[8] The release of the Pillar 2 Guidance (P2G) buffer and dividend pay-out restrictions directly increase bank capacity to lend. A further positive stimulus is also expected from public guarantees schemes that limit the risk taken by banks and loan moratoria that at least partially postpone the realisation of losses in banks' portfolios. Both can be an important factor in banks' decisions to lend.

capture the inertia in firm performance measures that could potentially be correlated with supply shocks. Third, I saturate the model with industry-time fixed effects. Last, I apply the methodology of Degryse et al. (2019), whereby the demand side is controlled for with industry-location-size-time fixed effects, which enables us to identify the supply shocks also for firms that take out loans with only one bank. Robustness checks are applied to the basic estimate of the impact of credit supply shock (estimate (1) in Table 1). The results are presented in Table 2.

The results in Table 1 show a contemporaneous impact of the credit supply shock on firm performance, i.e. I estimate how credit supply shock in time *t* affects investment, sales and employment in time *t*. In line with equation (1), the credit supply shocks are identified while controlling for loan demand and other firm characteristics with detailed firm-time fixed effects. The identified credit supply shocks are thus independent of firm characteristics and there should be no endogeneity issues with the contemporaneous estimate. To further strengthen the reliability of my estimates, I also estimate the impact of credit supply shock with a lag. The results are presented in column (1) in Table 2. The estimated coefficients are lower, but they remain positive and highly statistically significant for all the three measures of firm performance.

Table 2: **Robustness checks**

	(1) Lagged effect	(2) Add lagged dep. variable	(3) Industry-time fixed effects	(4) ILST estimate
			Investment	
Supply shock	0.236***	0.624***	0.445***	0.319***
Number of observations	101,662	132,081	133,925	376,496
R-square	0.289	0.311	0.325	0.224
			Sales	
Supply shock	0.230***	0.506***	0.150***	0.264***
Number of observations	104,764	136,988	137,592	403,897
R-square	0.294	0.304	0.319	0.248
			Number of employees	
Supply shock	0.096***	0.200***	0.093***	0.106***
Number of observations	100,206	129,509	131,631	363,374
R-square	0.308	0.315	0.329	0.244

Source: Bank of Slovenia, AJPES, own estimates.
Note: The table reports robustness estimates of the impact of credit supply shock on the growth of investment, sales and number of employees. The estimates are for the period 2000–2020. The coefficients in columns (1)–(3) are estimated for firms with multiple relations with banks, whereas estimate (4) includes also firms with single relations. The latter identifies credit supply where the demand is controlled for with industry-location-size-time (ILST) fixed effects (Degryse et al. (2019)). In addition to the supply shock, all the estimates include also the following controls: firm fixed effects, logarithm of total assets, return on assets, debt-to-assets, share of bank loans on firm balance sheet, asset turnover ratio, growth of trade credit, average credit rating assigned by banks, number of relations a firm has with banks and the estimated demand effects. Significance: * (p<0.10), ** (p<0.05), *** (p<0.01). Standard errors are clustered at industry-year level.

In the second robustness test, I extend the set of regressors with the lagged dependent variable, i.e. with lagged growth of investment, sales and number of employees. It is to be expected that all three measures of firm performance are persistent and omitting this term could bias the results. The results in column (2) in Table 2 show this is not the case. The magnitude of the coefficients is similar to the original estimate and all the effects remain highly statistically significant.

The estimates in Table 1 do not include any time controls. Although time controls are not expected to drive the results in such a detailed micro setup, they could bias the coefficient somewhat, as a system-wide drop in credit supply likely coincides with lower performance of the corporate sector. To address this issue, I include time ef-

fects, which are further clustered at the industry level. The results reported in column (3) remain robust.

Last, I extend the sample also to firms which borrow only from one bank. The identification strategy according to equation (1) is based on firms with multiple bank relations, which enables us to control for demand-side and other firm characteristics with firm-time fixed effects. A possible concern with this estimation is that lots of observations are dropped and thus the sample might not be representative. To address this concern, I rely on the methodology proposed by Degryse et al. (2019), whereby instead of firm-time fixed effects, loan demand is controlled for with industry-location-size-time (ILST) fixed effects. This assumes that loan demand is constant for all the firms within each ILST cluster, which is a weaker assumption compared to the original Khwaja and Mian (2008) setting. The advantage is that the ILST estimate enables us to include also firms with single bank relations, as long as an ILST cluster consists of firms borrowing from more than one bank. ILST clusters in my estimation consists of 22 industries, 13 location districts, 7 size classes and 21 years. The results are presented in column (4) in Table 2. Note that the number of observations is approximately 3-times larger, but the estimated coefficients are largely in line with estimates with firm-time demand controls.

4 Conclusion

This paper studies the impact of credit supply on real economic outcomes, measured by investment, sales and employment. Credit supply shocks are identified with detailed credit register data that enable us to control for loan demand factors with firm-time fixed effects. Using data for Slovenian firms for the period 2000–2020, I find a positive impact of credit supply on firm investment, sales and number of employees. Further, credit supply shocks have a greater impact on the performance of smaller firms as these are usually more bank-dependent and thus the cut of bank lending affects them more. I also find that credit supply has a greater impact in times of crisis, such as during the 2009–2013 economic/banking crisis and in 2020, when the COVID-19 pandemic erupted.

The results of this paper are important for policymakers, supervisors and regulators. They show the importance of a stable and strong banking system that is able to provide funding to the real economy, especially in a period of crisis. To achieve this, strong supervision is required that is able to detect early vulnerabilities in banks and address them before they rise to a problem for the banking system as a whole. At the same time, the capital regulatory threshold should be set sufficiently high, so that banks have large loss-absorption capacity at hand in the event of a crisis or other shock that would erode their capital. In this respect, an improvement in the capital position of banks over recent years is expected to decrease fluctuations in credit supply. This strong increase results from the regulatory policy of higher capital requirements, mainly through macroprudential buffers, that was taken after the Global Financial Crisis to strengthen the resilience of the banking system and to ensure that banks are in a position to extend lending even in stressed conditions. Our results also support the countercyclical element of capital requirements, such as the countercyclical capital

buffer, which releases capital in a period of pressure and enables greater bank lending.

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