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Björn Imbierowicz

(Deutsche Bundesbank)

Arne Nagengast

(Deutsche Bundesbank and CESifo)

Esteban Prieto

(Deutsche Bundesbank)

Ursula Vogel

(European Central Bank)

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Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main,  
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Please address all orders in writing to: Deutsche Bundesbank,  
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

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# Bank Lending and Firm Internal Capital Markets following a Deglobalization Shock

Björn Imbierowicz<sup>‡</sup>    Arne Nagengast<sup>\*</sup>    Esteban Prieto<sup>°</sup>    Ursula Vogel<sup>^</sup>

## Abstract

The pace of globalization has slowed since the global financial crisis, raising concerns about widespread deglobalization and market fragmentation. We examine the effects of a deglobalization shock on bank lending, firm internal capital markets, and the real economy. Leveraging a unique dataset that combines a credit register with foreign direct investment (FDI) data, we are able to observe both domestic and cross-border credit exposures of German banks as well as internal capital market dynamics within multinational corporations (MNCs) – a feature rarely available in other countries' data. We analyze the response to the Brexit referendum shock. On average, German banks reduced lending to United Kingdom (UK) firms following the shock due to increased uncertainty about future losses. More prudent banks reduced their credit more extensively, and less profitable subsidiaries experienced greater reductions. However, UK subsidiaries of large MNCs, with access to internal capital markets, offset this credit supply shock through internal funding, shielding them from negative real effects. We find that non-UK subsidiaries play a crucial role in internal capital markets by securing external financing and reallocating funds to support UK affiliates. Well capitalized banks reallocated lending to firms outside the UK, particularly those of German MNCs. Our findings underscore that while international financial frictions following deglobalization shocks can imply negative real effects, firms integrated into global networks mitigate these impacts through internal capital markets.

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

**JEL codes:** F23, F34, F36, G21.

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<sup>‡</sup> Deutsche Bundesbank, Research Centre, [bjorn.imbierowicz@gmail.com](mailto:bjorn.imbierowicz@gmail.com) (corresponding author)

<sup>\*</sup> Deutsche Bundesbank, DG Economics, [arne.nagengast@bundesbank.de](mailto:arne.nagengast@bundesbank.de)

<sup>°</sup> Deutsche Bundesbank, DG Financial Stability, [esteban.prieto@bundesbank.de](mailto:esteban.prieto@bundesbank.de)

<sup>^</sup> European Central Bank, DG Financial Stability, [ursula.vogel@ecb.europa.eu](mailto:ursula.vogel@ecb.europa.eu)

## 1 Introduction

The second wave of globalization peaked with the global financial crisis of 2007 to 2009, as nationalist tendencies and protectionism then started to gain ground. Political tensions slowed globalization, potentially triggering a deglobalization trend. This development was accelerated by events like the US-China trade war and Brexit. More recently, the COVID-19 pandemic coupled with the war in Ukraine have further exposed the fragility and vulnerability of a globalized economy. Potential new tariffs and stricter trade barriers under the second Trump administration, along with retaliation measures from trading partners, may further exacerbate existing deglobalization dynamics. Given the unprecedented level of globalization and economic interconnectedness, deglobalization shocks can propagate beyond their origin. Correspondingly, global economic policy uncertainty has spiked to record levels in the last decade (Baker et al., 2016; Davis, 2016), associated with higher stock price volatility and reduced investment and employment, raising concerns that deglobalization threatens economic growth.

This paper aims to understand the effects of deglobalization events in a globalized world and the role that financial and economic integration play. We explore how a deglobalization event affects a highly integrated economy and other connected economies. We use the unexpected outcome of the Brexit referendum in June 2016, a major deglobalization shock, and investigate its impact on bank credit supply, international spillovers, and real economic outcomes. The Brexit referendum is well suited for our analysis as it was unexpected and marked the start of the United Kingdom (UK) cutting its ties with EU countries.<sup>1</sup> The outcome of the referendum had immediate economic consequences in the UK, including declines in output and investment (Born et al., 2019; de Almeida et al., 2019), and an increase in uncertainty (Bloom et al., 2019; Faccini and Palombo, 2021; Hassan et al., 2024).<sup>2</sup>

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<sup>1</sup> While we acknowledge that the 2016 US election results impacted many firms and banks globally, we argue that this event is unlikely to be a confounding factor. US firms are included in our control group, which suggests that our results on differences between affected and unaffected firms are likely at the lower bound. In unreported tests, we exclude US firms and the results remain the same. Furthermore, we focus on a deglobalization shock that primarily affects a specific geographical region. While only a few such shocks occurred before the COVID-19 pandemic, since 2020, several shocks have occurred almost simultaneously across countries, complicating causal inference.

<sup>2</sup> The Brexit referendum had immediate macroeconomic consequences for the UK, resulting in 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 rose by nearly 80% the day after the referendum, and stock markets plummeted. Regarding (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 and by the US, one of the most important non-EU foreign investors. The UK's Economic Policy Uncertainty (EPU) index (Baker et al., 2016) shows a substantial rise 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, set to one from the time of the Brexit referendum onwards, shows that the index increased by 78 (76) points after the Brexit referendum, 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).

Importantly, the actual exit occurred much later, which implies that any effects are driven by changes in uncertainty, not by actual changes in rules or costs.

Central to our analysis is identifying 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 by examining the effects on cross-border lending from banks in Germany to firms in the UK. This has methodological advantages. A deglobalization shock affects both firms and banks in the same country, potentially causing additional feedback effects. German banks, by contrast, remained (mostly) unaffected by the immediate implications of the referendum. Changes in their lending to firms in the UK relate to their assessment of risk due to the deglobalization shock. Banks might not experience immediate losses, but uncertainty about the viability of the subsidiaries of German multinational corporations (MNCs) operating in the UK could lead them to pare back credit to UK firms. This increased uncertainty creates supply-side financial frictions, as banks anticipate potential future losses and adjust their lending accordingly. Investigating cross-border bank lending at the bank-firm-time level allows us to leverage a unique empirical setup, ensuring that lending banks and their primary business region are affected solely by uncertainty caused by the deglobalization shock. Furthermore, the Brexit referendum is exceptional as it stands alone as a deglobalization shock, unlike other such shocks that are clustered in time and across economies, making clear identification challenging. The estimated cross-border credit supply shock for UK firms then allows us to explore its implications for firms' internal funding, potential amplification effects to the real economy, and changes in banks' lending to firms in other countries.

A key aspect of our study is the unique dataset we employ, which is essential for identifying the effects we analyze. Specifically, we rely on a combination of several proprietary datasets from the Deutsche Bundesbank that offer unparalleled scope and detail. First, we utilize a comprehensive credit register containing quarterly information on German banks' lending to individual corporate borrowers, including cross-border credit exposures. A key advantage of this data is that it complies with the German Banking Act (§14 Kreditwesengesetz) and uses the credit exposure definition employed by banking supervisors, ensuring accurate, regulator-verified amounts.<sup>3</sup> Such detailed data on foreign

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<sup>3</sup> One limitation is that our data does not provide detailed information on the specific type of loan or the precise events that occurred within a given quarter.

credit exposures are exceptionally rare in credit registers, making our dataset particularly valuable for examining international lending behaviors. Second, we augment this with information on bank characteristics and extensive data on borrowing firms located abroad, including detailed ownership structures, balance sheet and income statement items, and, most importantly, the funding structure of firms, including internal debt. This allows us to examine the internal capital markets of MNCs, enabling us to analyze how firms adjust internal cross-border funding in response to negative credit supply shocks – a feature that is unmatched among firm-level data worldwide. The unique combination of cross-border bank-firm relationships and internal capital market information is essential for our identification strategy. This analysis would not be feasible using either dataset individually or other commonly used datasets.

The combination of these datasets enables us to analyze bank-firm lending dynamics, observe firms' ability to substitute external with internal funding, and assess real economic consequences around the time of the shock. The data structure allows us to isolate credit supply effects using a difference-in-differences setup in the spirit of Degryse et al. (2019).<sup>4</sup> This dataset is thus crucial to our identification strategy and provides novel insights into the role of international financial integration in the face of deglobalization shocks. Our sample is also representative of the broader population of German foreign direct investment (FDI), lending support to the validity of our findings.

In addition to the strengths of our dataset and identification strategy, Germany's high degree of integration with the UK provides an economically meaningful context for our analysis. The UK is a major destination for FDI from Germany.<sup>5</sup> As of 2016, the UK ranked second in terms of FDI volume and third in terms of the number of employees in affiliates of German MNCs. Moreover, German banks play an important role in funding the international activities of German MNCs (see, e.g., Buch, 2002; Seth et al., 1998; Williams, 2002), including the direct financing of foreign subsidiaries. For every €2 of credit extended to German MNCs, banks in Germany extend an additional €1 of cross-border credit to MNC subsidiaries abroad.<sup>6</sup> This close financial linkage, combined with our unique dataset, enables

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<sup>4</sup> In robustness checks, we also leverage multiple bank-firm relationships, following the approach of Khwaja and Mian (2008). These tests include less observations, but corroborate our findings.

<sup>5</sup> German FDI in the UK's non-financial sector increased steadily in the years leading up to the referendum and decreased thereafter (see Appendix Figure A2).

<sup>6</sup> In this paper, we define an 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 in other firms abroad, called subsidiaries. A German MNC is defined as an MNC with a German parent company.

us to precisely identify the effects of the Brexit referendum on cross-border lending and the subsequent adjustments in the internal capital markets of MNCs.

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 bank-firm level after the shock. 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 the UK declines in particular from banks with higher excess capitalization and higher nonperforming loans. We also find that less profitable firms face a larger credit crunch. These results suggest that a deglobalization shock like the Brexit referendum causes international financial frictions.<sup>7</sup>

Second, we examine whether the credit supply shock amplifies the deglobalization shock's immediate adverse effects on the real economy. First, we explore whether affected firms can compensate for the drop in bank credit supply within their international corporate structures. Notably, the firms in our analysis are subsidiaries of German parent companies, giving them access to their MNC's internal capital markets. Parent companies may use internal capital markets to shield subsidiaries when external funding worsens unexpectedly, especially to bridge short-term shortages. Substituting external with internal funding may mitigate or prevent potential negative real effects. We test this in instrumental variables (IV) regressions using shifters in loan supply that are orthogonal to firm demand. Our results show that a negative credit supply shock causes affected firms to increase internal debt, indicating that these firms obtain funds through MNCs' internal capital markets. This effect is stronger for firms belonging to larger MNCs. These firms can compensate for the credit supply shock such that, on average, they experience no real economic consequences. However, this 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.

Third, we examine whether banks shift their lending to borrowers outside the UK after the shock. We find that sound and prudent banks, which reduce their credit supply to UK borrowers, simultaneously increase their lending outside the UK. We further examine whether lender-borrower nationality is a relevant determinant for credit supply after a

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<sup>7</sup> Relatedly, in Section 6, we find that banks exposed to UK borrowers also reduce lending to non-UK firms, reflecting the impact of increased uncertainty on their overall lending behavior.

deglobalization shock. We divide firms into those with German owners (i.e., German parent companies) and those with foreign owners. We find 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 and positive effects of international integration during a deglobalization shock. We show that cross-border lending exacerbates the adverse effects of the shock while another type of international integration, the internal capital markets of multinational firms, cushions these effects as subsidiaries increase borrowing through this channel, thereby dampening adverse effects on the real economy.

### **Related literature**

Our paper contributes to several strands of the literature on the economic effects of deglobalization events, cross-border bank lending, and the role of internal capital markets within MNCs.

First, we relate to the literature examining the economic impact of deglobalization events, particularly trade tensions like the US-China trade war and the Brexit referendum. Studies have documented the significant economic consequences of such events. Amiti et al. (2019) analyze the effects of US import tariffs on the US economy. They find that tariffs increased costs for firms and consumers and reduced the availability of imported varieties. Correa et al. (2024) examine the impact of trade uncertainty during the 2018–2019 US-China trade war and find that heightened uncertainty led to a broad contraction in domestic credit supply, particularly for capital-constrained banks, with significant real effects on bank-dependent firms. Regarding Brexit, Faccini and Palombo (2021) highlight the persistent rise in economic policy uncertainty due to the referendum. Bloom et al. (2019) show that heightened uncertainty following the Brexit vote adversely affected investment and productivity. Berg et al. (2021) document a significant decline in syndicated lending to UK firms post-Brexit, attributing it primarily to reduced credit demand. Born et al. (2019) find that the referendum led to substantial output losses in the UK. Hassan et al. (2024) develop a text-based method to measure Brexit uncertainty and find that firms in 81 countries, particularly those most exposed to Brexit-related risks, experienced significant market value losses, reduced hiring, and lower investment. Our paper extends this literature by analyzing



how increased uncertainty from the Brexit referendum constrained cross-border lending from German banks to UK firms highlighting the role of financial frictions in amplifying the economic consequences of Brexit uncertainty.

Second, our study connects to the literature on international bank lending and the transmission of shocks across borders. Research has shown that internationally active banks can propagate financial shocks through their lending activities. Peek and Rosengren (1997) demonstrate how shocks to Japanese banks were transmitted to the US via reduced lending. Similarly, Schnabl (2012) provides evidence that bank liquidity shocks in international markets are transmitted to firms in emerging economies through reductions in cross-border lending. De Haas and van Lelyveld (2010) find that multinational banks adjust their foreign lending in response to home and host country shocks, affecting credit supply in host countries. We contribute to this literature by providing evidence that German banks reduced their cross-border lending to UK firms following the Brexit referendum due to increased uncertainty. This highlights how deglobalization events can induce international financial frictions beyond domestic borders.

Third, our paper relates to the literature on internal capital markets within MNCs and their role in mitigating external financing constraints. Studies such as Stein (1997) model the efficiency of internal capital markets in resource allocation. Desai, Foley, and Hines (2004) provide empirical evidence that MNCs use internal capital markets to fund investments when external capital is costly. Almeida, Kim, and Kim (2015) show that internal capital markets help MNCs mitigate the effects of financial crises. Our analysis extends this literature by demonstrating that MNCs' internal capital markets can offset the negative effects of a deglobalization-induced credit supply shock. This cushions subsidiaries from adverse real economic outcomes.

In summary, our paper provides novel insights into how a deglobalization shock, such as the Brexit referendum, affects cross-border bank lending and how MNCs' internal capital markets respond to such shocks. By leveraging unique and detailed data from the Deutsche Bundesbank, we isolate credit supply effects and examine the interplay between international financial integration and deglobalization events. This contributes to a deeper understanding of the transmission of economic shocks in a globalized world.

The rest of the paper is structured as follows. Section 2 describes the data and presents descriptive statistics. Section 3 outlines our empirical approach. Sections 4 to 6 present the

empirical implementation and results for the three main parts of the analysis. Finally, Section 7 concludes.

## 2 Data and descriptive statistics

Our data uniquely link information on banks' credit to individual firms with comprehensive data on both bank and borrower characteristics. We use three proprietary datasets from the Deutsche Bundesbank. The core of our analysis is the register on banks' credit towards borrowers (Section 2.1). We complement this with borrower-level data on international direct investments of firms (Section 2.2) and bank-level data on the lender side (Section 2.3). Our dataset covers the years 2014 to 2018, providing a symmetric window for analysis around the Brexit referendum in June 2016. All data are denominated in euros and adjusted for inflation. Section 2.4 presents descriptive statistics, while Appendix Table A1 provides variable definitions.

### 2.1 Bank credit

We source data on banks' credit from Deutsche Bundesbank's large credit microdatabase (*Mikrodatenbank Millionenkredite*, MiMik). The MiMik database provides quarterly information on German banks' credit to borrower units with credit amounts of at least €1 million per quarter.<sup>8</sup> It includes both domestic and cross-border credit, as well as borrower-related details such as industry and firm location. We focus on bank lending to non-financial private sector borrowers. The MiMik dataset, which includes firms with multiple bank relationships, allows us to identify credit supply effects using the methodology of Degryse et al. (2019), as well as Khwaja and Mian (2008) for robustness. We include only bank-firm relationships that exist for at least four quarters in both the pre- and post-Brexit referendum periods, covering a minimum of eight quarters during our sample period. This approach ensures robustness by focusing on stable relationships.<sup>9</sup>

Our main dependent variable to capture new lending is the number of quarterly increases in credit at the bank-firm level, as in Bittner et al. (2022).<sup>10</sup> We observe a bank's credit exposure to a given firm in euros each quarter, reflecting only utilized credit (not including

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<sup>8</sup> See Schmieder (2006) for a detailed description of the MiMik database, as well as the reporting rules and thresholds. The data include only credit exposures, not loan types.

<sup>9</sup> As an extension, in Section 6.2, we also analyze the extensive margin of bank-firm relationships in response to the Brexit shock.

<sup>10</sup> Note that we do not have data on loan-level originations available.

total loan commitments). Although we do not have information on the original currency of denomination for each loan, we observe the aggregate credit exposure reported in euros. To mitigate concerns about currency fluctuations affecting our results, we use the *credit increases* variable, which captures new lending irrespective of the amount and is less sensitive to exchange rate movements. Additionally, in robustness checks, we convert all credit amounts to the borrower’s local currency, and our findings remain qualitatively unchanged. This data follows the German Banking Act (§14 Kreditwesengesetz) and the credit exposure definition used by banking supervisors. To construct the “credit increases” variable, we identify when the credit exposure of a bank to a firm increases from one quarter to the next, indicating that new credit has likely been issued. Specifically, we count the number of quarterly increases in a bank’s credit to a firm during the pre-Brexit referendum period (2014:Q1 to 2016:Q2) and the post-Brexit referendum period (2016:Q3 to 2018:Q4), and then take the difference between the two. Each increase is counted equally, irrespective of the amount, as an indicator that new lending has occurred. 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.

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. This variable measures the percentage change in credit exposure and captures overall changes in lending, but it assumes comparable repayment patterns in both periods. The set of loans included in the “credit increases” variable is not distinct from those in the “loan growth” variable; rather, they are alternative measures derived from the same underlying credit exposure data.

## 2.2 Borrowing firms and their organizational structure

On the borrower side, we augment the credit data with the Microdatabase Direct Investment (MiDi), which covers the universe of annual German outward FDI.<sup>11</sup> Using MiDi, we identify non-financial firms in MiMik that are part of MNCs owned by German parent companies.<sup>12</sup> MiDi provides detailed information on firms’ assets and liabilities, profit

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

<sup>12</sup> In cases of multiple investors in the same firm, we focus on the largest investor.

or loss, and number of employees.<sup>13</sup> The dataset also includes information on the parent company located in Germany, such as its total assets or the number of employees.

Importantly, it includes the firms’ liability structures, distinguishing between external financing (e.g., from banks or bondholders) and internal financing (i.e., from the parent company or other subsidiaries within the MNC). This allows us to analyze how MNCs’ internal capital markets respond to credit shocks – a unique feature of our data. For analyses using MiDi, we focus on the two years before the referendum (2014 and 2015) and the two years after (2017 and 2018), and exclude 2016 due to overlapping pre- and post-Brexit referendum effects.

### 2.3 Bank characteristics

On the lender side, we complement the credit data with bank-level information from multiple sources to construct bank-specific variables. We use data at the consolidated bank level, implicitly assuming that lending decisions are made at the parent level. Data on bank balance sheet characteristics are drawn from Bundesbank monthly balance sheet statistics (BISTA; 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). These data allow us to construct variables for bank size (*Log. total assets*), banks’ Common Equity Tier 1 (CET1) capitalization in excess of regulatory requirements (*Excess CET1/RWA*), return on assets (*RoA*) to capture banks’ profitability, and the share of nonperforming loans in total loans (*NPL ratio*). To measure the *banks’ exposure to the UK* (credit extended to UK borrowers as a share of total credit), we use 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”), and in Panel C, split between banks with low excess capital and banks with high excess capital.<sup>14</sup> Statistics are for variables as used in the regression analyses. Dependent variables are the difference between their average value in the post-shock period (2016:Q3

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

<sup>14</sup> We acknowledge that our sample might be subject to some limitations, as the data only allow us to include firms affiliated with parent companies in Germany and borrowing from banks in Germany. For robustness, in Section 4, we also consider lending to all firms in the MiMik data.

to 2018:Q4) and their average value prior to the shock (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 1<sup>st</sup> and 99<sup>th</sup> percentiles at the industry level.<sup>15</sup> 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.<sup>16</sup> These firms borrow from 167 banks in Germany during our sample period.

Table 1 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. We do not observe significant differences in changes in credit when splitting by banks' excess capital though (Panel C). 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 foreign investment (*log. FDI*); 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 billion, an excess CET1 capital ratio of 5 percentage points, return on assets (RoA) 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 mostly not significant, suggesting that rather comparable firms (and banks) are included in our analyses, i.e., that the parallel trend assumption of our difference-in-differences specification is likely to hold unconditionally.<sup>17</sup> In Panel C, we split the sample by banks with low and those with high excess CET1 capital, using a ratio of 8% as threshold. It again confirms that the firms in our sample are rather comparable.

We check the representativeness of our data in more detail. Out of the 1,062 firms we incorporate in our study, 69 are located in the UK, representing 6.5% of the sample. Using

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<sup>15</sup> 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. For robustness, we also consider the extreme case and convert all data to British pounds. The results do not qualitatively change.

<sup>16</sup> 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.

<sup>17</sup> In Section 4, we explicitly test the parallel trends assumption to provide some evidence on its validity. For robustness, in Section 4, we also consider alternative estimation methods, where the parallel trends assumption only needs to hold conditional on covariates.

the complete data available on FDI (MiDi) from 2001 to 2018, the fraction of direct investment entities in the UK is 6.3%, and from 2014 to 2018, it is 5.8%.

We only include non-financial firms in our analysis as the economic activities and characteristics of financial firms are, by their nature, very different. The largest sectors in our sample are manufacturing (42%), construction, and energy and water supply (17.4%), and trade and maintenance (15.9%). This compares to 35.7% manufacturing, 5.4% construction, and energy and water supply, and 32.4% trade and maintenance in the whole sample of FDI excluding the financial sector. We therefore conclude that the sample in our study is rather representative of the population of FDI of German firms.

Regarding bank-firm relationships, our dataset includes a total of 1,740 observations from 1,062 firms. Among the 69 UK firms, 55 (79.7%) have a relationship with a single bank, while the remaining 14 firms have a relationship with 2 to 7 banks, resulting in a total of 95 observations. Of the remaining 993 firms, with overall 1,645 observations, 712 (71.7%) have a relationship with only one bank.

### 3 Empirical strategy

To explore the implications for cross-border lending, we examine lending dynamics at the bank-firm level. We estimate versions of the following equation in the spirit of Degryse et al. (2019):

$$Y_{b,f}^{post-pre} = \beta UK_f \times Z^{pre} + c_1 Z^{pre} + c_2 Exp_b^{pre} + c_3 Exp_b^{pre} UK_f + I_{MNC} + I_{C,ind} + \varepsilon_{b,f}. \quad (1)$$

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. Aggregating the data in the pre- and post-shock periods and then taking the difference accounts for possible autocorrelation (Bertrand et al., 2004). The variable  $UK_f$  is an indicator set to one for firms located in the UK.  $Z^{pre}$  represents 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 to UK firms prior to the shock, capturing a bank's exposure to the deglobalization shock. Banks might change their lending differently depending on their exposure to the shock.  $Exp_b^{pre}$  controls for the effect of the shock on a bank's overall lending

while interacting it with the UK dummy accounts for the conditional and differential effect for lending to UK firms.  $I_{MNC}$  are fixed effects accounting for differences in MNC characteristics, specifically one fixed effect for all firms of the same MNC.<sup>18</sup> To control for changes in firm credit demand, we include a set of country x firm-industry fixed effects  $I_{C,ind}$ .<sup>19</sup> 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). Firm fixed effects would identify supply effects of the Brexit referendum more rigorously (Khwaja and Mian, 2008). 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 only used to show the robustness of our results. Implementation and results for this part of the analysis are described in Section 4.

In the second part of our analysis, we investigate the effects of the identified credit supply shock on firms' internal debt and real activities. Regressing the change in a firm's internal debt or real outcomes on the change in firms' lending from banks does not suffice to address endogeneity concerns, as the direction of influence remains unclear. Therefore, to clearly isolate effects stemming from the bank credit supply shock, we implement 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. In the first stage of our IV regression, we use equation (1) with either of our two credit variables as endogenous variables. Pre-referendum bank characteristics and their interaction with the UK dummy serve as excluded instruments, as these bank characteristics affecting lending supply are orthogonal to firm demand. We additionally include a bank's pre-shock exposure towards UK borrowing firms and the interaction of the exposure variable with our indicator variable *UK*. The variation in banks' exposure to the deglobalization shock provides an additional, exogenous shifter of the bank loan supply curve, unrelated to firm demand but heterogeneous across banks. We deliberately exclude firm control variables from these

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<sup>18</sup> 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 potential time-varying changes in credit demand.

<sup>19</sup> 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.

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 are correctly excluded from the regression. In sum, we use equation (1) as our first-stage regression where  $Z_b^{pre}$  includes only bank characteristics prior to the shock. From this estimation, we obtain instrumented changes in pre- to post-shock lending at the bank-firm level,  $\widehat{Credit\ Supply\ Shock}_{b,f}$ , 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:

$$Y_f^{post-pre} = \beta_1 \widehat{Credit\ Supply\ Shock}_{b,f} + \beta_2 \widehat{Credit\ Supply\ Shock}_{b,f} \times W^{pre} + c_2 W_b^{pre} + c_2 Z_b^{pre} + I_{MNC} + I_{C,ind} + \varepsilon_f, \quad (2)$$

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 FDI, the RoA, and the logarithm of firm turnover. Note that FDI is equivalent to equity financing from the parent company.  $\widehat{Credit\ Supply\ Shock}_{b,f}$  is the instrumented bank credit supply shock, so that a more negative value implies a stronger reduction in bank loan supply, and thus a stronger 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, i.e., one fixed effect for all firms of the same MNC.<sup>20</sup> To address potential concerns about overweighting firms with multiple bank relationships, we also conduct firm-level analyses by aggregating our data to the firm level and replicating our main regressions, using the

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<sup>20</sup> Out of our 1,740 observations, 166 MNCs include 2 firms, 65 MNCs include 3 firms, 43 MNCs include 4 firms, and 100 MNCs include 5 or more firms.



instrumented average change in new credit at the firm level as the credit supply shock. 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. While our earlier analysis focused on borrowing firms that are subsidiaries of MNCs with the parent company located in Germany, we now include all firms borrowing from banks in Germany and located in our main countries of interest outside the UK, regardless of whether these firms belong to an MNC or not. While this allows for a complete overview of German 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, first, we 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 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 (Giannetti and Laeven, 2012b).

We estimate versions of the following regression:

$$Y_{b,f}^{post-pre} = Exp_b^{pre} + Z_b^{pre} + Exp_b^{pre} \times Z_b^{pre} + I_{c,ind} + \varepsilon_{b,f}, \quad (3)$$

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 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. This variable is included alongside its interaction 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 effects. The results for this part of our analysis are presented in Section 6.

## 4 Deglobalization and cross-border bank lending

This section presents the results of the analysis of the deglobalization shock on cross-border lending (Section 4.1). Furthermore, it shows which bank characteristics (Section 4.2) and firm characteristics (Section 4.3) are relevant determinants of cross-border lending in the context of the deglobalization shock.

### 4.1 Cross-border bank lending

The analysis of the effects of the deglobalization shock 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). The dependent variables are *credit increases* (Panel A of Table 2) and *loan growth* (Panel B). *Credit increases* measure new loan issuances, while *loan growth*, more common in the literature, assumes comparable repayment patterns in the pre- and post-shock periods.

Table 2 shows that after the deglobalization shock, banks reduce lending to UK firms relative to firms in other countries. All coefficients are statistically significant and economically meaningful. Banks extend, on average, one loan less to UK firms compared to firms in other countries in the 10 quarters after the Brexit referendum compared to the 10 quarters before it (Panel A). This reduction represents a decline of almost 30%, given that banks issued roughly 3.5 new loans to both UK and non-UK firms before the shock. Panel B shows that loan growth is 20 percentage points lower. Given that quarterly loan growth to UK firms was about 25% before the shock, this implies that on average, lending almost comes to a halt. Table 2 also shows that accounting for banks’ exposure to the deglobalization shock via our variable  $Exp^{pre}$  is important, as it substantially increases the

explanatory power of the regressions and the economic significance of the coefficients in both panels (starting in column (2)).<sup>21</sup>

We also explore the effects of the deglobalization shock on aggregate cross-border bank lending at the country level. We examine three sets of countries in which borrowing firms are located: all countries, EU countries and the countries to which banks in Germany issue the largest credit volume (China, Switzerland, Turkey, the UK, and the US), and EU countries only. Using *credit increases* as the dependent variable, we find that banks lend less to UK firms after the shock compared to firms in other countries, regardless of the set of countries included (Appendix Table A2).

Our estimations focus on borrowing firms that are subsidiaries of German MNCs, enabling us to analyze internal borrowing and a wide range of additional variables in subsequent analyses. To demonstrate the generality and robustness of our results, we also include all borrowing firms from the credit registry data across the countries in our sample in the regressions. This expansion significantly increases the number of observations to over 200,000. Nevertheless, the coefficient estimates of the *UK* indicator across both credit variables remain highly significant across all regression specifications (see Appendix Table A3, Panel A), confirming that these findings are not specific to our baseline sample.

To evaluate the overall effect of the referendum on firms' liabilities, we examine whether UK firms might compensate for the reduction in cross-border credit supply from German banks by accessing credit from other sources, such as UK banks or non-German lenders. While our dataset does not include data on lending by non-German banks, it does provide information on firms' total liabilities, which helps us assess potential substitution effects. Appendix Table A4 shows that the total liabilities of UK firms generally decline after the referendum, especially for smaller MNCs. This indicates that any substitution of credit supply is incomplete and the reduction in lending from German banks is not fully offset by other sources of credit.

We also ensure that the main identifying assumption of our difference-in-differences regressions, the parallel trends assumption, holds for our estimations. First, we conduct a placebo test by introducing a placebo shock in 2014:Q1 and using the 10 quarters before and after as estimation periods, comparable to our main regressions. We find no significant

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<sup>21</sup> 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.

effects, regardless of whether we include only borrowing firms that are subsidiaries of German MNCs or all borrowing firms in our sample countries (see Appendix Table A3, Panels B1 and B2). Second, we perform event-study regressions that include pre-treatment placebo effects and yearly post-treatment effects to validate the parallel trends assumption (see Appendix Figure A3). The results demonstrate that the effect is absent in the pre-treatment periods but sharply emerges immediately after the referendum, confirming that the observed impact is closely aligned with the timing of the shock. Third, we employ alternative estimation methods, where the parallel trends assumption only needs to hold conditional on covariates. Specifically, we use regression adjustment (RA), inverse probability weighting (IPW), and augmented inverse propensity weighting (AIPW), using pre-Brexit firm characteristics, i.e., log total assets, RoA, leverage, log FDI, and internal debt to total assets (see Appendix Table A3, Panel C). The coefficients remain virtually unchanged, confirming the robustness of our results. In conclusion, the findings provide no evidence of a violation of the parallel trends assumption.

Overall, Table 2 provides evidence that the shock due the Brexit referendum triggers a reduction in cross-border bank lending to UK firms compared to firms in other countries. Our findings add to those of Berg et al. (2021), who show for the syndicated loan market that loan issuances in the UK decrease after the referendum.

## 4.2 Bank characteristics

Next, to better isolate credit supply effects, we control for loan demand and investigate bank characteristics. We use equation (1) and include a set of bank characteristics in our vector  $Z^{pre}$ . These characteristics are a bank's excess capitalization (capitalization in excess of regulatory requirements) and bank soundness using the ratio of nonperforming loans (NPL) to total assets. As additional bank control variables, we also include the logarithm of total assets to capture bank size and bank profitability measured by RoA. All variables are used with their average value over the last four quarters before the shock. Additionally, bank excess capital and NPL are both interacted with our indicator variable *UK* to identify whether these characteristics are related to the decrease in bank loan supply to UK firms.

Table 3 shows the results with *credit increases* (Panel A) and *loan growth* (Panel B) as dependent variables. In both Panels A and B, columns (1) and (2) include bank variables individually, while column (3) includes all bank characteristics together. The interaction term between the indicator variable *UK* and the individual bank characteristics shows that banks

with higher excess capitalization and a higher NPL ratio reduce their cross-border lending to UK firms. This indicates that sounder banks, i.e., those that are better capitalized, reduce their cross-border lending more after a deglobalization shock. A higher NPL ratio can be interpreted in multiple ways. It can indicate that a bank is risky due to a high share of potentially defaulting loans, depleting bank capital. Alternatively, it can be a sign of bank prudence. A growing literature shows that banks engage in zombie lending (e.g., Caballero et al., 2008; Acharya et al., 2019; Blattner et al., 2024).<sup>22</sup> Recognizing loans as nonperforming and not continuing to extend loans to already distressed firms can signal bank prudence and stability. To confirm this interpretation and rule out a higher riskiness of bank lending, we later investigate the default probability estimates of firms by banks and do not observe any significant changes. Accordingly, the evidence is consistent with banks with higher excess capitalization and a higher NPL ratio being more sound and prudent overall.

In columns (4) of both panels, we use firm fixed effects instead of country x industry fixed effects to control for credit demand more rigorously (Khwaja and Mian, 2008). This is the strictest specification to account for firms' credit demand but also excludes a large number of firms with a lending relationship to only one bank. The results confirm our previous findings. Sounder and more prudent banks decrease their cross-border lending to UK firms to a greater degree after the shock.

### 4.3 Firm characteristics

Next, we show which firm characteristics relate to the credit supply shock after the Brexit referendum. We again estimate equation (1) and now use firm characteristics in  $Z^{pre}$ , including the logarithm of total assets as a measure of firm size, the RoA for firm profitability, and firm leverage (total liabilities over total assets) to capture the riskiness of a firm. All variables are average pre-shock values.<sup>23</sup> Again, all characteristics are interacted with our indicator variable *UK* to identify whether these firm characteristics are related to the decrease in bank loan supply to UK firms. Table 4 presents the results with *credit increases* (Panel A) and *loan growth* (Panel B) as dependent variables. 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, indicating a smaller credit supply shock for

<sup>22</sup> See also Acharya et al. (2022) for a comprehensive overview of the related literature.

<sup>23</sup> 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.

more profitable firms. A few firm characteristics are significant in some specifications but lose significance in others, suggesting that their effects may lack robustness. In column (5), we also include the bank characteristics explored in the previous subsection. These specifications show that firm profitability is a significant determinant of cross-border lending in the wake of a shock. Column (5) also confirms the previous result that sounder and more prudent banks reduce their cross-border lending to UK firms to a greater degree. We cannot include firm fixed effects in these estimations, as they 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 the characteristics of both the lending banks and the borrowing UK firms. These findings allow us to infer 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 adjustment of bank lending. Cross-border lending decreases more significantly by sounder and more prudent banks, and to less profitable firms.<sup>24</sup> This result raises 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. Before doing so, we examine firms' internal capital market dynamics and real economic effects after the shock.

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<sup>24</sup> In further tests, we investigate whether more sound and prudent banks in Germany only decrease their lending to less profitable firms located in the UK or to all firms in the UK by splitting the sample based on the median RoA. Appendix Table A5 presents the results of this analysis, showing that more sound and prudent banks reduce their lending to both low and high RoA firms. These results suggest that the reduction in lending was driven by bank characteristics, such as capital adequacy and NPL ratios, as well as by firm characteristics like profitability, though their interaction had a limited impact.

## 5 Effects of the credit supply shock on firms

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

### 5.1 Internal capital markets

MNCs operate internal capital markets within their corporate structures and across borders. The firms included in our analysis are part of a German MNC, i.e., they are an entity within an international corporate holding structure with the parent company in Germany and other subsidiaries worldwide. These firms can access their MNC's internal capital markets and may compensate for a decrease in bank lending due to the credit crunch after the shock with increased funding through the MNC's internal capital markets. MNCs may have different incentives and capabilities to support their subsidiaries compared to banks. Despite the uncertainty generated by the Brexit referendum, MNCs may support their UK subsidiaries to preserve long-term investments and operations. The substantial amount of "brick and mortar" investment in the UK creates 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.<sup>25</sup> We compute two variables to capture firms' funding via their MNC's internal capital markets. We have information on the amount of firms' total internal debt and the amount of internal debt from other subsidiaries of the MNC (excluding the parent company). We calculate the difference in the log of these amounts between the pre- and post-shock periods.

Table 5 reports the results from second-stage IV regressions based on the specification in equation (2). Our independent variables are the instrumented changes in new credit ( $Credit\ Supply\ Shock_{credit\ increases}$ ) and loan growth ( $Credit\ Supply\ Shock_{loan\ growth}$ ).  $Credit\ Supply\ Shock$  represents the instrumented change in bank lending supply from the pre- to post-shock period. A more *negative* value indicates a reduction in loan supply, i.e., a stronger credit supply shock. We ensure that standard errors are correctly computed using a two-stage least squares (2SLS) regression approach.

Columns (1) and (2) of Table 5 report results for the change in firms' total internal debt and columns (3) and (4) show results related to the change in internal debt from other

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<sup>25</sup> 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.

subsidiaries. The table indicates that a negative credit supply shock might lead to an increase in firms' internal debt as all coefficients are negative. All estimations pass the overidentification test, and the F-statistic is well above 10 (Staiger and Stock, 1997; Stock and Yogo, 2005).<sup>26</sup> However, no coefficient is statistically significant.

We hypothesize that 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) to obtain external financing and redistribute the funds across international structures. Firms belonging to MNCs with an SPE should be able to obtain and distribute internal financing more easily. We capture this with an indicator variable *MNC with SPE*, set to one for those firms and zero otherwise. We also hypothesize that larger parent companies and larger MNCs 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 are the logarithm of the total assets of the parent company in Germany ( $\log(Assets)_{parent}$ ), 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 the firms' internal debt from other subsidiaries over total assets as the dependent variable to capture the change in the relative importance of firms' internal debt within firms' capital structure. Table 6 reports the estimation results.

Columns (1) and (2) again do not show a significant relationship between the credit supply shock and internal debt. In contrast, columns (3) to (12) suggest that MNC and parent company characteristics imply differential effects across firms. Almost all interactions of parent company and MNC characteristics with the credit supply shock show negative and statistically significant coefficient estimates. Thus, our hypothesis is confirmed. For a given (negative) credit supply shock, firms' internal debt share is higher if their MNC includes an SPE and/or is larger. The overall effect hinges on the specific value of the interaction variable, as the base term exhibits a positive coefficient in many cases.<sup>27</sup> UK firms of smaller

<sup>26</sup> For robustness, Appendix Table A6 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 A6 is well above 104, which shows that our results do not suffer from a weak instruments problem (Lee et al., 2022).

<sup>27</sup> To test the robustness of our results, we again also 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.



parent companies and MNCs experience a decrease in both internal and cross-border bank credit. Those with larger parent companies and MNCs circumvent potential frictions by leveraging their internal capital markets.<sup>28</sup> This suggests that substitution via internal capital markets is incomplete, particularly for smaller MNCs.

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 Brexit referendum outcome. 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 analyze the ensuing real effects. We estimate versions of equation (2) using the previous IV regression setup, with variables capturing firm real effects on the left-hand side. These variables are the logarithm of a firm's employment ( $\log(\text{Employment})$ ), the logarithm of FDI ( $\log(\text{Equity financing})$ ), the return on assets ( $RoA$ ), and the logarithm of firm turnover ( $\log(\text{Turnover})$ ). Table 7 presents the results.

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These second stage regressions broadly confirm our results (see Appendix Table A7, Panel A), with F-statistics well above 104 in all cases (Lee et al., 2022). Furthermore, it might also be the case that multiple relationships with banks of some firms imply an overweighing of observations related to these when using the data at the firm-bank level. We therefore additionally also aggregate all data to the firm level and display the results in Appendix Table A7, Panel B. The table uses the instrumented average change in new credit at the firm level as credit supply shock and accordingly replicates the odd columns with interaction terms of Table 6 at the firm level. It confirms our main findings with interaction term coefficients in several cases even being stronger than in our estimations at the bank-firm level.

<sup>28</sup> MNCs can mitigate potential frictions by borrowing through firms in markets with lower frictions and reallocating resources via internal capital markets. To investigate this, we examine whether non-UK subsidiaries within the same MNC as UK subsidiaries increased their bank borrowing following the Brexit referendum. A panel data regression, with firm and year-quarter fixed effects, confirms this mechanism. The interaction term between affected subsidiaries and the post-referendum period (1 from 2016:Q3 onward and 0 otherwise) is 0.086, with a t-value of 3.09. This suggests that non-UK subsidiaries substitute the reduced bank lending to UK subsidiaries within the same MNC by borrowing more externally and reallocating these funds within the corporate group. These findings further support the idea that banks assess creditworthiness at the subsidiary level rather than uniformly reducing lending across the entire MNC group based on UK exposure (Houston, James, and Marcus, 1997). Non-UK subsidiaries play a critical role in accessing external financing and reallocating funds internally to support UK affiliates, consistent with theories on internal capital markets (e.g., Stein, 1997; Desai, Foley, and Hines, 2004), which highlight their capacity to mitigate financing frictions and respond to country-specific shocks.

All coefficient estimates for both *Credit Supply Shock* variables are statistically insignificant (with the exception of two weakly significant coefficient estimates in columns (3) and (6), for FDI and RoA, respectively). 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 credit supply shock. As a result, the usual adverse real economic consequences of a credit crunch cannot be observed. However, this effect may not hold for smaller MNCs or firms with less access to internal capital markets, as indicated by our previous results. 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, while increasing vulnerability to shocks. Our results complement this finding by showing that while 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. Firms with larger parent companies and/or MNCs are better able to mitigate credit supply shocks via their internal capital market (see Section 5.1). We expect this to translate into heterogeneous real effects across firms. To analyze this, we again estimate versions of equation (2) with a measure for firms' employment as the dependent variable. Employment serves as a key indicator of firms' operational adjustments and provides a meaningful proxy for the broader economic impact 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 6) 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 that are part of larger MNCs should also be reflected in more favorable real effects, measured by firm employment in our case. Table 8 reports the results.

We observe that firm heterogeneities influence the ensuing real effects following a credit supply shock. All coefficient estimates for interaction terms are negative and highly statistically significant, while the coefficients of the *Credit Supply Shock* are positive 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.

Taken as a whole, our results show that MNCs can mitigate a credit supply shock by providing funding through their internal capital markets, thereby mitigating or even preventing the real economic ramifications that usually follow a credit supply shock. However, this applies only to larger MNCs and those operating an SPE. While 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.<sup>29</sup> UK-owned firms, which do not belong to MNCs and represent the vast majority of businesses, have no access to cross-border internal capital markets. This particular mechanism to mitigate the credit supply shock caused by the referendum remains unavailable to them. Moreover, even among MNCs, smaller firms may not fully compensate for the reduction in external credit, potentially experiencing adverse real effects.

## 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, focusing on where banks shift their lending (Section 6.1). Furthermore, we examine changes in borrower and bank characteristics over time to substantiate our argument that uncertainty generated by the Brexit outcome is the main driver of our results (Section 6.2).

### 6.1 Bank lending dynamics after a deglobalization shock

Given potential future losses, banks may reduce their credit to UK firms and increase credit supply to firms elsewhere. To investigate general bank lending dynamics, we estimate versions of equation (3) and examine all borrowers outside the UK, regardless of whether they are subsidiaries of MNCs. We first examine the role of banks' exposure to UK borrowers before the Brexit referendum as a measure of their exposure to the deglobalization shock. Banks more exposed to uncertainty caused by a deglobalization shock are more likely to decrease their lending, including to indirectly affected borrowers (Correa et al., 2024). We also investigate whether the bank characteristics related to the reduction in lending to UK firms in Table 3 are associated with a stronger increase in loan supply to non-UK customers. Table 9 shows the main results.

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<sup>29</sup> 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>.

Table 9 confirms that, on average, banks with higher exposure to UK borrowers tend to reduce their lending to non-UK borrowers after the shock. This suggests that uncertainty about potential future losses in the UK leads banks to conserve capital by reducing lending elsewhere. However, this effect is reduced or even reversed for banks with high excess capitalization, defined as banks with a CET1/RWA ratio 8 percentage points above regulatory requirements. Banks with high excess capital ratios, which reduce lending to UK firms more after the shock (see Table 3), lend more to non-UK firms, shifting their lending away from UK firms to firms in other countries. Controlling for demand with firm fixed effects, despite a reduced sample size, leads to the same result (see columns (3), (6), and (9) in Table 9). Accordingly, banks with 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 banks that reduce their lending to affected firms the most.<sup>30</sup> This pattern suggests that well-capitalized banks can reallocate their lending to non-UK firms despite the uncertainty, whereas less-capitalized banks may reduce lending overall due to constrained capital and increased risk aversion.

After examining the role of bank heterogeneities in the shift of cross-border bank lending, we examine the role of heterogeneities among borrowing firms. Extending the sample to all borrowers, regardless of whether they are subsidiaries of an MNC, allows for a complete overview of German banks' lending, though it lacks detailed firm-level information, except for identifying subsidiaries of German MNCs and their industries. We explore whether German banks differentiate between firms that are subsidiaries of German MNCs and other firms when shifting their lending from the UK to other countries. The results are shown in Table 10.

Results show that banks with larger exposures to UK borrowers before the Brexit referendum relatively increase their lending to firms owned by German MNCs. All interaction terms with our variable *German MNCs* are highly statistically significant. This indicates a bias in lending in response to a deglobalization shock when the firm owner and the lender share 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 9. All results hold. Further tests show that both effects

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<sup>30</sup> 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 A8).

impact loan growth individually but not jointly.<sup>31</sup> In other words, banks with higher exposures to UK firms before the Brexit referendum reduce their lending to non-UK firms, but this reduction is smaller for firms that belong to German MNCs, suggesting a preference for lending to familiar firms during periods of increased uncertainty.

Our framework for nationality bias is broader than the home bias in previous literature, as we consider the location of the controlling firm instead of the direct borrower. We re-run all analyses and split borrowing firms by their own nationality and the nationality of their ultimate owner. For German owners, the results (not reported here for brevity) for borrowing firms in Germany and other countries are similar, though statistically stronger for firms based in Germany. However, we cannot rule out the possibility that statistical power drives this result, as out of the 59% borrowing firms with a German owner, 57.3% are also based in Germany, and only 1.7% are located in other countries. By contrast, 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, drives the bias in bank lending when the borrower's owner and the lender share the same nationality. These findings support the notion that, in times of increased uncertainty, banks may exhibit a home bias by favoring lending to firms with ties to familiar national affiliations or domestic parent companies.

## **6.2 Firm and bank characteristics over time**

Banks might not experience immediate losses after the Brexit referendum, but there is significant uncertainty about the future viability of some German MNCs operating in the UK. In this part, we therefore examine borrower and bank characteristics over our observation period to better understand the underlying dynamics and mechanisms related to our results. As mentioned earlier when discussing the parallel trends assumption, Appendix Figure A3 confirms that the lending supply effects we observe are related to the period after the Brexit referendum. We are now interested in whether this effect only relates to an increase in uncertainty or also an actual change in borrower risk. We first look at the intensive margin and the probability of default (PD) of borrowers. As Panel A of Table 11 shows, the PDs of

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<sup>31</sup> For robustness, Appendix Table A9, 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.

UK borrowers do not change significantly compared to other subsidiaries of MNCs. Although the coefficients are not statistically significant, they are consistently negative across all specifications. This suggests that banks generally maintain lending relationships with firms that do not exhibit increased risk. We also investigate the extensive margin and test in a firm-bank panel whether banks are more likely to end a lending relationship with a UK borrower after the Brexit referendum. Panel B of Table 11 indicates that banks tend to be more likely to end a lending relationship with a UK borrower after the referendum. However, although most coefficients are positive, only one specification shows a marginally significant coefficient. These results suggest that while there is a tendency for banks to withdraw from lending relationships, the evidence is not strong, possibly due to the relatively short observation period or limited statistical power. We conclude that uncertainty about the future viability of some German MNCs operating in the UK drives our results.<sup>32</sup> This uncertainty leads banks to adjust their lending behavior, also to some extent, to non-UK firms, particularly if they are less familiar.

## 7 Conclusion

The unexpected outcome of the Brexit referendum marked the beginning of the UK's disintegration from the EU. This major event fueled a potential deglobalization trend and initiated a period of heightened uncertainty. This study shows that the uncertainty generated by this deglobalization shock led to a cross-border credit supply shock for firms in the UK.

Controlling for loan demand, we find that certain firm and bank characteristics are relevant determinants of the credit supply shock. Specifically, more sound and prudent banks reduce their credit supply to a greater degree. Less profitable firms obtain less credit. However, firms that are part of larger MNCs mitigate the negative bank credit supply shock by tapping their internal capital markets. This substitution is incomplete, especially for smaller MNCs. Thus, being part of an MNC helps firms mitigate the negative real implications of deglobalization shocks.

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<sup>32</sup> We investigate these aspects in more detail on a descriptive basis, not shown for brevity. Consistent with prior literature, we observe that UK firms experience a strong decrease in (log) investment immediately after the Brexit referendum, which persists throughout the observation period. This supports the view that uncertainty results in negative real effects. Additionally, we examine whether banks with high versus low exposure to UK firms before the referendum experience differential changes in their characteristics over time. Our findings show no significant differences reinforcing the interpretation that banks do not face immediate losses and that uncertainty is the primary driver of our results.

Well-capitalized banks, that reduced their lending to the UK, reallocate their lending to firms in other countries, including their home country. This suggests that a deglobalization shock does not only imply negative real effects for affected firms but also affects funding conditions for firms in other countries.

Recent developments towards deglobalization and market fragmentation such as the global financial crisis, the COVID-19 pandemic, and the war in Ukraine, increase the urgency to understand the effects and consequences of deglobalization events. Potential new tariffs and stricter trade barriers under the second Trump administration, combined with retaliation from trading partners, could intensify the already growing trends of deglobalization and market fragmentation. We show that the adverse effects of a deglobalization shock are amplified by one type of international integration, cross-border bank lending. However, they are mitigated by another, internal capital markets operated across borders by MNCs. Our results indicate that international integration can simultaneously amplify and remedy the adverse real effects of a deglobalization shock. While our paper focuses on short-term effects, studying the longer-term consequences and adjustments in response to deglobalization events remains an important avenue for future research.

## **Declaration of generative AI and AI-assisted technologies in the writing process.**

Statement: During the preparation of this work the authors used ChatGPT in order to refine sentence phrasing and improve clarity. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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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), separately for firms located in the UK and those located elsewhere (Panel B), and separately for banks with low excess capital and high excess capital using an Excess CET1 / RWA threshold of 8%. The three rightmost columns in Panel B (Panel C) show the difference between UK firms and non-UK firms (Low excess capital banks and high excess capital banks), 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 1<sup>st</sup> and 99<sup>th</sup> percentiles by industry and adjusted for inflation. Appendix Table A1 provides variable descriptions.

**Panel A: Full sample**

	Mean	SD	p(5)	Median	p(95)
<b>Dependent variables pre- to post-shock difference)</b>					
<b>Bank lending</b>					
Credit increases	-0.609	2.188	-4.000	-1.000	3.000
Loan growth	-0.134	0.720	-1.310	-0.063	1.000
<b>Internal capital market</b>					
Log. internal debt	0.275	2.106	-1.888	0.032	5.745
Internal debt / total assets	0.010	0.151	-0.224	0.000	0.282
Log. Int. debt other subs.	0.038	0.541	-0.542	0.000	0.830
Int. debt other subs. / total assets	0.000	0.096	-0.155	0.000	0.143
<b>Firm-specific variables</b>					
Log. employment	0.070	0.375	-0.351	0.002	0.475
Log. equity financing	0.261	2.759	-1.429	0.122	4.098
RoA	0.013	0.173	-0.237	0.003	0.252
Log. turnover	0.186	1.919	-0.916	0.064	1.171
<b>Independent variables (pre-shock average)</b>					
<b>Bank characteristics</b>					
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
RoA	0.027	0.032	0.003	0.016	0.092
NPL ratio	0.030	0.045	0.009	0.018	0.075
<b>Firm Characteristics</b>					
Log. total assets	11.380	1.776	8.785	11.150	14.509
RoA	-0.002	0.287	-0.538	0.000	0.370
Leverage	0.605	0.272	0.192	0.588	1.005

Table 1 – continued

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

	UK firms (N = 95)			Non-UK firms (N = 1,645)			Difference	p(t)	p(z)
	Mean	Median	SD	Mean	Median	SD			
<b>Dependent variables pre- to post-shock difference)</b>									
<b>Bank lending</b>									
Credit increases	-1.000	-1.000	2.026	-0.586	-1.000	2.195	-0.414	0.057	0.044
Loan growth	-0.247	-0.075	1.019	-0.127	-0.062	0.699	-0.120	0.262	0.716
<b>Internal capital market</b>									
Log. internal debt	0.604	0.166	1.831	0.256	0.016	2.120	0.348	0.077	0.085
Internal debt / total assets	0.011	0.043	0.168	0.010	0.000	0.150	0.002	0.921	0.030
Log. Int. debt other subs.	0.179	0.033	0.572	0.030	0.000	0.538	0.149	0.015	0.001
Int. debt other subs. / total assets	0.020	0.005	0.111	-0.001	0.000	0.095	0.022	0.066	0.000
<b>Firm-specific variables</b>									
Log. employment	0.058	0.002	0.457	0.071	0.004	0.370	-0.012	0.794	0.632
Log. equity financing	-0.359	0.020	4.145	0.297	0.129	2.654	-0.657	0.130	0.018
RoA	0.037	0.017	0.314	0.012	0.003	0.161	0.025	0.435	0.330
Log. turnover	0.246	0.020	1.969	0.183	0.071	1.916	0.063	0.763	0.007
<b>Independent variables (pre-shock average)</b>									
<b>Bank characteristics</b>									
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
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
<b>Firm Characteristics</b>									
Log. total assets	11.707	11.318	1.976	11.361	11.144	1.763	0.347	0.098	0.127
RoA	-0.170	-0.015	0.492	0.008	0.000	0.268	-0.178	0.001	0.001
Leverage	0.612	0.605	0.279	0.605	0.583	0.271	0.007	0.821	0.644

Panel C: Low excess capital banks and high excess capital banks

	Low excess capital banks (N = 1,522)			High excess capital banks (N = 218)			Difference	p(t)	p(z)
	Mean	Median	SD	Mean	Median	SD			
<b>Dependent variables pre- to post-shock difference)</b>									
<b>Bank lending</b>									
Credit increases	-0.597	-1.000	2.161	-0.688	-1.000	2.368	0.091	0.593	0.773
Loan growth	-0.134	-0.055	0.720	-0.133	-0.121	0.722	-0.001	0.979	0.211
<b>Internal capital market</b>									
Log. internal debt	0.232	0.029	2.044	0.573	0.079	2.480	-0.341	0.054	0.214
Internal debt / total assets	0.009	0.000	0.152	0.013	0.000	0.147	-0.004	0.696	0.960
Log. Int. debt other subs.	0.037	0.000	0.535	0.046	0.000	0.580	-0.009	0.835	0.674
Int. debt other subs. / total assets	0.001	0.000	0.099	-0.009	0.000	0.074	0.010	0.077	0.077
<b>Firm-specific variables</b>									
Log. employment	0.063	0.006	0.363	0.123	0.000	0.449	-0.060	0.059	0.250
Log. equity financing	0.240	0.121	2.763	0.412	0.143	2.730	-0.172	0.386	0.355
RoA	0.011	0.003	0.175	0.030	0.012	0.163	-0.019	0.115	0.034
Log. turnover	0.130	0.070	1.850	0.579	0.015	2.311	-0.449	0.006	0.937
<b>Independent variables (pre-shock average)</b>									
<b>Bank characteristics</b>									
Log. total assets	26.298	27.073	2.082	24.360	24.009	2.301	1.938	0.000	0.000
Excess CET1 / RWA	0.039	0.034	0.013	0.137	0.157	0.025	-0.099	0.000	0.000
RoA	0.025	0.016	0.030	0.040	0.011	0.040	-0.015	0.000	0.000
NPL ratio	0.029	0.018	0.046	0.038	0.041	0.034	-0.009	0.001	0.000
<b>Firm Characteristics</b>									
Log. total assets	11.309	11.129	1.737	11.869	11.656	1.961	-0.560	0.000	0.000
RoA	-0.008	0.000	0.295	0.040	0.018	0.220	-0.047	0.005	0.032
Leverage	0.605	0.586	0.275	0.611	0.593	0.248	-0.007	0.713	0.627

**Table 2****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. These are the logarithm of total assets, the excess capital ratio, the return on assets, and the NPL ratio for banks, and the logarithm of total assets, the return on assets, and leverage for firms. 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. Appendix Table A1 provides variable descriptions.

Panel A: Credit increases					
	(1)	(2)	(3)	(4)	(5)
UK	-0.4140*** (-2.7966)	-1.3717*** (-3.3349)	-1.1992*** (-2.8749)	-1.2606*** (-2.7450)	-1.0647** (-2.3502)
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 <sup>2</sup>	0.0013	0.0157	0.0159	0.0247	0.0260

Panel B: Loan growth					
	(1)	(2)	(3)	(4)	(5)
UK	-0.1195 (-1.3235)	-0.1901*** (-2.7886)	-0.2033** (-2.3454)	-0.1735** (-2.0899)	-0.1905* (-1.8567)
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 <sup>2</sup>	0.0008	0.0003	-0.0013	0.0067	0.0047

**Table 3****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. Further bank control variables are the logarithm of a bank's total assets and its return on assets, both also interacted with the indicator variable *UK*. 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 (4) 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.

Panel A: Credit increases				
	(1)	(2)	(3)	(4)
BANK CHARACTERISTICS				
UK * Excess CET1 / RWA	-16.7906*** (-3.5542)		-16.6396*** (-2.7514)	-19.9584** (-2.1646)
UK * NPL ratio		-10.4148*** (-4.4593)	-9.0796*** (-2.7131)	-12.0789*** (-4.8151)
Excess CET1 / RWA	2.5077 (1.0493)		1.8102 (0.6696)	2.4062 (0.9501)
NPL ratio		0.9213 (0.6813)	0.1730 (0.1244)	-0.8810 (-0.4554)
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Further bank control variables	Yes	Yes	Yes	Yes
FIXED EFFECTS				
MNC	Yes	Yes	Yes	No
Country x Industry	Yes	Yes	Yes	No
Firm	No	No	No	Yes
Observations	1,740	1,740	1,740	973
Adjusted R <sup>2</sup>	0.3561	0.3541	0.3587	0.4375

Panel B: Loan growth				
	(1)	(2)	(3)	(4)
BANK CHARACTERISTICS				
UK * Excess CET1 / RWA	-8.2102** (-2.0612)		-9.9088*** (-3.1582)	-12.9776*** (-3.4397)
UK * NPL ratio		-7.0222*** (-6.5014)	-7.7879*** (-5.6714)	-15.7414*** (-6.7770)
Excess CET1 / RWA	0.5768 (1.2843)		0.6445 (1.5378)	0.7290* (1.6683)
NPL ratio		0.0415 (0.1649)	-0.0046 (-0.0142)	-0.0667 (-0.1575)
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Further bank control variables	Yes	Yes	Yes	Yes
FIXED EFFECTS				
MNC	Yes	Yes	Yes	No
Country x Industry	Yes	Yes	Yes	No
Firm	No	No	No	Yes
Observations	1,740	1,740	1,740	973
Adjusted R <sup>2</sup>	0.1086	0.1090	0.1119	0.1522

**Table 4****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)			0.0796 (1.0789)	0.0732 (1.0598)
RoA		0.5024** (2.1636)		0.6634*** (3.1733)	0.6716*** (3.3666)
Leverage			-0.0785 (-0.1615)	0.4045 (0.8360)	0.4112 (0.8253)
BANK CHARACTERISTICS					
UK * Excess CET1 / RWA					-16.9063** (-2.5841)
UK * NPL ratio					-9.9412*** (-3.2630)
Excess CET1 / RWA					1.7705 (0.6475)
NPL ratio					0.0186 (0.0128)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes
Further bank control 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 <sup>2</sup>	0.3538	0.3585	0.3536	0.3581	0.3633



**Table 4 – continued**

Panel B: Loan growth					
	(1)	(2)	(3)	(4)	(5)
FIRM CHARACTERISTICS					
UK * Log. total assets	0.1482 (0.8518)			0.1246 (0.5483)	0.1288 (0.5389)
UK * RoA		0.6269*** (2.8985)		0.4473 (1.5038)	0.5848* (1.8891)
UK * Leverage			-1.1623* (-1.6720)	-0.6682 (-0.7305)	-0.3909 (-0.4259)
Log. total assets	-0.0267* (-1.7516)			-0.0304* (-1.8768)	-0.0283* (-1.7528)
RoA		0.0809 (1.0048)		0.0623 (0.3348)	0.0646 (0.3442)
Leverage			-0.0936 (-0.7385)	-0.0775 (-0.3199)	-0.0722 (-0.2992)
BANK CHARACTERISTICS					
UK * Excess CET1 / RWA					-9.9873*** (-3.0444)
UK * NPL ratio					-7.5451*** (-4.4660)
Excess CET1 / RWA					0.7095* (1.7815)
NPL ratio					-0.0216 (-0.0673)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes
Further bank control 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 <sup>2</sup>	0.1037	0.1085	0.1085	0.1094	0.1179

**Table 5****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, and return on assets. 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. 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(Internal debt)		log(Internal debt from other subsidiaries)	
	(1)	(2)	(3)	(4)
Credit Supply Shock <sub>credit increases</sub>	-0.0518 (-0.8795)		-0.0243 (-1.3987)	
Credit Supply Shock <sub>loan growth</sub>		-0.1225 (-0.8315)		-0.0249 (-0.5981)
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				
Parent FE	Yes	Yes	Yes	Yes
Country x Industry FE	Yes	Yes	Yes	Yes
Observations	1,740	1,740	1,740	1,740
Overidentification test	0.532	0.519	0.235	0.362
F-statistic (first stage)	14.14	13.35	14.14	13.35

**Table 6****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, and return on assets. 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 base effect of the respective interaction variable is 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) <sub>parent</sub>		log(Employees) <sub>MNC</sub>		log(Assets) <sub>MNC</sub>		log(# Affiliates) <sub>MNC</sub>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credit Supply Shock <sub>credit increases</sub>	-0.0087 (-1.3350)		0.0214 (1.1382)		0.2404* (1.7530)		0.0613 (1.5457)		0.2487 (1.3254)		0.0873* (1.6569)	
Credit Supply Shock <sub>loan growth</sub>		0.0124 (0.5960)		0.0172 (1.0978)		0.3505*** (3.1599)		0.2096*** (3.3624)		0.4178*** (3.5135)		0.1156*** (3.7259)
Credit Supply Shock <sub>credit increases</sub> x Interaction Variable			-0.0588* (-1.9217)		-0.0181* (-1.9382)		-0.0088** (-2.0737)		-0.0171 (-1.4357)		-0.0290* (-1.9450)	
Credit Supply Shock <sub>loan growth</sub> x Interaction Variable				-0.1224** (-2.1961)		-0.0272*** (-2.8847)		-0.0348** (-2.5236)		-0.0296*** (-3.3173)		-0.0483*** (-3.2154)
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												
Parent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Industry FE	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	0.306	0.423	0.242	0.220	0.283	0.0514	0.285	0.442	0.349	0.0524	0.240	0.0598

**Table 7****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, and return on assets. 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 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 <sub>credit increases</sub>	0.0060 (0.4913)		0.4463* (1.8308)		0.0163 (1.1413)		-0.0528 (-0.5621)	
Credit Supply Shock <sub>loan growth</sub>		0.0445 (1.2453)		0.7093 (1.1142)		0.0516* (1.6876)		-0.0934 (-0.5746)
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								
Parent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Industry FE	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	0.416	0.359	0.293	0.226	0.442	0.466	0.924	0.896

**Table 8****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, and return on assets. 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 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 base effect of the respective interaction variable is 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	0.0520** (2.1342)	0.5632*** (4.9034)	0.3546*** (3.8299)	0.7296*** (3.5471)	0.2343*** (3.2313)
Credit Supply Shock x MNC with SPE	-0.2791*** (-2.6428)				
Credit Supply Shock x log(Assets) <sub>parent</sub>		-0.0417*** (-4.7664)			
Credit Supply Shock x log(Employees) <sub>MNC</sub>			-0.0551*** (-3.3660)		
Credit Supply Shock x log(Assets) <sub>MNC</sub>				-0.0500*** (-3.4234)	
Credit Supply Shock x log(# Affiliates) <sub>MNC</sub>					-0.0891*** (-2.6626)
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	0.628	0.631	0.569	0.635	0.395

**Table 9****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. Appendix Table A1 provides variable descriptions.

	Loan growth			Loan growth (excl. 2016)			Loan growth (2014 to 2018)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UK-loans/total loans <sub>pre</sub> (%)	-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)
UK-loans/total loans (%) <sub>pre</sub> x High Excess CET1 / RWA <sub>pre</sub>		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 FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Firm FE	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 <sup>2</sup>	0.0137	0.0143	0.1652	0.0150	0.0157	0.1740	0.0302	0.0313	0.2561

**Table 10****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. Appendix Table A1 provides variable descriptions.

	Loan growth		Loan growth excl. 2016		Loan growth (2014 to 2018)	
	(1)	(2)	(3)	(4)	(5)	(6)
Bank exposure to UK <sub>pre</sub>	-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 <sub>pre</sub> * 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 <sub>pre</sub> * High Excess CET1 / RWA <sub>pre</sub>		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 <sup>2</sup>	0.0138	0.0145	0.0151	0.0158	0.0305	0.0316

**Table 11****The impact of the shock on borrower risk and bank-firm relationships**

Panel A shows regression results of the pre- to post-shock change in the probability of default of firms at the bank-firm level on the indicator variable UK, which is set to one for firms located in the UK and zero otherwise. 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. Standard errors are heteroscedasticity-robust clustered at the bank level. Panel B reports regression results on the probability of termination of a bank-firm relationship in a panel with a pre-referendum period (2014:Q1 to 2016:Q2) and post-referendum period (2016:Q3 to 2018:Q4) on the indicator variable 'UK', which is set to one for firms located in the UK and zero otherwise, interacted with a post-Brexit dummy, which is set to one for the post-referendum period (2016:Q3 to 2018:Q4). The sample includes all corporate borrowers of German banks in EU countries, China, Switzerland, Turkey, the UK, and the US, excluding UK borrowers. Columns (1) and (2) are from a linear probability model (LPM), columns (3) and (4) are from a probit model, and columns (5) and (6) are from a logit model. Standard errors are heteroscedasticity-robust clustered at the bank level in columns (1), (3), and (5), while they are heteroscedasticity-robust without clustering in columns (2), (4), and (6). The statistical significance of results is indicated by \* = 10% level, \*\* = 5% level, and \*\*\* = 1% level. Appendix Table A1 provides variable descriptions.

Panel A: Probability of default (PD) of borrowers

	PD (%)			
	(1)	(2)	(3)	(4)
UK	-0.3263 (-1.1430)	-0.2838 (-0.9806)	-0.0500 (-0.1407)	-0.0320 (-0.0903)
Firm Characteristics	No	Yes	No	Yes
FIXED EFFECTS				
Industry (1-digit) FE	Yes	Yes	No	No
Industry (1-digits) FE	No	No	Yes	Yes
Observations	1,430	1,430	1,429	1,429
Adjusted R <sup>2</sup>	0.0154	0.0213	0.1619	0.1633

Panel B: Probability of termination of a bank-firm relationship

	(1)	(2)	(3)	(4)	(5)	(6)
UK*Post-Brexit	0.0455 (1.3629)	0.0455* (1.8250)	0.0455 (1.3631)	0.0455 (1.5749)	0.0455 (1.3631)	0.0455 (1.5749)
Model	LPM	LPM	Probit	Probit	Logit	Logit
Standard error clustering	Bank	None	Bank	None	Bank	None
UK fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,901	14,901	14,901	14,901	14,901	14,901



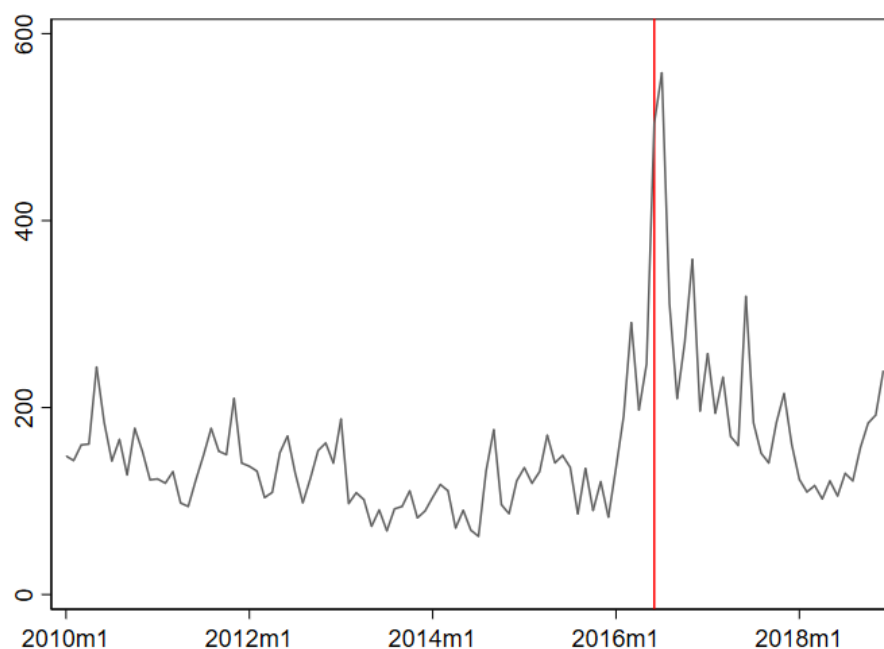
## APPENDIX

**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.

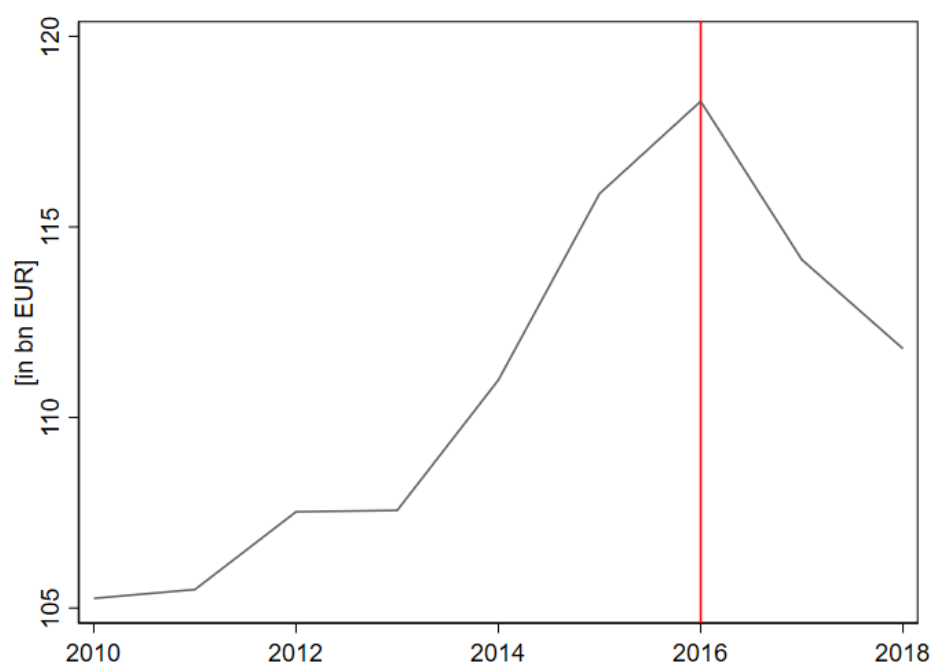


**Figure A2**

### **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.



### Figure A3

#### Parallel trends assumption and treatment effects over time

The figure shows the coefficient estimates from an event-study regression of the dependent variable, credit increases, at the bank-firm level, in an annual panel from 2014-2018 on the indicator variable 'UK,' which is set to one for firms located in the UK and zero otherwise, interacted with year dummies for the years 2014, 2016, 2017, and 2018 (i.e., the year 2015 is the reference period), while controlling for year and firm fixed effects. Figure A3.1 includes only firms that are subsidiaries of German MNCs (small sample) as in our baseline. Figure A3.2 includes all non-financial firms borrowing from German banks and located in the EU countries, China, Switzerland, Turkey, the UK, and the US (large sample). The figure shows 95 percent confidence intervals using heteroscedasticity-robust standard errors clustered at the bank level.

Figure A3.1 Event study – Small sample (only subsidiaries of German MNCs)

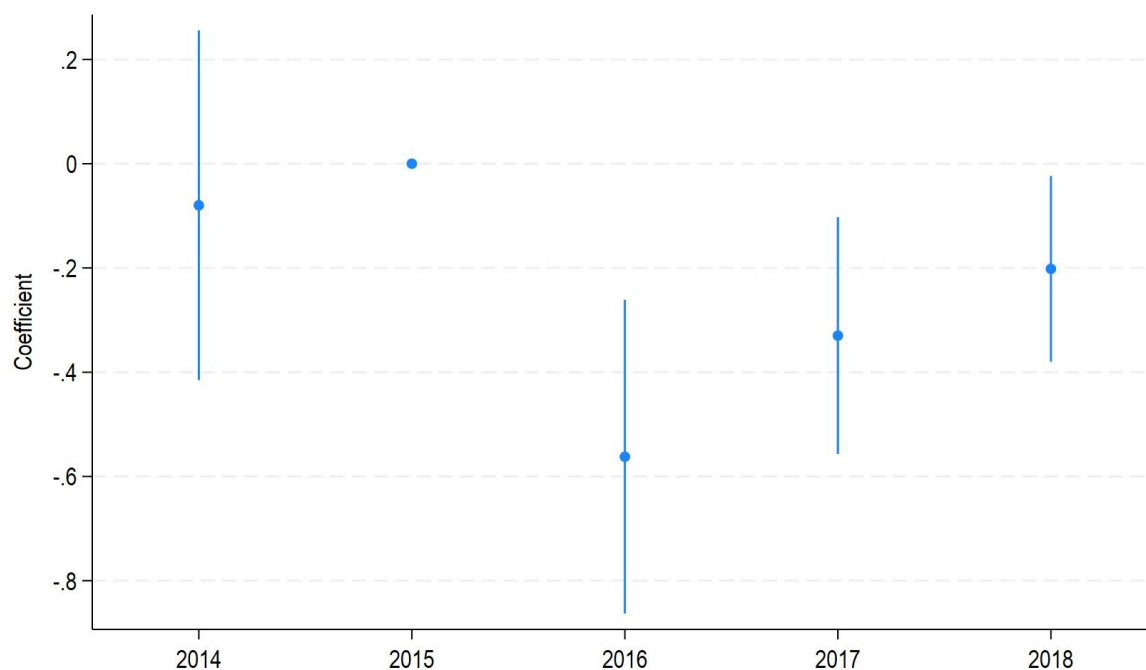
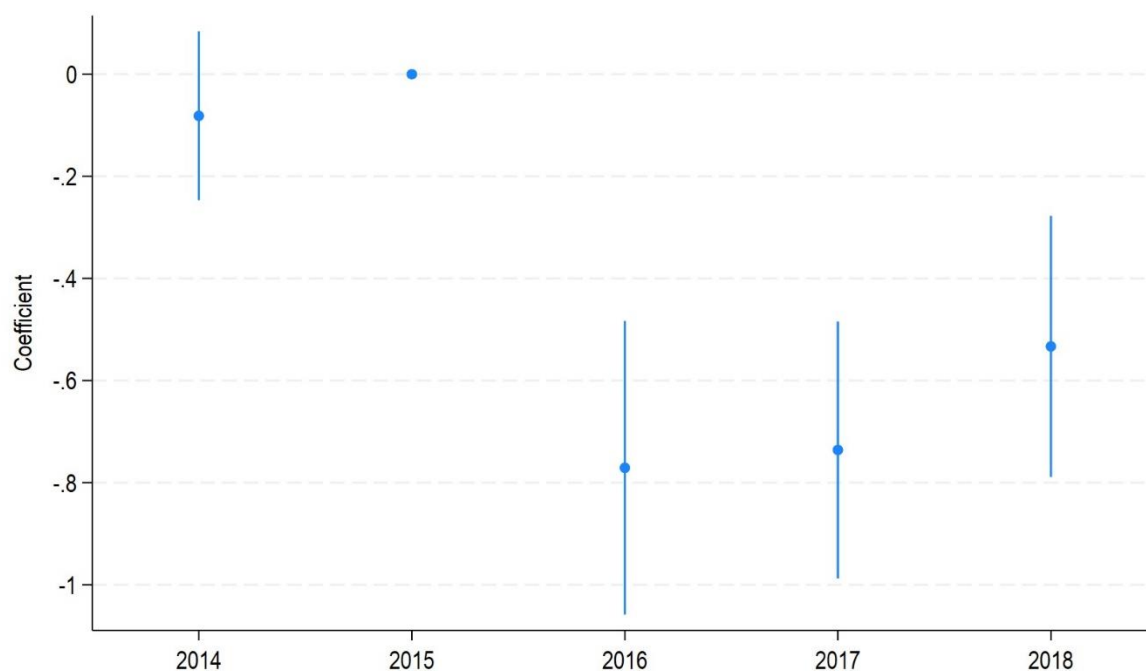


Figure A3.2 Event study – Large sample (all German bank borrowers abroad)



**Table A1**

**Variable definitions**

Variable Name	Definition
<b>Bank lending</b>	
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
<b>Internal capital market</b>	
Log. internal debt	Pre- to post-shock difference in the log. volume of internal debt from the whole MNC
Internal debt / total assets	Pre- to post-shock difference in the ratio of internal debt from the whole MNC over total assets
Log. internal debt other subs.	Pre- to post-shock difference in the log. volume of internal debt from other subsidiaries of the same parent company
Int. debt other subs. / assets	Pre- to post-shock difference in the ratio of internal debt from other subsidiaries of the same parent company over total assets
<b>Firm-specific variables</b>	
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 (i.e., FDI)
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
<b>Bank characteristics</b>	
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
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
<b>Bank UK-exposure variable</b>	
Bank exposure to UK <sub>pre</sub>	A bank's lending to UK firms over its total lending pre-Brexit referendum
<b>Firm Characteristics</b>	
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 – 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 <sup>2</sup>	0.9169	0.9184	0.9252	0.9288	0.9196	0.9228

**Table A3****Cross-border lending – robustness**

The table shows results of regressions of our main dependent variables *credit 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. 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. Panel C reports regressions of the main dependent variable, credit increases, in a panel with a pre-referendum period (2014:Q1 to 2016:Q2) and post-referendum period (2016:Q3 to 2018:Q4) on the indicator variable 'UK', which is set to one for firms located in the UK and zero otherwise, interacted with a post-Brexit dummy, which is set to one for the post-referendum period (2016:Q3 to 2018:Q4). The estimation is performed using the standard OLS estimator (Baseline), regression adjustment (RA), inverse probability weighting (IPW), and augmented inverse propensity weighting (AIPW), incorporating pre-Brexit firm characteristics (the logarithm of total assets, return on assets, leverage, log equity financing, and internal debt to total assets). 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 <sup>2</sup>	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 <sup>2</sup>	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 <sup>2</sup>	0.0085	0.0214	-0.0005	0.0223

**Table A3 – continued**

Panel C: Small sample – Conditioning on pre-referendum firm characteristics				
	Credit increases			
	(1)	(2)	(3)	(4)
UK*Post-Brexit	-0.3434* (-1.9541)	-0.3534** (-2.0737)	-0.3552** (-2.1136)	-0.3549** (-2.1114)
Estimator	Baseline	RA	IPW	AIPW
Bank-firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	3,480	3,480	3,480	3,480

**Table A4****Total liabilities and MNC characteristics**

The table shows results of instrumental variable regressions of the pre- to post-shock difference of the logarithm of total liabilities 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, and return on assets. 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 base effect of the respective interaction variable is 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:	Group SPE		log(Assets) <sub>Investor</sub>		log(Employees) <sub>Group</sub>		log(Assets) <sub>Group</sub>		log(# Affiliates) <sub>Group</sub>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credit Supply Shock <sub>credit increases</sub>	-0.0277 (-1.4551)		0.0077 (0.1152)		0.7314 (1.4923)		0.2420 (1.5784)		0.7959 (1.0255)		0.2963 (1.4737)	
Credit Supply Shock <sub>loan growth</sub>		-0.0172 (-0.2889)		0.0047 (0.0793)		0.8163** (2.5068)		0.4351** (1.9886)		0.7971* (1.8270)		0.1129 (0.8203)
Credit Supply Shock <sub>credit increases</sub> x Interaction Variable			-0.0588* (-1.9217)		-0.0181* (-1.9382)		-0.0088** (-2.0737)		-0.0171 (-1.4357)		-0.0290* (-1.9450)	
Credit Supply Shock <sub>loan growth</sub> x Interaction Variable				-0.1224** (-2.1961)		-0.0272*** (-2.8847)		-0.0348** (-2.5236)		-0.0296*** (-3.3173)		-0.0483*** (-3.2154)
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 FE	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	0.242	0.244	0.184	0.122	0.232	0.251	0.381	0.267	0.459	0.147	0.315	0.124

**Table A5****Bank and firm characteristics and cross-border lending**

The table shows results of regressions of the dependent variables *credit increases* and *loan growth* on the indicator variable *UK*, which is set to one for UK firms, and interactions of this variable with bank characteristics. The sample is split into low (columns (1) to (4)) and high (columns (5) to (8)) return on assets of firms using their median. 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. Further bank control variables are the logarithm of a bank's total assets and its return on assets, both also interacted with the indicator variable *UK*. 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 even columns include 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.

	Low RoA Firms				High RoA Firms			
	Credit increases		Loan growth		Credit increases		Loan growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>BANK CHARACTERISTICS</b>								
UK * Excess CET1 / RWA	-21.5643*	-20.4019**	-8.3452**	-8.2664*	-8.4790	-3.3470	-16.8645***	-18.5318***
	(-1.9819)	(-2.1854)	(-2.1457)	(-1.8992)	(-0.8877)	(-0.2307)	(-7.4189)	(-11.1113)
UK * NPL ratio	-14.9364***	-12.2799***	-15.8011***	-15.2956***	-47.5348***	-66.2591***	-33.5543***	-31.7029***
	(-3.5623)	(-3.4412)	(-6.1771)	(-5.6644)	(-2.8671)	(-3.6442)	(-10.7397)	(-12.6229)
Excess CET1 / RWA	1.1054	0.9573	-0.3407	-0.1986	2.4887	3.2936	0.9917**	1.0783**
	(0.3174)	(0.2902)	(-0.4331)	(-0.2845)	(0.9718)	(1.3475)	(2.0168)	(1.9849)
NPL ratio	0.2715	-0.7091	0.4711	0.3240	-1.2615	-1.0952	-0.1504	-0.2437
	(0.1271)	(-0.3627)	(0.9431)	(0.5288)	(-0.4864)	(-0.4818)	(-0.2412)	(-0.4277)
Bank UK-exposure variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Further bank control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>FIXED EFFECTS</b>								
MNC	Yes	No	Yes	No	Yes	No	Yes	No
Country x Industry	Yes	No	Yes	No	Yes	No	Yes	No
Firm	No	Yes	No	Yes	No	Yes	No	Yes
Observations	606	390	606	390	921	583	921	583
Adjusted R <sup>2</sup>	0.4008	0.4430	0.1827	0.0905	0.3822	0.4241	0.1277	0.1842



**Table A6****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, and Return on assets (RoA). 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 5 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. 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(Internal debt)		log(Internal debt from other subsidiaries)	
	(1)	(2)	(3)	(4)
Credit Supply Shock <sub>credit increases</sub>	-0.0225 (-0.3552)		-0.0269** (-2.2238)	
Credit Supply Shock <sub>loan growth</sub>		-0.0726 (-0.5435)		-0.0468 (-1.0760)
CONTROL VARIABLES				
Bank characteristics	Yes	Yes	Yes	Yes
INSTRUMENTS				
Bank UK-exposure variables	Yes	Yes	Yes	Yes
Bank characteristics x UK	Yes	Yes	Yes	Yes
Bank characteristics x UK x Bank UK-exposure variables	Yes	Yes	Yes	Yes
FIXED EFFECTS				
MNC	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes
Observations	1740	1,740	1,740	1,740
Overidentification test	0.462	0.508	0.411	0.461

**Table A7**

**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 in Panel A are used at the bank-firm level and in Panel B at the 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, and Return on assets (RoA). Bank characteristics are used with their average value of the last four quarters pre-Brexit referendum in Panel A, and additionally averaged over all bank lenders of a given firm in Panel B. In Panel A, 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, while Panel B shows regressions of the pre- to post-shock difference of the average number of *credit increases* on 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, in Panel A, 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. The base effect of the respective interaction variable is 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.

Panel A: Triple Interaction of excluded instruments

Panel A: Triple Interaction of Excluded Instruments												
Interaction Variable:			Group SPE		log(Assets) <sub>Investor</sub>		log(Employees) <sub>Group</sub>		log(Assets) <sub>Group</sub>		log(# Affiliates) <sub>Group</sub>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Credit Supply Shock <sub>credit increases</sub>	-0.0082 (-1.6509)		0.0168 (1.3669)		0.1660* (1.7980)		0.0269 (0.9982)		0.0863 (1.3400)		0.0228 (0.9912)	
Credit Supply Shock <sub>loan growth</sub>		0.0184 (0.9720)		0.0227 (1.2537)		0.2367** (2.3116)		0.1097* (1.9131)		0.2372* (1.9397)		0.0809** (2.4024)
Credit Supply Shock <sub>credit increases</sub> X Interaction Variable			-0.0460** (-2.4492)		-0.0125* (-1.9584)		-0.0043 (-1.4942)		-0.0064 (-1.5174)		-0.0094 (-1.4383)	
Credit Supply Shock <sub>loan growth</sub> X Interaction Variable				-0.0665* (-1.7511)		-0.0173** (-2.2196)		-0.0150* (-1.7432)		-0.0161* (-1.9564)		-0.0305** (-2.4795)
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
Bank characteristics x UK x Bank UK-exposure variables	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	0.468	0.331	0.827	0.551	0.723	0.322	0.536	0.521	0.494	0.467	0.600	0.462

**Table A7 continued**

Panel B: Data aggregated at the firm level					
	Internal debt / total assets				
	(1)	(2)	(3)	(4)	(5)
Credit Supply Shock	0.0295 (0.4995)	0.2928* (1.8448)	0.1887 (1.4348)	0.3371 (1.5257)	0.1691 (1.6223)
Credit Supply Shock x MNC with SPE	-0.0965 (-1.4565)				
Credit Supply Shock x log(Assets) <sub>parent</sub>		-0.0227** (-2.1246)			
Credit Supply Shock x log(Employees) <sub>MNC</sub>			-0.0237* (-1.7600)		
Credit Supply Shock x log(Assets) <sub>MNC</sub>				-0.0247* (-1.7105)	
Credit Supply Shock x log(# Affiliates) <sub>MNC</sub>					-0.0514** (-2.1082)
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					
MNC	Yes	Yes	Yes	Yes	Yes
Country x Industry	Yes	Yes	Yes	Yes	Yes
Observations	871	868	779	871	871
Overidentification test	0.223	0.308	0.172	0.440	0.295

**Table A8****Shift in banks' lending – robustness**

The table shows 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. 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.

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 <sub>pre</sub> *	0.0298***	0.0593**	0.0028**	0.0045
High Excess CET1 / RWA <sub>pre</sub>	(2.7688)	(2.3284)	(2.0556)	(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 <sup>2</sup>	0.0373	0.1909	0.0079	0.1114

**Table A9****Shift in banks' lending – extended analysis**

Panel A shows 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. Panel B 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 <sub>pre</sub>	-0.0114** (-2.1093)	-0.0151*** (-2.8490)	-0.0007 (-1.4356)	-0.0010** (-2.2869)
Bank exposure to UK <sub>pre</sub> *	0.0128***	0.0131***	0.0004	0.0005
German MNCs	(3.7131)	(3.7933)	(0.9953)	(1.0344)
Bank exposure to UK <sub>pre</sub> *		0.0299***		0.0028**
High Excess CET1 / RWA <sub>pre</sub>		(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 <sup>2</sup>	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 <sub>pre</sub> *	-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 <sub>pre</sub>					
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 <sup>2</sup>	0.0145	0.0158	0.0316	0.0376	0.0079