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Growing Like Germany: Local Public Debt, Local Banks, Low Private Investment¹

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Abstract

Over 2010-2016, municipal debt in Germany crowded out private investment worth 1 percent of GDP. Forced to lend to municipalities by their statutes, local public banks compensated for declining municipal-debt yields by charging higher rates to firms in Germany's locally segmented credit markets. The ensuing crowding-out was made worse by increased municipal borrowing when expensive fiscal commitments were shifted from federal and state to the municipal levels following the introduction of the debt brake. Our results identify new channels through which low interest rates adversely affect real outcomes and locally segmented credit markets can amplify contractionary effects from fiscal austerity.

KEYWORDS: local public finance, firm-level investment, crowding-out, fiscal austerity, global and intra-European imbalances

JEL-CODES: E22, E40, E62, G21, G28 F21, F32, H32

1 Introduction

Germany's exceptional growth over the decade after the 2008-09 global financial crisis was accompanied by declining private investment. Low private investment also contributed to the country's high current account surplus that is widely perceived as an important source of intra-European and even global imbalances and has therefore moved into the focus of international policy-makers.¹ In this paper, we draw attention to two important explanatory factors for Germany's low private investment rate that, so far, have not been explored in the context of advanced economies: the local segmentation of credit markets and the role of local public banks in local public finance.

Local public banks dominate lending to small and medium firms (SME) in Germany and, at the same time, also have an explicit mandate to lend to the local public sector (municipalities). As interest rates (and intermediation spreads) on municipal debt declined after the global financial crisis, this mandate effectively tied up a considerable part of local public banks' balance sheet in activities with practically zero margin. This put stress on the balance sheet of local public banks that they tried to alleviate by charging higher interest rates to their SME customers. Since SMEs could not easily switch lender in geographically segmented lending markets, they invested less. We estimate that this form of 'local crowding out' lowered aggregate private investment in Germany by around 30-40 billion euros per year (or 1 percent of GDP).

Perversely, fiscal consolidation at the state and federal levels substantially contributed to crowding out. It led to additional pressure on the (already strained) budgets of many municipal governments which were forced to plug the gaps by increased borrowing from local public banks. We use exogenous variation in the state-level fiscal consolidation needs stipulated by the constitutional debt brake as instrument for local public banks' holdings of municipal debt. These results show that Germany's fiscal austerity over the last decade can account for three quarters of the crowding out of private investment in our sample.

While local crowding out, i.e. the notion of crowding out in locally segmented credit markets, has recently been prominently documented for a major emerging economy, China (Huang et al. (2020)), our results provide important first evidence on local crowding out for an advanced economy. Importantly, they show how such crowding out can take place in a low-interest rate environment. At a more general level, we therefore also identify a novel mechanism through which low interest rates can have adverse effects on real economic activity.

¹The European Commission has repeatedly criticized the macroeconomic imbalances in Germany, see for example [European Commission \(2019\)](#). On May 30th, 2017, US president Donald Trump tweeted: "We have a MASSIVE trade deficit with Germany. (...) Very bad for U.S. This will change" ([Trump, 2017](#)).

Our findings also illustrate how the contractionary effects from fiscal austerity at higher (federal and state) levels of government can be exacerbated in segmented credit markets.

Germany's local banks come in two forms: local public banks (the 'Sparkassen' or savings banks) and local cooperative banks (the Volksbanken). Together, they dominate local banking markets in large parts of the country. They have designated geographical areas of business in which other banks of the same type (savings or cooperative) are not allowed to compete. This institutional backdrop—the so-called "Regionalprinzip" (regional principle)—implies that German banking markets are segmented along regional or municipal boundaries. Their dense branch network gives local banks a very strong presence in local markets that the big nationwide banks (mainly Deutsche Bank with its Postbank subsidiary and Commerzbank) cannot match. In Germany, only 29% of credit to firms and households stem from private banks, a comparatively low value (Gilquin, 2014).

The local segmentation of Germany's banking markets is particularly strong in lending to small and medium enterprises (SME). Many small German firms have long-standing relations with their local banks which are often their only bank connections. This relationship-based model is widely praised and the local banks pride themselves of it in their own publicity. Arguably, it allows the bank to screen borrowers much more closely and to continue lending to distressed firms even when arm's length lenders would long have stopped to provide credit. On the other hand, relationship lending also leads to a well-known hold-up problem (Sharpe, 1990): over the course of the relationship, the lender acquires private information about the borrower—and often holds the best collateral—which makes it hard for the borrowing firm to switch lender if the lender tightens loan terms.

While local cooperative and savings banks have a very similar clientele of private firms, the savings banks also play an important role in local public finance, including direct lending to municipalities and lending to local public enterprises. Differently from their local cooperative competitors, the savings banks have a statutory mandate to lend to the public sector. The savings banks are also under direct control of the municipalities in their respective district, with local mayors and other high-ranked officials being ex-officio members of their supervisory boards. This makes it hard for the savings banks to decline financing requests from the municipalities in their district.²

The local segmentation of Germany's banking markets and the role of savings banks for local public finance

²Note that municipalities depend on banks for virtually all their borrowing. Municipal bonds play a minor role in German municipal finance and are usually only issued by major cities. For example, in 2010, the total debt of German municipalities vis-à-vis the private sector was around 123 billion euros of which only 0.175 billion were issued in the form of debt securities. See for example Table 2.1 in https://www.statistischebibliothek.de/mir/receive/DEHeft_mods_00009385

are long-standing institutional features of Germany's banking landscape. We argue that there are two related reasons that explain why these features have started to matter for crowding out over the last decade in particular. First, as the municipal spread—the difference between interest rates on municipal borrowing rates and deposit rates—has declined over the last decade, it has become less and less attractive for banks to lend to municipalities. However, savings banks' statutory public lending requirement did not allow them to reduce municipal loans by much. Low interest rates also made it difficult for deposit-dependent local public banks to attract additional funding. Therefore, the statutory public lending requirement created an increasing shadow cost on their balance sheets that they rolled over into increased interest rates for their least elastic private borrowers: SMEs who rely on relationship-based bank finance in locally segmented credit markets. The second reason—compounding the effect of low interest rates—was the deterioration of the fiscal situation of Germany's municipalities over the last decade. As we discuss below, this was caused by the consolidation of state- and federal budgets which happened at the expense of local municipalities. This created additional demand for municipal loans that local savings banks had to satisfy, thus exacerbating the crowding out of private-sector lending.³

To guide our empirical analysis, we propose a stylized theoretical model in the spirit of Brunnermeier and Koby (2019). In the model banks face constraints on lengthening their balance sheet in the form of imperfectly elastic deposit supply. In this setting, savings banks' statutory public lending constraint can become binding once municipal loan demand increases or if municipal borrowing rates decline. The binding statutory lending requirement induces a shadow cost that the bank seeks to make up for by increasing rates in the local market for private lending where it has market power. Consistent with this theory, we find that SME lending rates of local public banks increases significantly in the share of their lending to local governments and with falling public sector borrowing rates. This link is absent for the control group of local cooperative banks which do not have a statutory public lending mandate. Hence, savings banks charge their customers a spread over what comparable local cooperative banks charge their very similar customer firms. We refer to this spread as the break-even spread.

We then ask to what extent the break-even spreads charged by savings banks affect firm-level investment. Our firm-level analysis is based on a unique German firm-level panel that covers more than 1m German firms over the period from 2010 until 2016, including many small ones not covered by other data sets. Our data also contains rich information on firms' bank relations that we use to construct a firm-specific measure of the

³This may raise the question why municipal spreads do not reflect the potential risks associated with lending to distressed municipalities. Under the Basel framework, loans to German municipalities have a risk weight of zero because local governments cannot declare bankruptcy under German law (their debt is legally guaranteed by the federal state).

break-even spreads charged by savings banks. We call this measure of exposure the firm's local public bank spread.

We show that the local public bank spread has a quantitatively important and significantly negative effect on firm level investment controlling for a host of firm-level variables and a rich set of controls for potential confounding factors. Specifically, our main specification controls for firm effects as well as for time-varying region-sector specific effects. This effectively accounts for compositional differences in the customer base of local banks. Hence, already in our baseline OLS estimates we can largely rule out that the effect of the local bank spread on investment arises because local banks in some areas lend to particularly small or risky firms or to some specifically risky sectors which would justify charging an interest rate spread even in the absence of our conjectured mechanism.

To fully account for any remaining reverse causality between firm investment and the financing conditions set by local public banks, in addition, we use a granular instrumental variable approach as recently proposed by [Gabaix and Koijen \(2020\)](#). This approach allows to purge local public bank spreads from unobserved factors that could be correlated with firm-level outcomes and that could affect different banks in a heterogeneous manner. Following [Gabaix and Koijen \(2020\)](#), we then construct an instrument from the granular residuals of this factor analysis. In this way we can fully dispel any concern that banks counterbalance particularly risky firm portfolios with high public lending shares or that risky, low-investment firms select to local public banks because no other banks would lend to them. These granular IV results confirm our earlier findings, both qualitatively and quantitatively.

We further buttress the causal interpretation of our findings by inspecting the transmission mechanism. First, we show that firms that face a higher local public bank spread see lower bank lending growth and pay slightly higher interest rates. Secondly, simple theory would suggest that crowding out is possible only if local demand for public borrowing can impact interest rates for other borrowers in the local economy. This requires local banking markets to be geographically segmented because otherwise borrowers could easily substitute local bank credit for alternative sources of finance. Consistent with this view, we document that our findings for investment, firm's bank borrowing and the average interest they pay are particularly strong in areas with strong geographical segmentation in which local public banks account for a high share of bank-firm relations. Our mechanism also requires that firms that face high public bank spreads cannot easily switch to other local (i.e. cooperative) banks in their area, e.g. because of hold-up problems that make it hard to signal their quality as a borrower to a new lender. We estimate logit models to show that firms are indeed not very likely to substitute

along the extensive margin (i.e. by establishing new bank relations), even when exposed to considerable public bank spreads. Consistent with our mechanisms, our findings are stronger for firms that are arguably more dependent on bank credit and find it harder to switch lender: younger or smaller firms and firms with fewer bank connections or a lack of internal funds.

Finally, to confirm that our results are driven by the special role of Germany's savings banks in municipal finance, we re-run our analysis using a placebo-sample in which firms' exposures are calculated based on break-even spreads imputed for our control group of local cooperative banks. Here, none of our previous results hold.

Our findings therefore suggest that local bank lending to the public sector crowds out private sector investment. The effect is economically important: according to our estimates, an increase in the local bank spread by 100 bps lowers investment for the average firm in our sample by about 6 percent. While many of the firms in our sample are small, the effect on Germany's aggregate investment—and therefore on the current account balance—is still considerable. We find that over our sample period, aggregate investment would have been, on average, 30-40 billion Euro per year higher in the absence of crowding out. This amounts to roughly 1 percent of German GDP per year.

Over the last decade, Germany's federal states and the federal government have tightened their spending under the influence of the so-called debt brake which was introduced into the federal constitution and most individual state constitutions in 2010. Against this backdrop, it may appear surprising that we find any evidence of crowding out in Germany at all. We argue that fiscal austerity at the state- and federal levels and the financial distress of many municipalities are actually two sides of the same coin. Federal and state governments shifted many expensive government spending commitments to the municipalities, whose debt is explicitly exempted from the debt brake. Since municipalities' ability to raise taxes is very limited, they plugged the gap by increased borrowing.

This setting allows us to explore to what extent fiscal austerity at the state and federal levels can account for the crowding out we see in firm-level data. Specifically, we use the consolidation needs of state-level budgets imposed by the debt brake as an instrument for the share of public lending on savings banks' balance sheets. We then repeat our firm-level analysis based on local public banks spreads constructed from instrumented public lending shares. This analysis confirms our earlier results and suggests that the debt brake alone accounts for roughly three quarters of the crowding out of private investment that we observe over our sample period.

Our findings identify an important new channel through which the contractionary effects of fiscal austerity can be amplified by locally segmented credit markets. Many countries with federal systems of government

(including e.g. the United States) have two-chamber systems in which federal and state level have to agree on any measures for fiscal consolidation. Such settings create incentives to shift the burden of fiscal adjustment to lower levels of government that do not have direct parliamentary representation. Our results suggest that this may lead to substantial crowding out if lower levels of government then finance their borrowing needs in locally segmented credit markets. This increases the economic costs of fiscal consolidation.

The paper is structured as follows. Section 2 takes a first look at the data and section 3 embeds our paper into the literature. Section 4 describes our bank- and firm-level data sets. It also introduces our theoretical and empirical framework and discusses identification. Section 5 presents our main firm-level results. In section 6, we discuss the impact of fiscal austerity at the state- and federal levels on municipal borrowing and crowding out. In section 7, we explore extensions and provide further robustness checks. Section 8 concludes.

2 A first look at the data and the mechanism

In this section we take a first look at the data to motivate the central elements of our mechanism.

One important motivation for our analysis is Germany's external surplus which has been rising considerably since the global financial crisis. Our argument is that Germany's current account surplus is partly the result of low private investment which, in turn, can be explained by local crowding out. Figure 1 plots Germany's current account balance and its composition in terms of sectoral net lending of households, non-financial and financial corporations and of the government. As is apparent, the country has been running increasing current account surpluses since the late 1990s. Turning to the composition of the current account surplus, we see that in the years before the financial crisis it is predominantly the shrinking deficit of the public sector that drives the surplus. However, net non-financial corporate lending soars during the global financial crisis and remains high thereafter. Interestingly, this is also the period when the net lending of the government sector turns positive (after temporarily turning negative during the financial crisis). In the following we argue that these developments are related. The consolidation of (federal and state-level) public finances led to a deterioration in the financial situation of local municipalities. This increased pressure on local savings banks to lend to municipalities, crowding out private investment in locally segmented credit markets. This contributed to the increase in corporate net saving that we observe in Figure 1.

Our mechanism crucially relies on the local segmentation of Germany's credit markets. The map in Figure 2 shows the county-level variation in the share of firms with a local bank relationship in our sample. While

the figure reveals considerable regional variation, its predominantly dark colour suggest that in many areas local banks are the main—and often only—provider of credit to SMEs. This dominance of local banks in their respective markets is one of the key elements of the mechanism we highlight in this paper. Not only are many SMEs too small and too opaque to borrow from the bigger, nationwide banks which are arm’s length lenders. The map suggest that in many areas local banks are actually the “only game in town”. This leaves SMEs highly exposed to changes in funding conditions imposed by the local banks.⁴

Figure 3 illustrates the role of savings banks in local public finance. It plots a municipality’s debt level (relative to GDP) against the public lending share on local banks’ balance sheet. There is a clear positive relation but it is present mainly for the savings banks not for the cooperative banks. There are several important conclusions from this figure. First, it illustrates that public sector lending by savings banks is essential to local municipalities and their connected enterprises. Secondly, it shows that there is considerable variation in the municipal lending shares of savings banks. Third, our mechanism requires that there is a certain rivalry between lending to SMEs and to municipalities. If local public banks could elastically accommodate any municipal demand for credit by lengthening their balance sheet, we would not see any crowding out. In fact, Germany’s local banks are highly dependent on local deposits. The typical savings banks will not be able to fully refinance increased municipal borrowing by simply lengthening its balance sheet proportionally. Figure 3 supports this view. Increased borrowing by municipalities not only increases the amount of municipal lending by savings banks but also the *share* of this lending in savings banks’ balance sheet.

Another important ingredient of our mechanisms is that the decline in public sector borrowing rates has made it less attractive for banks to lend to municipal borrowers. Figure 4 shows time series for the average municipal borrowing rate and the average deposit rate of German banks. The difference between these series—to which we refer as the municipal spread—has fallen to virtually zero over the period since the global financial crisis.

This fall in the municipal spread has affected savings banks more than other banks because their statutes require them to engage in municipal lending. Given the length of the banks’ balance sheet, this leads to a high shadow cost in terms of forgone lending to more lucrative borrowers. We argue that this shadow cost has induced public banks to try to break even by charging higher rates on their other customers. Figure 5

⁴However, local segmentation of banking markets alone would not be sufficient for our mechanism if firms could easily switch between the two types of local banks in their respective local market. As we show in our firm-level analysis, this is not the case. Increasing a firm’s local public bank spread by one standard deviation increases its probability of adding a new relationship with a cooperative bank by just between 1 and 2 percentage points. This suggests that the informational capital that both the firm and the bank acquire in the course of their relationship cannot easily be transferred to other lenders, even if these lenders are local.

illustrates this point. It plots the average firm lending rates of local banks (cooperative and public) against municipal lending shares for selected years in our sample.

Consistent with our hypothesis that high levels of public lending adversely affect financing conditions for local SMEs, a higher public loan share is associated with a significantly higher average firm-lending rate for the public savings banks. Conversely, the cooperative banks—which have no statutory requirement to lend to the public sector—generally have much lower public loan shares than the savings banks and the correlation between the firm-lending rate and the public loan share is weak and not statistically significant. Note also that the slope of this relation for the savings banks is becoming steeper over time, as we would expect—declining municipal lending rates increase the opportunity cost of municipal lending for the local public banks, leading to higher lending rates for firms.⁵

3 Contribution to the literature

Our paper integrates and builds on several strands of literature. Foremost, we contribute to a nascent literature on local crowding out. Using Chinese city- and firm-level data, [Huang et al. \(2020\)](#) show that private firms in cities with high levels of local government debt have lower investment while state-owned firms do not. Like ours, the mechanism explored by [Huang et al. \(2020\)](#) relies on the local segmentation of credit markets. However, our analysis differs from and extends [Huang et al. \(2020\)](#) in several important dimensions. The first is the institutional setting. Ours is the first paper to provide firm-level evidence of local crowding out in the context of a developed economy. Secondly, our use of matched bank-firm data allows us to put the crowding-out mechanism under the microscope. Specifically, [Huang et al. \(2020\)](#) cannot answer the question if bank lending to local government crowds out firm-level lending directly by reducing credit to firms connected to a specific bank or if it does so through a general equilibrium effect in which increased credit demand by local governments leads to a general increase in interest rates in the local credit market. Our bank-firm-level analysis allows us to show that crowding out takes place directly on individual banks' balance sheet through a tightening of credit conditions for the bank's firm customers.

⁵Contrasting the findings in Figure 5 for savings banks with those obtained for the cooperative banks already allows us to effectively rule out an alternative explanation for a positive correlation between banks' municipal lending share and the average firm-lending rate: that local public banks in regions where SME lending is riskier (which would be associated with higher firm-lending rates) offset the impact of this risk on their balance sheets with higher public loan shares. Cooperative banks and savings banks have a very similar customer base of borrowers and are generally active in the same local markets. It is therefore implausible that the savings banks generally have riskier loan portfolios than their cooperative counterparts and that they should display a stronger tendency than cooperative banks to offset this balance sheet risk with a higher share of notionally safe public sector loans. In our firm-bank-level analysis below, we formally dispel this concern using a granular instrumental variable procedure.

The idea that some form of financial repression by governments can reduce private sector lending has recently been explored by [Becker and Ivashina \(2018\)](#) in the context of the European sovereign debt crisis. We complement these results by showing that—due to the segmentation of local banking markets—there is intra-national variation in the strength of this crowding out channel and that its economic cost is primarily borne by the least elastic customers, i.e. small and medium sized companies. Importantly, we also show how crowding out could happen against the backdrop of a booming German economy of the last decade and of secularly low interest rates.

In its use of matched bank-firm data, our analysis builds on the seminal work by [Khwaja and Mian \(2008\)](#) and the literature spawned by this paper. [Huber \(2018\)](#) examines how an exogenous shock to Commerzbank, one of Germany's few big private banks, affected its dependent firms and counties in the aftermath of the financial crisis. While we make use of the same data source, our analysis benefits from access to historic volumes to obtain time-varying bank connections. [Popov and Rocholl \(2018\)](#) show that external financing shocks to savings banks lead to a decline in labor demand of firms which are connected to savings banks. Related, [Bian et al. \(2017\)](#) show that German firms with a government-owned bank as their main bank have lower innovation rates.

While these papers focus on credit supply shocks that adversely affect the length of the balance sheet of banks, our paper draws attention to how local banks' mandate to engage in municipal lending imposes constraints on the composition of savings banks' balance sheets and thus lead to reduced lending to firm customers *ceteris paribus*. At a methodological level, our analysis specifically addresses some potential biases that could arise in studies using bank-firm level data, e.g. because firms sort to specific banks or because there is some other form of reverse causality from firm characteristics to bank balance sheets. We do so by exploiting the unique information about the sectoral composition of bank portfolios that is implicit in our data set to construct a granular instrumental variable following the lead of [Gabaix and Koijen \(2020\)](#).

One of our key contributions to show that (and how) crowding out can happen against the backdrop of a secular decline in interest rates. In our setting declining municipal borrowing rates exacerbate the statutory public lending constraints of local public banks and thus impose a shadow cost that they try to roll over to their customers. Our analysis therefore directly relates to recent studies that have investigated the impact of low and negative interest rates on bank behavior ([Heider et al. \(2019\)](#), [Brunnermeier and Koby \(2019\)](#), [Balloch and Koby \(2022\)](#), [Basten and Mariathan \(2018\)](#)).

[Heider et al. \(2019\)](#) show that banks that mainly rely on deposit funding (i.e. are deposit-dependent) are particularly hit by the introduction of negative interest rates in the euro area. These banks cannot easily pass

on negative rates to customers which implies comparatively higher cost of funding. As a consequence, deposit-dependent banks increase their interest rates and reduce lending.

[Brunnermeier and Koby \(2019\)](#) offer an elegant theoretical analysis of the impact of persistently low interest rates on bank lending. They show that the impact of interest rates on bank lending is not monotonic, i.e. there exists a minimum level of monetary policy rates, referred to as the reversal rate, below which bank credit supply starts to decrease. We propose an extension of Brunnermeier’s and Koby’s model by adding a statutory public lending constraint to the banks problem. This model provides guidance for our empirical analysis.

[Balloch and Koby \(2022\)](#) examine the long-run impact of low interest rates on bank profitability and bank lending in Japanese data and find that the effect of low rates is particularly pernicious for deposit-dependent banks. In our empirical setting, both types of local banks—cooperative banks and savings banks—are deposit-dependent and, as shown by [Heider et al. \(2019\)](#), their business models have been affected by declining monetary policy rates. We add to these papers by arguing that the ability of savings banks to adjust to declining interest margins is particularly constrained by their mandate to engage in municipal lending. Coupled with the local segmentation of banking markets, this leads to a crowding out of private sector lending and thus of private investment. This aspect of low interest rates has not been discussed in the literature so far. Our results show that this effect is quantitatively important. Our mechanism is potentially relevant in other settings as well since public banks are a feature of the banking landscape in many countries.

Our analysis is also informed by a number of recent papers that have shown that lending decisions of Germany’s savings banks are subject to political influence. [Englmaier and Stowasser \(2017\)](#) document an electoral cycle in the lending of Germany’s savings banks. [Markgraf and Rosas \(2019\)](#) show that mayors who sit on the boards of German savings banks are more likely to get re-elected than their peers who are not board members. [Koetter and Popov \(2021\)](#) suggest that local governments try to curry favor with state-level governments of a different party by letting their savings banks increase their holding of state-level bonds. Different from these papers, our analysis benefits from having access to matched bank-firm data. This allows us to identify the specific channel through which real outcomes are affected.

We also place our results against the backdrop of a recent literature that documents a secular rise in corporate net savings since the 1980s. [Chen et al. \(2017\)](#) and [Dao and Maggi \(2018\)](#) argue that this increase is a global phenomenon that affects all industrialized economies. However, these studies generally focus on large, listed firms. By contrast, Germany’s local banks predominantly lend to SMEs and our results are therefore driven by small, non-listed firms, Germany’s famous “Mittelstand”. Ours is the first paper to document the low investment

rates of German “Mittelstand” firms and to draw attention to their financing situation as one of its causes.

Our results also contribute to the literature on local fiscal multipliers (Nakamura and Steinsson (2014); Adelino et al. (2017)) and, more generally, the literature on the potentially pernicious effects of fiscal austerity (see e.g. Fetzner (2019)). It is particularly interesting to study the link between local public finance and firm investment in the German context of the last decade because Germany was one of the global leaders in the drive to fiscal austerity. Our results show how fiscal austerity can backfire in unexpected ways. When credit markets are locally segmented, preferential lending of local public banks to local governments creates an adverse effect on the real economy. In other words: if municipalities were to finance their debt through bonds or at the national or international level, the adverse effects on the local economy would plausibly be much smaller.⁶

Finally, our paper connects to a classic study by Song et al. (2011) which also inspires the title of our paper. Song et al. (2011) show that China’s persistent current account surpluses reflect a domestic misallocation of capital: since only politically connected (state-owned) firms can borrow from banks, domestic private firms are required to finance investment from internal funds. This keeps private sector investment lower than it would otherwise be. While the details of our mechanism differ, our analysis reveals that the basic insight that current account surpluses can be the reflection of domestic financial frictions, can usefully be applied to a developed economy. In our setting it is the requirement for savings banks to lend to politically connected borrowers (municipalities) that forces local banks to impose tighter funding conditions on unconnected borrower firms.

4 Data and empirical framework

4.1 Data sources

We build a data set of firm outcomes and firm-bank relationships matched with lending statistics for the banks. To this end, we rely on two data sources, *Dafne* and *FitchConnect*.

Dafne is a data base provided by *Bureau van Dijk* which contains the balance sheets and income statements for up to 1.4 million German firms based on annual reports of the companies. *Dafne* also contains bank relationships for the majority of firms. Since bank relationships are overwritten in each year, we make use of historical volumes of the data base to obtain a panel of firm-level data. This panel also provides us with time-varying

⁶Recall that our identification exploits matched bank-firm data and a de-facto control group of firms borrowing from other (co-operative) local banks. This allows us to effectively rule out that low firm investment is driven by a direct negative multiplier effect of fiscal austerity on local or sector-specific demand. Building on our approach here, Pinardon-Touati (2022) provides a taxonomy based on French data of how local crowding out affects the magnitude of local fiscal multipliers.

bank-firm connections.

To proxy investment behaviour of the firm, we compute the investment rate as the difference in fixed assets from t to $t + 1$ divided by fixed assets in t . We measure the effective interest rate paid by the firm using the ratio of interest payments over last period's bank liabilities. We compute bank liabilities growth as the t to $t + 1$ change in bank liabilities divided by bank liabilities in t .

Our main measure of firm size is the natural logarithm of total assets. We compute equity and cash flow shares as the ratio of the respective variable to total assets.

We merge our firm-level data set with bank-level information from *FitchConnect*, a database provided by *Fitch* which contains historical bank balance sheets. We extract information on the net interest margin, net loans, and on public sector loans. Public sector loans in the bank balance sheet data comprise all lending to public borrowers, including the lending to public owner-operated enterprises and municipal enterprises without legal capacity ("Eigenbetriebe") which are legally part of their respective municipality but whose financial budgets are formally separate. We compute municipal lending shares as the ratio of public sector loans to total bank assets. Data on public sector loans in *FitchConnect* are available from 2009. For this reason and because our interest is in the recent, post-crisis period of Germany's high current-account surpluses, our empirical analysis in this paper generally focuses on the period 2010-2016.

4.2 Public sector lending and private-sector borrowing rates

The decline of the municipal spread that we documented in Figure 4 is a particular problem for Germany's local public banks. By their statutory mandate they have to provide financing to the public sector. At the same time, they are generally highly dependent on local deposits and their mandate as retail bank for the masses makes it much harder for them than for commercial banks to charge negative deposit rates, increase fees or to make cuts to their dense (and expensive) branch networks. We argue that, over our sample period, these constraints lead Germany's local public banks to charge their least elastic SME customers higher interest rates than they would otherwise have done.

In the appendix, we provide a simple model inspired by [Brunnermeier and Koby \(2019\)](#) to formalize this idea. In the model, banks have market power in local SME lending markets. As in [Brunnermeier and Koby \(2019\)](#), all banks face an equity constraint. They also face a supply of deposits that is not perfectly elastic. In addition, because of their public mandate, local public banks also have a statutory requirement to hold a minimum fraction of their balance sheet in the form of local public debt.

The model predicts that the bank will charge its other customers (i.e. SMEs) higher interest rates if the statutory public lending requirement is binding. As long as the banks' supply of deposits is not perfectly elastic, a binding constraint on public sector lending leads to inefficiently low provision of credit to other customers. In order to at least partially make up for this, a profit-maximizing bank will therefore use its market power to charge higher SME lending rates than it would do otherwise. We refer to this differential between the constrained and the unconstrained lending rate as the break-even spread, θ . The break-even spread captures the banks' success at making up for the shadow cost of a binding statutory public lending requirement and is our measure of the extent to which this requirement crowds out SME lending. Formally, the model allows us to write the SME (firm) lending rate $i_t^{F,b}$ of bank b in year t as

$$i_t^{F,b} = \theta_t^b + i_t^{U,b} \quad (1)$$

where $\theta_t^b > 0$ is bank b 's break-even spread at time t and $i_t^{U,b}$ is the lending rate that the bank would set if it was not constrained by the statutory public lending requirement. The break-even spread θ_t^b reflects the shadow price on the statutory public lending constraint which stipulates that the share of municipal lending, λ_t^b must not fall below an exogenously given bank-specific threshold $\bar{\lambda}_t^b$. In appendix A we show that the break-even spread can be written as

$$\theta = \frac{\frac{1}{\varepsilon_D} - (i^P - i^D)}{1 - \bar{\lambda}} \quad (2)$$

where ε_D is the elasticity of deposit supply, i^P is the lending rate for public sector loans (common across all banks) and i^D is the bank's deposit rate. For notational convenience, we have suppressed the bank and time index. Three features of equation 2 are worth highlighting.

First, equation (2) implies that, for constrained banks (for which $\lambda = \bar{\lambda}$), the break-even spread will be increasing in λ . Note also that an exogenous increase in $\bar{\lambda}$ will make it more likely that the statutory public lending requirement becomes binding for previously unconstrained banks. In the second part of the paper, we argue that an exogenous increase in the fiscal burden imposed on municipalities by state-level debt brakes increased the lower bounds $\bar{\lambda}$ for the local savings banks. This will allow us to use the debt brake as an instrument for the λ of savings banks.

Secondly, as can be seen from the first term in the numerator, banks with a less elastic supply of funds

(deposits), will charge a higher break-even spread *ceteris paribus*. The less elastic the supply of deposits to the bank, the costlier it is to raise additional funds to satisfy the statutory lending requirement. Hence, a less elastic balance sheet forces the bank to curtail lending to firms more. Since the bank has market power in the SME lending market, this reduction in lending will happen through an increase in the spread charged to SME customers. We note that the assumption that banks' balance sheet is not fully elastic is likely to be satisfied for Germany's local banks (both cooperative and public) with their heavy reliance on deposits.⁷

Third, equation (2) predicts that an exogenous decline in the municipal spread $i^P - i^D$ leads to a higher break-even spread. The intuition here is that the decline in $i^P - i^D$ makes it less attractive to invest in municipal loans and lowers the optimal (unconstrained) level of λ . This increases the shadow cost on the statutory public lending requirement. It also makes it more likely that the statutory public lending binds for previously unconstrained banks. This link between the municipal spread and the break-even spread is an important feature of our model since it can explain why our mechanism should be particularly pertinent to the low-interest rate environment of the last decade, during which spreads between municipal lending rates and banks' refinancing rates have been lower than ever before.

4.3 Identifying break-even spreads in the data

Note that neither θ_t^b nor in fact $i_t^{F,b}$ is directly observable. To explore the link between public loans and SME lending rates in the data, we therefore start from the following representation of the bank's net interest margin:

$$\text{NetInterestMargin}_t^b = \lambda_t^b (i_t^P - i_t^D) + (1 - \lambda_t^b) (i_t^{F,b} - i_t^D) + (1 - \delta) i_t^D \quad (3)$$

where λ_t^b is again the public (municipal) debt share of a banks' total lending and δ is the share of deposits in the bank's balance sheets. Furthermore, i_t^D and i_t^P denote the deposit rate, and the rate on public sector lending respectively and $i_t^{F,b}$ denotes the firm lending rate from above.⁸

In our bank data set, we directly observe the bank's net interest margin as well as the share of public sector

⁷In the next subsection, we discuss how to estimate θ from data on λ and the municipal spread. In this setting the assumption that $1/\varepsilon_D = 0$ becomes easily testable for constrained banks and is rejected by the data. See also our discussion in appendix A and the additional empirical results discussed there.

⁸Strictly speaking, in this decomposition $i_t^{F,b}$ is the average borrowing rate of all private-sector customers of the bank. To what extent $i_t^{F,b}$ ultimately reflects firms borrowing conditions is therefore an empirical question. As we have argued before, SMEs are arguably the least elastic private borrowers so that we would expect them to bear the brunt of the real impact of this spread. We therefore identify this average private-sector borrowing rate with the firm lending rate $i_t^{F,b}$ of the bank. To the extent that other private borrowers (such as e.g. private households) are considerably more elastic in their credit demand, $i_t^{F,b}$ would actually tend to underestimate the effective interest rate and the break-even spread charged to firms.

loans, λ_t^b and the deposit share δ . To obtain an estimate of $i_t^{F,b}$, we therefore assume that i_t^P is given by the benchmark rate of return on municipal bonds⁹ and we use the average deposit rate for all banks published by the Deutsche Bundesbank as our measure of the deposit rate i_t^D .¹⁰ Based on these assumptions, for each bank in our sample, we then obtain a time-series of the firm-lending rate $i_t^{F,b}$ by rearranging equation (3).

Having thus obtained an estimate of $i_t^{F,b}$, we can use our model to identify the break-even spread θ_t^b . Recall from equation (2) that our model implies a non-linear relationship between the municipal lending share λ and the firm-lending rate. Defining $\Lambda_t^b = \frac{1}{1-\lambda_t^b}$ and plugging (2) into (1), we can estimate the relationship from the following panel regression

$$i_t^{F,b} = \underbrace{\mathbf{a} \times \Lambda_t^b + \mathbf{b} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t}_{\theta_t^b} + \underbrace{\text{TIME} + \text{REGION} + \text{BANK CONTROLS}}_{i_t^{U,b}} \quad (4)$$

which we run separately for the sample of Sparkassen and Volksbanken. This regression is our direct empirical counterpart to the decomposition (1) and to equation (2) above. Note that the first two terms on the right hand side capture the dependence of $i_t^{F,b}$ on the public lending share and on the declining spread of municipal borrowing rates over deposit rates and can therefore be associated with the break-even spread, θ_t^b . The remaining terms on the right hand side capture time, regional and bank-level variation in firm lending rates.

The results are presented in Table 2. Both coefficients \mathbf{a} and \mathbf{b} are significant only for the savings banks, not for cooperative banks. This is consistent with the prediction from our model, that a significant link between municipal lending and the firm-lending rate should only be present for banks that actually face a binding statutory lending constraint. Also consistent with our model, the coefficient \mathbf{a} is positive, while \mathbf{b} is close to negative unity, as predicted by theory.

Equation (2) implies that, for constrained banks, the estimate of \mathbf{a} corresponds to the inverse of the elasticity of banks' deposit supply, $1/\epsilon_D$. Banks with less elastic balances sheets (i.e. that find it harder to raise additional

⁹While direct evidence on the borrowing conditions municipalities face is scarce, we note again that loans to municipalities carry a risk weight of zero and that the federal states are ultimately liable for these loans. This suggests that spreads of individual loans to local governments over, say, German treasury bills are likely to be small and that the common component is likely to be dominant. Some indicative evidence can be gleaned from the risk premia on municipal bonds of major German cities that are around 25-30 basis points on average and appear rather uniform across cities (Friedrich et al. (2014)).

¹⁰We do not have direct observations on bank refinancing rates. Our model predicts that by assuming i_t^D is the same across banks, we will underestimate $i_t^{F,b}$ and θ for constrained banks. According to the model, constrained banks partially accommodate higher public borrowing demand by taking on additional deposits, paying higher deposit rates in order to do so. This suggests that our empirical results are conservative. To check for robustness, we also ran all our bank- and firm-level results with a version of $i_t^{F,b}$ computed using a bank-specific measure of refinancing costs, $i_t^{D,b}$ that is constructed as the weighted average between the country-wide deposit and the money market rate, using the bank-specific shares of core deposits and wholesale funding in total funding as weights. All our conclusions remain unaffected.

deposits) should have higher estimates of \mathbf{a} and thus higher firm-lending rates. This is what we find if we split the sample of savings banks into subsamples with low and high core deposit dependence. See Table A.6 and appendix A and for further discussion of the model properties.

4.4 Constructing firm-level exposures: the local public bank spread

We now construct firm-level exposures to the funding conditions set by local public banks. As we have shown in the previous subsection, differences in firm lending rates across banks and regions are related to the extent of the banks' municipal lending and to the general decline in the spread of public sector loans over the bank's refinancing rate. We therefore use estimates of regression (4) for the local public banks to back out an empirical estimate of the break-even spread, $\hat{\theta}_t^b$, as the fitted value

$$\hat{\theta}_t^b = \hat{\mathbf{a}} \times \Lambda_t^b + \hat{\mathbf{b}} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t \quad (5)$$

where $\hat{\mathbf{a}}$ and $\hat{\mathbf{b}}$ are the estimates of the respective coefficients in regression (4).

In a next step, we then combine the break-even spreads charged by local public banks with information on firms' bank relations to construct the average break-even spread that a firm is exposed to because it is connected to local public banks. For firm f in year t we define this exposure to spreads charged by local public banks, SPK_t^f , as follows:

$$SPK_t^f = \sum_{b \in \mathcal{B}_t(f)} \omega_t^{f,b} \times \hat{\theta}_t^b \times \mathbb{1}_{b=\text{LOCAL PUBLIC BANK}} \quad (6)$$

where $\mathcal{B}_t(f)$ is the set of all local banks with which firm f maintains a lending relationship in year t , $\omega_t^{f,b}$ is the weight of the relation with bank b and $\mathbb{1}_{b=\text{LOCAL PUBLIC BANK}}$ is an indicator variable for whether bank b is a local public bank. We refer to SPK as local public bank spread.

We make two remarks concerning the construction of SPK . First, our data set does not contain direct information about the amount of loans that a firm borrows from each bank. Also, even if this information was available, the actual extent to which each firm borrows from a bank could be endogenous to firm- or bank-level characteristics. Petersen and Rajan (1995) and Degryse and Ongena (2005) have shown that distance to the lending bank and the competitors is a key determinant of the lending conditions faced by SMEs. We therefore impute the weights $\omega_t^{f,b}$ based on the inverse of the geographical distance, $\text{dist}^{f,b}$, between firm f and the closest branch of bank b :

$$\omega_t^{f,b} = \frac{\frac{1}{1+\text{dist}^{f,b}}}{\sum_{j \in \mathcal{B}_t(f)} \frac{1}{1+\text{dist}^{f,j}}} \quad (7)$$

This weighting reflects the notion that distance is a key determinant of the intensity of a bank relation, in particular when lending is relationship-based, as is the case for Germany's SMEs.

Second, we note that an implicit assumption in constructing SPK is that cooperative and other banks do not charge a local public bank spread. This assumption is empirically justified by the results in Table 2 and reflects the different institutional constraints faced by local public and cooperative banks. In our empirical analysis below, we generate a placebo treatment by assigning non-zero values for $\hat{\theta}_t^b$ to cooperative and other banks based on the procedure above. None of our main results holds under this placebo treatment, providing further evidence that our mechanism is driven by the institutional features of local public banks.

4.5 Firm-level regressions: estimation and identification

We conjecture that higher levels of the local public bank spread lead firms to invest less. However, consistent with the literature on the firm-borrowing channel (Khwaja and Mian (2008)), the impact of SPK on firm-level outcomes should also depend on the firm's ability to tap alternative sources of finance. Our baseline specification therefore becomes

$$\text{INV}_t^f = \alpha \times SPK_t^f + \beta \times \boldsymbol{\eta}^f \times SPK_t^f + \boldsymbol{\beta}' \mathbf{X}_t^f + \boldsymbol{\delta}_t^f + u_t^f \quad (8)$$

where the dependent variable INV_t^f is the investment rate of firm f in year t and $\boldsymbol{\eta}^f$ is a generic measure of the firm's ability to substitute credit from local public banks with other funds, such as firm size, the availability of internal funds, firm age or the number of bank relationships. We therefore refer to $\boldsymbol{\eta}$ as the firm's substitution elasticity with respect to local public bank credit.

The vector \mathbf{X}_t^f contains time-varying firm-specific controls and the vector $\boldsymbol{\delta}_t^f$ collects a range of fixed effects, including firm fixed effects, municipality-time and sector-time effects. Since $\boldsymbol{\eta}$ will generally be time-invariant in our specifications, its stand-alone term will be absorbed by firm effects and is therefore not included above.

The marginal effect of SPK on investment (or other firm-level outcomes) is then given by $\alpha + \beta \times \eta$, where we would expect that $\alpha < 0$ and $\beta > 0$: the real impact of a higher local public bank spread is dampened for firms with a higher substitution elasticity. In our analysis below, we will generally measure η as deviation from the median value of the substitution elasticity for a reference group of firms (e.g. a sector). This normalization allows us to interpret α as an average treatment effect of SPK on firm-level investment in the respective reference group.

There are a number of reasons that underpin this causal interpretation. First, our use of matched bank-firm data effectively allows us to rule out a lot of factors that could confound our estimate of α . Specifically, the break-even spreads used to compute SPK are constructed using bank's balance sheet information about public lending and aggregate information on the municipal spread only, while controlling for local and time variation in market interest rates and bank characteristics. Hence, SPK is likely uncorrelated with omitted time-varying firm-specific factors such as variation in the firm's demand for loans or a firm's riskiness. Second, SPK exploits variation across firms in the same location in terms of their banking relations. This makes SPK uncorrelated with common, region-specific influences that affect all firms in the same location.

Our approach also takes account of potential threats to identification that could arise if specific firms match with specific banks. For example, it is well known that savings banks specialize in relationship lending to small and medium sized firms. If these firms happen to have lower investment rates, e.g. because they are less productive or subject to higher levels of idiosyncratic risk, this could bias the estimate of α towards the negative. We can effectively alleviate this concern because the composition of the customer base and the business model of local cooperative banks are very similar to that of savings banks and many small firms are customers of both types of banks. Since only the savings banks customers get exposed to the break-even spreads, the estimate of α is therefore unaffected by sorting of small firms to specific local banks.

5 Firm-Level Results

5.1 Descriptive statistics

Table 1 provides summary statistics for the main variables in our data set. The average of the local bank spread across all firm-year observations in our sample is 71 basis points. The variation across firms is also considerable. The standard deviation of SPK is 86 basis points. The average investment rate (as a fraction of assets) for the firm in our sample is around 15 percent, while the average interest rate firms pay on their liabilities is around

3 percent. Interest rates vary widely across firms, the standard deviation of interest rates paid by firms is of the same magnitude as the mean. Average bank liabilities growth across our sample of firms is around 1 percent per year, again with wide variation. The average firm has around $420000 = 1000 * \exp(6.04)$ EUR in assets and has a cash flow of 9 percent of total assets.

5.2 Firm-level: baseline results

As our baseline measure of the substitution elasticity η^f in the firm-level regression (8) we choose firm size as measured by the log of firms' total assets. We take the value in the first year of our sample (2010) and subtract the sector-median firm size in that year. This normalization ensures that the stand-alone coefficient α measures the marginal impact of SPK on the median firm in the firm's respective sector which facilitates the interpretation of our quantitative results. We estimate (8) using OLS and clustering standard errors at the municipal (county) level. Table 3 presents the results .

Column (1) shows a plain specification with time and firm fixed effects. Our estimate of the coefficient on SPK , α , is negative and significant. Conversely, the coefficient on the interaction term $SPK \times \eta$ is significantly positive, in line with our conjecture that bigger firms can more easily substitute loans from local public banks with other sources of finance and are therefore less exposed to SPK .

In column (2), we add firm size and the equity share as firm-specific controls. We refer to these variables as the baseline controls as we will use them in most specifications throughout the rest of the paper.¹¹ Adding firm-level controls hardly affects the estimate of α .

Low firm-level investment could be the results of some regions or sectors being in relative decline or being exposed to specific adverse shocks. If, for some reason, local public banks are particularly active in these declining regions or if they lend primarily to certain sectors, this could lead to a correlation between these firm's investment rates and SPK that could bias our estimates of α downward. To rule out that our results are confounded by such regional or sector-specific factors, we include municipality-time effects in column (3) and also add sector-specific time effects in column (4). This decreases our estimate of α to around -0.8 but the coefficient stays highly significant. In column (5) we further tighten our specification, by including county-sector-time dummies. This effectively allows sectoral factors to load differently on different regions and also

¹¹With these controls, derived from firm-balance sheets, our data set comprises roughly 1.8 mio observations. In the appendix we report results with an extended set of controls including e.g. revenue growth and cash flow that are derived from income statements. None of our main results is sensitive to this choice. However, the majority of firms in our data set only consistently report balance sheet items and not the income statements. Hence, including variables derived from income statements in the regression, considerably lowers the number of observations.

controls for heterogeneous effects of regional factors across sectors. The estimate of α remains stable and significantly negative. We consider the specification in column (5) with our baseline set of firm-level controls and with firm-level and county-sector-time fixed effects as our benchmark for firm-level regressions in the rest of the paper.

In Table 4, we provide estimates of this benchmark specification for three alternative measures of the substitution elasticity η^f : (log) firm employment, firm age and the number of bank relationships of the firm. In column (1), for convenience, we also reproduce the baseline specification from column (4) of the previous table. Table 4 reveals the same pattern we have documented before. The coefficient α is negative and significant throughout and a higher ability to substitute funds lowers the impact of the local public bank spread on firm-level investment. Our estimates of α vary somewhat across different specifications in Table 4 since by varying the concept of η we effectively normalize the stand-alone coefficient α to measure the marginal impact of SPK at very different points of the firm distribution.

It is instructive to gauge the economic significance of our estimates of α and to evaluate the impact of SPK on firm-level investment implied by the different specifications in Table 4.

Consider first our benchmark specification in column (1) (or, equivalently, column (5) of Table 3). The value of α of -0.88 means that a one-standard deviation increase in the local bank spread of around 85 basis points will lower the investment rate for the median firm by around 0.75 percentage points. With an average investment rate of 15 percent of fixed assets across all firms, this amounts to a 5 percent ($0.0075/0.15$) decrease in firm-level investment.

At the other end of the spectrum of estimates of α , consider the specification where η is measured by firm employment in column (2). Here, the value of -3.48 implies that a one standard deviation increase in SPK lowers investment by almost 3 percentage points or 2 percent of the usual level of investment of the average firm.

Hence, the results in Table 4 show that firms invest considerably less in response to increases in their local bank spread. Since the local public bank spread ultimately reflects the shadow costs of municipal debt holdings across savings banks, our results suggest that local public debt crowds out private investment in Germany's locally segmented credit markets to a considerable extent.

To appreciate the magnitude of the sensitivity of investment to local public bank spreads, we relate our estimates to earlier studies in the literature.

Consistent with Gilchrist and Zakrajsek (2007) and Guiso et al. (2002) we find that investment is highly

sensitive to truly exogenous measures of firm interest rates.¹² Our most conservative baseline estimate for α implies that a 100 basis point increase in the interest rate lowers investment by 90 basis point. This is only slightly higher than the 75 basis points reduction found by Gilchrist and Zakrajsek (2007).

While of the same order of magnitude, the sensitivities implied by the other specifications in Table 4 are 2-3 times higher. To understand this discrepancy, note that Gilchrist and Zakrajsek (2007)'s estimates are based on a sample of big, listed and bond-issuing firms from the period before the financial crisis. We would expect that the smaller and more opaque firms that dominate in our sample are considerably more sensitive to changes in financing conditions. Furthermore, as recently highlighted by Lin et al. (2018), the secular drop in interest rates since the financial crisis and the commitment of monetary policymakers to keep rates low for long will considerably increase the sensitivity of investment to small changes in interest rates. Against this backdrop, it may not appear surprising that the estimates by Gilchrist and Zakrajsek (2007) should provide a lower bound on our estimates here.¹³

5.3 Transmission mechanism

Firm-level borrowing and interest rates Our theory would predict that higher local public bank spreads lead to a deterioration of credit terms and to reduced lending to customer firms. Table 5 provides evidence to this effect.

Here we re-run our baseline regression with the growth rate of firms' bank liabilities (column (1)) and the average interest rate firms pay on their loans (column (2)) as the dependent variables. Higher exposure to SPK lowers firms' bank borrowing. The estimated coefficient on SPK in column (1) implies that a 100 basis points increase in the local bank spread would lower firms' bank borrowing by about 7 percent. The results in column (2) suggest that the average interest rate that firms pay on their outstanding bank liabilities increases by around 25 bps after a 100 bps increase in SPK .

Crowding out of private investment should only be possible in markets where the savings banks have sufficiently high market power. If firms can easily switch away from the savings banks, then variation in SPK should

¹²The early literature in this area based on macro or sectoral time series evidence generally found it difficult to establish a significant link between interest rates and investment. As discussed by Guiso et al. (2002), studies based on firm-level evidence that use truly exogenous shifters in firm's cost of capital (such as e.g. tax reforms or indicators of firm-level interest rates constructed using bank-level information, as we do here) tend to find much larger effects.

¹³The finding that small spreads have a relatively bigger impact on SME investment in a low-for-long environment also has implications for the transmission of monetary policy. If average borrowing rates are low, then relatively small frictions in the financial system may have a disproportionate effect on firm-level investment. This can frustrate attempts by the monetary authority to stimulate the economy with low or negative interest rates.

have no bearing on real outcomes. Table 6 illustrates that savings banks' market power in Germany's locally segmented lending markets is indeed an important ingredient of our mechanism. The table reports results for investment, bank liability growth and the average interest rates paid by firms on two sub-samples: one for firms head-quartered in counties where savings banks account for a high (above-median) share of all bank-firm relationships ("high SPK share") and one for firms head-quartered in counties with a low share of savings banks in firm-bank relations ("low SPK share"). In the investment regression, our estimate of α in the high-SPK-share counties (column (1)) is significant and much higher than when estimated with the same controls on the whole sample (compare column (4) of Table 3). Conversely, the coefficient is much lower and insignificant when estimated on the low-SPKs-share sample (column (2)). The same pattern holds for the bank-liability growth and interest rate regressions. SPK has a much stronger bearing on firm-level outcomes in the high-SPK-share counties (columns (3) and (5)) than in the low-SPK-share counties (columns (4) and (6)).

Firm's switching behavior Table A.1 provides direct evidence that firms exposed to SPK cannot easily switch to other banks. The table presents results of logit regressions of firms' bank relationship choice on the local public bank spread of the form

$$\text{SWITCH}_{t,t+1}^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f \quad (9)$$

where $\text{SWITCH}_{t,t+1}^f$ is a dummy capturing changes in firms' bank relationships between period t and $t + 1$. We consider two versions of this dummy. The first captures if a bank that was previously only linked to savings banks establishes bank relations with any other bank type. The second explores if the firm establishes a bank relationships with a cooperative bank, i.e. with savings banks direct local competitors. In estimating (9) we subset to those firms that only report savings bank relationships at time t . This allows us to focus on firms that can mitigate exposure to the local public bank spread only by establishing new banks relations along the extensive margin (rather than intensifying existing relations with non-savings banks). This set of fully savings-bank dependent firms accounts for around 50 percent of the firm-year observations in our sample, reflecting the dominance of savings banks in most local markets. We again run regression 9 for the sub-samples of high- and low savings-bank shares. The table shows that being exposed to SPK significantly increase the probability of firms to switch to other bank types in the low-SPK-share municipalities but has no significant effect on firm's switching behavior in the high-SPK-share areas. Even in the former set of municipalities, the effect is

quantitatively small. A one standard deviation increase in SPK increases the firm's probability of switching to any other bank type within the next year by just 1.5 percentage points and by only 0.3 percentage points for switches to cooperative banks. This suggests that there are considerable hold-up problems making it hard for savings-bank dependent firms to avoid the exposure to the local public bank spread.

Placebo treatment To further illustrate the particular role that the local public banks play for our results, we repeat our analysis using a placebo treatment. To this end, we construct a break-even spread for the local cooperative banks using the bank-level regression in column 3 of Table 2 while setting the break-even spreads for the savings banks to zero. We then re-construct SPK using this set of break-even spreads and re-estimate the previous firm-level regressions. The results are in Tables A.2 in the appendix. As is apparent, the local public bank spread SPK is insignificant for investment but also for the two variables that should play a central role for submission: firms' bank liability growth and the average interest rate they pay.

5.4 Granular IV estimation

An important assumption underlying our identification strategy is that local public banks' break-even spread are exogenous with respect to firms' investment decisions after controlling for our rich set of time-varying sector and regional effects.

In this subsection we probe this assumption empirically. Specifically, our identification strategy would be threatened if certain firms select to savings banks based on some unobserved or uncontrolled firm-specific characteristics *and* if the local public bank spread is affected by these characteristics. For example, this could be the case if local savings banks are charging a higher interest rate when lending to particularly risky firms in certain sectors that other banks do not want to lend to. The number of such firms might be particularly high in distressed areas with high public debt levels (and therefore high municipal lending shares). In this setting higher local public bank spreads would arise because firms connected to savings banks are risky and not because the statutory public lending requirement imposes a shadow cost on the bank. In the same mould, it could be that municipal lending and high public expenditures of local government affect demand of savings-bank dependent firms more strongly than their peers connected to local cooperative banks. This could lead them to demand more loans, leading to higher local public bank spreads. In both cases, we would then have a reverse causality between firms' investment and public banks' break-even spreads.

Making this point more formally, assume that our measurement of banks' break-even spreads is correlated

with an unobserved vector of factors F_t , so that

$$\widehat{\theta}_t^b = \phi_t^b F_t + \zeta_t^b \quad (10)$$

where ϕ_t^b is a vector of bank-specific loadings on F_t and ζ_t^b is the ‘true’ break-even spread that is uncorrelated with F_t .

If F_t is for some reason correlated with firm investment, then the estimated residual of the investment equation (8) will be $\widehat{u}_t^f = u_t^f + \gamma_t^f F_t$ for some vector of firm-specific loadings γ_t^f and our OLS estimate of α would be biased.

To check to what extent our OLS results are affected by such confounders, we propose to adapt the granular instrumental variable (GIV) approach pioneered by [Gabaix and Koijen \(2020\)](#). Specifically, assume for a moment that we had estimates of the factors F_t and the loadings ϕ_t^b . Then we can obtain an estimate $\widehat{\zeta}_t^b$ of the exogenous part of the break-even spread and construct the granular instrumental variable

$$\mathcal{GIV}_t^f = \sum_{b \in \mathcal{B}_t(f)} \omega_t^{f,b} \times \widehat{\zeta}_t^b \quad (11)$$

where $\mathcal{B}_t(f)$ is again the set of banks with which firm f maintains relations and $\omega_t^{f,b}$ is our set of distance weights from 6 above. \mathcal{GIV}_t^f would be a valid instrument for SPK because $\widehat{\zeta}_t^b$ is correlated with SPK via $\widehat{\theta}_t^b$ while being uncorrelated with the vector of confounders F_t by construction.

Estimation of the confounding factors F_t could be done jointly with the loadings ϕ_t^b using some factor-analytical technique. Alternatively, we could use some economic theory to parametrize the loadings in terms of economic observables. This is the approach we follow here. In particular, we make use of the structure of our data set and interpret ϕ_t^b as the vector of sectoral portfolio weights of bank b . While our data set does not contain the actual amount bank b lends to each firm, it allows us to compute the number of firms connected to each bank and also the share of each sector in the banks’ firm relationships. In this way, we obtain a time-varying sequence of sectoral proxy portfolio weights for each bank which we take as our loadings ϕ_t^b . Once the loadings ϕ_t^b are known, the factors F_t in (10) can now easily be estimated by running a cross-sectional regression of the break-even spreads on the banks’ portfolio shares for each year.¹⁴ To obtain an optimal, precision-weighted

¹⁴To keep the number of factors manageable, we limit ourselves to the sectors which on average have the highest shares in the portfolios of local banks: manufacturing (NACE-1 code C), construction (F), commerce (G), and technical and professional services

instrument in the sense of [Gabaix and Koijen \(2020\)](#), we estimate (10) using weighted least squares with the weights given by the inverse of the bank-specific mean of Λ_t^b .¹⁵ We construct gIV_t^f using the residual of this regression as our measure of $\widehat{\zeta}_t^b$.

In Table 7 we report results using gIV and its interaction with η as instruments for SPK and its interaction with η . Our earlier conclusions prevail: firms exposed to higher break-even spreads have significantly lower investment and bank liability growth, and the effect on interest rates is significantly positive. The first-stage regressions (for SPK and its interaction with η respectively) are both highly significant. Since we have more than one endogenous variable, we also have to check that the instruments span the space of the endogenous regressors, i.e. that they are linearly independent. To this end, we use the [Sanderson and Windmeijer \(2016\)](#) conditional F-statistics and bootstrap its p-values using 1000 replications. These signal that the instruments (gIV and its interaction with η) are indeed linearly independent. Turning to the quantitative economic interpretation of the IV estimates, we note that the point estimates of α in all three regressions are very similar to those obtained in our corresponding OLS specifications in column (5) of Table 3 and in Table 5. While the coefficients are generally a bit bigger (in absolute value) than the OLS estimates, we have to bear in mind that the standard deviation of the first-stage fitted value of SPK at around 75 basis points is also slightly lower than that of SPK itself (85 basis points). Hence, our previous conclusions that a one-standard deviation increase in SPK lowers investment by around 5 percent, bank liabilities by around 7 percent and increases firms average interest payments by around 30 basis points remain virtually unaltered.

6 The role of fiscal austerity

Our results show that banks with higher public debt shares charge higher interest rates to their private borrowers and that this crowds out private investment in Germany’s locally segmented banking markets. Against the background of Germany’s recent fiscal consolidation over the last decade, this finding may appear surprising, at first. In this section, we provide evidence that fiscal austerity at the state and federal levels and the financing of public debt by local banks are two sides of the same coin.

Starting in 2009, the federal government and most federal states incorporated so-called debt brakes into

(M).

¹⁵[Gabaix and Koijen \(2020\)](#) show that it is efficient to weight the granular residuals $\widehat{\zeta}_t^b$ with the inverse of their volatility. However, our sample is relatively short, so that estimates of the volatility of $\widehat{\zeta}_t^b$ for individual banks are likely to be very noisy. We therefore take guidance from our economic theory: equation (2) states that banks’ break even-spread should be more sensitive to exogenous fluctuations in the municipal spread if they have higher values of Λ , implying that these banks should have more volatile $\widehat{\theta}_t^b$.

the federal and state constitutions. These debt brakes stipulate that the federal government and the states may not incur new debt by 2016 and 2020, respectively. While some allowances are made for recessionary periods, the debt brakes limit the federal government to 0.35 percent of GDP and that of the states to zero in normal times.

We argue that the debt brake legislation generated exogenous variation in fiscal consolidation needs at the state-level that then impacted municipalities differentially depending on their specific fiscal situation at the time the debt brake came into being (2010). We exploit this variation to instrument the municipal lending share in our bank-level regressions. This allows us to answer the question what fraction of the crowding-out that we have documented in the data can be accounted for by fiscal consolidation.

As discussed before, the debt brake has encouraged state- and federal governments to shift expensive government tasks to the municipalities.¹⁶ Importantly, the constitutional debt brakes do not generally cover the debt of the municipalities. However, already prior to the introduction of the debt brake, the debt levels of many municipalities were so high that their ability to take on new expensive government tasks, let alone to generate new public investment, was severely impaired. We argue that fiscal consolidation needs at the state level directly impacted municipalities and led to increased public debt shares on local bank balance sheets. Since municipalities have only very limited taxation powers, they had to fill the funding gaps through increased borrowing.¹⁷

Due to their statutory public lending requirement, we would expect this increased municipal credit demand to lead to increased municipal lending by savings banks, particularly in municipalities where there was high public debt to begin with. To make this point formally, we construct a measure of fiscal consolidation needs ('fiscal pressure') at the state level as follows:

$$FP_t^s = - \min (\text{DEFICIT}_t^s - \text{CONSOLIDATION PATH}_t^s, 0) \quad (12)$$

where s indexes the federal state, DEFICIT_t^s is the state's public deficit relative to GDP and the term $\text{CONSOLIDATION PATH}$

¹⁶Germany's parliamentary system puts considerable emphasis on finding a balance of power and compromise between the states and the federal government. However, while the federal and state-levels of government have direct parliamentary representation in the Bundestag (the lower chamber) and the Bundesrat (the upper chamber) respectively, municipalities as the lowest levels of government, have no such representation. This is what makes this burden-shifting politically possible in the first place.

¹⁷We can effectively rule out that additional municipal borrowing benefited the local economy through other channels, e.g. by stimulating expenditure and aggregate demand. The fiscal burden-shift from federal and state governments towards local municipalities pertained mainly to spending that was pre-committed by federal legislation and that would have benefited the municipality anyway. In line with our findings here, Fratzscher, Kriwolutzky and Michelsen discuss in [Fuest et al. \(2019\)](#) that higher levels of government increasingly passed legislation that shifted considerable financial burdens onto the municipalities. They cite social security payments, notably the cost of accommodation of households on social benefits or payments to asylum seekers as examples. In return, municipalities obtained a share of the tax revenue that federal states and the federal government raise, but these funds were generally insufficient to cover the additional expense imposed on municipalities, creating additional borrowing needs at the local level.

denotes the projected structural deficit for state s in year t as stipulated by the debt brake. Introduced in 2010, the debt break requires that states close their structural deficits to zero by 2020. The projected consolidation path therefore assumes that a state's 2010 deficit is reduced linearly until 2020. We then run the following bank-level regression for the period 2010-2016 on our sample of all local banks (cooperative and public):

$$\begin{aligned} \lambda_t^b = & \gamma \times \text{LOCALPUBLICDEBT}_{2010}^c(b) + \delta \times \text{LOCALPUBLICDEBT}_{2010}^c(b) \times \text{FP}_t^{s(b)} \\ & + \phi \mathbb{1}_b \times \text{LOCALPUBLICDEBT}_{2010}^c(b) + \rho \mathbb{1}_b \times \text{LOCALPUBLICDEBT}_{2010}^c(b) \times \text{FP}_t^{s(b)} \\ & + \psi \mathbb{1}_b \times \text{FP}_t^{s(b)} + \kappa \mathbb{1}_b + \text{CONTROLS}_t^b + \nu_t^b \end{aligned} \quad (13)$$

where λ_t^b is again the public debt share on local bank b 's balance sheet, $\text{FP}_t^{s(b)}$ is the pressure for fiscal consolidation in state $s(b)$ in which bank b is located and $\text{LOCALPUBLICDEBT}_{2010}^c(b)$ is the ratio of outstanding local public debt to local GDP in municipality (county) $c(b)$, at the beginning of the sample period (2010) and $\mathbb{1}_b$ is an indicator dummy that is one if bank b is a savings bank. CONTROLS contains bank controls as well as state- and time fixed effects.

Regression (13) examines the link between banks' municipal lending share and local fiscal pressures for all local banks. It is effectively a diff-in-diff specification where the local cooperative banks are the control group. Estimation results are presented in Table 8. First, note that higher local public debt increases municipal lending for all local banks ($\gamma > 0$) but more so for savings banks ($\phi > 0$). Also, savings banks generally have a higher share of local public debt on their books ($\kappa > 0$). Importantly, only the savings banks react to pressures on local public finances by lending more to municipalities: We find $\rho > 0$, while the corresponding coefficient for the local cooperative banks is negative ($\delta < 0$). This suggests that cooperative banks become more cautious in their lending to local municipalities as fiscal pressures increase.

As a last exercise, we ask to what extent the impact of the debt brake on local public finances in Germany can explain the crowding out of private investment that we documented in our firm-level data. To this end, we take guidance from the results of regression (13) and generate a measure of the extent to which state-level consolidation needs weigh on local public finances. We refer to this measure as LFP_t^b or 'local fiscal pressure':

$$\text{LFP}_t^b = \frac{1}{1 - \text{LPD}_{2010}^b \times \text{FP}_t^{s(b)}} \quad (14)$$

We use LFP_t^b and its interaction with the municipal spread as instruments for $\Lambda_t^b = \frac{1}{1-\lambda}$ and $\Lambda_t^b \times \text{MUNICIPALSPREAD}$ in the interest-rate regression (4) from above. These IV results are in Table 9. In line with our conjecture, local fiscal pressure is significantly correlated with municipal lending shares only for the savings banks, leading to strong first stages in the IV-regression, with both F-statistics exceeding 10. Also, the instruments have sufficient linearly independent variation as indicated by the high values of the conditional F-statistics proposed by Sanderson and Windmeijer (2016). By contrast, local fiscal pressure has almost no traction as an instrument for the municipal lending of the cooperative banks.

Turning to the second-stage estimates, we find them to be in line with those previously reported in Table 2 for the OLS regression. For the savings banks, the coefficient on Λ_t^b is positive and bigger than one (though not quite significant in the second stage) while the coefficient on the interaction of Λ_t^b with the municipal spread is significantly negative, around -1, as suggested by the theory. Conversely, the estimates for the cooperative banks are small and insignificant again.

In a next step, we use our estimates of the bank-level IV regression in Table 9 to generate the break-even spreads according to equation (5). We then recalculate \mathcal{SPK} with the resulting austerity-induced spreads, that we abbreviate with $\hat{\theta}_t^{A,b}$, thus obtaining a measure of the austerity induced component of the local public bank spread (to which we refer with $\mathcal{SPK}_t^{A,f}$). For easier comparison with our earlier findings, we rescale this "fiscal austerity induced" \mathcal{SPK}^A to the same standard deviation as our baseline \mathcal{SPK} . We then re-run our previous firm-level regressions using this austerity-induced local public banks spread. The results are in Table 10. The first column is for investment, the second and third columns show results for the key transmission variables, bank liability growth and the average interest rate firms pay.

Table 10 clearly confirms our previous findings. The local bank shock has a significantly negative effect on investment and firms' borrowing and increases the average interest rate paid. Regarding the magnitude of the coefficient on the investment equation, it is roughly 70 percent of the size of the estimate in our baseline specification in column 4 of Table 3. This suggests that fiscal austerity over our sample period quantitatively explains between two thirds and three quarters of the crowding out effect induced by local public bank spreads.

7 Extensions and robustness

7.1 Implications for aggregate investment

In this section, we gauge the importance of our crowding-out mechanism for Germany’s aggregate investment. Our aim is to provide a conservative estimate of the aggregate investment loss. To this end, we re-estimate our main specification from column (5) in Table 3 subtract the initial (2010) sector-regional mean from SPK . In this way we take *ex ante* sector- and region-specific differences across firms in their exposure to the local public bank spread as given, counting only firm-specific dynamics in SPK over our sample period as contributing to our mechanism. We then aggregate the partial fitted value $\alpha \times SPK + \beta \times \eta \times SPK$ across all firms in our sample, weighting each firm with its total fixed assets to obtain a measure of crowding out in our sample. We call this aggregate the predicted loss and subtract this loss from the aggregate gross investment that we obtain from firms in our *Dafne* sample. In this way, we obtain the counterfactual investment path that would have obtained in our sample in the absence of crowding-out.

Based on these in-sample calculations, we then extrapolate the effect on Germany’s official aggregate investment data, by multiplying official investment with the ratio of the counterfactual to aggregate gross investment from our sample, thus obtaining a counterfactual investment path for aggregate German investment.¹⁸ Figure 6 presents time series for this counterfactual investment path along with the official investment data from the federal statistical office. Without crowding-out, aggregate investment in Germany over 2010–2016 could have been around 7 percent higher, amounting to around 35 billion Euros or roughly 1 percent of GDP per year. The gap is between actual and counterfactual investment bottoms out in the year 2012 with around 1.5 percent of aggregate investment or 8.5 billion Euro and rises to around 32 billion or 6 percent of aggregate investment by the end of the sample period. Notably, the increase after 2012 is quite consistent with our mechanism since 2012 is the year in which the ECB started quantitative easing and in which the spread between municipal borrowing and banks’ refinancing rates – a key driver of our mechanism – reached zero for the first time in our sample (compare Figure 4). Note that our simple calculations here cannot take account of any multiplier effects that low private investment by treated firms may have in general equilibrium. However, to the extent that there are likely to be positive spillovers from treated firms’ investment to the output and investment of non-treated firms and to local public finances, it is legitimate to speculate that our estimates could well constitute a lower

¹⁸This effectively assumes that our data base is sufficiently representative of Germany’s economy as a whole. Indeed, investment of firms in the *Dafne* database accounts for roughly 50 percent of Germany’s gross private investment over our sample period. The investment of firms in our regression sample (i.e. for which we have the full set of included covariates, in particular SPK) in turn accounts for roughly 70–80 percent of aggregate investment in *Dafne*.

bound of the aggregate effects of our mechanism.¹⁹

7.2 Additional robustness checks

Extended set of controls We also report results with an extended set of firm-level controls. See Table A.3 and A.4. In these regressions we include cash flow and revenue growth along with our baseline controls, i.e. firm size and the equity share. This substantial reduces our sample size since income statements are not reported for most firms in our sample. Still, our results remain qualitatively the same.

East-West Germany sample split Local banks have a different history in the western and eastern parts of Germany. In the 19th century, local banks were founded mainly in the west and the south of the country. During the communist era in East Germany, only big, state-run banks existed that were eventually dissolved following the reunification of the country in 1990. While the big West German banks started to enter the market in the east by opening new branches, local banks in East Germany essentially had to be founded anew in the years after reunification. To make sure that our results are not driven by some East-West divide, we also run our baseline regressions by splitting the sample into East and West. The results in Table A.5 show that our mechanism is not driven by some unobserved West-East divide. However, it is interesting to observe that the results are, if anything, qualitatively stronger in East Germany. This is consistent with the fact that East German firms are generally smaller than West-German ones (e.g. none of the big companies listed in the large-cap stock market index DAX is headquartered in East-Germany).

8 Conclusion

Germany's high current account surpluses have attracted increasing scrutiny in policy circles over the last decade. By contrast, the academic literature has given relatively little attention to this topic. In this paper, we draw attention to low private investment as one important driver of Germany's current account surplus. Specifically, we have shown how two key characteristics of Germany's banking system—local segmentation and the role of local public banks in local government finance—have contributed to the crowding out of private investment. Our paper is the first to provide evidence of such local crowding out for a developed economy. It is also the first paper to provide detailed evidence that such crowding out happens through the balance sheet of local public banks and against the backdrop of low interest rates.

¹⁹We thank Gianluca Violante and Thomas Drechsel for independently suggesting this point.

Local public banks' special role in municipal finance derives from their statutory mandate to provide municipal lending. Using a simple theoretical model, we have shown that this mandate imposes a shadow cost on public banks' balance sheet that materializes as a spread on their lending rates to private customers. The least elastic private customers, SMEs, are most exposed to this spread because they cannot easily switch lender in Germany's locally segmented credit markets that are dominated by local public banks. We document this mechanism empirically using matched bank-firm data covering more than 1 million German firms. Local public banks with higher levels of public lending charge their SME customers higher interest rates on average. This local public bank spread reduces the investment rate of these firms by an economically important margin. For the average firm, increasing the local public bank spread by 100 basis points will lower investment by around 5 percent. We estimate that aggregate investment in Germany would have been around 30-35 bio Euro per year (or roughly 1 percent of GDP) higher without this mechanism.

The mechanism can also explain why crowding out of private investment can take place against the backdrop of secularly low interest rates. Declining interest rates on municipal lending increase the opportunity cost of holding municipal debt for local public banks and thus increase the spreads they charge SME customers. Our empirical results strongly support this prediction and show that declining interest rates have led to more crowding out. Our analysis therefore also identifies a new channel through which quantitative easing and monetary policy with low-for-long interest rates can backfire by eventually reducing lending to the private sector.

Our findings also uncover a new channel through which fiscal austerity can have contractionary effects. Over the last decade, Germany's federal states and the federal government have tightened their spending under the influence of the debt brake introduced in 2010. In the process of fiscal consolidation, the federal and state governments have shifted many expensive government tasks to the municipalities, whose debt is explicitly exempted from the debt brake. Since municipalities' ability to raise taxes is very limited, they turned to local public banks for credit. Using the exogenous consolidation needs of state-level budgets stipulated by the debt brake to instrument for local public banks' municipal lending shares, we have shown that up to three quarters of the crowding out we observe over our sample period could be driven by fiscal austerity.

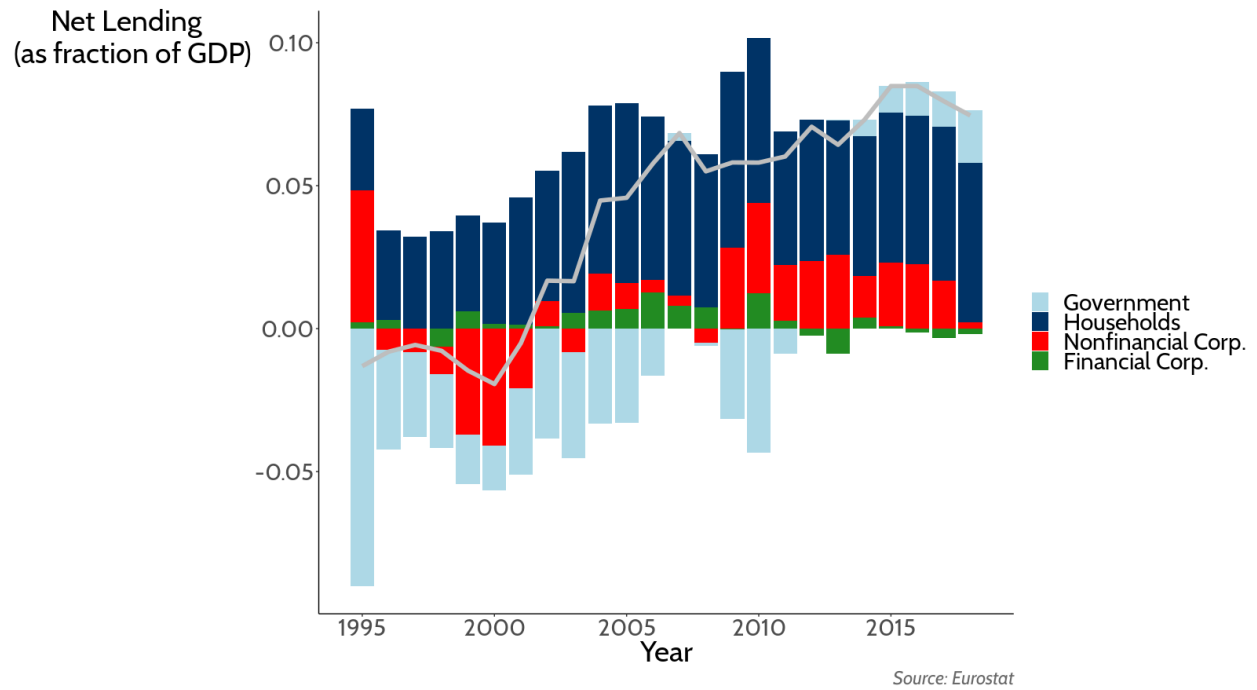
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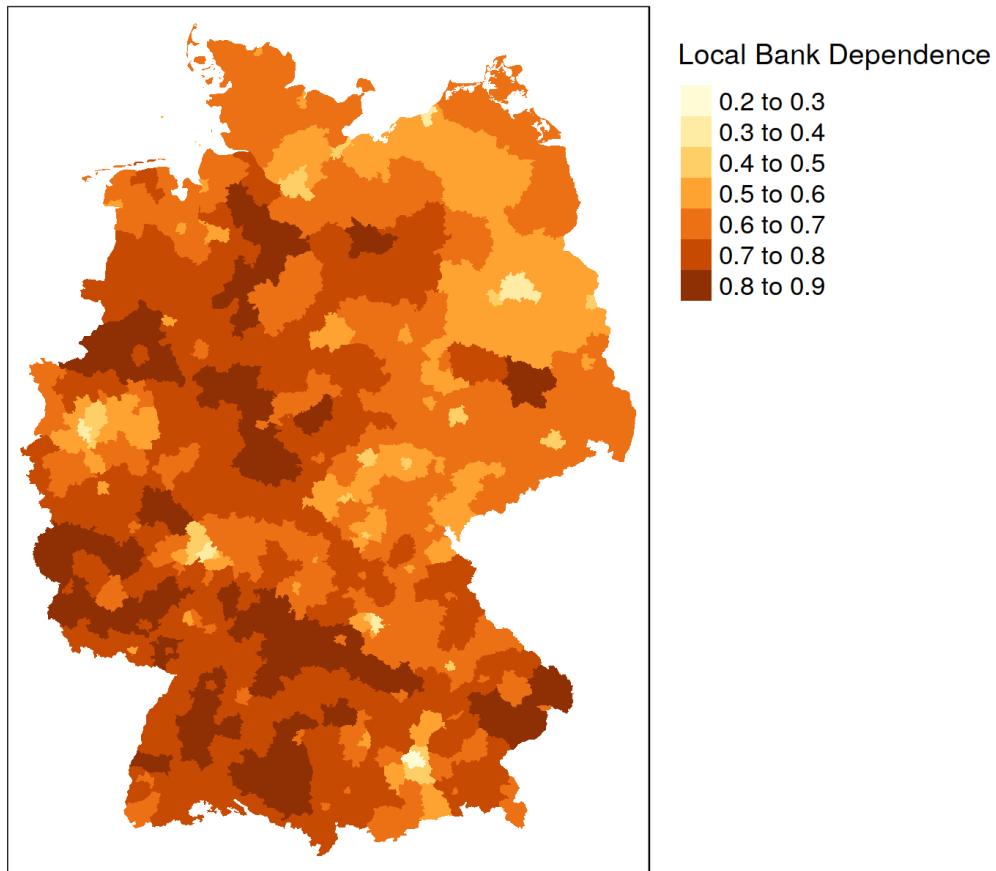
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Figure 1: Sectoral Decomposition of Germany's Net Lending



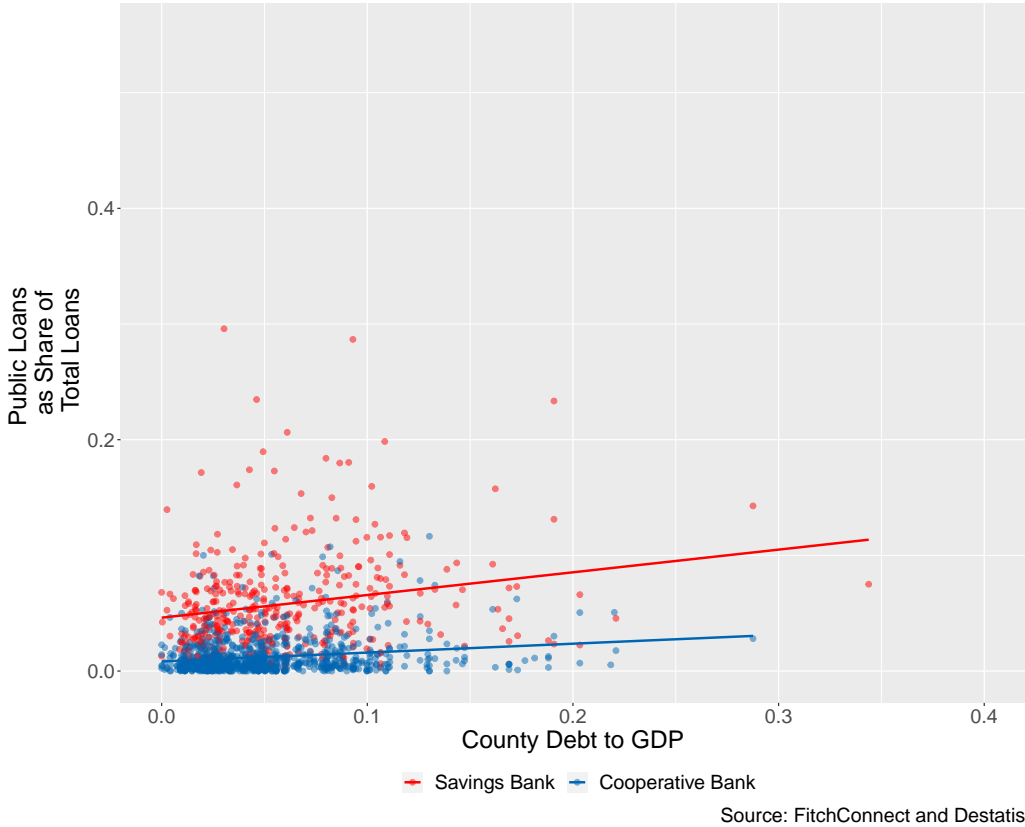
Note: The figure plots Germany's current account balance and its sectoral composition in terms of the ratio of net lending to GDP.

Figure 2: Map of local bank dependence



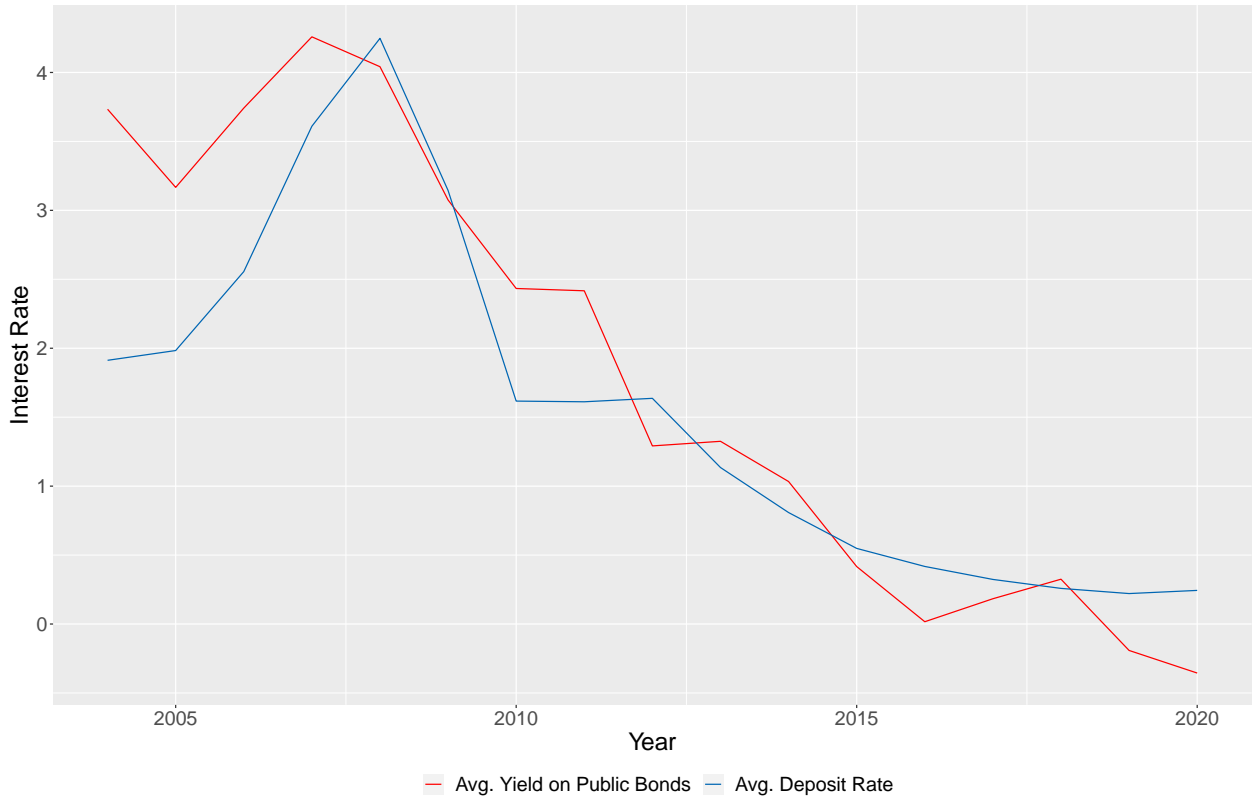
Note: This figure shows the dependence of firms on local banks in German counties in 2009. The dependence is computed as the share of savings and cooperative bank connections in the total number of bank connections in a county.

Figure 3: Correlation between county-level public debt and local banks' public loans share



Note: Each dot represents a local bank in Germany. The y-axis indicates the share of public loans in total loans taken from the bank's balance sheet in 2010. The x-axis denotes the debt to GDP ratio of the county, in which the bank is based, also in 2010.

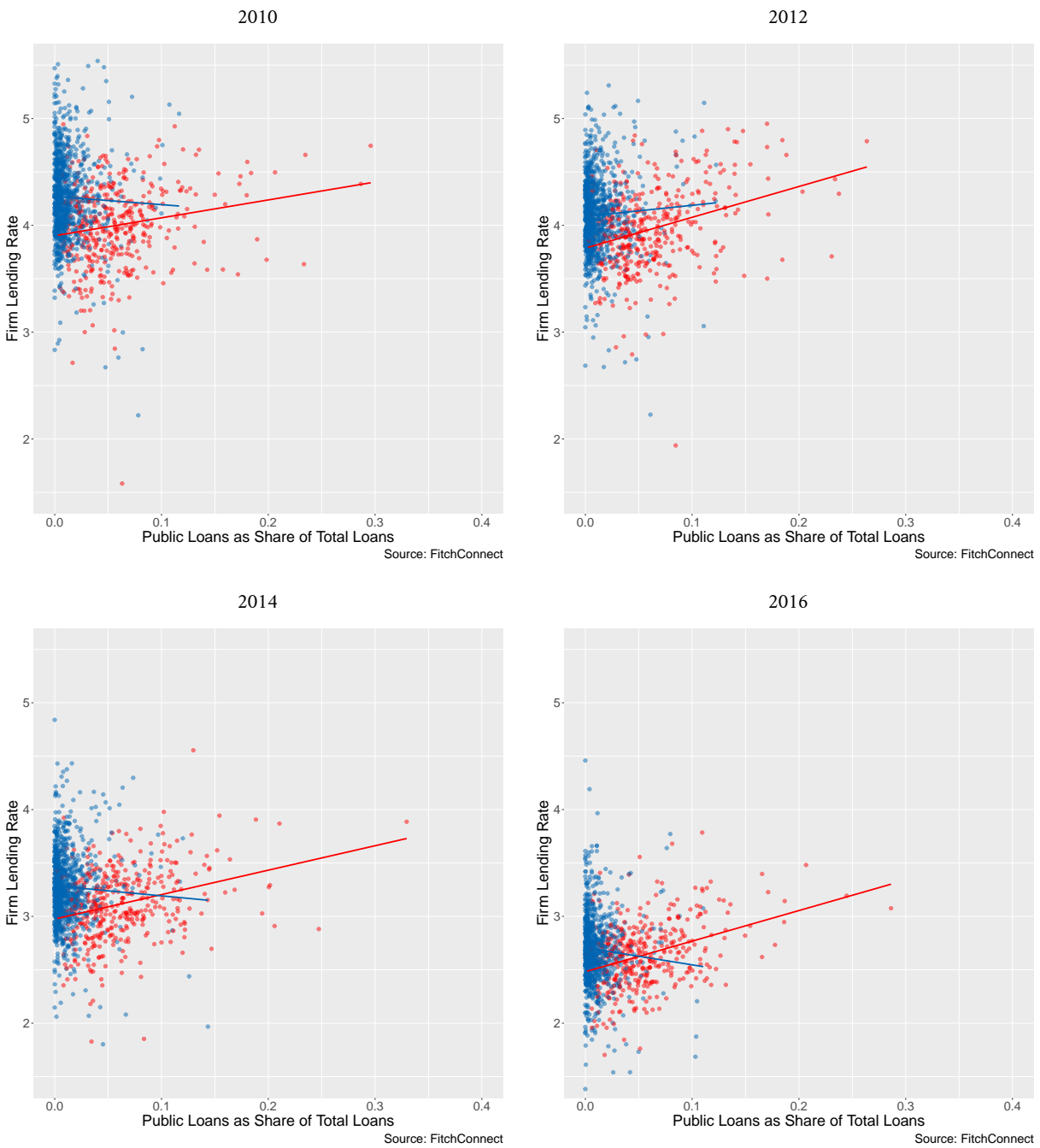
Figure 4: Average bank deposit rate and municipal bond rate



Source: Bundesbank

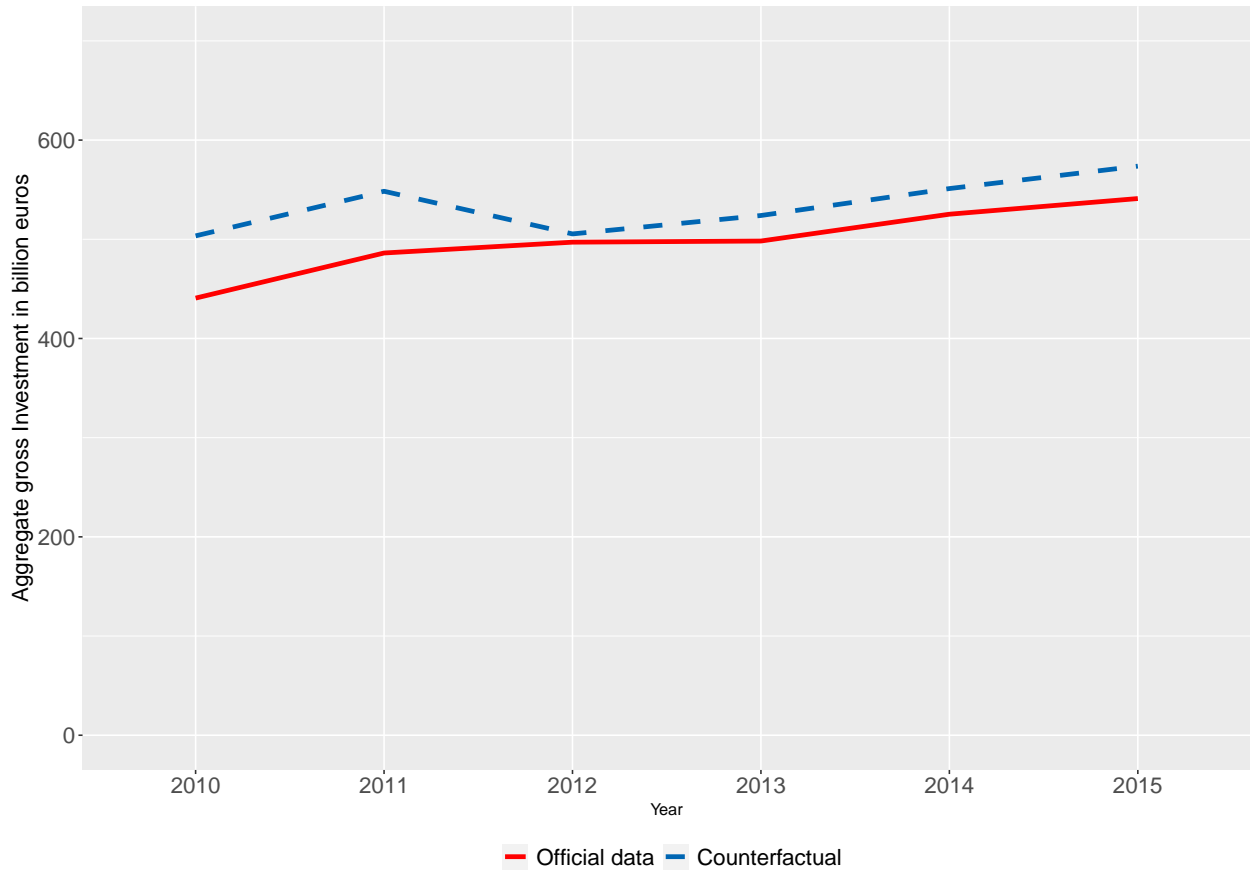
Note: This figure compares the average yield on public bonds (“Umlaufrendite”) with the average short-term deposit rate for private households.

Figure 5: Correlation between local banks municipal lending share and firm-lending rates



Note: Each dot represents a local bank in Germany, red for savings banks, blue for cooperative banks. The y-axis indicates the firm lending rate which is imputed based on the identity in equation (3). The x-axis denotes the public loans share from the bank balance sheet in the respective year. Red (blue) lines indicate the regression line for the savings and cooperative bank sub-samples respectively.

Figure 6: Implications of crowding out for aggregate investment



Note: The figure shows the time official times series for Germany's aggregate gross investment from the federal office of statistics (red, solid line) and the counterfactual aggregate investment series (blue, dashed line) implied by the absence of crowding out. See subsection 7.1 for details.

Table 1: Summary Statistics of Main Variables

Statistic	N	Mean	St. Dev.
Local Public Bank Spread	5,600,816	0.0071	0.0086
Investment Rate	2,470,268	0.1511	0.8417
Interest Rate	233,433	0.1075	0.1147
Bank Liability Growth	269,471	0.1664	0.9778
Cashflow Share	550,543	0.0944	0.1483
Firm Size	4,167,569	6.0420	1.9451
Sales Growth	847,770	0.0729	0.2830
Equity Ratio	4,084,037	0.4036	0.3360
Employment	2,165,117	28.2831	63.1735
Age	9,124,290	17.7486	19.6768

Note: The table shows the numbers of observation, the mean and the standard deviation of the main variables and controls. Data are annual, sample period is 2010-2016.

Table 2: Firm lending rates and municipal lending shares

Dependent Variable: Bank Type:	Firm Interest Rate			
	savings banks		cooperative banks	
	(1)	(2)	(3)	(4)
<i>Variables</i>				
Λ	1.866*** (4.949)	1.734*** (3.591)	-1.278 (-1.286)	-1.203 (-1.198)
$\Lambda \times$ Municipal Spread	-0.8379*** (-4.130)	-0.6199** (-2.113)	-0.5017 (-0.6535)	0.1871 (0.2299)
Tier 1 regulatory capital ratio		0.0127** (2.084)		0.0009 (0.2789)
<i>Fixed-effects</i>				
Region	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
<i>Fit statistics</i>				
Observations	2,849	1,960	6,603	4,883
R ²	0.90118	0.90590	0.79199	0.79116
Within R ²	0.05756	0.07323	0.00376	0.00267

Note: The table shows the results from the bank-level panel regressions run separately for the sample of savings banks (columns 1 and 2) and cooperative banks (columns 3 and 4)

$$i_t^{F,b} = \mathbf{a} \times \Lambda_t^b + \mathbf{b} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t + \beta' \mathbf{X}_t^b + \delta_t^b + u_t^b$$

where $i_t^{F,b}$ and Λ_t^b are the average firm lending rate and the public (municipal) debt share of a banks' total lending of bank b in year t respectively. $\text{MUNICIPAL SPREAD}_t$ is the spread of municipal borrowing rates over deposit rates. The vector \mathbf{X}_t^f contains Tier 1 regulatory capital ratio as time-varying bank-specific control. The vector δ_t^f collects region- and year-fixed effects. Standard errors are clustered by region. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table 3: Firm-level evidence - baseline results

Dependent Variable:	Investment				
	(1)	(2)	(3)	(4)	(5)
<i>Variables</i>					
<i>SPK</i>	-1.317*** (-3.591)	-1.047*** (-2.870)	-0.8834** (-2.373)	-0.8221** (-2.195)	-0.8811** (-2.239)
<i>SPK</i> × η	1.968*** (11.74)	1.392*** (8.358)	1.364*** (8.184)	1.307*** (7.724)	1.345*** (7.531)
Firm size		-0.3682*** (-77.41)	-0.3688*** (-77.37)	-0.3701*** (-77.07)	-0.3678*** (-73.95)
Equity ratio		0.3307*** (34.00)	0.3307*** (33.95)	0.3317*** (34.04)	0.3273*** (32.28)
<i>Fixed-effects</i>					
Firm	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes			
Region-Year			Yes	Yes	
Sector-Year				Yes	
Region-Year-Sector					Yes
<i>Fit statistics</i>					
Observations	1,886,235	1,865,386	1,865,386	1,865,386	1,865,386
R ²	0.35593	0.37151	0.37249	0.37285	0.41686
Within R ²	0.00014	0.02268	0.02271	0.02278	0.02227

Note: The table shows the results from the firm-level panel regression

$$INV_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where INV_t^f and SPK_t^f are the investment rate and the local bank spread of firm f in year t respectively. η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f collects a range of fixed effects, including firm fixed effects, year fixed effects, region-year, sector-year and/or region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table 4: Firm-level evidence on investment - results with different measures of substitution elasticities η .

Dependent Variable:		Investment			
Measure of η :	Firm size (1)	Employment (2)	Age (3)	Number of banks (4)	
<i>Variables</i>					
SPK	-0.8811** (-2.239)	-3.480*** (-4.075)	-0.9250** (-2.325)	-1.598*** (-3.143)	
$SPK \times \eta$	1.345*** (7.531)	3.158*** (8.814)	0.0581*** (6.321)	1.488*** (5.209)	
η			-0.4415*** (-5.350)	-0.0227*** (-7.367)	
Firm size	-0.3678*** (-73.95)	-0.3100*** (-30.55)	-0.3708*** (-74.76)	-0.3707*** (-74.76)	
Equity ratio	0.3273*** (32.28)	0.3053*** (13.99)	0.3292*** (32.65)	0.3292*** (32.65)	
<i>Fixed-effects</i>					
Firm	Yes	Yes	Yes	Yes	
Region-Year-Sector	Yes	Yes	Yes	Yes	
<i>Fit statistics</i>					
Observations	1,865,386	420,716	1,916,405	1,916,405	
R ²	0.41686	0.51985	0.42242	0.42243	
Within R ²	0.02227	0.01730	0.02258	0.02259	

Note: The table shows the results from the firm-level panel regression

$$INV_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where INV_t^f and SPK_t^f are the investment rate and the local bank spread of firm f in year t respectively. η^f is the firm's substitution elasticity, which measure is defined in the column headings. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table 5: Firm-level evidence on bank lending and interest rate

Dependent Variables:	Bank Liability Growth (1)	Interest Rate (2)
<i>Variables</i>		
<i>SPK</i>	-6.701*** (-3.079)	0.2428 (1.389)
<i>SPK</i> × η	2.186*** (3.178)	-0.1317** (-2.258)
Firm size	-0.6490*** (-31.62)	0.0001 (0.0855)
Equity ratio	2.317*** (32.69)	-0.0572*** (-11.15)
<i>Fixed-effects</i>		
Firm	Yes	Yes
Region-Year-Sector	Yes	Yes
<i>Fit statistics</i>		
Observations	215,833	180,817
R ²	0.63856	0.85114
Within R ²	0.05605	0.00303

Note: The table shows the results from the firm-level panel regression

$$Y_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' X_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. SPK_t^f is the local bank spread of firm f in year t . η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector X_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table 6: Firm-level evidence - results for high and low savings banks market power counties

Dependent Variables:	Investment		Bank Liability Growth		Interest Rate	
Savings banks share:	high	low	high	low	high	low
<i>Variables</i>						
<i>SPK</i>	-1.279** (-2.418)	-0.4674 (-0.8051)	-10.33*** (-3.446)	-2.969 (-0.9419)	0.6374*** (2.588)	-0.1509 (-0.6137)
<i>SPK</i> × η	1.656*** (7.316)	1.006*** (3.657)	3.199*** (3.467)	1.058 (1.039)	-0.1712** (-2.117)	-0.0919 (-1.094)
Firm size	-0.3928*** (-54.81)	-0.3498*** (-53.34)	-0.6381*** (-21.78)	-0.6564*** (-23.29)	0.0002 (0.0921)	8.34×10^{-5} (0.0389)
Equity ratio	0.3352*** (23.06)	0.3211*** (23.03)	2.407*** (24.69)	2.246*** (22.52)	-0.0539*** (-7.154)	-0.0601*** (-8.577)
<i>Fixed-effects</i>						
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>						
Observations	858,158	1,007,228	100,545	115,288	87,218	93,599
R ²	0.41900	0.41521	0.64155	0.63618	0.85114	0.85116
Within R ²	0.02390	0.02109	0.05625	0.05601	0.00278	0.00348

Note: The table shows the results from the firm-level panel regression

$$Y_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{INVESTMENT RATE}_t^f, \text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. SPK_t^f is the local bank spread of firm f in year t . η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. The regression is estimated for two sub-samples: for firms located in counties where savings banks account for a high (above-median) share of all bank-firm relationships (high, columns 1, 3, 5) and one for firms located in counties with a low share of savings banks (low, columns 2, 4, 6). Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table 7: Firm-level evidence based on granular IV

Dependent Variables:	Investment (1)	Bank Liability Growth (2)	Interest Rate (3)
<i>Variables</i>			
$SPK (fit)$	-1.015** (-2.556)	-7.182*** (-3.271)	0.3344* (1.923)
$SPK \times \eta (fit)$	1.433*** (8.097)	2.394*** (3.470)	-0.1431** (-2.471)
Firm size	-0.3678*** (-73.94)	-0.6491*** (-31.64)	0.0001 (0.0958)
Equity ratio	0.3273*** (32.28)	2.317*** (32.69)	-0.0572*** (-11.14)
<i>Fixed-effects</i>			
Firm	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes
<i>First stage statistics</i>			
$F_{cond} (SPK(fit))$	5300.3 [p<0.001]	4744.2 [p<0.001]	4752.4 [p<0.001]
$F_{cond} (SPK \times \eta(fit))$	5178.4 [p<0.001]	3724.8 [p<0.001]	3903.5 [p<0.001]
<i>Fit statistics</i>			
Observations	1,865,386	215,833	180,817
R ²	0.41686	0.63856	0.85114
Within R ²	0.02227	0.05604	0.00302

Note: The table shows the results of the second stage from the firm-level panel IV regression

$$Y_t^f = \alpha \times \widehat{SPK}_t^f + \beta \times \eta^f \times \widehat{SPK}_t^f + \beta' X_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{INVESTMENT RATE}_t^f, \text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. \widehat{SPK}_t^f and $\eta^f \times \widehat{SPK}_t^f$ are instrumented using the granular instrumental variable (GIV) defined in equation (11). See section 5.4 for details. SPK_t^f is the local bank spread of firm f in year t . η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector X_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector and presented in parentheses. The section first stage statistics reports tests for weak identification of the two endogenous variables, the conditional F-statistics F_{cond} proposed by Sanderson and Windmeijer (2016). The associated p-values are bootstrapped and reported in rectangular brackets. Data are annual, sample period is 2010-2016.

*p<0.1; **p<0.05; ***p<0.01

Table 8: Banks' municipal lending shares and local public debt

Dependent Variable:	Bank's Municipal Lending Share, λ	
	(1)	(2)
<i>Variables</i>		
LOCAL PUBLIC DEBT IN 2010	0.0865*** (3.176)	0.0941*** (2.685)
LOCAL PUBLIC DEBT IN 2010 \times <i>FP</i>	-6.700 (-1.358)	-7.594 (-1.249)
SPK-DUMMY \times LOCAL PUBLIC DEBT IN 2010	0.1082** (2.017)	0.1021 (1.487)
SPK-DUMMY \times LOCAL PUBLIC DEBT IN 2010 \times <i>FP</i>	31.30*** (3.197)	32.97** (2.533)
SPK-DUMMY \times <i>FP</i>	-1.384* (-1.725)	-1.580* (-1.733)
SPK-DUMMY	0.0374*** (11.70)	0.0379*** (9.428)
Tier 1 regulatory capital ratio		0.0003* (1.912)
<i>Fixed-effects</i>		
State-Year	Yes	Yes
<i>Fit statistics</i>		
Observations	9,335	6,746
R ²	0.50426	0.52245
Within R ²	0.44540	0.45352

Note: The table shows the results from the bank-level panel regression

$$\begin{aligned} \lambda_t^b = & \gamma \times \text{LOCALPUBLICDEBT}_{2010}^c(b) + \delta \times \text{LOCALPUBLICDEBT}_{2010}^c(b) \times \text{FP}_t^{s(b)} \\ & + \phi \mathbb{1}_b \times \text{LOCALPUBLICDEBT}_{2010}^c(b) + \rho \mathbb{1}_b \times \text{LOCALPUBLICDEBT}_{2010}^c(b) \times \text{FP}_t^{s(b)} \\ & + \psi \mathbb{1}_b \times \text{FP}_t^{s(b)} + \kappa \mathbb{1}_b + \text{CONTROLS}_t^b + \nu_t^b \end{aligned}$$

where λ_t^b is the public debt share on local bank b 's balance sheet, $\text{FP}_t^{s(b)}$ is the pressure for fiscal consolidation in state $s(b)$ in which bank b is located and $\text{LOCALPUBLICDEBT}_{2010}^c(b)$ is the ratio of outstanding local public debt to local GDP in municipality (county) $c(b)$, at the beginning of the sample period (2010) and $\mathbb{1}_b$ is an indicator dummy that is one if bank b is a savings bank. CONTROLS contains bank controls as well as state-year fixed effects. Standard errors are clustered by region. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 9: Firm lending rates and municipal lending shares - local fiscal pressure as IV

Dependent Variable: Bank Type	Firm Interest Rate	
	savings banks (1)	cooperative banks (2)
<i>Variables</i>		
Λ (<i>fit</i>)	1.085 (1.005)	-0.4829 (-0.1138)
$\Lambda \times$ Municipal Spread (<i>fit</i>)	-1.456** (-2.146)	-0.6132 (-0.1517)
Deposit share	-1.718*** (-2.665)	-1.817** (-2.317)
(log) Total assets	-0.0608*** (-3.374)	-0.0989*** (-6.416)
<i>Fixed-effects</i>		
State-Year	Yes	Yes
<i>First-stage statistics</i>		
$F_{cond}(\Lambda(\text{fit}))$	22.24 [p<0.001]	11.91 [p<0.01]
$F_{cond}(\Lambda \times \text{Municipal Spread}(\text{fit}))$	23.95 [p<0.001]	11.61 [p<0.01]
<i>Fit statistics</i>		
Observations	2,742	6,514
R ²	0.82759	0.73475
Within R ²	0.09981	0.09173

Note: The table shows results of panel IV regressions of banks' average firm lending rates on their municipal lending shares of the form

$$i_t^{F,b} = \mathbf{a} \times \widehat{\Lambda}_t^b + \mathbf{b} \times [\Lambda_t^b \times \widehat{\text{MUNICIPAL SPREAD}}_t] + \beta' \mathbf{X}_t^b + \delta_t^b + u_t^b$$

for local savings banks (left column) and local cooperative banks (right column). Here, $i_t^{F,b}$ is the average firm lending rate of bank b in year t . $\Lambda_t^b = \frac{1}{1-\lambda}$, where λ is the public (municipal) debt share of a banks' total lending and $\text{MUNICIPAL SPREAD}_t$ is the spread of municipal borrowing rates over deposit rates. The vector \mathbf{X}_t^b contains deposit share and total assets as time-varying bank-specific control. The vector δ_t^b collects state-year fixed effects. Standard errors are clustered by county and provided in parentheses. The left column reports results for local public banks, the right column for local cooperative banks. Both regressions use local fiscal pressure (LFP_t^b) as defined in equation (14) and its interaction with the municipal spread as instruments. The section first stage statistics reports tests for weak identification of the two endogenous variables, the conditional F-statistics F_{cond} proposed by Sanderson and Windmeijer (2016). The associated p-values are bootstrapped and reported in rectangular brackets. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01.

Table 10: Firm-level evidence with austerity-induced SPK .

Dependent Variables:	Investment (1)	Bank Liability Growth (2)	Interest Rate (3)
<i>Variables</i>			
SPK	-0.6347*** (-3.338)	-3.505*** (-3.224)	0.2026** (2.380)
$SPK \times \eta$	0.8200*** (10.26)	1.264*** (3.847)	-0.0760*** (-2.755)
Firm size	-0.3676*** (-73.96)	-0.6495*** (-31.64)	0.0002 (0.1082)
Equity ratio	0.3273*** (32.28)	2.317*** (32.66)	-0.0572*** (-11.14)
<i>Fixed-effects</i>			
Firm	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	1,865,386	215,833	180,817
R ²	0.41688	0.63858	0.85114
Within R ²	0.02231	0.05609	0.00307

Note: The table shows the results from the firm-level panel regression

$$Y_t^f = \alpha \times SPK^{A,f,t} + \beta \times \eta^f \times SPK^{A,f,t} + \beta' X_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{INVESTMENT RATE}_t^f, \text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. $SPK^{A,f,t}$ is the austerity induced component of local public bank spread of firm f in year t that we obtained from the IV regression presented in Table 9. η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector X_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

A Appendix: Theoretical framework

We consider a stylized model based on Brunnermeier and Koby (2020) which we extend to include a statutory requirement for the local public banks to engage in public (municipal) lending. Banks engage in public lending to local municipalities or in private lending to local firms. The bank's problem is to maximize its equity E_1 in the next period:

$$E_1 = (1 + i^F) F + (1 + i^P) P - (1 + i^D) D \quad (\text{A.1})$$

where F is private lending to firms, P is public (municipal) lending and D are deposits and i^F , i^P and i^D the associated interest rates. The bank's decision is subject to the balance sheet identity

$$F + P = D + E_0 \quad (\text{A.2})$$

and initial equity, E_0 , is exogenous. The bank also faces a capital constraint

$$\bar{\psi} \leq \frac{E_0}{F} =: \psi \quad (\text{A.3})$$

in which municipal lending P has a risk weight of zero.

Local public banks (savings banks) differ from local cooperative banks because they face a statutory requirement to engage in lending to the local public sector. We formalize this requirement in the simplest possible manner as a lower bound $\bar{\lambda}$ on the fraction of its balance sheet that the savings bank has to invest into public lending:

$$\bar{\lambda} \leq \frac{P}{F + P} =: \lambda \quad (\text{A.4})$$

We call this the statutory public lending constraint. It arises from the bank's specific statutory mandate and/or from the direct political control of municipalities over the local public banks.

Importantly, we assume that banks have market power in their lending market. Firms' loan demand func-

tion F is downward sloping in i_F , so that $F' = dF/di^F < 0$. We also assume that there is market power in deposit markets, with deposit supply upward sloping in i_D , so that $D' = dD/di^D > 0$. The interest rate on public loans, i_P , is exogenous and the bank chooses the optimal P subject to its statutory constraint.

With these assumptions we can write the Lagrangian as

$$\begin{aligned} \mathcal{L} = & (1 + i^F) F + (1 + i^P) P - (1 + i^D) D - \mu (F + P - D - E_0) \\ & - \chi (\psi F - E_0) - \theta ((\bar{\lambda} - 1) P + \bar{\lambda} F) \end{aligned}$$

which leads to the following first-order conditions:

$$\frac{\partial \mathcal{L}}{\partial i^F} = F + (1 + i^F) F' - \mu F' - \chi \psi F' - \theta \bar{\lambda} F' = 0 \quad (\text{A.5})$$

$$\frac{\partial \mathcal{L}}{\partial i^D} = -D - (1 + i^D) D' + \mu D' = 0 \iff \mu = \frac{D}{D'} + (1 + i^D) \quad (\text{A.6})$$

$$\frac{\partial \mathcal{L}}{\partial P} = (1 + i^P) - \mu + \theta (1 - \bar{\lambda}) = 0 \iff \mu = (1 + i^P) + \theta (1 - \bar{\lambda}) \quad (\text{A.7})$$

and yields the following solutions for lending and deposit rates:

$$i^F = i^P - \frac{1}{\varepsilon_F} + \chi \psi + \theta \quad (\text{A.8})$$

$$i^D = i^P - \frac{1}{\varepsilon_D} + \theta (1 - \bar{\lambda}) \quad (\text{A.9})$$

where we have used the abbreviations $\varepsilon_F = \frac{F'}{F} < 0$ and $\varepsilon_D = \frac{D'}{D} > 0$ for the (semi-) elasticities of loan demand and deposit supply w.r.t the respective interest rate.

Rearranging equation (A.9), we obtain

$$\theta = \frac{\frac{1}{\varepsilon_D} - (i^P - i^D)}{1 - \bar{\lambda}} \quad (\text{A.10})$$

We refer to θ as the ‘break-even’ spread since it reflects the increase in the interest rate that the bank will charge firms to at least partially make up for the opportunity cost of having a part of its balance sheet being tied up in relatively low-yielding municipal lending (as compared to firm lending). The break-even spread decreases in the municipal bond spread $i^P - i^D$ and increases when the statutory constraint tightens due to an exogenous increase in $\bar{\lambda}$. The spread should also be higher for banks with less elastic funding supply (low ε^D).

To build intuition on the underlying mechanism, consider a previously unconstrained bank that becomes constrained through an exogenous increase in $\bar{\lambda}$. The bank can react to this increase in two ways: it can lengthen its balance sheet by taking on additional deposits to increase municipal lending or it can reduce firm lending in order to increase municipal lending. Equations (A.8) and (A.9) show that the bank will generally do both. First, as is apparent from (A.8), the bank will charge higher interest rates to its firm customers whenever θ becomes positive. This prediction is the main focus of our empirical analysis here. Second, the bank will also try to lengthen its balance sheet by raising additional deposits. To this end, as can be seen from the third term on the right hand side of equation (A.9), the bank will increase its deposit rate. By attracting additional funding, it can dampen the impact of the statutory lending constraint on firm lending.

Note that the optimal trade-off between reducing firm lending and lengthening the balance sheet will depend on the elasticity of the banks’ funding supply. With a low elasticity of funding supply, attracting additional funds is costly. This makes it relatively more attractive to satisfy the statutory lending constraint by increasing firm lending rates, thus reducing firm lending F . This is exactly what equation (A.10) is saying: the break-even spread increases with decreasing funding supply elasticity and increasing funding costs, i^D .

The model also predicts that our mechanism should be weaker for capital-constrained banks. To see this, rearrange equation (A.5) to obtain

$$\frac{1}{\varepsilon^F} + (1 + i^F) - \mu - \chi\psi = \theta\bar{\lambda}$$

Hence, a binding equity constraint will lower the break-even spread ceteris paribus. The internal rate of return of a capital-constrained bank is lower which tends to drive down the shadow cost of a binding statutory lending constraint. Indeed, in our model, public debt has a risk weight of zero, so that the capital constraint is effectively a restriction on the ratio between equity and firm lending F . Thus, as long as the capital constraint binds, the statutory constraint is not a direct constraint on the volume of firm lending. This reduces the opportunity cost of municipal lending, leading to lower θ .

Below, we provide further empirical evidence on these predictions of the model.

From theory to empirical specification Plugging (A.10) into (A.8), we get the solution for the firm lending rate that is the basis for the empirical estimation of the break-even spread in regression (4) in the main body of the paper:

$$i^F = \underbrace{i^P - \frac{1}{\varepsilon_F} + \chi\psi}_{i_t^U} + \underbrace{\frac{1}{\varepsilon_D}}_{\mathbf{a} \times \Lambda_t^b} \underbrace{- \frac{(i^P - i^D)}{1 - \bar{\lambda}}}_{\mathbf{b} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t} \quad (\text{A.11})$$

Importantly, for constrained banks, an increase in the lower bound $\bar{\lambda}$ will also increase the observed levels of λ . At the same time, a decline in the spread between public sector borrowing and deposit rates, $i^P - i^D$ will increase the break-even spread and thus the firm-lending rate and it does so more strongly for banks with high shares of public debt on their books. This is what our empirical specification in (4) captures.

Note that in our model, the bank's deposit rate is a decision variable and its optimal values will differ across banks, depending e.g. on the parameters ε_D and ε_F and on $\bar{\lambda}$. Our empirical implementation in (4) uses the municipal spread defined as the difference between the municipal bond rate and the *average* deposit rate across all German banks. Focusing on this common component across all banks allows us to isolate the exogenous part of the decline in the difference $i^P - i^D$. As we have discussed above, banks with binding statutory constraints will tend to have higher deposit rates. This implies that using the average deposit rate for all banks in our estimation will tend to underestimate the break-even spread for constrained banks. This makes all our empirical results conservative.

Exploring balance sheet elasticity The model predicts that our mechanisms should be stronger for banks that face a less elastic supply of funding. We measure the elasticity of a bank's funding supply by its dependence on core deposits measured as the share of core deposits in total (i.e. wholesale plus core deposit) funding. Specifically, we associate banks with high (low) core deposit dependence with a low (high) balance sheet elasticity. The idea is that core deposits are typically a very stable funding base but it is also relatively hard to attract additional core deposit funding as compared to e.g. wholesale or interbank funding. In Table A.6, we re-run our bank-level regressions (4) on two sub-samples according to high (low) core deposit dependence. We find

that the coefficient \mathbf{a} on the stand-alone term Λ , which according to the model should correspond to $1/\varepsilon_D$, is higher for the core deposit-dependent savings banks. Hence, in line with the prediction of our model, (core) deposit-dependent banks have less elastic balance sheets overall and will have higher break-even spreads for given $\bar{\lambda}$.

Break-even spreads and capital constraints Another prediction of the model is that our mechanism should be weaker for capital-constrained banks. In Table [A.7](#), we re-run our bank-level regressions (4) on two subsamples, this time splitting the sample into weakly and well-capitalized banks. We classify a bank as weakly capitalized if the Tier 1 capital ratio (in our model equivalent to the ratio of equity to firm lending) is below 9 percent. The results corroborate the predictions of the theory: the impact of public lending on firm-lending rates is significant only in the sample of well-capitalized banks.

Table A.1: Bank switching behavior of firms

Dependent Variables:	Switch from savings bank			
	to other bank type		to cooperative banks	
Savings banks share:	high	low	high	low
	(1)	(2)	(4)	(5)
<i>Variables</i>				
<i>SPK</i>	-0.0007 (-0.2252)	0.0174*** (4.622)	-0.0007 (-0.6063)	0.0030** (2.036)
<i>SPK</i> × η	-0.0003 (-0.1934)	-0.0006 (-0.4684)	0.0001 (0.1683)	-0.0002 (-0.3994)
Firm size	-0.0019 (-1.392)	-0.0004 (-0.3190)	0.0045*** (8.788)	0.0042*** (8.357)
Equity ratio	-0.0025 (-0.7051)	0.0038 (1.070)	0.0013 (0.8962)	0.0025* (1.906)
<i>Fixed-effects</i>				
Firm	Yes	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes	Yes
<i>Fit statistics</i>				
Observations	477,543	417,276	463,319	404,389
R ²	0.69927	0.71227	0.68955	0.69073
Within R ²	1.26 × 10 ⁻⁵	0.00020	0.00030	0.00041

Note: The table shows the results from the firm-level logit regression

$$\text{SWITCH}_{t,t+1}^f = \alpha \times \text{SPK}_t^f + \beta \times \eta^f \times \text{SPK}_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f$$

where $\text{SWITCH}_{t,t+1}^f$ is a dummy capturing changes in firms' bank relationships between period t and $t + 1$ away from savings bank to any other bank type (columns 1-2) or to cooperative banks (column 3-4). SPK_t^f is the local public bank spread of firm f in year t (here normalized by its cross-sectional standard deviation). η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. The sample comprises all bank-year observations for which firms are fully savings-bank dependent, i.e. report only savings-bank relations in period t . The regressions are estimated for two sub-samples: for firms located in counties where savings banks account for a high (above-median) share of all bank-firm relationships (high, columns 1, 3) and one for firms located in counties with a low share of savings banks (low, columns 2, 4). Standard errors are clustered by region and sector, t-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.2: Firm-level evidence - results with placebo LBS

Dependent Variables:	Investment (1)	Bank Liability Growth (2)	Interest Rate (3)
<i>Variables</i>			
$SPK_{placebo}$	-2.224*** (-5.174)	-2.076 (-0.8430)	-0.1724 (-0.8262)
$SPK_{placebo} \times \eta$	1.217*** (5.431)	1.348 (1.520)	0.0188 (0.2475)
Firm size	-0.3680*** (-73.90)	-0.6472*** (-31.61)	7.68×10^{-5} (0.0501)
Equity ratio	0.3271*** (32.27)	2.316*** (32.64)	-0.0573*** (-11.15)
<i>Fixed-effects</i>			
Firm	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	1,865,386	215,833	180,817
R ²	0.41685	0.63851	0.85113
Within R ²	0.02225	0.05593	0.00296

Note: The table shows the results from the firm-level panel regression

$$Y_t^f = \alpha \times SPK_{placebo,t}^f + \beta \times \eta^f \times SPK_{placebo,t}^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{INVESTMENT RATE}_t^f, \text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. $SPK_{placebo,t}^f$ is the placebo local bank spread of firm f in year t that was constructed for the local cooperative banks as in Table 2 column 3. η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.3: Firm-level investment - extended set of firm-specific controls

Dependent Variable:		Investment			
Measure of η :	Firm size (1)	Employment (2)	Age (3)	Number of banks (4)	
<i>Variables</i>					
<i>SPK</i>	-8.323*** (-4.075)	-4.683*** (-2.777)	-4.492*** (-3.401)	-5.595*** (-3.488)	
<i>SPK</i> \times η	2.572*** (4.424)	0.0238*** (4.579)	0.0801*** (3.550)	2.027*** (3.011)	
η			0.3455 (1.611)	-0.0333*** (-4.313)	
Firm_Size	-0.3936*** (-19.89)	-0.2852*** (-12.38)	-0.3987*** (-20.28)	-0.3995*** (-20.34)	
Equity_Ratio	0.2007*** (4.199)	0.2324*** (4.090)	0.1905*** (4.026)	0.1897*** (4.011)	
Cashflow_Share	0.3030*** (6.422)	0.2595*** (4.307)	0.2861*** (6.189)	0.2864*** (6.198)	
Revenue_Growth	0.1593*** (11.92)	0.1838*** (9.704)	0.1599*** (12.22)	0.1598*** (12.22)	
<i>Fixed-effects</i>					
Firm	Yes	Yes	Yes	Yes	
Region-Year-Sector	Yes	Yes	Yes	Yes	
<i>Fit statistics</i>					
Observations	180,199	103,675	186,930	186,930	
R ²	0.67239	0.63549	0.67585	0.67590	
Within R ²	0.02724	0.01939	0.02744	0.02760	

Note: The table shows the results from the firm-level panel regression

$$INV_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where INV_t^f and SPK_t^f are the investment rate and the local bank spread of firm f in year t respectively. η^f is the firm's substitution elasticity, which measure is defined in the column headings. The vector \mathbf{X}_t^f contains equity share, firm size, cashflow share and revenue growth as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.4: Firm-level investment - results with different etas for high and low SPK market power counties

Dependent Variable:		Investment					
Measure of η :	Employment		Age		Number of banks		
	high (1)	low (2)	high (3)	low (4)	high (5)	low (6)	
<i>Variables</i>							
<i>SPK</i>	-2.285* (-1.900)	-4.595*** (-3.793)	-1.004* (-1.808)	-0.9245 (-1.621)	-1.895*** (-2.745)	-1.314* (-1.749)	
<i>SPK</i> \times η	3.016*** (6.235)	3.360*** (6.323)	0.0518*** (4.284)	0.0677*** (4.759)	1.578*** (4.122)	1.389*** (3.217)	
η					-0.0231*** (-5.137)	-0.0224*** (-5.275)	
Firm_Size	-0.3342*** (-22.53)	-0.2943*** (-21.71)	-0.3960*** (-55.27)	-0.3527*** (-54.19)	-0.3959*** (-55.25)	-0.3526*** (-54.19)	
Equity_Ratio	0.2925*** (9.281)	0.3131*** (10.50)	0.3380*** (23.35)	0.3225*** (23.29)	0.3380*** (23.35)	0.3226*** (23.29)	
<i>Fixed-effects</i>							
Firm	Yes	Yes	Yes	Yes	Yes	Yes	
Region-Year-Sector	Yes	Yes	Yes	Yes	Yes	Yes	
<i>Fit statistics</i>							
Observations	188,753	231,963	879,751	1,036,654	879,751	1,036,654	
R ²	0.53654	0.50737	0.42414	0.42113	0.42413	0.42112	
Within R ²	0.01880	0.01624	0.02417	0.02145	0.02415	0.02144	

Note: The table shows the results from the firm-level panel regression

$$INV_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where INV_t^f and SPK_t^f are the investment rate and the local bank spread of firm f in year t respectively. η^f is the firm's substitution elasticity, which measure is defined in the column headings. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. The regression is estimated for two sub-samples: for firms located in counties where savings banks account for a high (above-median) share of all bank-firm relationships (high, columns 1, 3, 5) and one for firms located in counties with a low share of savings banks (low, columns 2, 4, 6). Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.5: Firm-level evidence - results for West and East Germany

Dependent Variables:	Investment		Bank Liability Growth		Interest Rate	
West_Germany Model:	west (1)	east (2)	west (3)	east (4)	west (5)	east (6)
<i>Variables</i>						
<i>SPK</i>	-0.8321* (-1.882)	-1.093 (-1.272)	-4.662* (-1.816)	-12.12*** (-2.945)	0.2199 (1.022)	0.2770 (0.9666)
<i>SPK</i> × η	1.309*** (6.532)	1.523*** (3.984)	1.738** (2.184)	3.563*** (2.628)	-0.1445** (-2.090)	-0.0763 (-0.7249)
Firm size	-0.3595*** (-67.66)	-0.4045*** (-28.58)	-0.6711*** (-28.89)	-0.5956*** (-13.67)	0.0007 (0.3970)	-0.0013 (-0.4317)
Equity ratio	0.3127*** (28.45)	0.3961*** (14.75)	2.403*** (30.62)	2.014*** (12.97)	-0.0596*** (-10.04)	-0.0486*** (-4.972)
<i>Fixed-effects</i>						
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Region-Year-Sector	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>						
Observations	1,546,530	318,856	167,568	48,265	141,116	39,701
R ²	0.41318	0.43652	0.64285	0.62298	0.85039	0.85375
Within R ²	0.02048	0.03243	0.05763	0.05137	0.00329	0.00228

Note: The table shows the results from the firm-level panel regression

$$Y_t^f = \alpha \times SPK_t^f + \beta \times \eta^f \times SPK_t^f + \beta' \mathbf{X}_t^f + \delta_t^f + u_t^f,$$

where $Y_t^f = [\text{INVESTMENT RATE}_t^f, \text{BANK LIABILITY GROWTH}_t^f, \text{INTEREST RATE}_t^f]$. SPK_t^f is the local bank spread of firm f in year t . η^f is the firm's substitution elasticity, which is measured by firm's total assets size. The vector \mathbf{X}_t^f contains equity share and firm size as time-varying firm-specific controls. The vector δ_t^f includes firm fixed effects and region-sector-year fixed effects. The regression is estimated for two sub-samples: for firms located in west (column 1, 3, 5) and east Germany (column 2, 4, 6). Standard errors are clustered by region and sector. T-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.6: Firm lending rates and municipal lending shares - results for high and low core deposit dependence

Dependent Variable:	Firm Interest Rate	
Core deposit dependence:	high (1)	low (2)
<i>Variables</i>		
Λ	2.213*** (3.107)	0.8303* (1.690)
$\Lambda \times \text{Municipal Spread}$	-0.8273* (-1.740)	-0.7709** (-2.274)
Tier 1 regulatory capital ratio	0.0046 (1.197)	0.0141 (0.9677)
<i>Fixed-effects</i>		
Region	Yes	Yes
Year	Yes	Yes
<i>Fit statistics</i>		
Observations	868	843
R ²	0.94510	0.87860
Within R ²	0.13172	0.02773

Note: The table shows the results from the bank-level panel regressions

$$i_t^{F,b} = \mathbf{a} \times \Lambda_t^b + \mathbf{b} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t + \beta' \mathbf{X}_t^b + \delta_t^b + u_t^b$$

where $i_t^{F,b}$ and Λ_t^b are the average firm lending rate and the public (municipal) debt share of a banks' total lending of bank b in year t respectively. $\text{MUNICIPAL SPREAD}_t$ is the spread of municipal borrowing rates over deposit rates. The regression is estimated for two sub-samples: for saving banks with high core deposit dependence (measured as below-median interbank dependence ratio) and low core deposit dependence (measured as above-median interbank dependence ratio). Interbank dependence ratio is defined as the share of short-term wholesale funding in total funding. The vector \mathbf{X}_t^f contains Tier 1 regulatory capital ratio as time-varying bank-specific control. The vector δ_t^f collects region- and year-fixed effects. Standard errors are clustered by region, t-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

Table A.7: Firm lending rates and municipal lending shares - results for more and less capital constrained banks

Dependent Variable:		FirmInterestRate
Tier 1 capital ratio:	low	high
Model:	(1)	(2)
<i>Variables</i>		
Λ	0.7908 (1.269)	1.620** (2.577)
$\Lambda \times \text{Municipal Spread}$	-1.065*** (-4.438)	-0.7606** (-2.519)
<i>Fixed-effects</i>		
Region	Yes	Yes
Year	Yes	Yes
<i>Fit statistics</i>		
Observations	1,240	1,253
R ²	0.89367	0.92542
Within R ²	0.01643	0.05650

Note: The table shows the results from the bank-level panel regressions

$$i_t^{F,b} = \mathbf{a} \times \Lambda_t^b + \mathbf{b} \times \Lambda_t^b \times \text{MUNICIPAL SPREAD}_t + \boldsymbol{\delta}_t^b + u_t^b$$

where $i_t^{F,b}$ and Λ_t^b are the average firm lending rate and the public (municipal) debt share of a banks' total lending of bank b in year t respectively. $\text{MUNICIPAL SPREAD}_t$ is the spread of municipal borrowing rates over deposit rates. The regression is estimated on sub-samples of savings banks with above (below) median tier 1 capital ratios (defined as the ratio of equity to firm lending in our model). The vector $\boldsymbol{\delta}_t^f$ collects region- and year-fixed effects. Standard errors are clustered by region, t-statistics are presented in parentheses. Data are annual, sample period is 2010-2016. *p<0.1; **p<0.05; ***p<0.01

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