

Bank Lending and Firm Internal Capital Markets following a Deglobalization Shock

Björn Imbierowicz[‡] Arne Nagengast* Esteban Prieto[°] Ursula Vogel[^]

Abstract

The pace of globalization has slowed since the global financial crisis, and recent events have sparked fears of a more widespread deglobalization and market fragmentation. We investigate the implications of a deglobalization shock for bank lending and its ensuing effects for firm internal capital markets and the real economy. After the shock of the unexpected outcome of the Brexit referendum, (more sound and prudent) banks in Germany decrease their lending to (less profitable) firms located in the UK. Subsidiaries of large multinational corporations (MNCs) with access to internal cross-border capital markets, however, are able to compensate the cross-border credit supply shock with internal funds, as MNCs shield their equity investments. This prevents the negative real effects usually caused by a credit supply shock. Banks shift their lending to borrowers outside the UK, in particular to firms belonging to German MNCs. Our results highlight the fact that in case of a deglobalization shock, international integration has both positive and negative implications, because increases in international financial frictions which usually imply negative real effects are mitigated when the affected firms are internationally integrated.

Keywords: Bank lending, deglobalization shock, policy uncertainty, real-financial linkages, internal capital markets.

JEL codes: F23, F34, F36, G21.

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[‡] Deutsche Bundesbank, Research Centre, bjorn.imbierowicz@gmail.com (corresponding author)

* Deutsche Bundesbank, DG Economics, arne.nagengast@bundesbank.de

[°] Deutsche Bundesbank, DG Financial Stability, esteban.prieto@bundesbank.de

[^] European Central Bank, DG Financial Stability, ursula.vogel@ecb.europa.eu

1 Introduction

The second wave of globalization reached its peak with the global financial crisis of 2007 to 2009, as nationalist tendencies and economic protectionism gained ground in the aftermath of the crisis. Resulting political tensions fueled a slowdown in globalization, if not triggering a deglobalization trend. This new development was accelerated by multiple events and policies including trade-related tensions, most prominently the US-China trade war and Brexit. More recently, the COVID-19 pandemic coupled with the ongoing war in Ukraine have added further momentum by revealing the fragility of a globalized economy and its vulnerability to shocks. Against the background of the (still) unprecedented high level of globalization and economic interconnectedness, deglobalization shocks and related repercussions do not necessarily remain confined to the local level, but may well propagate further afield from their place of origin. In line with this, perceived global economic policy uncertainty – capturing uncertainty about who will make economic policy decisions, what economic policy actions will be undertaken and when, and the economic effects of policy actions – have seen the largest recorded spikes and highest index values in the last decade (Baker et al., 2016; Davis, 2016). This heightened uncertainty is associated with greater stock price volatility as well as reduced investment and employment, causing concerns that deglobalization is threatening economic growth.

This paper aims to better understand the effects of deglobalization events in a globalized world, and the role that financial and economic integration play in this regard. We explore how an event implying a turn towards deglobalization affects a highly integrated economy as well as other economies, which are economically and financially connected. To do so, we use the unexpected outcome of the Brexit referendum in June 2016, a major deglobalization shock of the last decade, and investigate its impact on bank credit supply, international spillovers, and real economic outcomes. The Brexit referendum is particularly well suited for our analysis as it came about unexpectedly, and as it clearly marks the start of the United Kingdom (UK) cutting its ties to the high-income and neighboring EU countries.¹ The outcome of the referendum had severe immediate economic consequences in the UK,

¹ While we acknowledge that the US election results in 2016 affected many firms and banks globally, we argue that we can rule out the possibility of this being a confounding event. US firms are included in our control group, suggesting that our results on differences between affected and unaffected firms are at the lower bound. In unreported tests, we exclude US firms and all results remain the same. Furthermore, we are interested in a deglobalization shock that primarily affects a particular geographical region. While there were only a few of these shocks prior to the COVID-19 pandemic, since 2020, several shocks have occurred almost simultaneously across countries, complicating causal inference.

including declines in output and investment (Born et al., 2018; De Almeida et al., 2019), as well as an increase in uncertainty (Bloom et al., 2019; Faccini and Palombo, 2021).² Importantly, the actual exit only occurred much later what implies that any effects are only driven by changes in uncertainty and not by specific actual changes of rules and/or costs.

Central to our analysis is the identification of the implications of the Brexit referendum for bank lending. Berg et al. (2021) identify a significant decline in bank lending following the Brexit referendum. We take this further, investigating the effects on cross-border lending from banks in Germany to borrowers in the UK. This has some methodological advantages. A deglobalization shock affects both firms and banks in the respective country, and may cause additional feedback effects between them. Banks in Germany, by contrast, remained (mostly) unaffected by the immediate implications of the referendum. Changes in their lending to borrowers in the UK are thus related to their assessment of changes in risk due to this deglobalization shock. Investigating cross-border bank lending at the bank-firm-time level allows us to utilize a unique empirical setup that ensures that lending banks and their main business region are only affected through the uncertainty caused by the deglobalization shock.³ Furthermore, the Brexit referendum is quite unique in that it stands alone as a deglobalization shock, whereas other shocks of this kind, especially those since 2020, have often been clustered in time and across economies, making a clear identification of effects challenging. The estimated cross-border credit supply shock for borrowers in the UK then allows us to explore its implications for firms' internal funding, potential ensuing amplification effects to the real economy, and changes in banks' lending to firms in other countries.

Beyond the methodological advantages, the high degree of integration between Germany and the UK also allows for an economically meaningful analysis. The UK is a major

² The Brexit referendum had immediate macroeconomic consequences for the UK and caused an output loss of 1.7%-2.5% by the end of 2018 (Born et al., 2019). The cost of insuring against a UK default increased by almost 80% on the day after the referendum, and stock markets plummeted. With regard to (greenfield) FDI, De Almeida et al. (2019) document a post-referendum decline in announced projects and capital expenditures in the UK by other EU countries as well as by the US, one of the most important non-EU foreign investors. The economic policy uncertainty (EPU) index for the UK (Baker et al., 2016) shows a substantial increase in policy uncertainty around the time of the Brexit referendum, especially in the months thereafter (see Appendix Figure A1). Regressing the index on a constant and an indicator, which is set to one from the time of the Brexit referendum onwards, shows that the index is 78 (76) points larger after the Brexit referendum than before, with a t-value of 3.523 (9.436), when using our sample period 2014:M1 to 2018:M12 (the period 1998:M1 to 2022:M6).

³ Radev and Waibel (2022) show, by contrast, that UK banks are affected directly and substantially by the outcome of the Brexit referendum, depending on their size as well as their trading activity.

destination of FDI from Germany.⁴ As of 2016, the UK ranked second in terms of FDI volume and third in terms of the number of employees in affiliates of multinational corporations (MNCs). Moreover, German banks traditionally play an important role in funding the international activities of German MNCs (see e.g. Buch, 2002; Seth et al., 1998; Williams, 2002), and are instrumental in the direct financing of foreign subsidiaries of German MNCs. For every €2 of credit extended to German MNCs, banks in Germany extend an additional €1 of cross-border credit to MNC subsidiaries abroad.⁵

For our analysis, we rely on a unique combination of several proprietary datasets of the Deutsche Bundesbank. We use credit register data containing quarterly information on German banks' credit to individual corporate borrowers. We augment the credit register data with information on bank characteristics and with information on borrowing firms located abroad. The latter include detailed information on ownership, various balance sheet and income statement items, and, most importantly, the funding structure of firms, including internal debt. These detailed data are available for all subsidiaries of MNCs, which are the main focus of our analysis. The combination of these datasets permits us to analyze bank-firm lending dynamics, firms' internal capital markets, and real economic consequences around the time of the shock. The data structure with multiple bank-firm relationships allows us to isolate credit supply effects as well as to explore the implications of various bank and firm characteristics using a difference-in-differences setup in the spirit of Khwaja and Mian (2008) and Degryse et al. (2019).

Our analysis consists of three parts. First, we investigate the effect of the deglobalization shock on cross-border bank lending. We observe that banks' lending to UK firms decreases at the country level as well as at the bank-firm level after the shock. Then, controlling for loan demand, we investigate which bank and firm characteristics affect the change in credit supply. Our results show that cross-border credit supply to firms in the UK declines in particular, from banks with higher excess capitalization and with a higher return on assets. We also find that less profitable firms face a larger credit crunch. These results suggest that a deglobalization shock such as the Brexit referendum causes international financial frictions.

⁴ German FDI to the UK's non-financial sector increased steadily in the years prior to the referendum, and decreased thereafter (see Appendix Figure A2).

⁵ In this paper, we define a multinational corporation (MNC) as a group of firms located in different countries. These firms have a main investor, called the parent company, which is located in Germany and invests into other firms abroad, which are called subsidiaries. A German MNC is defined as an MNC with a German parent company.

In the second part of our analysis, we investigate whether the credit supply shock amplifies the deglobalization shock's immediate adverse effects to the real economy. To do so, we first explore whether the affected firms are able to compensate for the drop in bank credit supply within their own international corporate structures. A distinguishing characteristic of the firms in our analysis is that they are subsidiaries of German parent companies. These firms therefore have access to the (cross-border) internal capital markets of the MNC to which they belong. Parent companies might use internal capital markets when external funding for subsidiaries worsens unexpectedly. They have an incentive to do so in order to shield their equity investments, i.e. their subsidiaries abroad, particularly in cases when short-term and temporary shortages need to be bridged. The substitution of external funding with internal funding might mitigate or even prevent potential negative real effects. We test this conjecture in an instrumental variables (IV) setup using shifters in loan supply that are orthogonal to firm demand. Our results show that a negative credit supply shock causes an increase in the internal debt of affected firms, indicating that these obtain funds through MNCs' internal capital markets. This effect is stronger for firms belonging to larger MNCs. These firms are able to compensate for a credit supply shock to an extent that, on average, they experience no real economic consequences from this shock. However, differentiating by the characteristics of the MNC shows that the average effect is driven by firms belonging to larger MNCs with more sophisticated internal capital markets, while firms with less access to internal capital markets experience negative real outcomes. Taken together, these results show that whilst one type of international integration amplifies the deglobalization shock (i.e. international bank lending), another type counters its adverse effects (i.e. MNCs' internal capital markets). The latter has beneficial implications for real effects.

In the last part of our analysis, we investigate whether banks shift their lending to borrowers outside the UK after the shock. We observe that the banks which reduce their credit supply to UK borrowers simultaneously increase their lending outside the UK. We further investigate whether lender-borrower nationality is a relevant determinant for credit supply after a deglobalization shock. To do so, we divide firms into those with German owners (i.e. German parent companies) and those with foreign owners. We observe that banks in Germany increase their lending to German-owned firms. This indicates that a deglobalization shock might also imply a home bias comparable to the previously established

flight home effect in times of crisis (see e.g. Giannetti and Laeven, 2012a, 2012b; Coeurdacier and Rey, 2013).

We contribute to the literature by highlighting both the negative as well as the positive effects of international integration in the event of a deglobalization shock. We show that one type of international integration, namely cross-border lending, exacerbates the adverse effects of the shock, by causing a reduction in credit supply. In contrast, we also observe that another type of international integration, namely internal capital markets of multinational firms, cushions these effects as subsidiaries increase borrowing through this channel, thereby dampening adverse effects to the real economy.

Related literature

Our analysis ties into several strands of the existing literature. Besides the extensive literature looking at the economic effects of increasing globalization and integration, driven by the recent deglobalization tendencies, a body of literature studying the effects of related protectionist measures and nationalistic policy decisions has lately developed. In recent years, various deglobalization events and policy actions have led to elevated economic policy uncertainty with harmful effects on macroeconomic performance (Baker et al., 2016). An increasingly restrictive US trade policy since 2018 and ensuing trade uncertainty have had adverse effects on the real economy (see e.g. the survey by Fajgelbaum and Khandelwal, 2021), with spillovers to third countries (Amiti et al., 2019), and this has been further amplified by banks exposed to affected firms (Correa et al., 2022).⁶ The particular deglobalization event that we look at in this study has already received considerable attention in the literature. Ex-ante conjectured economic costs of Brexit (Sampson, 2017; Latorre et al., 2020) have largely materialized, with the UK experiencing, for instance, an output loss of 1.7% to 2.5% by year-end 2018 (Born et al., 2019). The Brexit referendum has also led to a substantial and persistent upward shift in uncertainty (Faccini and Palombo, 2021) with adverse implications for investment and productivity (Bloom et al., 2019). We contribute to this strand of the literature by using a major deglobalization event, i.e. the unexpected outcome of the Brexit referendum, to analyze the implications for cross-border bank lending to the UK and ensuing firm reactions and real effects.

⁶ Federico et al. (2020) show, in another instance, that banks exposed to sectors losing out from trade policies decrease their lending not only to affected but also to unaffected borrowers.

Our analysis further relates to the literature studying internal capital markets of MNCs. Those taking a “bright side” view of internal capital markets argue that they are more efficient than external capital markets. This is because headquarters have greater incentives to monitor due to their residual control rights over the firms’ assets (e.g. Gertner, Scharfstein and Stein, 1994; Stein, 1997, 2003). By contrast, a large part of the literature emphasizes the “dark side” of internal capital markets, in which agency problems such as divisional rent seeking can distort resource allocation towards weaker divisions with poor investment opportunities, thereby decreasing allocative efficiency (e.g. Shin and Stulz, 1998; Rajan, Servaes and Zingales, 2000; Scharfstein and Stein, 2000). In the context of MNCs, cross-border internal capital markets can be used to overcome local constraints related to weak institutional quality and underdeveloped capital markets (e.g. Desai, Foley and Hines Jr., 2004; Egger, Keuschnigg, Merlo and Wamser, 2014; Foley and Manova, 2015).⁷ Several studies show that non-financial corporations’ internal capital markets are particularly valuable when external capital is more costly and more difficult to access, such as, for example, during economic crises (e.g. Gopalan, Nanda and Seru, 2007; Almeida et al., 2015; Buchuk et al., 2019).⁸ De Haas and Van Lelyveld (2010) show that multinational banks support their foreign subsidiaries via internal capital markets during crises in subsidiaries’ host countries. Biermann and Huber study a negative domestic credit supply shock and find that parent firms transmit these shocks to their foreign subsidiaries through their internal capital markets. Most closely related to our paper, Santioni, Schiantarelli and Strahan (2020) study the response of internal capital markets in Italian business groups to changes in the availability of external funding during the 2007-2009 global financial crisis. They show that when an individual firm’s banking relationship becomes impaired, its internal capital market becomes more important. Their study, however, focuses on the domestic setting. We contribute to this by exploring corporate cross-border internal capital markets as well as ensuing effects to the real economy.

Finally, our study connects to the broad literature on internationally active banks and their propagation of shocks. When exposed either to global shocks or to shocks originating in their home countries, internationally active banks transmit these shocks across borders to

⁷ There is also some indirect evidence that points to the importance of credit constraints and internal capital markets in explaining the better performance of MNC affiliates during economic crises (e.g. Desai, Foley and Forbes, 2007; Manova, Wei and Zhang, 2015). Apart from financial factors, real linkages might also account for the differential response of MNC affiliates in crisis years (Alfaro and Chen, 2012).

⁸ For evidence on the importance of internal capital markets on firms’ stock market valuation during crisis episodes, see, for example, Matvos and Seru (2014); Almeida, Kim and Kim (2015); and Kuppusswamy and Villalonga (2016).

previously unaffected borrowers to an extent that affects the real economy (see e.g. Ongena et al., 2015; Paravisini et al., 2015; Peek and Rosengren, 1997, 2000). While the literature is quite unanimous in this regard, the empirical evidence on banks' reactions to adverse developments in host countries is more variable. Banks propagate shocks in their host countries to borrowers in other unaffected host countries via the common lender channel (see e.g. Van Rijckeghem and Weder di Mauro, 2001; Schnabl, 2012). Other evidence shows that some, but not all, international banks in host countries are a source of strength compared to domestic banks (e.g. Borsuk et al., 2022; De Haas and Van Lelyveld, 2006). As for the Brexit referendum, Berg et al. (2021) document a significant decline in syndicated lending to firms in the UK in the wake of the vote and find that lower credit demand was the driving factor. We supplement this finding by showing that the Brexit referendum also increased international (supply side) financial frictions. Furthermore, our results relate to the flight home effect during crises, whereby lenders rebalance their loan portfolios in favor of domestic borrowers (e.g. Giannetti and Laeven, 2012a, 2012b)⁹ with adverse effects being larger for foreign borrowers (Hale et al., 2020). We add to this by showing that the same firm owner-lender nationality implies positive credit supply effects after a deglobalization shock.

The paper is structured as follows. Section 2 provides an overview of our data and some descriptive statistics. Section 3 sets forth our empirical approach. Our empirical implementation and results for the three main parts described above are presented in Sections 4 to 6. Section 7 concludes.

2 Data and descriptive statistics

Our data are unique in connecting information on banks' credit to individual firms with information on bank and borrower characteristics. We rely on three proprietary datasets from the Deutsche Bundesbank. The main building block is the register on banks' credit towards borrowers (Section 2.1), which we complement with borrower level data on international direct investments of firms (Section 2.2), and with bank-level data on the lender side (Section 2.3). Our dataset covers the years 2014 to 2018, thereby allowing for a symmetric window of analysis around the Brexit referendum which took place at the end of June 2016. All data are

⁹ Presbitiero et al. (2014) provide evidence for a home bias within a country, where firms experienced a harsher credit crunch when borrowing from more geographically distant banks during the financial crisis.

denominated in euro and adjusted for inflation. Section 2.4 shows some descriptive statistics, whilst Appendix Table A1 provides variable definitions.

2.1 Bank credit

Data on banks' credit are taken from Deutsche Bundesbank's large credit microdatabase (*Mikrodatenbank Millionenkredite* (MiMik)). The MiMik database provides quarterly information on German banks' credit to borrower units amounting to at least €1 mn. in a quarter.¹⁰ Banks report domestic and cross-border credit as well as some borrower-related information, such as industry or the location of the firm. We focus on bank lending to non-financial private sector borrowers. We include only bank-firm relationships which exist at least for four quarters in both the pre- and post-Brexit referendum periods, and hence over a minimum of eight quarters during our sample period. As the MiMik includes firms with multiple bank relationships, it allows for the identification of credit supply effects using the methodology of Khwaja and Mian (2008).

We use the MiMik database to generate some of our dependent variables. Our main dependent variable to capture a bank's new lending is the number of increases in credit at the bank-firm level (comparable to e.g. Bittner et al. 2022). More specifically, we count the number of increases in a bank's credit to a firm during the pre-Brexit referendum period (i.e. 2014:Q1 to 2016:Q2) as well as during the post-Brexit referendum period (i.e. 2016:Q2 to 2018:Q4), and take the difference between the two. We primarily use this variable because quarterly changes in the reported credit of banks to firms may also include decreases in credit due to regular (partial) repayments of loans. Using *credit increases* ensures that we directly capture all new loans extended by a bank to a firm. However, we also use the pre- to post-shock difference in the quarterly growth rate of a bank's lending to a specific firm (*loan growth*) as the dependent variable. Whilst it is a very common measure capturing loan growth, it rests on the assumption of comparable (partial) repayment patterns of loans in both the pre- and the post-Brexit referendum period.

2.2 Borrowing firms and their organizational structure

On the borrower side, we augment the credit data with the MiDi (Microdatabase Direct Investment) database, which covers the universe of German outward foreign direct

¹⁰ See Schmieder (2006) for a detailed description of the MiMik database as well as the reporting rules and thresholds.

investments (FDI).¹¹ Based on these data, we identify those firms in the MiMik that are investments of MNCs with the main investor being located in Germany.¹² As the MiDi dataset is based on balance sheet reports, it provides us with detailed information on asset and liability structures as well as several other characteristics, such as the profit or loss of the financial year and the number of employees at each firm. The dataset also includes information on the parent company located in Germany, such as its size or the number of employees.¹³

Crucial for our analysis is the detailed information on firms' liability structures. For each firm located abroad, we know its total amount of liabilities as well as what share of these liabilities is external, e.g. from banks or bond holders, and what share is internal, i.e. from the parent company or other subsidiaries of the MNC. These data allow us to explore the dynamics of MNCs' internal capital markets and how they are put to use in reaction to an adverse shock to one or some firms in the overall corporate group. The MiDi is based on annual firm balance sheet data. In order to carve out the effect of the Brexit referendum, for analyses which incorporate data from the MiDi, we focus on the two years prior to the referendum (i.e. 2014 and 2015) and the two years thereafter (i.e. 2017 and 2018), and exclude 2016 as it may reflect pre- as well as post-Brexit referendum dynamics.

2.3 Bank characteristics

On the lender side, we augment the credit data with bank-level information from different sources to construct bank-specific variables. We obtain data on banks' balance sheet characteristics from the BISTA (Bundesbank monthly balance sheet statistics; see e.g. Gomolka et al., 2021) and from supervisory data on solvency and financial reporting (Common Reporting Framework (COREP), Financial Reporting Framework (FINREP), and national reports). We use these data to construct variables for banks' size (*Log. total assets*), banks' CET1 capitalization in excess of regulatory requirements (*Excess CET1/RWA*), the ratio of a bank's total liabilities to its total assets (*Leverage*), return on assets (*RoA*) to capture banks' profitability, and the share of non-performing loans in total loans (*NPL ratio*). To measure banks' *Internationalization*, i.e. the share of their total credit accounted for by international credit, as well as *banks' exposure to the UK*, i.e. credit extended to borrowers in

¹¹ For a description of the general characteristics and properties of the MiDi dataset, see Blank et al. (2020).

¹² In case of multiple investors in the same firm, we focus on the largest investor.

¹³ Friederich et al. (2021) provide a detailed overview of all the variables and technical features of the dataset.

the UK as a share of total credit, we rely on the MiMik data. All bank variables enter the analysis with their pre-shock values.

2.4 Descriptive statistics

Table 1 shows the descriptive statistics of all major variables: in Panel A, for the full sample, in Panel B, split into firms in the UK (“UK firms”) and firms outside the UK (“Non-UK firms”). Statistics are for variables as used in the regression analyses. Dependent variables are the difference between their average value in the post-shock period, i.e. 2016:Q3 to 2018:Q4, minus their average value prior to the shock, i.e. 2014:Q1 to 2016:Q2. Independent variables are reported with their average value prior to the shock. All data are deflated and winsorized at the 1st and 99th percentiles at the industry level.¹⁴ The table is based on the main dataset, which consists of 1,062 unique firms that are subsidiaries of parent companies in Germany and are located in EU countries, China, Switzerland, Turkey, the UK and the US.¹⁵ These firms borrow from 167 banks in Germany during our sample period.

[Table 1]

The table shows that on average, credit decreases over the sample period. Additionally, both our main variables *credit increases* and *loan growth* show a stronger decline for firms in the UK than for firms elsewhere. While firms’ average internal debt increases over time, we observe a larger increase for UK firms, especially for the internal debt from other foreign affiliates (*Int. debt other subs.*). The opposite is true of employment and investment; here, UK firms experience less favorable or even negative changes from the pre- to the post-Brexit referendum period compared with firms elsewhere. The average bank in our sample has total assets of roughly €200 bn, an excess CET1 capital ratio of 5 percentage points, return on assets of 2.7%, and a ratio of nonperforming loans to total loans of 3% prior to the shock. Panel B shows that the differences between variables for firms in the UK and for firms elsewhere are not significant, suggesting that rather comparable firms (and banks) are

¹⁴ The data are winsorized at the industry-quarter level prior to aggregation and again at the industry level after aggregation. In unreported robustness checks, we winsorize the data solely at the quarter level and find that all results are very comparable. Furthermore, all data are denominated in euro with no breakdown of individual original currencies. We consider the extreme case and convert all data to pound. Results do not change.

¹⁵ Note that these are the countries to which German banks issue the highest volume of cross-border credit. The sample is based on an initial pre-cleaned panel dataset with 206 banks and 1,822 firms totaling 44,155 quarterly cross-border credit observations. Using the entire credit register (MiMik), as in the last part of the paper and in several robustness tests, the sample consists of 206,644 firm-bank relationships with 1,331 banks and 149,551 firms.

included in our analyses, i.e. there is no selection bias between banks' lending to UK firms compared with non-UK firms.¹⁶

3 Empirical strategy

We divide our analysis into three parts. First, in order to explore the implications for cross-border lending, we investigate the differential effect of the Brexit referendum on banks' cross-border lending to the UK at the country level and compared with other countries. To do so, we estimate versions of the following regression equation:

$$Y_{C,t} = \beta * UK * Brexit + I_C + I_t + I_{C,s} + \varepsilon_{C,t} \quad (1)$$

where the dependent variable $Y_{C,t}$ is the number of increases in bank credit on the bank-firm level per country C and quarter t . UK is an indicator variable which is set to one for the UK, and $Brexit$ is an indicator variable which is set to one for all quarters after the Brexit referendum.¹⁷ I_C are a set of country fixed effects and I_t a set of time fixed effects (quarterly). To control for potential country-specific seasonality, we additionally include country \times season-quarter fixed effects $I_{C,s}$, with $s=1, \dots, 4$.

We then proceed to explore cross-border lending dynamics at the bank-firm level. To do so, we estimate versions of the following equation, following the approach of Khwaja and Mian (2008):

$$Y_{b,f}^{post-pre} = \beta * UK_f * Z^{pre} + c_1 Z^{pre} + c_2 Exp_b^{pre} + c_3 Exp_b^{pre} UK_f + I_{MNC} + I_{C,ind} + \varepsilon_{b,f} \quad (2)$$

where the dependent variable $Y_{b,f}^{post-pre}$ is either the pre- to post-shock difference in the number of credit increases (*credit increases*), or the difference in average loan growth (*loan growth*) at the bank-firm level. Note that aggregating the data in the pre- as well as in the post-shock period and then taking the difference accounts for possible autocorrelation (Bertrand et al., 2004). UK is again an indicator variable which is set to one for firms located in the UK, and Z^{pre} are either bank or firm characteristics with their average values prior to the shock. Exp_b^{pre} is the share of a bank's total lending accounted for by lending to UK firms prior to

¹⁶ We acknowledge that our sample might be subject to some limitations, as the data available only allow us to include firms affiliated with parent companies in Germany and borrowing from banks in Germany.

¹⁷ The interaction of these two dummy variables is equivalent to the post*treated interaction term in difference-in-differences regressions. Note that the base terms are subsumed by the included fixed effects.

the shock and captures a bank's exposure to the deglobalization shock. Banks might change their lending differently depending on their exposure to the shock. Accordingly, Exp_b^{pre} controls for the effect of the shock for bank's overall lending whilst interacting it with the UK dummy accounts for the conditional and differential effect for lending to UK firms. I_{MNC} are a set of fixed effects accounting for changes in MNC characteristics.¹⁸ To distill out credit supply effects and control for changes in firm credit demand, we include a set of country x firm-industry fixed effects $I_{C,ind}$.¹⁹ These proxy firms' credit demand at a higher level than that of the individual firm (see e.g. Popov and van Horen, 2015; Acharya et al., 2018; Degryse et al., 2019; Berg et al., 2021) and firm fixed effects would identify supply effects of the Brexit referendum more rigorously. However, as this would restrict the sample to only firms with lending relationships with at least two banks, and as it is essential to also include single-bank firms in the analyses for the identification of credit supply shocks (Degryse et al., 2019), the results with firm fixed effects are used to show the robustness of our results. Implementation and results for this part of the analysis are described in Section 4 of this paper.

In the second part of our analysis, we investigate the effects of the identified credit supply shock on firms' internal debt as well as on firm real effects. Regressing the change in a firm's internal debt or real outcomes on the change in firms' lending from banks does not suffice to efface endogeneity concerns, as the direction of influence remains unclear. Therefore, to clearly isolate effects stemming from the bank credit supply shock, we implement instrumental variable (IV) regressions. To trace out the credit demand curve, we require instruments that shift the bank loan supply curve but are orthogonal to firms' credit demand. As bank characteristics affecting bank lending supply are orthogonal to firm demand, we build on equation (2) and use the interaction of these characteristics with our dummy variable UK as shifters of banks' credit supply (excluded instruments) in the first stage of our regressions. We additionally include a bank's pre-shock exposure towards UK borrowing firms as well as the interaction of the exposure variable with our indicator variable UK . The variation in banks' exposure to the deglobalization shock provides an additional,

¹⁸ Note that differencing between the pre- and the post-shock period already accounts for the time-invariant characteristics of the group as well as of the firm. These fixed effects accordingly additionally account for a potential time-varying change in credit demand.

¹⁹ In robustness tests, not shown for brevity, we include MNC x industry fixed effects in addition to the country x firm-industry fixed effects. This requires two firms of the same corporate group operating in the same industry but in different countries, which reduces the number of observations to some extent but does not affect our overall results.

exogenous shifter of the bank loan supply curve, unrelated to firm demand but heterogeneous across banks. We deliberately exclude firm control variables from these regressions, as these might be both significantly related to bank loan supply and highly (in some cases mechanically) correlated with firms' internal debt. In all regressions, we also report the test for overidentifying restrictions, which tests the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. To sum up, we use equation (2) as our first-stage regression with Z including only bank characteristics prior to the shock. From this estimation, we obtain instrumented changes in pre- to post shock lending on the bank-firm level, which we use as the exogenous credit supply shock in the second stage of the IV.

We then proceed to estimate versions of the following regression equation as our second stage:

$$Y_f^{post-pre} = \beta_1 * Credit\ Supply\ Shock_{b,f} + \beta_2 * Credit\ Supply\ Shock_{b,f} * W^{pre} + c_1 Z_b^{pre} + I_{MNC} + I_{C,ind} + \varepsilon_f \quad (3)$$

with $Y_f^{post-pre}$ as the pre- to post shock difference of the logarithm of the average amount of a firm's internal debt. Alternatively, we also use the amount of internal debt from other subsidiaries of the same MNC to analyze whether MNCs redistribute funds across their foreign subsidiaries. Other dependent variables we use to measure firm real effects are the logarithm of employment, the logarithm of foreign direct investment, the return on assets, and the logarithm of firm turnover. Note that foreign direct investment is equivalent to equity financing from the parent company. *Credit Supply Shock* is the instrumented bank credit supply shock, multiplied by minus one for ease of interpretation so that a higher value implies a larger bank credit supply shock. W^{pre} are characteristics of either the parent company or the entire MNC the firm is part of, and Z_b^{pre} are bank characteristics, all used with their average values in the pre-shock period. Again, $I_{C,ind}$ are a set of country x firm-industry fixed effects to control for changes in firm demand, and I_{MNC} are a set of fixed effects accounting for changes in MNC characteristics. Implementation and results for this part of the analysis are described in Section 5.

In the third part of our analysis, we explore banks' lending to firms outside the UK following the deglobalization shock. To do this, we widen the sample of firms under analysis. Whilst until now we were studying borrowing firms that are subsidiaries of MNCs with the

parent company being located in Germany, we now turn our attention to all firms borrowing from banks in Germany and located in the countries of our main interest but outside of the UK, regardless of whether these firms belong to an MNC or not. While this allows for a complete overview of banks' lending, it comes at the cost of not having detailed firm level information, meaning that we cannot analyze firm reactions and real effects. That said, we do have information regarding which of the firms are subsidiaries of German MNCs.

To understand shifts in banks' cross-border lending, we first look at the role played by banks' exposure to UK borrowers prior to the Brexit referendum in general. We are interested in whether credit supply through banks is reallocated in such a way that it also affects firms which are at first not directly exposed to the event. Second, we analyze whether the bank characteristics which are shown to be related to the loan supply to UK firms in the first part of our analysis also imply differential effects for banks' lending to non-UK firms. We hypothesize that banks which reduce their lending to UK firms to a greater degree also show a stronger increase in loan supply to non-UK firms. In other words we expect banks to shift from lending to UK borrowers to lending to borrowers in other countries. Third, we analyze whether a deglobalization shock implies that banks focus more strongly on lending to firms with the same national affiliation. Banks may perceive firms belonging to MNCs based in their own country of location as less risky. This might relate to lower information asymmetries and a change in the loan mix that reduces credit market integration following a negative shock (Gianetti and Laeven, 2012).

We estimate versions of the following regression:

$$Y_{b,f}^{post-pre} = Exp_b^{pre} + Exp_b^{pre} * Z_b^{pre} + Exp_b^{pre} * German\ MNC + I_{C,ind} + \varepsilon_{b,f} \quad (4)$$

with the dependent variable $Y_{b,f}^{post-pre}$ as the loan growth of bank b to firm f from the period prior to the period following the shock. Exp_b^{pre} is the share of a bank's total lending accounted for by lending to UK firms prior to the shock and captures that bank's exposure to the deglobalization shock. We interact this variable with bank characteristics Z_b^{pre} , taken with their average value prior to the shock, to measure whether the types of banks that reduce their UK firm lending simultaneously increase their non-UK firm lending. In further analyses, we add a dummy variable *German MNC*, which is set to one when a borrowing firm belongs to a German MNC, and interact it with a bank's exposure to UK borrowers prior to the Brexit referendum. The interaction term allows us to investigate whether bank credit supply after a deglobalization shock is related differentially to borrower-lender nationality.

As before, we account for firm demand with country x industry fixed effects, or, alternatively, with firm fixed affects. The results for this part of our analysis are presented in Section 6.

4 Deglobalization and cross-border bank lending

This section presents details of our empirical implementation and results for the analysis of the deglobalization shock on cross-border lending at the country level (4.1) and at the bank-firm level (4.2). Furthermore, it shows which bank characteristics (4.2.1) and firm characteristics (4.2.2) are relevant determinants of cross-border lending against the background of the deglobalization shock.

4.1 Cross-border bank lending at the country level

To explore the effects of the deglobalization shock on aggregate cross-border bank lending at the country level, we look at three different sets of countries in which borrowing firms are located: all countries (columns (1) and (2) in Table 2), EU countries and the countries to which banks in Germany issue the largest credit volume (i.e. China, Switzerland, Turkey, the UK and the US) (columns (3) and (4)), and EU countries only (columns (5) and (6)). Our dependent variable is *credit increases*.

[Table 2]

Table 2 shows our results from estimating equation (1). We find that banks lend less to firms located in the UK after the shock and compared with firms in other countries, irrespective of the set of countries included in the analysis. All coefficients are highly statistically significant. The results in Table 2 suggest that the deglobalization shock is associated with a relative decrease of cross-border lending of roughly one-fourth of its standard deviation from banks in Germany to UK firms.

4.2 Cross-border bank lending at the bank-firm level

The analysis of effects at the bank-firm level includes all borrowing firms in the EU and the five countries to which banks in Germany issue the largest volumes of credit (China, Switzerland, Turkey, the UK and the US). Dependent variables are *credit increases* (Panel A of Table 3) and *loan growth* (Panel B). While the former ensures that we measure new loan issuances, the latter is more common in the literature, but rests on the assumption of comparable (partial) repayment patterns in the pre- and post-shock periods.

[Table 3]

The results presented in Table 3 again confirm that after the deglobalization shock, banks reduce their lending to firms located in the UK relative to firms in other countries. All coefficients are highly statistically significant and economically meaningful. Banks extend on average one loan less to UK firms relative to firms in other countries in the 10 quarters after the Brexit referendum compared with the 10 quarters prior to it (Panel A). As this compares to roughly 3.5 new loans (to both UK and non-UK firms) prior to the shock, it represents a reduction of almost 30%. Coefficient estimates in Panel B show loan growth that is 20 percentage points lower. Given that quarterly loan growth to UK firms was about 25% in the period prior to the shock, this implies that on average, lending almost comes to a halt. Table 3 also shows that accounting for banks' exposure to the deglobalization shock via our variable Exp^{pre} and its interaction with our indicator variable UK is important, as in both panels coefficients gain substantially in economic significance when they are included in regressions (starting in column (2)).²⁰

Note that all our estimations focus on borrowing firms that are subsidiaries of German MNCs. To show the generality and robustness of our results, we run the previous regression including all borrowing firms in our sample countries. The coefficient estimates of UK , which is our main point of interest, are highly significant across all regression specifications (see Appendix Table A2, Panel A). Regarding the overall effect of the referendum on firms' liabilities, it might be the case that UK banks replace the decrease in cross border credit supply. While we do not have data available on the lending of banks outside Germany, we know the total liabilities of firms. In unreported tests, we include both the logarithm of total liabilities as well as the ratio of total liabilities to total assets as dependent variables. The results show that the liabilities of UK firms in general relatively decrease after the referendum suggesting that a potential substitution of credit supply is, if at all, not complete. Furthermore, we ensure that the parallel trends assumption holds for our estimations. For this purpose, we introduce a placebo shock in 2014:Q1 and use the 10 quarters before and 10 quarters after as estimation periods, comparable to our main regressions. We do not find any significant effects, irrespective of whether only borrowing firms that are subsidiaries of German MNCs or all borrowing firms in our sample countries are included (see Appendix

²⁰ As a robustness test, we re-run all regressions in the first part of our analyses without accounting for banks' pre-shock exposure towards the UK. All results are confirmed.

Table A2, Panels B1 and B2). We therefore conclude that the parallel trends assumption holds.

Overall, the results in Tables 2 and 3 provide evidence that the shock caused by the Brexit referendum triggers a reduction in cross-border bank lending to UK firms compared with lending to firms in other countries. Our findings add to the results of Berg et al. (2021), who show for the syndicated loan market that loan issuances in the UK decreases after the referendum.

4.2.1 Bank characteristics

Next, to clearly distill out credit supply effects, we control for loan demand as well as determining relevant bank characteristics. To do so, we use equation (2) and include a set of bank characteristics in our vector Z^{pre} . These are the logarithm of total assets to capture bank size, bank's excess capitalization (i.e. the capitalization in excess of regulatory requirements), and bank leverage, measured as total liabilities over total assets. Bank profitability is measured by return on assets (RoA) and banks' soundness is established by the ratio of nonperforming loans (NPL) to total assets. We go on to measure a bank's degree of internationalization with its share of loans to firms located abroad relative to all of its corporate loans. All variables are used with their average value over the last four quarters prior to the shock. Additionally, each bank characteristic is interacted with our indicator variable UK in order to identify those characteristics which are related to the decrease in bank loan supply to UK firms.

Table 4 shows the results with *credit increases* (Panel A) and *loan growth* (Panel B) as dependent variables.

[Table 4]

In both Panels A and B, columns (1) to (6) include bank variables individually, while column (7) displays all bank characteristics together. Focusing on the interaction term between the indicator variable UK and the individual bank characteristics, we observe that banks with higher excess capitalization, higher RoA and a higher NPL ratio reduce their cross-border lending to UK firms more significantly. This points towards the fact that sounder banks, i.e. those that are better capitalized and more profitable, reduce their cross-border lending more after a deglobalization shock. Note that a higher NPL ratio allows for different interpretations. On the one hand, it might indicate that a bank is risky because it

has a high share of potentially defaulting loans in its portfolio and thereby depletes bank capital. By contrast, it might also be a sign of bank prudence. A growing portion of the literature shows that banks engage in zombie lending (e.g. Caballero et al., 2008; Acharya et al., 2019; Blattner et al., forthcoming).²¹ Hence, recognizing loans as nonperforming and not continuing to extend loans to already distressed firms could be a positive signal of bank prudence and therefore bank stability. To further ensure this conclusion and rule out a higher riskiness of banks' lending, in unreported robustness tests, we investigate the internal ratings of firms by banks and do not observe any significant changes. Accordingly, banks with higher excess capitalization, higher RoA and a higher NPL ratio can be considered as being more sound and prudent overall. In columns (8) of both panels, we use firm fixed effects instead of country x industry fixed effects in order to control for credit demand more rigorously. Note that while this is the strictest specification to account for firms' credit demand in our setup, it excludes the large number of firms with a lending relationship to only one bank. The results in column (8) of both panels largely confirm our previous findings. Banks that are more sound and prudent decrease their cross-border lending to UK firms to a greater degree after the shock.

4.2.2 Firm characteristics

Next, we show which firm characteristics relate to the credit supply shock after the Brexit referendum. We again estimate equation (2) and now use firm characteristics in our vector Z^{pre} including the logarithm of total assets as a measure of firm size, the return on assets (RoA) for firm profitability, and firm leverage (i.e. equity over total assets) to capture the riskiness of a firm. All variables are average pre-shock values.²² Table 5 presents the results with *credit increases* (Panel A) and *loan growth* (Panel B) as dependent variables.

[Table 5]

In columns (1) to (3) of each panel, we show the results for each firm variable individually, and in column (4), we display the results for all firm variables together. The coefficient of RoA is positive and highly significant in Panel A and almost statistically significant in Panel B, pointing towards a smaller credit supply shock for more profitable firms. In column (5), we also include the bank characteristics explored in the previous

²¹ See also Acharya et al. (2022) for a comprehensive overview of the related literature.

²² Data on firm characteristics obtained from the MiDi (see Section 2.2) are available on an annual frequency only. We use year-end 2014 and 2015 values to compute pre-shock averages.

subsection. These specifications show that firm profitability is a significant determinant of cross-border lending in the wake of a shock. Column (5) confirms the previous result that more sound and prudent banks reduce their cross-border lending to UK firms to a greater degree. Note that we cannot include firm fixed effects in these estimations, as these would absorb firm characteristics.

Overall, our results show that the magnitude of the cross-border credit supply shock after the Brexit referendum is significantly related to characteristics of both the lending banks as well as the borrowing UK firms. They accordingly allow to infer about the type of banks and firms experiencing a cut in credit supply and add to the findings of Berg et al. (2021) who focus more on the overall general adjustment of bank lending. Cross-border lending decreases more significantly on the part of sounder and more prudent banks and to less profitable firms. This result begs the question of whether this credit supply shock to UK borrowers implies a general shift of German banks' loan portfolios towards firms outside the UK. We explore this in Section 6. However, before doing so, we look at firms' internal capital market dynamics and real economic effects after the shock.

5 Effects of the credit supply shock on firms

This section presents estimation details and results for the analysis of MNCs' internal capital markets (5.1) as well as firm real effects, and the relation between the two (5.2).

5.1 Internal capital markets

Internationally active corporations, MNCs, operate internal capital markets within their corporate structures and across borders. Recall that the firms included in our analysis are part of an MNC, i.e. they are an entity within an international corporate holding structure with the parent company located in Germany and other subsidiaries located worldwide. Hence, as these firms have access to MNCs' internal capital markets, they may be able to compensate their reduced bank lending due to the credit crunch after the Brexit referendum with increased funding through MNCs' internal capital markets, though the MNC is exposed to the same shock as the banks. The reason for this is the substantial amount of "brick and mortar" investment in the UK, which creates very different incentives than those by banks. Given the high overall uncertainty following the shock, it may pay off for firms, especially in

the longer term, to support their subsidiaries during the immediate credit crunch.²³ We compute two variables to capture firms' funding via MNCs' internal capital markets. We have information on the amount of firms' total internal debt as well as on the amount of internal debt towards other subsidiaries of the MNC (excluding the parent company) and are able to calculate the difference of the log of these amounts between the pre- and post-shock periods.

Table 6 reports the results from estimating equation (3). Note that these are second stage IV regressions and that our independent variables are the instrumented changes in new credit ($Credit\ Supply\ Shock_{credit}$) and loan growth ($Credit\ Supply\ Shock_{loan\ growth}$). Recall that $Credit\ Supply\ Shock$ is the instrumented change multiplied by minus one for ease of interpretation, as we are interested in the effects of a *negative* shock to lending and therefore the impact of the sudden decrease in lending. Accordingly, a higher value implies a larger credit supply shock.

[Table 6]

Results for the change in firms' total internal debt are reported in columns (1) and (2), while results related to the change in internal debt towards other subsidiaries are shown in columns (3) and (4). The table shows that a negative credit supply shock leads to an increase in firms' internal debt. This effect is statistically stronger for the internal debt towards other subsidiaries of the same corporate group (columns (3) and (4)). The coefficient estimates relate to an increase of about 10 percent in response to a negative credit supply shock of one standard deviation due to a deglobalization shock. Accordingly, UK firms see an increase in funding via their international holding structure when they experience a negative bank credit supply shock. Across all estimations, the overidentification test is rejected and the F-statistic is well above 10 (Staiger and Stock, 1997; Stock and Yogo, 2005).²⁴

The ability to provide funding to subsidiaries in the event of a shock may depend on certain parent company or general MNC characteristics. Some MNCs operate one or several special purpose entities (SPEs) whose purpose is to obtain external financing and redistribute the funds across international structures. Firms belonging to MNCs where an SPE is part of the corporate group should be able to obtain and distribute internal financing more easily.

²³ Firms do, of course, have other sources of external funding, too, such as loans from banks not located in Germany, public debt markets or equity markets. However, given our data, we are unable to analyze this in more detail.

²⁴ Appendix Table A3 shows the results for estimations that additionally include a triple interaction of bank characteristics, our indicator variable UK for UK firms, and a bank's share of lending to UK firms in its total lending prior to the shock, as well as all double interactions and base effects as excluded instruments. All results hold. Importantly, the F-statistic for the first stage of each column in Appendix Table A3 is well above 104, which shows that our results do not suffer from a weak instruments problem (Lee et al., 2022).

We capture this with an indicator variable *MNC with SPE* that is set to one for those firms and zero otherwise. Furthermore, we hypothesize that larger parent companies and MNCs in general are better able to provide funding to an affiliated firm affected by a credit supply shock. Our proxy variables for the size of the parent company and the MNC in general are the logarithm of the total assets of the parent company in Germany ($\log(Assets)_{parent}$), and the logarithms of the number of employees of the MNC ($\log(Employees)_{MNC}$), the amount of total assets of an MNC ($\log(Assets)_{MNC}$), and the number of affiliated firms per MNC ($\log(\#Affiliates)_{MNC}$). We interact each of these variables with our two measures for the credit supply shock to explore heterogeneous effects across firms. We now take firms' internal debt over total assets as the dependent variable in order to capture the change in the relative importance of firms' internal debt. Previous results (in Table 6) have shown that the amount of internal debt increases in response to the negative bank credit supply shock. If we were to regress changes in amounts on our proxy variables for MNC and parent company size, any possible statistical significances could be a mere mechanical effect with larger changes relating to larger parent companies or MNCs. Normalizing internal debt with assets addresses this concern and allows us to observe the change in the relative importance of internal debt within firms' capital structure. Table 7 reports the estimation results.

[Table 7]

While the results in columns (1) and (2) do not show a significant relationship between the credit supply shock and internal debt, columns (3) to (12) suggest that MNC and parent company characteristics imply differential effects across firms, as all interactions of parent company and MNC characteristics with the credit supply shock show positive and statistically significant coefficient estimates. Thus, our hypothesis is confirmed. For a given credit supply shock, firms' internal debt share is higher if their MNC includes an SPE and/or is larger. It is, however, important to note that the overall effect crucially hinges on the specific value of the interaction variable, as the base term is negative.²⁵ Accordingly, UK firms of smaller parent companies and MNCs experience a decrease in both internal as well as cross-border bank credit while those with larger parent companies and MNCs are able to mitigate a negative bank credit supply shock with internal funding.

²⁵ To test the robustness of our results, we extend the first-stage regression to include a triple interaction of bank characteristics, the UK dummy, and the pre-shock exposure to the UK as instruments. These second stage regressions broadly confirm our results (see Appendix Table A4), with F-statistics well above 104 in all cases (Lee et al., 2022).

Overall, our results indicate that a credit supply shock leads to an increase in MNCs' internal funding for firms belonging to larger parent companies and/or MNCs. Larger MNCs, which may extend across more geographic regions and be more diversified, are probably less affected by a local shock. As a consequence, they are a source of stability to their subsidiaries that experience an adverse local shock.

5.2 Firm real effects

Our results indicate that borrowing firms are affected by the credit supply shock caused by the outcome of the Brexit referendum, and the literature shows that negative credit supply shocks have adverse implications for the real economy (see e.g. Ongena et al., 2015; Peek and Rosengren, 2000). However, we also observe that firms affiliated with (larger) MNCs experience an increase in internal funding that counters the credit supply shock. In this subsection, we proceed to analyze the ensuing real effects. To do so, we estimate versions of equation (3) using the previous IV regression setup, and with variables capturing firm real effects on the left hand side. These variables are the logarithm of a firm's employment ($\log(\textit{Employment})$), the logarithm of foreign direct investment ($\log(\textit{Equity financing})$), the return on assets (\textit{RoA}), and the logarithm of firm turnover ($\log(\textit{Turnover})$). Table 8 presents the results.

[Table 8]

All coefficient estimates for both *Credit Supply shock* variables are statistically insignificant (with the exception of one coefficient estimate in column (6)). This indicates that on average, the credit supply shock does not have implications for real outcomes. This is an interesting and important result that adds to our previous findings. Firms that are subsidiaries of MNCs receive funding through internal capital markets to an extent that mitigates, on average, the experienced credit supply shock, with the result that the usual adverse real economic consequences of a credit crunch cannot be observed. This result adds a new insight to shock transmission in a globalized world. Currently, the prevailing understanding in the literature is that international integration implies numerous benefits, whilst at the same time increasing vulnerability to shocks. Our results complement this finding by showing that whilst one form of international integration amplifies a deglobalization shock (i.e. international bank lending), another form counters its adverse implication (i.e. internal capital markets of MNCs), with the latter having beneficial implications for real effects.

Finally, we turn our attention again to firm heterogeneities. As firms with larger parent companies and/or MNCs are better able to mitigate credit supply shocks via their internal capital market (see previous subsection), we expect this to translate into heterogeneous real effects across firms. To analyze this, we again estimate versions of equation (3) with a measure for firms' employment as the dependent variable. Firms' employment can be adjusted rather quickly and provides for an adequate proxy for the direct effect of a deglobalization shock on the affected country. To capture firm heterogeneities, we use the same proxy variables for parent company and MNC size as before (see Table 7) and interact these measures with our estimated *Credit Supply Shock* derived using the pre- to post-shock difference in loan growth. We hypothesize that the benefits of internal capital markets for firms which are part of larger MNCs should also be reflected in more favorable real effects, measured by firm employment in our case. Table 9 reports the results.

[Table 9]

We observe that firm heterogeneities certainly have a bearing on ensuing real effects following a credit supply shock. All coefficient estimates for interaction terms are positive and highly statistically significant, while coefficients of the *Credit Supply Shock* are negative and significant. This indicates that a decrease (increase) in a firm's employment after the shock is stronger the smaller (larger) the parent company and/or MNC the firm belongs to. As an example, estimation results in column (1) show that the *Credit Supply Shock* leads to a 10 percentage point decrease in employment for firms belonging to an MNC without an SPE, whereas for those firms belonging to an MNC that operates an SPE, employment increases by 16 percentage points.

Taken as a whole, our results show that MNCs are able to mitigate a credit supply shock by providing funding through their internal capital markets, and thereby mitigate or even prevent the real economic ramifications that usually follow a credit supply shock. However, this applies only to larger MNCs and for those operating an SPE. Whilst in principle this could bode well for aggregate economic dynamics, it should be noted that out of a total of 2.2 million firms in the UK (as of end-2015), only about 24,000 (i.e. about 1%) were foreign-owned.²⁶ UK-owned firms, which do not belong to MNCs and which represent the vast majority of businesses, however, have no access to cross-border internal capital markets, and

²⁶ Data are taken from the Annual Business Survey on foreign-owned businesses in the UK, provided by the UK Office for National Statistics: <https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/datasets/annualbusinesssurveyforeignownedbusinessesbusinesscountturnoverandagvabreakdown>.

this particular mechanism to mitigate the credit supply shock caused by the referendum therefore remains unavailable to them.

6 Deglobalization and shifts in banks' lending

We have established that banks abruptly reduced their lending to UK firms after the Brexit referendum. Our next step is to investigate general bank lending dynamics after the shock, with a focus on where banks shift their lending to. To do this, we now look at all borrowers outside the UK, regardless of whether they are a subsidiary of an MNC or not. We first examine the role that banks' exposure to UK borrowers prior to the Brexit referendum plays as a measure for their exposure to the deglobalization shock. Banks which are more exposed to uncertainty caused by a deglobalization shock are more likely to generally decrease their lending, also including only indirectly affected borrowers (Correa et al., 2022). We are additionally interested in whether the bank characteristics shown to be related to the reduction in lending to UK firms in Table 4 are associated with a stronger increase in loan supply to non-UK customers. Table 10 shows the main results.

[Table 10]

The table confirms that on average, banks with a higher exposure to UK borrowers tend to reduce their lending to non-UK borrowers after the shock. However, this effect is reduced or even reversed for banks with high excess capitalization, defined as banks with a ratio of CET1/RWA of 8 percentage points above regulatory requirements. We observe that banks with high excess capital ratios, which reduce lending to UK firms more significantly after the shock, lend more to non-UK firms, i.e. shift their lending away from UK firms to firms located in other countries. Controlling for demand with firm fixed effects at the cost of a substantially reduced sample size leads to the same result (see columns (3), (6), and (9) in Table 10). Accordingly, banks with a larger exposure to a deglobalization shock also reduce their lending to unaffected firms to a greater degree. However, this effect is attenuated and, in some cases, even reversed for those banks which reduce their lending to affected firms the most.²⁷

After looking into the role that bank heterogeneities play in the shift of cross-border bank lending, we go on to examine the role played by the heterogeneities of borrowing firms.

²⁷ These results are also confirmed for the change in the number of increases in credit or the change in bank-firm loan growth as dependent variables (see Appendix Table A5, Panel A) as well as for using high RoA instead of high CET1/RWA (see Appendix Table A5, Panel B).

As explained earlier, extending the sample to all borrowers independent of whether they are a subsidiary of an MNC or not allows for a complete overview on banks' lending at the cost of not having detailed firm level information, except information on which of the firms are subsidiaries of German MNCs. We explore whether (German) banks differentiate firms which are subsidiaries of German MNCs from other firms when shifting their lending from the UK to other countries. The results are shown in Table 11.

[Table 11]

Results show that banks with more exposures to UK borrowers prior to the Brexit referendum relatively increase their lending to firms which are owned by German MNCs. All interaction terms with our variable *German MNCs* are highly statistically significant. This points towards a bias in lending in response to a deglobalization shock when the owner of the firm and the lender have the same nationality. In columns (2), (4), and (6), we additionally include the interaction term of bank exposure to UK borrowers and banks' excess capital ratio to control for the effects observed in Table 10. All results continue to hold. Further tests show that both effects impact loan growth individually but not jointly.²⁸ In other words, banks with higher exposures to UK firms prior to the Brexit referendum shift from lending to UK firms to lending to non-UK firms and to firms that belong to German MNCs.

Note that our framework for a nationality bias is defined more broadly than the home bias in previous literature, as we resort to the location of the eventual controlling firm instead of the location of the direct borrower. We re-run all analyses and split borrowing firms by their own nationality as well as the nationality of their eventual owner. For German owners, the results (not reported here for the sake of brevity) for borrowing firms in Germany and borrowing firms in other countries are similar, albeit statistically stronger for firms based in Germany. However, we cannot rule out the possibility that statistical power is driving this result, as out of the 59.03% of all borrowing firms with a German owner, 57.29% are also based in Germany and only 1.74% are located in other countries. By contrast, when we investigate the results for borrowers with an owner based outside Germany, we find neither economically nor statistically strong effects for firms located in Germany. This strongly suggests that ownership location, rather than direct borrower location, is the relevant driver

²⁸ Appendix Table A6, Panel B shows that the triple interaction term between bank exposure to UK borrowers, German-owned firms and high excess capital is insignificant in all regression specifications. In addition, Panel A confirms that all results continue to hold when we alternatively use the change in the number of increases in credit or the change in bank-firm loan growth as dependent variables.

of bias in bank lending when the owner of a borrower and the lender have the same nationality.

7 Conclusion

The unexpected outcome of the Brexit referendum marked the sudden beginning of the disintegration of the UK from the EU, a major event fueling a potential deglobalization trend. With the referendum, an extended period of heightened uncertainty began. This study shows that this deglobalization shock led to a cross-border credit supply shock for firms in the UK. Controlling for loan demand, we show that certain firm and bank characteristics are relevant determinants of the credit supply shock. More sound and prudent banks reduce their credit supply to a greater degree, particularly to less profitable firms. However, firms which are part of larger MNCs are able to mitigate the negative bank credit supply shock by tapping their internal capital markets. Firms being part of MNCs thereby help to mitigate the ensuing negative real implications of deglobalization shocks. Banks that reduced their lending to the UK increased their lending to firms in other countries, including in their home country. This suggests that a deglobalization shock does not only imply negative real effects to affected firms, but also affects funding conditions for firms in other countries.

Recent developments towards deglobalization and market fragmentation in the aftermath of the global financial crisis and more recently, the COVID-19 pandemic and the war in Ukraine, have increased the urgency to better understand the effects and consequences of deglobalization events. We show that the adverse effects of a deglobalization shock are amplified by one type of international integration, namely cross-border bank lending, but are mitigated by another, i.e. internal capital markets operated across borders by MNCs. Our results therefore indicate that international integration can at the same time be an amplifier of and a remedy for adverse real effects of a deglobalization shock. Whilst our paper focuses on short-term effects, studying the longer-term consequences and adjustments in response to deglobalization events remains an important avenue of future research.

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Table 1**Descriptive statistics**

The table provides descriptive statistics of variables for the sample period 2014 to 2018 for all firms in the sample, taken together (Panel A) and separately for firms located in the UK and those located elsewhere (Panel B). The three rightmost columns in Panel B show the difference between UK firms and non-UK firms, the p-value for the difference in mean values (t-statistic), and the difference in median values (z-statistic, Mann-Whitney two-sample test statistic) (Wilcoxon, 1945; Mann and Whitney, 1947). Dependent variables are shown as the pre- to post-shock difference. Independent variables are used with their pre-shock average value. Data on bank lending and bank characteristics are at a quarterly frequency, while data on firms are at an annual frequency. The data include 1,740 observations with 167 banks and 1,062 unique firms that are foreign subsidiaries of German MNCs and are located in EU countries, China, Switzerland, Turkey, the UK, and the US. All variables are winsorized at the 1st and 99th percentiles by industry and adjusted for inflation. Appendix Table A1 provides variable descriptions.

Panel A: Full sample

	Mean	SD	p(5)	Median	p(95)
Dependent variables (pre- to post-shock difference)					
Bank lending					
Credit increases	-0.609	2.188	-4.000	-1.000	3.000
Loan growth	-0.135	0.735	-1.250	-0.063	0.983
Internal capital market					
Log. internal debt	0.293	2.162	-1.888	0.041	5.745
Internal debt / total assets	0.012	0.165	-0.224	0.000	0.282
Log. int. debt other subs.	0.040	0.546	-0.542	0.000	0.830
Int. debt other subs. / total assets	0.001	0.101	-0.155	0.000	0.154
Firm-specific variables					
Log. employment	0.084	0.541	-0.351	0.006	0.475
Log. FDI	0.268	2.901	-1.429	0.129	4.098
RoA	0.014	0.189	-0.237	0.004	0.253
Log. turnover	0.153	1.997	-0.916	0.070	1.165
Independent variables (pre-shock average)					
Bank characteristics					
Log. total assets	26.055	2.205	21.314	27.073	28.029
Excess CET1 / RWA	0.051	0.036	0.030	0.034	0.157
Leverage	0.956	0.018	0.925	0.966	0.969
RoA	0.027	0.032	0.003	0.016	0.092
NPL ratio	0.030	0.045	0.009	0.018	0.075
Internationalization	0.521	0.338	0.007	0.404	0.942
Firm characteristics					
Log. total assets	11.380	1.776	8.785	11.150	14.509
RoA	-0.005	0.322	-0.538	0.000	0.369
Leverage	0.608	0.283	0.192	0.588	1.000

Table 1 – continued

Panel B: Firms in the UK and firms outside the UK

	UK firms			Non-UK firms			Difference	p(t)	p(z)
	Mean	Median	SD	Mean	Median	SD			
Dependent variables (pre- to post-shock difference)									
Bank lending									
Credit increases	-1.000	-1.000	2.026	-0.586	-1.000	2.195	-0.414	0.057	0.044
Loan growth	-0.271	-0.075	1.018	-0.127	-0.062	0.715	-0.144	0.177	0.694
Internal capital market									
Log. internal debt	0.601	0.166	1.832	0.275	0.027	2.179	0.326	0.096	0.116
Internal debt / total assets	0.012	0.043	0.176	0.012	0.000	0.164	0.000	0.994	0.032
Log. int. debt other subs.	0.180	0.033	0.573	0.032	0.000	0.544	0.148	0.016	0.001
Int. debt other subs. / total assets	0.023	0.005	0.122	0.000	0.000	0.100	0.023	0.070	0.000
Firm-specific variables									
Log. employment	0.060	0.002	0.487	0.085	0.007	0.544	-0.025	0.633	0.506
Log. FDI	-0.470	0.020	4.338	0.310	0.137	2.791	-0.780	0.086	0.015
RoA	0.067	0.017	0.353	0.011	0.003	0.174	0.056	0.125	0.237
Log. turnover	0.244	0.020	1.980	0.148	0.075	1.999	0.096	0.648	0.007
Independent variables (pre-shock averages)									
Bank characteristics									
Log. total assets	26.788	27.073	1.424	26.013	27.073	2.235	0.775	0.000	0.006
Excess CET1 / RWA	0.053	0.034	0.043	0.051	0.034	0.036	0.002	0.623	0.272
Leverage	0.958	0.966	0.018	0.956	0.966	0.018	0.002	0.356	0.155
RoA	0.019	0.011	0.022	0.027	0.016	0.032	-0.008	0.002	0.058
NPL ratio	0.029	0.016	0.050	0.030	0.018	0.044	-0.001	0.831	0.096
Internationalization	0.597	0.427	0.293	0.517	0.404	0.340	0.080	0.012	0.059
Firm characteristics									
Log. total assets	11.707	11.318	1.976	11.361	11.144	1.763	0.347	0.098	0.127
RoA	-0.177	-0.015	0.524	0.005	0.000	0.304	-0.182	0.001	0.001
Leverage	0.614	0.605	0.290	0.607	0.583	0.283	0.007	0.821	0.644

Table 2**Cross-border lending – country level analysis**

The table shows results of regressions of the number of increases in credit between banks and firms at the country-quarter level on the interaction term UK * post-shock, which is set to one after the Brexit referendum for firms located in the UK and zero otherwise, and fixed effects. The sample period is 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. Regressions in columns (1) and (2) include firms in all countries, in columns (3) and (4) firms in EU countries, China, Switzerland, Turkey, the UK, and the US, and in columns (5) and (6) firms in EU countries and the UK only. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors.

	World		EU + main bank credit countries		EU	
	(1)	(2)	(3)	(4)	(5)	(6)
UK * post-shock	-0.4529*** (-3.6959)	-0.4080*** (-3.7176)	-0.5356*** (-3.5216)	-0.4679*** (-3.4365)	-0.5624*** (-3.5137)	-0.4918*** (-3.4069)
FIXED EFFECTS						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Time (quarter)	Yes	Yes	Yes	Yes	Yes	Yes
Season	No	Yes	No	Yes	No	Yes
Observations	1,462	1,443	612	612	532	532
Adjusted R ²	0.9169	0.9184	0.9252	0.9288	0.9196	0.9228

Table 3
Cross-border lending – bank-firm level analysis

The table shows results of regressions of the dependent variables *credit increases* (Panel A) and *loan growth* (Panel B) at the bank-firm level on the indicator variable *UK*, which is set to one for firms located in the UK and zero otherwise, as well as control variables capturing bank and firm characteristics. The sample period is 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. The total lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable *UK* account for banks' pre-Brexit exposure to the UK. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

Panel A: Credit increases					
	(1)	(2)	(3)	(4)	(5)
UK	-0.4140*** (-2.7966)	-1.3717*** (-3.3349)	-1.1837*** (-2.8446)	-1.2790*** (-2.8726)	-1.0678** (-2.4227)
Bank UK-exposure variables	No	Yes	Yes	Yes	Yes
Bank characteristics	No	No	Yes	No	Yes
Firm characteristics	No	No	No	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,740
Adjusted R ²	0.0013	0.0157	0.0149	0.0224	0.0226
Panel B: Loan growth					
	(1)	(2)	(3)	(4)	(5)
UK	-0.1441* (-1.6914)	-0.2089*** (-3.1606)	-0.2115*** (-2.7441)	-0.1949** (-2.5031)	-0.2008** (-2.2400)
Bank UK-exposure variables	No	Yes	Yes	Yes	Yes
Bank characteristics	No	No	Yes	No	Yes
Firm characteristics	No	No	No	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,740
Adjusted R ²	0.0014	0.0008	-0.0013	0.0068	0.0043

Table 4**Bank characteristics and cross-border lending**

The table shows results of regressions of the dependent variables *credit increases* (Panel A) and *loan growth* (Panel B) on the indicator variable *UK*, which is set to one for UK firms, and interactions of this variable with bank characteristics. The sample period is 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. Bank characteristics are average values over the last four quarters prior to the shock. The total lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable *UK* account for banks' pre-Brexit exposure to the UK. Column (8) includes firm fixed effects which reduce the sample to only firms with at least two bank relationships. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Credit increases								
BANK CHARACTERISTICS								
UK * Log. total assets	0.5706*** (3.9569)						0.2715 (0.8950)	0.2910 (0.8269)
UK * Excess CET1 / RWA		-16.7906*** (-3.5542)					-25.0322** (-2.0625)	-28.4971 (-1.4092)
UK * Leverage			43.7481*** (5.3220)				-30.5508 (-0.7450)	-24.3281 (-0.3723)
UK * RoA				-29.0690** (-2.2959)			-49.4644** (-2.0318)	-37.4907 (-0.8528)
UK * NPL ratio					-10.4148*** (-4.4593)		-10.7031*** (-2.6348)	-14.7885*** (-5.9600)
UK * Internationalization						2.0596*** (3.8449)	-1.7729 (-1.3534)	-2.0999 (-1.0495)
Log. total assets	-0.0762* (-1.7194)						-0.1375 (-1.3593)	-0.0885 (-0.8117)
Excess CET1 / RWA		2.5077 (1.0493)					2.5932 (1.0567)	2.7305 (1.1702)
Leverage			-6.6634* (-1.8252)				0.6481 (0.1082)	-1.2063 (-0.1982)
RoA				1.3462 (0.5538)			-0.7347 (-0.2424)	-0.1231 (-0.0396)
NPL ratio					0.9213 (0.6813)		0.3853 (0.2845)	-0.7740 (-0.4198)
Internationalization						-0.0422 (-0.1498)	0.5276* (1.7485)	0.3422 (0.8066)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS								
MNC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Country x Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm	No	No	No	No	No	No	No	Yes
Observations	1,740	1,740	1,740	1,740	1,740	1,740	1,740	973
Adjusted R ²	0.3585	0.3561	0.3581	0.3553	0.3541	0.3545	0.3582	0.4355

Panel B: Loan growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BANK CHARACTERISTICS								
UK * Log. total assets	0.0835 (1.2750)						0.2467 (1.2248)	0.2735 (1.2692)
UK * Excess CET1 / RWA		-7.8374* (-1.9092)					-24.8386*** (-3.1368)	-37.0160*** (-4.0086)
UK * Leverage			3.3903 (0.9226)				-67.6716*** (-2.6800)	-88.1738** (-2.5887)
UK * RoA				-0.4128 (-0.0992)			-47.0739*** (-3.5726)	-65.7160*** (-3.5081)
UK * NPL ratio					-7.5639*** (-6.0556)		-10.3382*** (-7.5121)	-21.4341*** (-17.5181)
UK * Internationalization						0.7786* (1.7658)	-2.4035*** (-3.0278)	-3.9697*** (-3.7744)
Log. total assets	-0.0005 (-0.0376)						-0.0177 (-0.8075)	-0.0227 (-0.7930)
Excess CET1 / RWA		0.7155* (1.8620)					0.9355* (1.9057)	1.0873* (1.9697)
Leverage			-0.4280 (-0.3500)				0.3866 (0.2330)	0.5397 (0.3296)
RoA				-0.4383 (-0.5736)			-0.4188 (-0.4802)	-0.2515 (-0.3026)
NPL ratio					0.1112 (0.4339)		0.0713 (0.2277)	0.1466 (0.3602)
Internationalization						0.0443 (0.6211)	0.1119 (1.3215)	0.1138 (0.8517)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS								
MNC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Country x Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm	No	No	No	No	No	No	No	Yes
Observations	1,740	1,740	1,740	1,740	1,740	1,740	1,740	973
Adjusted R ²	0.1167	0.1218	0.1160	0.1160	0.1237	0.1188	0.1291	0.2015

Table 5
Firm characteristics and cross-border lending

The table shows results of regressions of the dependent variables *credit increases* (Panel A) and *loan growth* (Panel B) on the indicator variable *UK*, which is set to one for UK firms, and interactions of this variable with firm characteristics. The sample period is 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. Firm characteristics are average values prior to the shock. The total lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable *UK* account for banks' pre-Brexit exposure to the UK. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

Panel A: Credit increases					
	(1)	(2)	(3)	(4)	(5)
FIRM CHARACTERISTICS					
UK * Log. total assets	0.1841 (0.7685)			0.1901 (0.6387)	0.2833 (1.0058)
UK * RoA		1.3154*** (2.6350)		1.4452** (2.5286)	1.6374** (2.5224)
UK * Leverage			-1.3467*** (-3.0971)	0.3548 (0.7669)	0.8546 (1.3184)
Log. total assets	0.0855 (1.0368)			0.0853 (1.1377)	0.0879 (1.3730)
RoA		0.1189 (1.1092)		0.1136 (0.4465)	0.1213 (0.4875)
Leverage			-0.0724 (-0.1477)	0.0653 (0.1139)	0.0762 (0.1310)
BANK CHARACTERISTICS					
UK * Log. total assets					0.2552 (0.8462)
UK * Excess CET1 / RWA					-23.9917* (-1.8129)
UK * Leverage					-21.9642 (-0.4898)
UK * RoA					-44.5531* (-1.7768)
UK * NPL ratio					-13.2811*** (-3.4789)
UK * Internationalization					-2.0898 (-1.4402)
Log. total assets					-0.1347 (-1.3473)
Excess CET1 / RWA					2.5621 (1.0323)
Leverage					0.2904 (0.0483)
RoA					-0.7659 (-0.2506)
NPL ratio					0.3500 (0.2509)
Internationalization					0.5628* (1.8752)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS					
MNC	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,740
Adjusted R ²	0.3538	0.3562	0.3536	0.3553	0.3604

Panel B: Loan growth

	(1)	(2)	(3)	(4)	(5)
FIRM CHARACTERISTICS					
UK * Log. total assets	0.1409 (0.8374)			0.1110 (0.4909)	0.0880 (0.3780)
UK * RoA		0.5348*** (4.4993)		0.3716 (1.4686)	0.6156** (2.0806)
UK * Leverage			-0.9512* (-1.7184)	-0.4654 (-0.5910)	0.1168 (0.1311)
Log. total assets	-0.0382* (-1.9152)			-0.0422** (-2.0525)	-0.0413** (-2.1938)
RoA		0.0503* (1.9485)		0.0223 (0.2892)	0.0248 (0.3077)
Leverage			-0.1069 (-0.9811)	-0.1210 (-0.7357)	-0.1200 (-0.7271)
BANK CHARACTERISTICS					
UK * Log. total assets					0.2369 (1.2566)
UK * Excess CET1 / RWA					-24.4681*** (-2.9262)
UK * Leverage					-65.3145** (-2.5636)
UK * RoA					-45.5099*** (-3.2865)
UK * NPL ratio					-11.1020*** (-7.0173)
UK * Internationalization					-2.5039*** (-3.0032)
Log. total assets					-0.0193 (-0.8871)
Excess CET1 / RWA					1.0215** (2.1211)
Leverage					0.5731 (0.3586)
RoA					-0.4263 (-0.4946)
NPL ratio					0.0614 (0.1986)
Internationalization					0.1048 (1.2389)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS					
MNC	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,740
Adjusted R ²	0.1181	0.1212	0.1214	0.1220	0.1333

Table 6
Credit supply shock and firms' internal debt

The table shows results of instrumental variable regressions of the pre- to post-shock difference of the logarithm of the volume of internal debt (columns (1) and (2)) and the logarithm of the volume of internal debt from other affiliated subsidiaries (columns (3) and (4)) on a credit supply shock, bank characteristics and control variables. The data are used at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the pre- to post-shock difference of the average number of *credit increases* (odd-numbered columns) and the average *loan growth* (even-numbered columns) are regressed on different instruments. These instruments are the interaction terms of all bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the total lending of a bank to UK firms over its total lending pre-Brexit referendum, and the interaction of this variable with the indicator variable UK. In the second stage, the credit supply shock is the instrumented variable multiplied by minus one for ease of interpretation. The overidentification test is based on Hansen's J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The F-statistic reports the F test of excluded instruments. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	log(Total Internal Debt)		log(Internal Debt from other subsidiaries)	
	(1)	(2)	(3)	(4)
Credit Supply Shock <i>credit</i>	0.1067*		0.0458**	
	(1.7682)		(2.3224)	
Credit Supply Shock <i>loan growth</i>		0.2705		0.1027*
		(1.5078)		(1.7310)
CONTROL VARIABLES				
Bank characteristics	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS				
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes
FIXED EFFECTS				
MNC	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740
Overidentification test	0.425	0.819	0.168	0.296
F-statistic (first stage)	19.64	37.05	19.64	37.05

Table 7**Credit supply shock, internal debt, and MNC characteristics**

The table shows results of instrumental variable regressions of the pre- to post-shock difference of internal debt from other affiliated subsidiaries over total assets on a credit supply shock, bank characteristics and control variables. The data are used at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the difference of the average number of *credit increases* (odd-numbered columns) and the average *loan growth* (even-numbered columns) are regressed on different instruments. These instruments are the interaction terms of all bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the total lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable UK. In the second stage, the credit supply shock is the instrumented variable multiplied by minus one for ease of interpretation. The individual investor and MNC related variables are included but not shown for brevity. The overidentification test is based on Hansen's J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	Interaction variable:		MNCs with SPEs		log(Assets) _{parent}		log(Employees) _{MNC}		log(Assets) _{MNC}		log(# Affiliates) _{MNC}	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credit Supply Shock _{credit}	0.0074 (0.9608)		-0.0165 (-1.1335)		-0.2003** (-1.9800)		-0.0574 (-1.3726)		-0.1351* (-1.8670)		-0.0657 (-1.5151)	
Credit Supply Shock _{loan growth}		-0.0177 (-0.8758)		-0.0303* (-1.8894)		-0.4831*** (-4.3324)		-0.2761*** (-4.4319)		-0.5319*** (-3.7587)		-0.1266*** (-3.4927)
Credit Supply Shock _{credit} * Interaction Variable			0.0539** (2.3539)		0.0153** (2.2466)		0.0085* (1.8744)		0.0096** (2.1258)		0.0227* (1.8697)	
Credit Supply Shock _{loan growth} * Interaction Variable				0.1159*** (2.9328)		0.0375*** (3.8442)		0.0456*** (3.2087)		0.0378*** (3.6550)		0.0590*** (2.7618)
CONTROL VARIABLES												
Bank characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS												
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS												
MNC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,711	1,711	1,614	1,614	1,740	1,740	1,740	1,740
Overidentification test	0.462	0.689	0.443	0.292	0.473	0.237	0.458	0.687	0.550	0.122	0.362	0.171

Table 8
Credit supply shock and firm real effects

The table shows results of instrumental variable regressions of the pre- to post-shock difference of average firm characteristics on a credit supply shock, bank characteristics and control variables. The data are at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the difference of the average number of *credit increases* (odd-numbered columns) and the average *loan growth* (even-numbered columns) are regressed on different instruments. These instruments are the interaction terms of all bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the total lending of a bank to UK firms over its total lending pre-Brexit referendum, and the interaction of this variable with the indicator variable UK. The credit supply shock is the instrumented variable multiplied by minus one for ease of interpretation. The overidentification test is based on Hansen's J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	log(Employment)		log(Equity financing)		RoA		log(Turnover)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Supply Shock <i>credit</i>	-0.0174		-0.4436		-0.0271		0.0879	
	(-0.8312)		(-1.6210)		(-1.3799)		(0.9136)	
Credit Supply Shock <i>loan growth</i>		-0.0715		-0.3481		-0.0885**		0.1905
		(-1.5630)		(-0.9247)		(-2.0423)		(1.0420)
CONTROL VARIABLES								
Bank characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS								
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS								
MNC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740
Overidentification test	0.453	0.331	0.467	0.315	0.620	0.528	0.122	0.0740

Table 9**Credit supply shock and firm employment by parent company and MNC characteristics**

The table shows results of instrumental variable regressions of the pre- to post-shock difference of the log of employment of firms on a credit supply shock, bank characteristics and control variables. The data are at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the average *loan growth* is regressed on different instruments. These instruments are the interaction terms of all bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the total lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable UK. The credit supply shock is the instrumented variable multiplied by minus one for ease of interpretation. The overidentification test is based on Hansen's J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The individual investor and MNC-related variables are included but not shown for brevity. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	log(Employment)				
	(1)	(2)	(3)	(4)	(5)
Credit Supply Shock	-0.0966** (-2.1020)	-0.6455*** (-3.2527)	-0.2904** (-2.5647)	-0.9584*** (-3.8068)	-0.2721*** (-4.3137)
Credit Supply Shock x MNC with SPE	0.2657** (2.5959)				
Credit Supply Shock x log(Assets) _{parent}		0.0461*** (2.7757)			
Credit Supply Shock x log(Employees) _{MNC}			0.0386** (2.1180)		
Credit Supply Shock x log(Assets) _{MNC}				0.0653*** (3.5332)	
Credit Supply Shock x log(# Affiliates) _{MNC}					0.1088*** (3.0434)
CONTROL VARIABLES					
Bank characteristics	Yes	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS					
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS					
Parent FE	Yes	Yes	Yes	Yes	Yes
Country x Industry FE	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,711	1,614	1,740	1,740
Overidentification test	0.394	0.463	0.399	0.622	0.578

Table 10**The impact of the shock on bank lending to non-UK firms**

The table shows regression results of the pre- to post-shock growth in credit at the bank-firm level on a bank's pre-Brexit referendum exposure to UK firms, measured as the credit to UK firms as a fraction of total credit, also interacted with the indicator variable High Excess CET1 / RWA, which is set to one for banks with an Excess CET1 / RWA ratio larger than 8% pre-Brexit referendum and zero otherwise, and control variables. The data include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. The sample includes all corporate borrowers of German banks in EU countries, China, Switzerland, Turkey, the UK, and the US, excluding UK borrowers. Columns (4) to (6) exclude the year 2016 for the calculation of the growth in credit from pre- to post-shock, columns (7) to (9) include only 2014 as the pre- and 2018 as the post-shock period. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

	Loan growth			Loan growth (excl. 2016)			Loan growth (2014 to 2018)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bank exposure to UK _{pre}	-0.0105*** (-3.7203)	-0.0109*** (-3.8054)	-0.0059** (-2.2174)	-0.0152*** (-4.0560)	-0.0157*** (-4.1399)	-0.0080** (-2.0628)	-0.1001*** (-6.7342)	-0.1029*** (-6.8093)	-0.0501*** (-4.5485)
Bank exposure to UK _{pre} * High Excess CET1 / RWA _{pre}		0.0134*** (3.9488)	0.0179* (1.7524)		0.0175*** (3.8831)	0.0241* (1.8729)		0.0739*** (2.8484)	0.0795** (2.4767)
Base effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS									
Country x Industry	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Firm	No	No	Yes	No	No	Yes	No	No	Yes
Observations	204,199	203,834	88,695	204,199	203,834	88,695	204,199	203,834	88,695
Adjusted R ²	0.0137	0.0143	0.1652	0.0150	0.0157	0.1740	0.0302	0.0313	0.2561

Table 11**The impact of the shock on same borrower-lender nationality lending**

The table shows regression results of the pre- to post-shock growth in credit at the bank-firm level on a bank's pre-Brexit referendum exposure to UK firms, measured as the credit to UK firms as a fraction of total credit, also interacted with an indicator variable for a firm owned by a German corporation, and with the indicator variable High Excess CET1 / RWA, which is set to one for banks with an Excess CET1 / RWA ratio larger than 8% pre-Brexit referendum and zero otherwise, and control variables. The data include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. The sample includes all corporate borrowers of German banks in EU countries, China, Switzerland, Turkey, the UK, and the US, excluding UK borrowers. Columns (3) and (4) exclude the year 2016 for the calculation of the growth in credit from pre- to post-shock, columns (5) and (6) include only 2014 as the pre- and 2018 as the post-shock period. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

	Loan growth		Loan growth excl. 2016		Loan growth (2014 to 2018)	
	(1)	(2)	(3)	(4)	(5)	(6)
Bank exposure to UK _{pre}	-0.0134*** (-5.2472)	-0.0139*** (-5.3541)	-0.0192*** (-5.5829)	-0.0197*** (-5.4763)	-0.1299*** (-6.9706)	-0.1331*** (-6.8134)
Bank exposure to UK _{pre} * German MNCs	0.0052*** (2.9143)	0.0052*** (3.1702)	0.0069*** (2.6533)	0.0070*** (2.9611)	0.0491*** (3.5351)	0.0497*** (3.8569)
Bank exposure to UK _{pre} * High Excess CET1 / RWA _{pre}		0.0134*** (3.9497)		0.0176*** (3.8656)		0.0744*** (2.7448)
Base effects	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS						
Country x Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	204,199	203,834	204,199	203,834	204,199	203,834
Adjusted R ²	0.0138	0.0145	0.0151	0.0158	0.0305	0.0316

APPENDIX

Figure A1
Economic policy uncertainty in the UK

The figure shows how economic policy uncertainty (EPU) has evolved over time. EPU data are at a monthly frequency and the vertical red line marks June 2016, when the Brexit referendum was held.
Source: Baker/Bloom/Davies EPU Index for UK, authors' compilation.

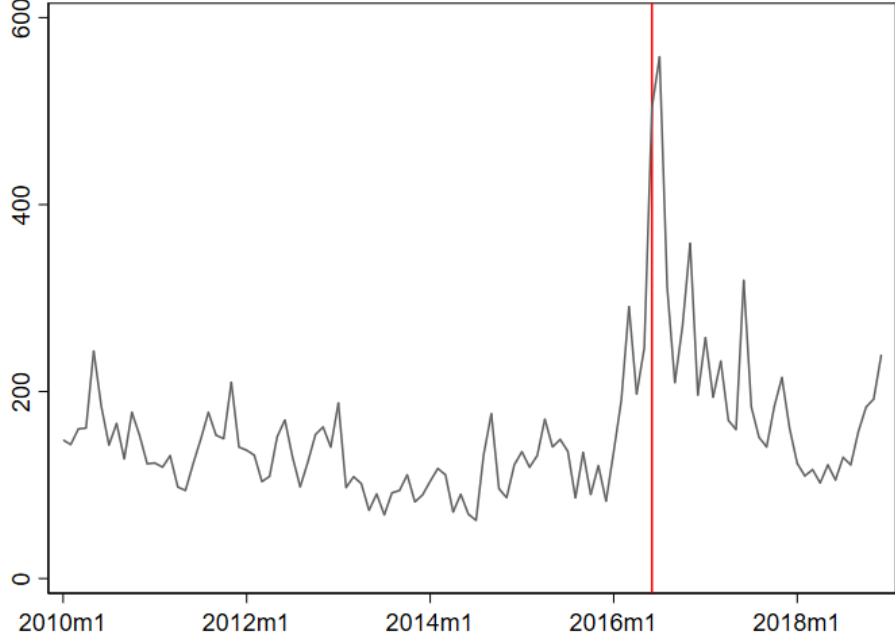


Figure A2
German FDI to the UK

The figure shows how FDI measured by the amount of subscribed capital, endowment capital, and contributions of the local investment entities have evolved over time. The vertical red line marks the year 2016, when the Brexit referendum was held. Due to data limitations, FDI to Northern Ireland are not included.
Source: MiDi database, authors' compilation.

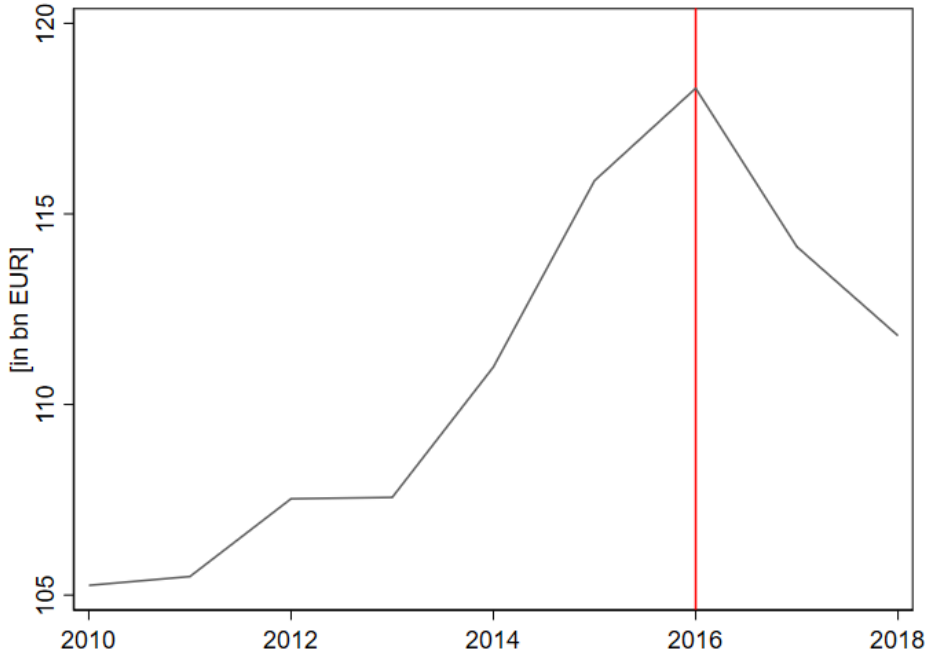


Table A1**Variable definitions**

Variable Name	Definition
Bank lending	
Credit increases	Pre- to post-shock difference in the number of increases in quarterly credit
Loan growth	Pre- to post-shock difference in average growth in loans to a firm
Internal capital market	
Log. internal debt	Pre- to post-shock difference in the log. volume of internal debt towards the whole MNC
Internal debt / total assets	Pre- to post-shock difference in the ratio of internal debt towards the whole MNC over total assets
Log. internal debt other subs.	Pre- to post-shock difference in the log. volume of internal debt towards other subsidiaries of the same parent company
Int. debt other subs. / assets	Pre- to post-shock difference in the ratio of internal debt towards other subsidiaries of the same parent company over total assets
Firm-specific variables	
Log. employment	Pre- to post-shock difference in the log. of number of firms' employees
Log. equity financing	Pre- to post-shock difference in the log. volume of MNC equity financing of a firm
RoA	Pre- to post-shock difference in the net income to total assets (RoA)
Log. turnover	Pre- to post-shock difference in the log. volume of turnover
Bank characteristics	
Log. total assets	Log of total assets, pre-shock average over the last four quarters prior to the shock
Excess CET1 / RWA	Excess CET1 to risk weighted assets, pre-shock average over the last four quarters prior to the shock
Leverage	Total equity to total assets, pre-shock average over the last four quarters prior to the shock
RoA	Net income to total assets, pre-shock average over the last four quarters prior to the shock
NPL ratio	Non-performing loans to loans, pre-shock average over the last four quarters prior to the shock
Internationalization	Foreign non-financial private sector (NFPS) loans to total NFPS loans, pre-shock average over the last four quarters prior to the shock
Bank UK-exposure variable	
Bank exposure to UK _{pre}	A bank's lending to UK firms over its total lending pre-Brexit referendum
Firm Characteristics	
Log. total assets	Log of total assets, annual, pre-shock average over year-end 2014 and 2015 values
RoA	Net income to total assets, annual, pre-shock average over year-end 2014 and 2015 values
Leverage	Total liabilities to total assets, annual, pre-shock average over year-end 2014 and 2015 values

Table A2**Cross-border lending – robustness**

The table shows results of regressions of our main dependent variables *exposure increases* and *loan growth* at the bank-firm level on the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and control variables. Panels A and B1 include all non-financial firms borrowing from German banks and located in EU countries, China, Switzerland, Turkey, the UK, and the US. Out of these, Panel B2 includes only firms that are subsidiaries of German MNCs. Panel B uses the period 2011:Q3 to 2016:Q2 and a placebo shock starting in 2014:Q1. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

Panel A: Large sample – main effects						
	Credit increases			Loan growth		
	(1)	(2)	(3)	(4)	(5)	(6)
UK	-0.8727*** (-4.2927)	-0.8843*** (-3.1887)	-0.8088*** (-3.1668)	-0.0352*** (-3.6712)	-0.0537*** (-4.2888)	-0.0475*** (-3.6997)
Bank UK-exposure variables	No	Yes	Yes	No	Yes	Yes
Bank characteristics	No	No	Yes	No	No	Yes
Observations	206,644	206,644	206,277	206,644	206,644	206,277
Adjusted R ²	0.0020	0.0021	0.0048	0.0001	0.0002	0.0007

Panel B1: Large sample – pre-period trend				
	Credit increases		Loan growth	
	(1)	(2)	(3)	(4)
UK	0.1944 (1.1544)	0.1013 (0.3166)	-0.0238 (-1.0871)	-0.0181 (-0.5091)
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Bank characteristics	Yes	No	Yes	No
Bank fixed effects	No	Yes	No	Yes
Observations	156,665	156,596	156,665	156,596
Adjusted R ²	0.0029	0.0185	0.0010	0.0042

Panel B2: Small sample – pre-period trend				
	Credit increases		Loan growth	
	(1)	(2)	(3)	(4)
UK	0.1893 (0.8691)	0.2773 (1.2144)	0.0134 (0.1336)	-0.0189 (-0.1494)
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Bank characteristics	Yes	No	Yes	No
Bank fixed effects	No	Yes	No	Yes
Observations	2,287	2,287	2,287	2,246
Adjusted R ²	0.0085	0.0214	-0.0005	0.0223

Table A3**Firm-internal capital markets – robustness**

The table shows results of instrumental variable regressions of the pre- to post-shock difference of the logarithm of the volume of internal debt (columns (1) and (2)) and the logarithm of the volume of internal debt from other affiliated subsidiaries (columns (3) and (4)) on a credit supply shock, bank characteristics and control variables. The data are used at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the difference of the pre- to post-shock difference of the average number of *credit increases* (odd-numbered columns) and the average *loan growth* (even-numbered columns) are regressed on different instruments. These are the interaction terms of bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the lending of a bank to UK firms over its total lending pre-Brexit referendum and the interaction of this variable with the indicator variable UK. In addition to the specification in Table 6 of the paper, the triple interaction of bank characteristics, the indicator variable UK, and the lending of a bank to UK firms over its total lending as well as all base effects (including all double interactions) are also included. In the second stage, the credit supply shock is then derived as the instrumented variable multiplied by minus one for ease of interpretation. The overidentification test is based on Hansen’s J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	log(Total Internal Debt)		log(Internal Debt from other subsidiaries)	
	(1)	(2)	(3)	(4)
Credit Supply Shock <i>credit</i>	0.1026*		0.0462***	
	(1.8963)		(3.0844)	
Credit Supply Shock <i>loan growth</i>		0.1697		0.0991*
		(1.4751)		(1.8540)
CONTROL VARIABLES				
Bank characteristics	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS				
Accounting for pre-Brexit % of UK loans	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes
Bank characteristics x UK x pre-shock. % of UK loans	Yes	Yes	Yes	Yes
FIXED EFFECTS				
Parent	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740
Overidentification test	0.602	0.626	0.326	0.707

Table A4

Firm heterogeneity and real effects - robustness

The table shows results of instrumental variable regressions of the pre- to post-shock difference of internal debt from other affiliated subsidiaries on a credit supply shock, bank characteristics and control variables. The data are used at the bank-firm level and include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3, and include firms in EU countries, China, Switzerland, Turkey, the UK, and the US. Bank characteristics include Log. total assets, Excess CET1 / RWA, the NPL ratio, Leverage, Return on assets (RoA), and Internationalization. Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum. In the first stage, the difference of the pre- to post-shock difference of the average number of *credit increases* (odd-numbered columns) and the average *loan growth* (even numbered columns) are regressed on different instruments. These are the interaction terms of bank characteristics with the indicator variable UK, which is set to one for firms located in the UK and zero otherwise, and the lending of a bank to UK firms over its total lending pre-Brexit referendum, and the interaction of this variable with the indicator variable UK. In addition to the specification in Table 7 of the paper, the triple interaction of bank characteristics, the indicator variable UK, and the lending of a bank to UK firms over its total lending as well as all base effects (including all double interactions) are also included. In the second stage, the credit supply shock is the instrumented variable multiplied by minus one for ease of interpretation. The individual investor and MNC related variables are included but not shown for brevity. The overidentification test is based on Hansen's J-statistic of the test of overidentifying restrictions. It reports the p-value of the joint null hypothesis that the instruments are valid and that the excluded instruments should be excluded from the regression. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level. Appendix Table A1 provides variable descriptions.

	Interaction Variable:		MNC with SPE		ln(Assets) _{parent}		ln(Employees) _{MNC}		ln(Assets) _{MNC}		ln(# Affiliates) _{MNC}	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credit Supply Shock <i>credit</i>	0.0120**		-0.0045		-0.0843**		-0.0263		-0.0613		-0.0180	
	(2.0092)		(-0.4864)		(-2.2112)		(-0.9923)		(-1.5659)		(-0.9106)	
Credit Supply Shock <i>loan growth</i>		-0.0062		-0.0215		-0.2752***		-0.1199**		-0.2299**		-0.0656*
		(-0.4544)		(-1.3656)		(-3.2515)		(-2.0685)		(-2.3619)		(-1.8666)
Credit Supply Shock <i>credit</i> * Interaction Variable			0.0314**		0.0068***		0.0046		0.0049*		0.0089	
			(2.3875)		(2.6504)		(1.5983)		(1.9530)		(1.6216)	
Credit Supply Shock <i>loan growth</i> * Interaction Variable				0.0867***		0.0204***		0.0177**		0.0156**		0.0248*
				(3.4948)		(3.2317)		(2.0757)		(2.5077)		(1.9489)
CONTROL VARIABLES												
Bank characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EXCLUDED INSTRUMENTS												
Accounting for pre-Brexit % of UK loans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank characteristics x UK x pre-shock. % of UK loans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS												
Parent	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740	1,711	1,711	1,614	1,614	1,740	1,740	1,740	1,740
Overidentification test	0.358	0.0870	0.687	0.611	0.522	0.629	0.838	0.460	0.620	0.473	0.572	0.391

Table A5**Shift in banks' lending – robustness**

The table shows in Panel A regressions of the dependent variables *credit increases* (columns (1) and (2)) and *loan growth* (columns (3) and (4)) on a bank's pre-Brexit referendum credit to UK firms as a fraction of its total credit volume, interacted with the indicator variable High Excess CET1 / RWA, which is set to one for banks with an Excess CET1 / RWA ratio larger than 8% pre-Brexit referendum and zero otherwise, and control variables. The data in both panels include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3 and include all corporate borrowers of German banks in EU countries, China, Switzerland, Turkey, the UK, and the US, excluding UK borrowers in both panels. Panel B shows regression results of the pre- to post-shock growth in credit at the bank-firm level on a bank's pre-Brexit referendum credit to UK firms as a fraction of its total credit volume, interacted with the indicator variable High RoA, which is set to one for banks with RoA larger than 8% (75th percentile) pre-Brexit referendum and zero otherwise, and control variables. Columns (3) and (4) exclude the year 2016 for the calculation of the growth in credit from pre- to post-shock, columns (5) and (6) include only 2014 as the pre- and 2018 as the post-shock period. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

Panel A: Change in credit increases and loan growth for non-UK firms by bank excess CET1 / RWA ratio

	Credit increases		Loan growth	
	(1)	(2)	(3)	(4)
Bank exposure to UK _{pre} * High Excess CET1 / RWA _{pre}	0.0298*** (2.7688)	0.0593** (2.3284)	0.0028** (2.0556)	0.0045 (1.2043)
Base effects	Yes	Yes	Yes	Yes
FIXED EFFECTS				
Country x Industry	Yes	No	Yes	No
Firm	No	Yes	No	Yes
Observations	203,834	88,695	203,834	88,695
Adjusted R ²	0.0373	0.1909	0.0079	0.1114

Panel B: Loan growth for non-UK firms by bank RoA

	Loan growth		Loan growth excl. 2016		Loan growth (2014 to 2018)	
	(1)	(2)	(3)	(4)	(5)	(6)
Bank exposure to UK _{pre} * High RoA _{pre}	0.0248*** (6.1372)	0.0117** (2.3987)	0.0357*** (6.7104)	0.0159** (2.4373)	0.2061*** (5.5741)	0.1252*** (3.8996)
Base effects	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS						
Country x Industry	Yes	No	Yes	No	Yes	No
Firm	No	Yes	No	Yes	No	Yes
Observations	204,198	88,965	204,198	88,965	204,198	88,965
Adjusted R ²	0.0144	0.1645	0.0158	0.1731	0.0329	0.2557

Table A6**Shift in banks' lending – extended analysis**

The table shows in Panel A regression results of the dependent variables *credit increases* (columns (1) and (2)) and *loan growth* (columns (3) and (4)) on a bank's pre-Brexit referendum credit to UK firms as a fraction of its total credit volume, interacted with an indicator variable for a German-owned firm, and with the indicator variable High Excess CET1 / RWA, which is set to one for banks with an Excess CET1 / RWA larger than 8% pre Brexit referendum and zero otherwise, and control variables. In Panel B, it reports regression results of the pre- to post-shock growth in credit at the bank-firm level, excluding the year 2016 for the calculation of the growth in credit from pre- to post-Brexit referendum in column (2), and including only 2014 as the pre- and 2018 as the post-Brexit referendum period in column (3), the change in the number of increases in credit, and average loan growth at the bank-firm level on a bank's pre-Brexit referendum credit to UK firms as a fraction of its total credit volume, interacted with an indicator variable for a firm owned by a German corporation, and with the indicator variable High Excess CET1 / RWA, which is set to one for banks with an Excess CET1 / RWA larger than 8% pre-Brexit referendum and zero otherwise, and control variables. The data include the period 2014:Q1 to 2018:Q4, with the post-Brexit referendum period starting in 2016:Q3. The sample includes all corporate borrowers of German banks in EU countries, China, Switzerland, Turkey, the UK, and the US, excluding UK borrowers. The statistical significance of results is indicated by * = 10% level, ** = 5% level, and *** = 1% level using heteroscedasticity-robust standard errors clustered at the bank level.

Panel A

	Credit increases		Loan growth	
	(1)	(2)	(3)	(4)
Bank exposure to UK _{pre}	-0.0114** (-2.1093)	-0.0151*** (-2.8490)	-0.0007 (-1.4356)	-0.0010** (-2.2869)
Bank exposure to UK _{pre} *	0.0128***	0.0131***	0.0004	0.0005
German MNCs	(3.7131)	(3.7933)	(0.9953)	(1.0344)
Bank exposure to UK _{pre} *		0.0299***		0.0028**
High Excess CET1 / RWA _{pre}		(2.8227)		(2.0657)
Base effects	Yes	Yes	Yes	Yes
FIXED EFFECTS				
Country x Industry	Yes	Yes	Yes	Yes
Observations	204,199	203,834	204,199	203,834
Adjusted R ²	0.0138	0.0145	0.0151	0.0158

Panel B

	Loan growth	Loan growth excl. 2016	Loan growth (2014 to 2018)	Credit increases	Change in Loan growth
	(1)	(2)	(3)	(4)	(5)
Bank exposure to UK _{pre} *	-0.0034	-0.0005	0.0078	0.0067	-0.0004
German MNCs *	(-0.6596)	(-0.0510)	(0.1594)	(0.6902)	(-0.3164)
High Excess CET1 / RWA _{pre}					
Base effects and interaction terms	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS					
Country x Industry	Yes	Yes	Yes	Yes	Yes
Observations	203,834	203,834	203,834	203,834	203,834
Adjusted R ²	0.0145	0.0158	0.0316	0.0376	0.0079