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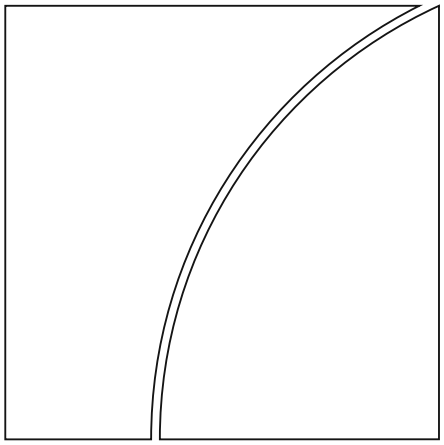

BIS Working Papers
No 857

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Monetary and Economic Department

April 2020

JEL classification: G21, G32, F32, F34.

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This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

International bank lending and corporate debt structure*

Jose-Maria Serena† and Serafeim Tsoukas‡

April 2020

Abstract

Using a cross-country sample of bank-dependent public firms we study the international spillovers of a change in banking regulation on corporate borrowing. For identification we examine how US firms' liabilities vis-à-vis banks, non-bank lenders and bond markets evolve after an increase in capital requirements implemented by the European Banking Authority (EBA) in 2011. We find that US firms experience a reduction in credit lines but not in term loans from EU banks. In addition, US firms are able to compensate for the reduction in credit lines from EU banks by securing liquidity facilities from US non-bank financial institutions, without increasing borrowing from corporate bond markets. These results suggest that diversified domestic loan markets, with both banks and non-bank financial institutions providing loans to corporations, can help overcome cuts in cross-border bank funding.

Key words: Credit lines; term loans; bank capital requirements; firm-level data; non-bank financial intermediaries.

JEL: G21, G32, F32, F34

*We are grateful for comments, suggestions, and discussions to Rolf Campos, Stijn Claessens, Tim Eisert, Laura Hospido, Enisse Kharroubi, Ulf Lewrick, Patrick McGuire, Dubravko Mihaljek, Steven Ongena, Iliana Reggio, Yasushi Shiina, Előd Takáts and Nikola Tarashev. The views expressed in this paper are those of their authors and not necessarily those of the BIS. E-mail addresses: jose.serena@bis.org, serafeim.tsoukas@glasgow.ac.uk.

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1 Introduction

One lesson learned from the Great Financial Crisis (GFC) is that international lending sharply contracts when banks need to deleverage, partly reflecting the tendency of banks to reduce exposures to firms headquartered outside their home jurisdictions (Giannetti and Laeven (2012)). Firms borrowing from such banks could face the dry-up of the credit lines commitments, which represent half of the international loans maturing every quarter (Figure 1).[1] They could also experience a contraction of bank term loans. Corporate bond markets could in principle make up for a reduction in term loans, but seem less well suited to compensate for the loss of cross-border credit lines if foreign-headquartered banks cut them. This raises the question of whether and how domestic credit markets could help firms weather a reduction in international bank lending.

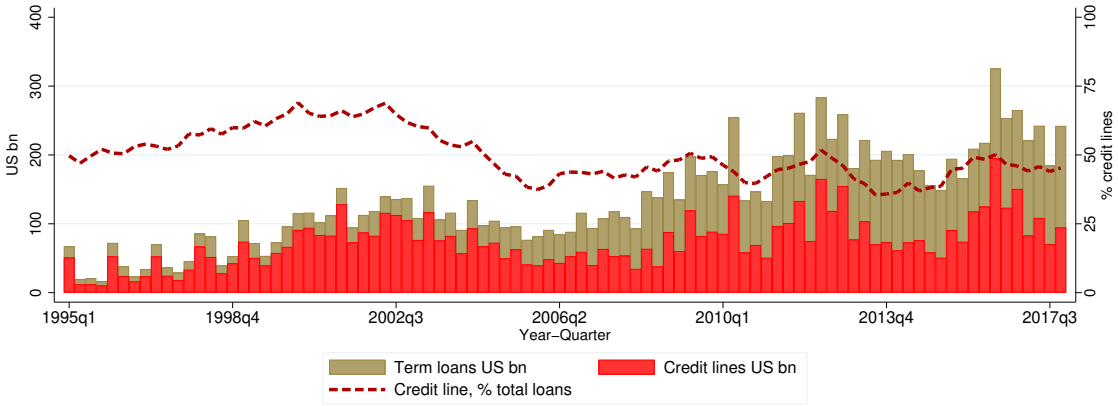

Figure 1: **International rollover risks, redemptions per instrument and quarter:** Volume of bank international term loans and credit line commitments expiring each quarter. International loans are those in which the ultimate parent of the borrower and the lender are incorporated in different countries. Banks are deposit-taking institutions. Credit lines include undrawn commitments. To estimate banks' share in a syndicated loan, we allocate the total amount among the lead arrangers only.

In this paper, we shed light on this question by investigating the impact of international banks' deleveraging on corporate borrowing, using a cross-country sample of

[1]Credit lines often finance working capital, or increase firms' financial flexibility. Market participants sometimes refer to them as revolving loans.

bank-dependent public firms. In doing so, we ask whether firms experience a reduction in bank credit when their foreign creditors need to deleverage. In addition, we investigate the channels of adjustments of bank credit, and whether the withdrawal of financing takes place primarily in credit lines or term loans, or both. Finally, we explore if the contraction in bank credit reduces total corporate borrowing, or whether firms are able to maintain their borrowing by issuing corporate bonds or securing loans from non-bank financial institutions.

Empirically identifying the effects of banks' deleveraging pressures on corporate borrowing is challenging for two reasons. First, one needs to isolate a supply shock to bank credit transmitted internationally, from contemporaneous changes in firms' demand for finance. Second, corporate bond markets in most countries are not large and liquid enough to compensate fully for shocks in cross-border corporate financing. To address this empirical challenge we use a novel dataset with rich cross-sectional information and exploit an exogenous contraction in international lending that affects only (a subset of) European Union (EU) banks. Specifically, EU banks' international deleveraging was triggered by the October 2011 EBA announcement, which increased the minimum Core Tier 1 ratio to 9% by the end of 2011 and to 10% by the end of 2012.[2] The increase, which we call, for the sake of brevity the EBA capital exercise, was sizable.[3] Requirements were set on a consolidated basis, so affected banks could opt to adjust their international exposures. These were large, as many banks had extended credit to firms headquartered outside the EU, including in the United States.

We carry out a difference-in-differences analysis to estimate how this regulatory change affected firms' debt liabilities. Our data span a pre-policy (2010Q2–2011Q2) and a post-policy period (2012Q3–2013Q3). On this basis, we identify the exogenous effect of

[2]Throughout the paper we mention that the requirement was imposed on EU banks although properly speaking it affected the banks of the European Economic Association (EEA), which includes the EU countries plus Iceland, Liechtenstein, and Norway.

[3]This explains its appeal as an opportunity for analysing domestic credit flows (Gropp et al. (2018)), or banks' decisions to grant collateralized rather than uncollateralized loans (Degryse et al. (2018)).

a reduction in international lending on corporate debt structure. We define two groups: treated firms with half of the European bank loans coming from EBA-affected banks, and the control group, comprising the rest of EBA-dependent firms. Therefore, not all firms are affected in the same way, and the identification comes from cross-sectional differences in firms' exposures to EBA-affected banks. Our identification assumption is that the EBA capital exercise did not affect treated firms' demand for finance, relative to the control group. Furthermore, we assume that US corporate bond market is deep and well developed, and could cushion the cut in international bank credit.

To conduct the analysis we construct a cross-country panel of bank-dependent firms, defined as those with at least one outstanding loan at the onset of the EBA capital exercise. We further narrow down the sample implementing two filters. First, we remove the firms that did not have an outstanding loan vis-à-vis European banks. This way we avoid assortative matching in our control group. Second, we select firms that are already disclosing financial information, as they comply with the reporting requirements imposed by securities regulation (listed firms, plus some private companies). Of the 2,830 firms in our sample, 1,117 are incorporated in the European Union (EU), 1,415 are incorporated in the United States, and 215 are incorporated in other advanced economies.[4] Hence, the final sample is very well suited to exploring a reduction in international bank credit, as triggered by the tightening of bank capital requirements in the EU.

We summarize our main results, which are robust to several tests, as follows. First, bank liabilities of EBA-dependent firms decrease relative to the control group. However, bank credit to EU firms remains resilient; only US firms experience a reduction in loans from EU banks. The resilience of bank credit to EU firms reflects the sample selection used in the paper, which focuses on large firms.[5] Next, we inspect the mechanism behind the

[4]More specifically, the requirement was imposed on EU banks proper as well as banks in Iceland, Liechtenstein and Norway.

[5]Besides reducing credit to US firms, EU banks also cut back credit to small and medium sized enterprizes (SMEs) in Europe (see for example, Acharya et al. (2018); Balduzzi et al. (2018); Bentolila et al. (2018);

contraction in bank credit, paying special attention to the evolution of credit lines and term loans of US firms. Our main finding is that bank credit lines of the treated firms decrease relative to the control group. This suggests that credit lines account for the bulk of the drop in international bank lending.

We also find that credit to US firms does not dry up, as the relative growth of total credit to treated and control firms remains more or less stable. This occurs despite the contraction in bank credit discussed above. We find that non-bank credit lines to EBA-dependent firms increase, relative to the control group. There is also a small but quantitatively less important increase in bond borrowing. Term loans provided by non-bank financial institutions do not grow. The main conclusion is, therefore, that non-bank financial intermediaries smooth the contraction in bank credit by providing credit lines.

Our study further documents that the US firms hit by the cut in EU bank lending and switching to non-bank loans experience a change in their capital structure: bank borrowing decreases, and credit from non-bank financial intermediaries rises. This finding potentially implies that the funding of corporates becomes financially more fragile, as banks generally have a more stable funding structure than do non-banks. Most non-bank financial institutions rely on wholesale funding and lack customer deposits, which may lead them to cut credit in the case of market-wide liquidity stress faster than is the case with banks do (Cornett et al. (2011)).

Our paper makes three contributions to the literature. First, we show that non-financial corporates experience a cut in bank lending when their foreign bank creditors need to deleverage. We obtain this result after controlling for changes in corporates' demand for finance, and hence provide further evidence in favour of a "financial home bias" in periods of bank deleveraging. This finding relates to research on how banks adjust their international

Dwenger et al. (2020) and Farinha et al. (2019)). The SMEs tend to carry the highest risk weights in banks' internal ratings-based approach used for lending purposes.

lending in response to financial stress (Cetorelli and Goldberg (2011), De Haas and Van Horen (2012); Popov and Udell (2012) and Giannetti and Laeven (2012)), as a result of prudential tightening (Buch et al. (2017)), or as part of the deleveraging process after the great financial crisis (McCauley et al. (2017)).

Second, we show that a significant share of the contraction in cross-border bank lending relates to credit lines. This result contributes to the literature on credit line dynamics in periods of financial stress, which has so far focused on the demand side, suggesting that firms' drawdowns of credit lines could exacerbated banks' liquidity needs (Ivashina and Scharfstein (2010), Cornett et al. (2011)), Campello et al. (2010) and Acharya et al. (2013)). We show that banks in such situations prefer to cut credit lines rather than term loans.

Third, we shed new light on the ability of non-bank financial institutions to cushion a reduction in bank lending. We show that if domestic markets are well developed, non-bank financial institutions can fully smooth the shock to short-term bank financing. Furthermore, and consistent with previous research, we find no significant increase in corporate bond financing in response to a contraction in cross-border bank lending (Fernández et al. (2018), and Goel and Zemel (2018)). Interestingly, we find this result in a sample of US firms, which have access to a well-developed and liquid corporate bond market.

The remainder of the paper is structured as follows. Section 2 describes the data and presents summary statistics. Section 3 discusses institutional aspects concerning corporate borrowing and develops testable hypotheses. Section 4 describes our methodology. Section 5 presents the main empirical results. Section 6 provides robustness checks, and Section 7 discusses the implications. Section 8 concludes.

2 Data

2.1 Data description

We construct a firm-level quarterly panel for the period 2009Q3 to 2014Q1 combining two data sources. We obtain firms' financial statements from Capital IQ, including balance sheets, cash flow statements, and income statements, key financial ratios, and reference data (sector, country of incorporation, etc). To enhance the capital structure that companies disclose in their financial statements, we retrieve 223,211 bonds and 229,608 syndicated loans by non-financial firms from Refinitiv SDC Platinum. In the syndicated loan data we include both term loans and (potentially undrawn) credit lines, and drop bridge loans. To classify loans as term loans or credit lines, we use the description of the tranche facility provided by Refinitiv. Term loans include also loans provided term financing for project finance, or capital expenditures. Credit lines are made up by all revolving line facilities, receivables, trade finance instruments (letters of credit), and liquidity lines. In some instances (around 1% of the observations), the tranche simultaneously provide term financing and a credit line, and we classify them as credit lines. We use the bond and syndicated loan data to generate firm-level credit stocks. Specifically, we produce three measures of outstanding debt: (1) bonds; (2) loans by banks; and (3) loans by non-bank financial intermediaries (for the sake of brevity referred to as non-banks).

We analyze borrowers (firms) and lenders (banks and non-banks) on a consolidated basis. On the lender side we consolidate all loans at the ultimate parent level, as banks can restore capital ratios by reducing lending to nonresidents, and also by curbing the lending activities of their affiliates.[6] For both reasons this consolidated approach provides a better measure of international financial integration than the unconsolidated one McCauley et al. (2017)). On the borrower side, consolidating all loans and bonds allows us to account that

[6]Bank subsidiaries are also subject to individual capital requirements.

firms may borrow through affiliates (Avdjiev et al. (2016)). Defined such way, international loans include credit granted by any affiliate of a bank to any affiliate of a firm as long as the parent companies are incorporated in different countries.[7]

Throughout the analysis we focus on the lead arranger, as they are in charge of monitoring borrowers and attracting investors (Sufi (2007)). When a loan has several lead arrangers, we treat each as a different lender. We classify lead arrangers as banks or non-banks according to their funding structure, following the post-crisis definition of the shadow banking system (Pozsar et al. (2012); FSB (2011a); FSB (2011b)). Consequently, banks are deposit-taking institutions and other lenders relying on stable funding (eg saving banks). non-banks include the rest of lenders, and the majority of them are investment banks (security-broker dealers).[8] To implement this classification, we use the NAICS and the TRBC system. Banks are those under NAICS code 5221, as well as other banks that are not investment banks in the TRBC.[9]

We identify the full list of creditors of each firm, defined as those with an outstanding loan to a firm. To assess if a loan is outstanding, we use the issuance and maturity date. This measure of firm-bank dependency is therefore bilateral and time-varying. Having the complete list of creditors of each firm in each quarter, we impose three filters to define a homogeneous sample of bank-dependent firms. First, we define a firm as bank-dependent if it has an outstanding loan vis-á-vis a lead arranger banks. Second, we keep companies that have at least one outstanding loan vis-á-vis lead bank headquartered in the EU. This

[7]This measure is relatively similar to the foreign loans in the BIS Consolidated Banking Statistics (CBS) on a guarantor basis, since we treat lenders and borrowers on a consolidated basis. Specifically, the two measures would be similar if parent companies guarantee the debt of their affiliates, and differ if they do not.

[8]The group of non-bank lenders includes financial institutions subject to bank-like capital requirements, which however do not take deposits. See Claessens et al. (2012) for a discussion.

[9]NAICS stands for the North American Industry Classification Scheme, which superseded the SIC in 1987. The NAICS maps the UN International Standard Industrial Classification of All Economic Activities (ISIC). TRBC stands for the Thomson Reuters Business Classification, which is a market-based system classifying firms into 10 economic sectors, 136 industries, and 837 activities. Appendix C provides further details on the sectoral classification of financial intermediaries.

controls for potential assortative matching between firms and banks. This may be particularly important for non-EU firms, as those not borrowing from EBA banks may be very different–perhaps having a more regional focus. Third, we select only listed companies, or those that are already disclosing financial information, as do not have to incur additional fixed costs to access the bond markets.

We merge the firm-level measures of credit stocks with the accounting data from Capital IQ using firms' ISINs and LEIs, which uniquely identify them in both. Following normal selection criteria used in the literature, we control for the potential influence of outliers by excluding observations in the 1% upper and lower tails of the distribution of the regression variables. Our final sample includes 2,830 firms, of which 1,177 are based in the EEA, 1,415 are based in the United States, and 215 are based in other developed economies.

2.2 Sample analysis

In Table 1 we report descriptive statistics for the whole sample (panel A), for firms dependent on banks with exposure to the capital exercise as of 2011Q3 (panel B) and for the rest of bank dependent firms.[10] The average firm in our sample has a leverage ratio of 30.3% with a median of 28.2%. In addition, the firms in our sample are well collateralized, with mean of tangible assets being 34.6% and the median equals 28.2%. At the foot of the table we report p-values for the tests of equality of medians of the two groups presented in panels B and C. We observe that with the exception of assets treated and control firms are similar across a number of financial indicators. These statistics help us inspect residual differences between the two groups.

[10]In Appendix A we define all variables and provide the relevant data sources.

Table 1: **Summary statistics** The table reports summary statistics. Panel A reports summary statistics for the whole sample. Panel B reports statistics for firms that dependent on EBA affected banks. Panel C shows statistics for firms that are dependent on nonEBA affected banks. At the foot of the table we report p-values for the tests of the median of the variables reported in panels B and C.

Panel A: Full sample

	Assets	Tangible assets	Leverage	Current ratio	EBITDA y-o-y growth	Altman score
mean	13 299	34.6	30.3	2.7	90.5	1.6
p25	1 130	12.3	17.5	1.0	-14.9	0.9
p50	3 060	28.2	28.3	1.4	9.8	1.5
p75	9 574	54.9	40.3	2.0	41.0	2.2

Panel B: Treated: EBA dependent

	Assets	Tangible assets	Leverage	Current ratio	EBITDA y-o-y growth	Altman score
mean	14 526	34.9	29.3	3.0	97.1	1.6
p25	1 138	11.8	16.8	1.0	-14.4	0.9
p50	3 222	27.6	27.2	1.4	9.8	1.5
p75	10 430	56.3	39.6	2.0	41.2	2.2

Panel C: Control group

	Assets	Tangible assets	Leverage	Current ratio	EBITDA y-o-y growth	Altman score
mean	10 209	33.9	32.7	1.8	74.3	1.6
p25	1 080	13.3	19.6	1.1	-15.8	1.0
p50	2 816	29.4	30.9	1.5	10.1	1.5
p75	8 059	50.9	41.7	2.1	41.0	2.3
p-value	0.05	0.15	1	0.14	0.33	0.48

3 Institutional background and hypotheses

3.1 Firms' financial choices

Understanding some institutional aspects of corporate borrowing is important to explore the role domestic credit markets may play when international bank lending contracts. Large firms raise debt from three major sources: bank loans, non-bank loans, and bond markets. Figure 2 shows the fraction of total borrowing secured by firms from each of these three sources, using a pro-rata split of loans across lead arrangers and confirms the importance of firms' financial mix. It also shows that the relative relevance of the funding choices fluctuates over time, which may reflect demand or supply factors.

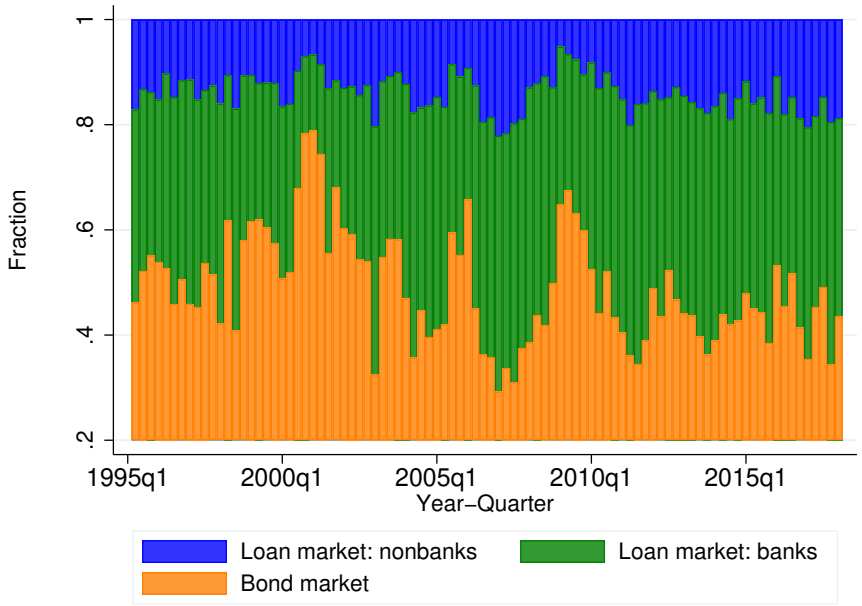

Figure 2: **Sources of corporate funding:** Total amount raised by large corporates in the period 1995-2018, broken down between bonds and syndicated loans (term loans and credit lines, including undrawn). Syndicated loans are further broken down between bank and non-bank loans.

There are several models that study the co-existence of loan and bond financing (see for example Bensanko and Kanatas (1993) or Diamond (1991)), although for two reasons

bond issuance may not attenuate an adverse shock to bank credit. The first one, which is well known, is that loan markets better satisfy the funding needs of companies that are smaller, more opaque, or riskier (Faulkender and Petersen (2006), Blackwell and Kidwell (1988), Diamond (1991), Chemmanur and Fulghieri (1994), Cantillo and Wright (2000)). This reflects, respectively, that loans entail lower flotation costs than bonds (eg no need of registering a security), loan markets better address informational asymmetries between borrowers and lenders, and better handle the liquidation and renegotiation process in case of distress. Bond markets are appealing for large and public firms, as they allow raising large amounts of funds.[11] Consequently, switching from loans to to bonds when bank credit is interrupted is difficult for many companies, including large and public ones (Goel and Zemel (2018)), especially if the lack previous market experience (Hale and Santos (2008)).

The second reason, often neglected, is that a significant fraction of bank loans are not term financing, but credit line commitments, also known as revolving loans. Firms typically secure credit lines to finance working capital, and exploit potential business opportunities as they arise (Lins et al. (2010)). They do not imply an effective disbursement. The provision of credit lines is, indeed, one of the traditional functions of banks, as they have an advantage in smoothing liquidity demands, coming from both the asset side - credit lines - and the liability side - sight deposits (Kashyap et al. (2002)).[12] Bond markets, on the other hand, provide term financing, and therefore are not a good alternative to credit lines.

Taken together, these aspects suggest that bond markets may not be able to fully smooth a cut in bank credit when it dries up. In this scenario, credit lines granted by some non-banks may be a viable alternative. Figure 3 shows the fraction of loans granted to non-US corporates (Panel A) and US corporates (Panel B), split by type of instrument and lender into four categories: bank term loans, bank credit lines, non-bank term loans,

[11] An additional appealing characteristic of the bond market is that they give more financial flexibility to make investment decisions, which implies that creditors do not actively monitor the way the company is using the proceeds during the length of the debt contract Rajan (1992)).

[12] Appendix B provides stylized facts on credit lines in the syndicated loan market.

and non-bank credit lines. We observe that for US corporate borrowing, non-banks provide around 20% of the total number of credit lines. Thus, they may be in a good position to attenuate a bank funding shock.

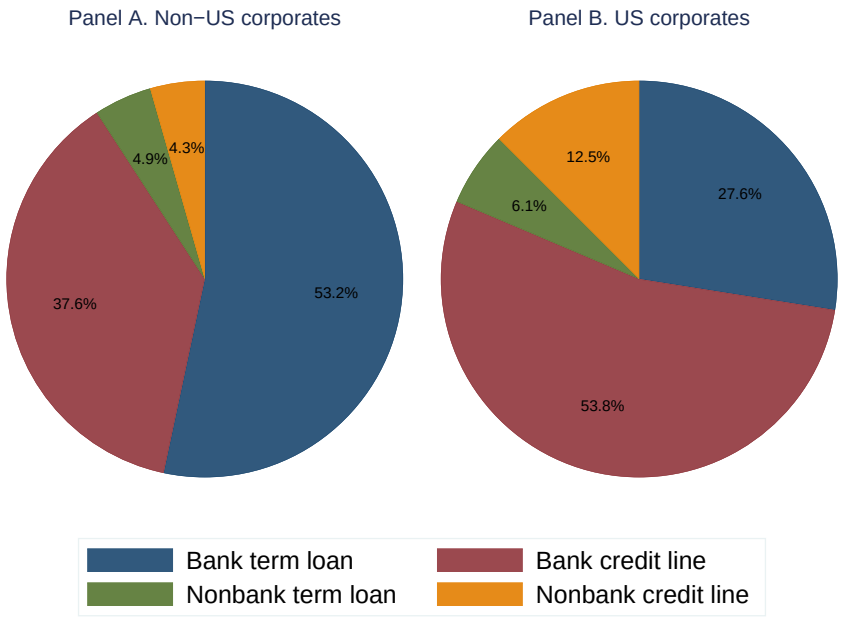

Figure 3: **Term loans and credit line commitments, by type of lender:** Fraction of term loans and credit lines originated by (lead arranger) banks and non-banks. Panel A shows loans to non-US corporates, and Panel B to US corporates.

3.2 Hypotheses

A large and growing body of literature argues that banking shocks are transmitted internationally and affect the supply of bank loans abroad during banking crises. Giannetti and Laeven (2012) show that when banking crises adversely affect banks in their home markets, they rebalance their portfolios in favor of domestic borrowers by decreasing the proportion of foreign loans. There is also evidence that banks sharply reduce lending to overseas customers (Peek and Rosengren (1997); Cetorelli and Goldberg (2011); De Haas and Van Horen (2012); Popov and Udell (2012)), and shift away from foreign borrowers that are geographically and in other ways more distant (De Haas and Van Horen (2013)). This expectation is enhanced

by some features of the EBA capital exercise, which we use to identify the shock to the supply of international bank credit. Specifically, the initiative aimed at ensuring that bank adjustments do not contract the flow of lending to the EU's real economy" (EBA (2011)). Motivated by these considerations, we hypothesize that the EBA capital exercise affects firms incorporated outside the EU more heavily than their EU counterparts.[13]

Our second testable hypothesis is about the channels through which banks' deleveraging occurs. We investigate whether banks cut credit lines, term loans, or both. Two aspects may condition their choice, and pull the final outcome in different directions. For one, term loans imply an effective disbursement, whereas credit lines constitute contingent liquidity. If banks are liquidity constrained, they may prefer to reduce term loans fist. However, banks can sell term loans in the secondary market, while credit lines are highly illiquid, and are rarely sold after origination (Bord and Santos (2012)). Therefore, whether banks prefer to cut term loans or credit lines remains an empirical issue.

Finally, our expectation is that certain non-bank financial intermediaries can provide credit lines if banks cut them. Specifically, investment banks borrow on wholesale funding markets, so are exposed to liquidity risks on the liability side. This reliance on short-term funding makes them similar to deposit-taking institutions, and enables them to provide credit lines (Kashyap et al. (2002)). In contrast, bond markets are unlikely to smooth a cut in bank credit if it concentrates in credit lines, as they provide term financing and not contingent liquidity.[14]

[13]This hypothesis is further supported by the EBA who specifically aims at ensuring "that such plans do not lead to a reduced flow of lending to the EU's real economy" (EBA (2011))

[14]Bonds may be an alternative when banks cut term lending, but even in this case switching to bonds may not be easy. Previous research shows that only a subset of high-quality firms manage to issue more bonds after banking crises (Goel and Zemel (2018)). Similarly, Fernández et al. (2018) find that non-bank credit only partially substitutes for bank loans in bank-dependent firms after the onset of the global financial crisis with some variation across different countries.

4 Empirical strategy

4.1 Identification issues

To test the hypotheses stipulated above we need to address two issues. First, the supply shock to bank credit must be uncorrelated to firms' demand for finance. Second, we should rule out the possibility that the response of firms to the shock is independent of the degree of bond market development.

Tackling the first issue is challenging since the majority of the shocks to bank credit transmitted internationally are large enough to impair the overall demand for credit, and can also affect the relative demand for specific sources of credit. For example, the cut in international lending triggered by the GFC contracted economic activity and depressed the demand for finance. Further, bank funding costs rose, so corporates' demand for bank credit decreased relative to market-based finance.

To address the concern we exploit a policy shift that only affected (a subset of) EU banks, which had outstanding loans vis-á-vis some US firms. Specifically, we analyze the decision announced by the EBA in October 2011, requiring a number of banks to raise their Core Tier 1 capital ratio to 9 percent by June 2012. This exercise (the EBA capital exercise) was implemented in the backdrop of adverse developments in European capital markets following the sovereign debt crisis. Its main objective was to restore confidence in the EU banking sector by ensuring that banks were adequately capitalized to mitigate unexpected losses. The EBA capital exercise was unexpected, as was announced soon after the stress tests conducted in July 2011 (Mésonnier and Monks (2015); Gropp et al. (2018) and Degryse et al. (2018)). The appealing characteristic of this shock is that there are cross-sectional differences in the degree of firms' exposure to EBA-affected banks. That is, some bank-dependent firms had not borrowed from EBA banks. Consequently we can test if firms

that depend on banks subject to the EBA requirements (treatment group) experienced a change in their liabilities *relative* to those exposed to other European banks that do not participate in the capital exercise (control group). We assume that the EBA capital exercise did not impair the demand for finance of the treated (EBA dependent firms), relative to the control group.

Figure 4 shows the time line of our differences-in-differences analysis, based on the timing of the EBA capital exercise. We date the EBA announcement in 2011Q3, since we use quarterly data and the decision was taken in October 2011. We define a pre-EBA capital exercise period comprising the four quarters before the announcement that is 2010Q2-2011Q2. The exercise ended in 2012Q2. Hence we define a post-EBA capital exercise period comprising the four quarters after its end, that is 2012Q2-2013Q2.

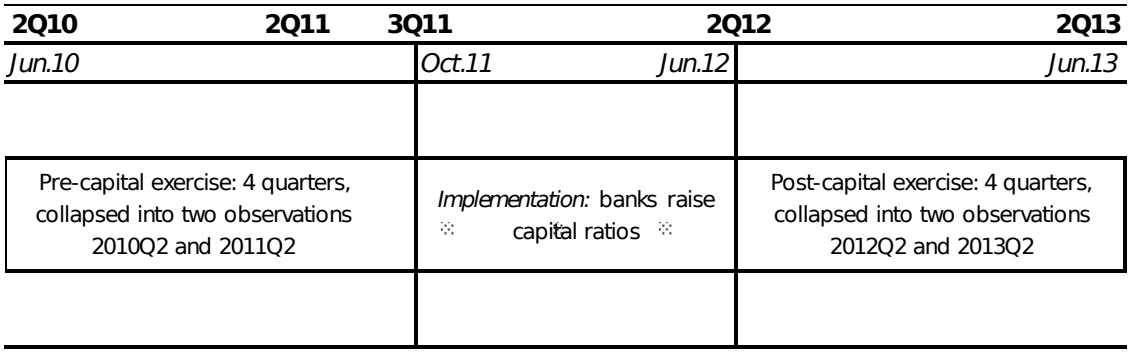

Figure 4: **Time line EBA capital exercise:** This figure shows the time line of the EBA capital exercise. The EBA announced in October 2011 that some EU banks should raise their capital ratios by June 2012. We define the pre capital exercise period as the four quarters before the announcement. Since we use quarterly data, we date it in 2011Q3. The post capital exercise period comprise the four quarters after June 2012, that is, 2012Q2-2013Q2.

As for the second requirement, we recognize that corporate bond markets in the majority of the jurisdictions are characterized by small size and liquidity (CGFS (2019), BIS (2016), Bhatia et al. (2019)). Hence, the lack of substitution towards bonds may just signal that markets lack depth, and not that corporate bond markets cannot smooth cuts in international bank credit. To identify the role of corporate bond markets we focus the analyses on US firms, as US corporate bond markets are deep and liquid. Finally, to mitigate

endogeneity concerns further, we include all firm variables at their levels before the bank EBA capital exercise.

4.2 Baseline model

Our empirical model examines how firms' liabilities change around the EBA capital exercise. We estimate our regressions using a difference-in-difference method to identify how bank capital requirements affect lending composition. For identification, we use the exogenous increase in capital requirements by the EBA in 2011Q3, and we test whether firms that depend on banks subject to the EBA requirements experience a change in lending composition relative to those exposed to other European banks that do not participate in the capital exercise. Formally, we estimate the following equation:

$$F_{ijt}^{X} = \alpha_i + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 Treated_i * Post_t + \beta_4 Controls_{it} + \varepsilon_{ijt} \tag{4.1}$$

where F_{it}^{X} denotes the stock of liabilities of type X for firm i in country j at quarter t. α_i is a vector capturing firm-specific intercepts and ε_{ijt} is the disturbance term. In line with Gropp et al. (2018), we measure a firm's i dependence on credit supply from EBA affected banks prior to the capital exercise using the share of outstanding loans vis-à-vis EBA banks:

$$Share_i^{EBA} = \frac{\sum_{q=2010Q2}^{2011Q2} F_{i,q}^{B-EBA}}{\sum_{q=2010Q2}^{2011Q2} F_{i,q}^{B-EU}} \tag{4.2}$$

where $Share_i^{EBA}$ is a firm-specific and time-invariant metric, that takes higher values for firms heavily dependent on EBA affected banks. We use it to define the covariate

$Treated_i$, which is a binary variable that equals 1 if half of the firm's $Share_i^{EBA}$ is above 50%, and 0 otherwise. By using this approach, we seek to include in the treatment group firms with high dependence on EBA affected banks. The control group is made up by the firms with below-average dependence on credit supply from EBA affected banks, which also depend on EU banks.[15]

$Post_t$ equals 1 for observations in the post-capital exercise period, and 0 in the pre-capital exercise. We collapse the sample into two periods, each with with the first and last quarter. Hecce the pre-capital exercise period includes 2010Q2 and 2011Q2; the post-capital exercise period, 2012Q3 and 2013Q3.

The coefficient of interest is β_3, which measures the difference in lending X between treated and control firms in the post-EBA period. Put differently, the point estimate measures how the EBA exercise affects borrowing by firms dependent on EBA-affected banks, relative to firms borrowing from banks that are not subject to the capital exercise. To deal with serial correlation we cluster standard errors at the firm level, and define a short panel with only two periods before (after) the EBA capital exercise (Bertrand et al. (2004)). Furthermore, we include the firm-fixed effects, which effectively remove time-invariant unobserved heterogeneity impacting on the demand for finance (including the sector of incorporation), between treated and control firms. The country and industry-specific differences are absorbed by the more granular firm-fixed effects.

To ease interpretation of the results, we standardize the dependent variable with its average value in 2010Q2. Consequently, the coefficient β_3 measures the percentage change experienced by the stock of liabilities of type X of treated firms, relative to the control group, after the EBA capital exercise. The effect of the EBA capital exercise β_3 is well identified if two assumptions hold. The first one is that the measures of firms' liabilities

[15]In this benchmark measure, the denominator does not include credit from non-EU banks. In robustness tests we show that the results are robust to alternative definitions, although by construction lowers the dependency on EBA banks.

we use as dependent variable (eg, bank credit) exhibit a common trend across treated and control firms. While this cannot be tested, the patterns observed pre EBA capital exercise are reassuring: in all instances, the evolution is similar for treated and control firms, as we graphically depict below in the results section. Furthermore, economic reasoning suggests that the assumption is sensible, as firms typically satisfy their financing needs by increasing borrowing at the extensive margin. Rapid changes from loan to bond markets are unlikely, as these decisions reflect companies' life-cycle (Berger and Udell (1998)). Furthermore, firms have limited incentives to stop borrowing from a lender, as longer lending relationships lower their funding costs (Berger and Udell (1995), Elyasiani and Goldberg (2004)).

Last, we include additional controls that influence firms' choices of external financing. Firm size (total assets), and ratio of tangible to total assets. These are the two dimensions in which treated and control firms differ, according to the summary statistics shown in Table 1. Size accounts for the fact that larger firms typically have better access to external financing as they are less likely to be financially constrained (Mizen and Tsoukas (2014); Almeida et al. (2017); Bose et al. (2019)). In addition, we include the tangible assets to total assets ratio, which proxies for firms' ability to pledge collateral for external financing.

4.3 International impact of bank deleveraging

To examine whether the EBA exercise affects firms incorporated outside the EU more heavily than their EU counterparts, we estimate regressions spliting our firms into those incorporated in the EU, those incorporated outside the EU, and those incorporated in the United States.

$$F^B_{ijt} = \alpha_i + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 Treated_i * Post_t + \beta_4 Controls_{it} + \varepsilon_{ijt} \qquad (4.3)$$

where the dependent variable is the stock of bank liabilities, so that F_{it}^{X} equals F_{it}^{B}. $Post_t$ captures the general increase/decrease in bank credit around the EBA capital exercise. $Treated_i$ accounts for time invariant differences in bank credit between treated and control firms.[16] Our interest lies in the interaction between $Treated{*}Post$, which shows the relative evolution of bank credit between treated and control firms around the EBA capital exercise. Obtaining a negative coefficient β_3 in the subsample of US firms would support the hypothesis that bank credit contracts when their foreign bank creditors need to deleverage.

It is important to remember that our identification comes from the comparison of stocks of firm liabilities, and not stocks of bank claims. Consequently, our only assumption is that the relative demand for bank credit of firms exposed to EBA-affected banks, and the control group, did not change around the EBA capital exercise. Under this assumption, any change in the growth of bank credit reflects the impact of the EBA capital exercise.

4.4 Channels of adjustment

To quantify the extent to which banks delevarage via different channels, we focus exclusively on US firms, adapting equation 4.1 and remove the subscript country j accordingly:

$$F_{it}^{X} = \alpha_i + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 Treated_i * Post_t + \beta_4 Controls_{it} + \varepsilon_{it} \tag{4.4}$$

where the dependent variable is in turn the stock of bank term loans (F_{it}^{B-T}) and credit lines F_{it}^{B-CL}. A negative coefficient β_3 for $Treated{*}Post$ in the regressions signals that a particular type of bank claim contracts. For example, if we find that β_3 is negative when using bank credit lines as the dependent variable, this indicates that banks cut credit lines

[16] This variable is absorbed by the firm fixed effects.

overseas when they need to deleverage. Once again, we analyze stocks of firm liabilities, and not changes in banks' claims. Consequently the identification assumption is that the treated firms do not alter their demand for bank term loans (or credit lines), relative to control group, around the EBA capital exercise.

4.5 Credit substitution

To identify a potential switch across financing choices, we estimate equation 4.3 using as dependent variables four stocks of credit, F_{it}^{X}: non-bank credit, F_{it}^{NB}; bonds, F_{it}^{Bonds}; non-bank term loans, F_{it}^{NB-T}; and non-bank credit lines, F_{it}^{NB-CL}.

A positive coefficient for β_3 in $Treated{*}Post$ in the relevant regression signals that this type of financial claim expands. Here the identification assumption is that the demand for the type of financial claim (eg bonds) of the treated does not change around the EBA capital exercise, relative to the control group. Under this assumption, any change in the use of the specific instrument reflects the impact of the EBA capital exercise.

5 Results

5.1 International impact of bank deleveraging

Our first question relates to whether corporates suffer a cut in bank credit when their foreign creditors struggle to deleverage. Figure 5 provides a visual inspection of the evolution of bank credit by EU (Panel A) and US firms (Panel B) around the EBA capital exercise.[17] The blue line represents the stock of bank credit of of firms highly dependent on EBA banks (treated

[17]Specifically, it plots its evolution four quarters before its beginning, in 2011Q2, and after its end in 2012Q2.

group), while the red line represents the rest of the firms (control group). The stock of bank credit is indexed at 100 in 2011Q2, and the two dashed vertical lines in each panel mark 2011Q2 and 2012Q2, the quarters immediately before and after the capital exercise. Three patterns emerge. First, treated and control firms exhibit a common trend before the capital exercise, as bank credit experiences a general increase. Second, EU treated and control firms also exhibit a common trend post capital exercise, as bank borrowing decrease for both groups, probably reflecting the lower demand for credit. Consistent with our hypothesis, bank borrowing by US firms changes after the EBA capital exercise: it shrinks for firms dependent on EBA banks, and keeps on increasing for the rest.

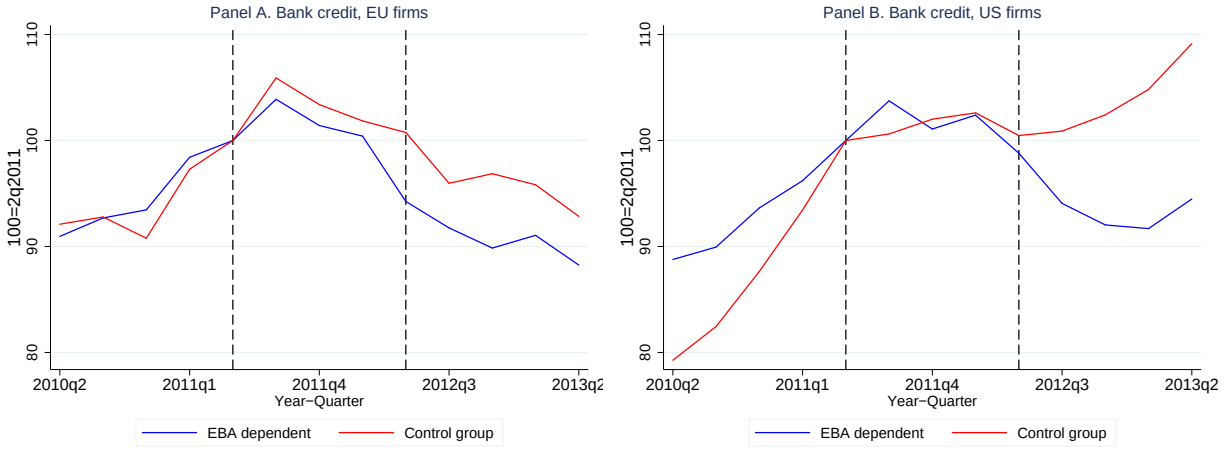

Figure 5: **Bank credit to EU and US firms:** This figure shows the stock of bank liabilities of firms dependent on EBA banks (more than half of the European bank loans vis-á-vis them, blue line) and the control group (red line), four quarters before (2011Q2) and after (2012Q2) the EBA capital exercise. The left hand-side panel shows the time evolution for firms headquartered in the EU, whereas the bottom panel shows the evolution for US firms. The two dashed vertical lines in each panel mark 2011Q2 and 2012Q2, the quarters immediately before and after the capital exercise.

To formally explore the above-mentioned question, we begin by estimating models of credit supply for firms with different exposure to EBA affected banks. Table 2 shows the results from the estimation of equation 4.1. We report coefficient estimates and t-statistics with standard errors clustered at the firm-level. Our key variable of interest is the interaction between the firm-level $Treated$ dummy and the time dummy $Post$ ($Treated$*$Post$).

Controlling for firm characteristics, industry differences, and country differences, we find a negative but significant coefficient for the whole sample in column 1. This finding, however, masks the heterogeneity across different firms' location. When we split our sample to EU and US firms, the results underscore significant differences. Specifically, bank credit to EU firms remains resilient (column 2), while bank credit to US firms experiences a drop (column 3).

Table 2: **International impact of bank deleveraging** All specifications are estimated using the difference-in-differences estimator. Treated equals 1 if half the firm's bank loans are from banks subject to EBA requirements, and 0 otherwise. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The specifications further include country and sector fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

	(1) ALL	(2) EU	(3) US
Total assets (log)	0.19	−0.58	0.25
	(0.27)	(−0.71)	(0.51)
Tangible assets	0.05	−0.03	0.05
	(0.51)	(−0.33)	(0.58)
Post	0.14**	−0.03	0.19***
	(2.40)	(−0.38)	(2.79)
Post*Treated	−0.08	−0.05	−0.18**
	(−1.24)	(−0.45)	(−2.42)
Observations	6583	2549	3359
Number of clusters	1773	686	907
R-squared	0.860	0.889	0.896

The negative effect on bank credit to US firms is not only statistically significant, but also economically important. Specifically, the policy change leads to a 18% reduction in bank borrowing for US firms dependent on EBA-affected banks, relative to the control group. To give a sense of its importance, this totally offsets the growth in bank borrowing experienced by US firms after the EBA capital exercise, which is given by the coefficient of *Post*.

This finding supports earlier research showing that the deleveraging of the financial sector through the reinforcement of the banks' capital positions is likely to reduce bank lending (Brun et al. (2017); Jiménez et al. (2017) and Gropp et al. (2018)). In addition, given that we reply on a sample made up by large corporates, our results highlight the banks cut credit to US firms, and shield domestic corporates (Peek and Rosengren (1997); Cetorelli and Goldberg (2011); De Haas and Van Horen (2012); Popov and Udell (2012)). However, we base our analysis on a much broader sample compared to previous studies, and we rely on a novel policy shift. Therefore, consistent with our expectations and findings from prior studies, negative policy shocks adversely affect banks' supply of credit.

5.2 Channels of adjustment

In this section, we formally explore the impact of the EBA capital exercise on credit lines and term loans. In other words, our aim is to understand whether the contraction of bank credit to US firms occurs through the cut of credit lines or term loans. We begin by providing graphical evidence on the evolution of different types of finance. In Figure 6 we visually inspect the evolution of the stock of bank term loans (panel A) and bank credit lines (panel B). The Figure supports the common pre-trend assumption of bank credit lines and term loans, as the dynamics of treated and control firms are similar before the EBA capital exercise, exhibiting a gradual increase. After the EBA capital exercise, the stock of bank credit lines of treated firm decrease, while control firms experience an increase. In contrast, post-EBA capital exercise dynamics of bank term loans are more similar for treated and control firms, although the growth of term loans of treated firms seems smoother. All together, we interpret banks' deleveraging after the EBA capital exercise seem to concentrate on credit lines, and less so on term loans.

In our formal analysis, we estimate equation 4.3 and report the results in Table

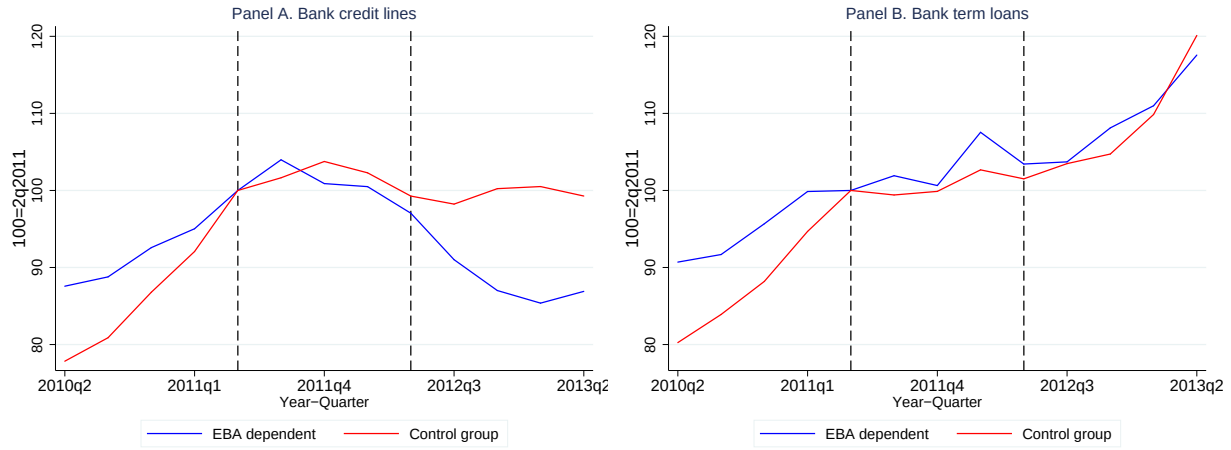

Figure 6: **Bank credit lines and term loans, US firms:** This figure shows the stock of bank credit lines (panel A) and term loans (B) of firms dependent on EBA banks (more than half of the European bank loans vis-á-vis them, blue line) and the control group (red line), four quarters before (2011Q2) and after (2012Q2) the EBA capital exercise. The two dashed vertical lines in each panel mark 2011Q2 and 2012Q2, the quarters immediately before and after the capital exercise.

3. For reference, column 1 shows the results when we consider all types of loans (already reported in column 3 of Table 2), while columns 2 and 3 report bank term loans and credit lines, respectively. When we use bank term loans as dependent variable (column 2), the interaction term is not statistically significant, which suggests that the evolution of bank term loans of EBA-dependent firms (the treated) and the control group do not differ. In contrast, treated firms experience a contraction in bank credit lines, as the coefficient of the interaction term is negative and statistically significant (column 3). The effect is economically important: after the EBA capital exercise, treated firms witness a reduction of 18% in credit lines, relative to the control group.

In summary, our results so far suggest that firms associated with banks that were exposed to the EBA capital exercise experience a decline in credit lines. This new result complements earlier work and highlights the role of international lending shocks in way that firms alter their financing mix.

Table 3: **Channels of adjustment. Term loans and credit lines** All specifications are estimated using the difference-in-differences estimator. EBAshare is the share of loans from both EBA- and nonEBA-affected banks prior to the capital exercise over the total borrowing in the same time period. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

	(1) Bank-Loans	(2) Bank-Term	(3) Bank-Lines
Total assets (log)	0.25	−0.24	0.57
	(0.51)	(−0.47)	(0.66)
Tangible assets	0.05	−0.05	0.12
	(0.58)	(−0.61)	(0.99)
Post	0.19***	0.33***	0.10
	(2.79)	(2.72)	(1.49)
Post*Treated	−0.18**	−0.20	−0.18**
	(−2.42)	(−1.51)	(−1.98)
Observations	3359	3359	3359
Number of clusters	907	907	907
R-squared	0.896	0.908	0.848

5.3 Non-bank credit: bonds and non-bank loans

We now consider whether bond markets or non-bank lenders can smooth the reduction in credit for US firms. Figure 6 plots the evolution of total credit (panel A), which is the sum of bank and non-bank credit; and the three components of non-bank credit: bonds (panel B), non-bank term loans (panel C), and non-bank credit lines (panel D). The blue and red lines stand for the stock of credit of the treated and control group, respectively. The Figure supports the common pre-trend assumption, as in the four panels both lines increase, signalling that treated and control firms experience a similar growth in total credit, and in the three components of non-bank credit. Post-EBA capital exercise, the pattern of total credit is also very similar for treated and control firms. We do not observe notable changes in bond borrowing (panel B), although treated firms seem to slightly increase it relative to

control firms. We do not see any differences in borrowing from non-bank term loans (panel C). In the three cases, the red and the blue lines increase to a similar extent, which signals that the post-EBA capital exercise evolution is similar for treated and control firms.[18] We show non-bank credit lines in panel D, which exhibit a different pattern: post-EBA capital exercise, treated firms significantly increase their reliance on non-bank credit lines, as the blue line increases, while the red line (representing control firms), remains relatively flat.

We estimate equation 4.3 for total credit, and the three components of non-bank credit. Table 4 presents the estimates of various types of non-bank credit. In the first column, we report point estimates using total credit as a dependent variable, while in the subsequent columns, we rely on bond, non-bank term loans and non-bank credit lines. Firms heavily dependent on EBA-affected banks do not seem to face a reduction in total credit as can be seen from the insignificant coefficient for the interaction term $Treated{*}Post$ in column 1. This finding underscores that treated firms must be increasing their non-bank borrowing, as the have experienced a cut in bank credit lines (highlighted in column 3 of Table 3).

Moving to column 2, we find that treated firms marginally increase their bond borrowing. This is evident from the coefficient of the interaction term, which is positive and statistically significant (an increase of 11%, relative to control firms).[19] There is no notable difference in non-bank term loans borrowing, as the coefficient in column 3 is statistically insignificant. The main change occurs in treated firms' reliance on non-bank credit lines, shown in column 4. The interaction term is negative and highly significant. Furthermore, the economic impact is large, as the increase in non-bank credit line borrowing relative to control firms is 64%. The main conclusion is that, after experiencing a cut in bank credit, firms increase their reliance on non-bank credit lines.

Finally, we explore if the substitution is broad, or restricted to firms with previous

[18]There are some differences, however, in the reliance that treated and control firms have on non-bank term loans, which is higher for control firms.

[19]This result is however feeble, as it does not hold in the robustness checks conducted in Section 6

Table 4: **Non-bank credit** All specifications are estimated using the difference-in-differences estimator. Treated equals 1 if half the firm's bank loans are from banks subject to EBA requirements, and 0 otherwise. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

	(1) Credit	(2) Bond	(3) NonBank-Term	(4) NonBank-Lines
Total assets (log)	0.77***	2.42**	−0.76	3.01
	(3.10)	(2.06)	(−1.00)	(1.56)
Tangible assets	0.08	−0.01	0.21	0.10
	(1.09)	(−0.14)	(0.83)	(0.45)
Post	0.18***	0.04	0.46*	0.05
	(3.36)	(1.01)	(1.72)	(0.48)
Post*Treated	−0.02	0.08**	−0.26	0.64***
	(−0.31)	(2.49)	(−0.93)	(3.57)
Observations	3359	3359	3359	3359
Number of clusters	907	907	907	907
R-squared	0.951	0.977	0.902	0.833

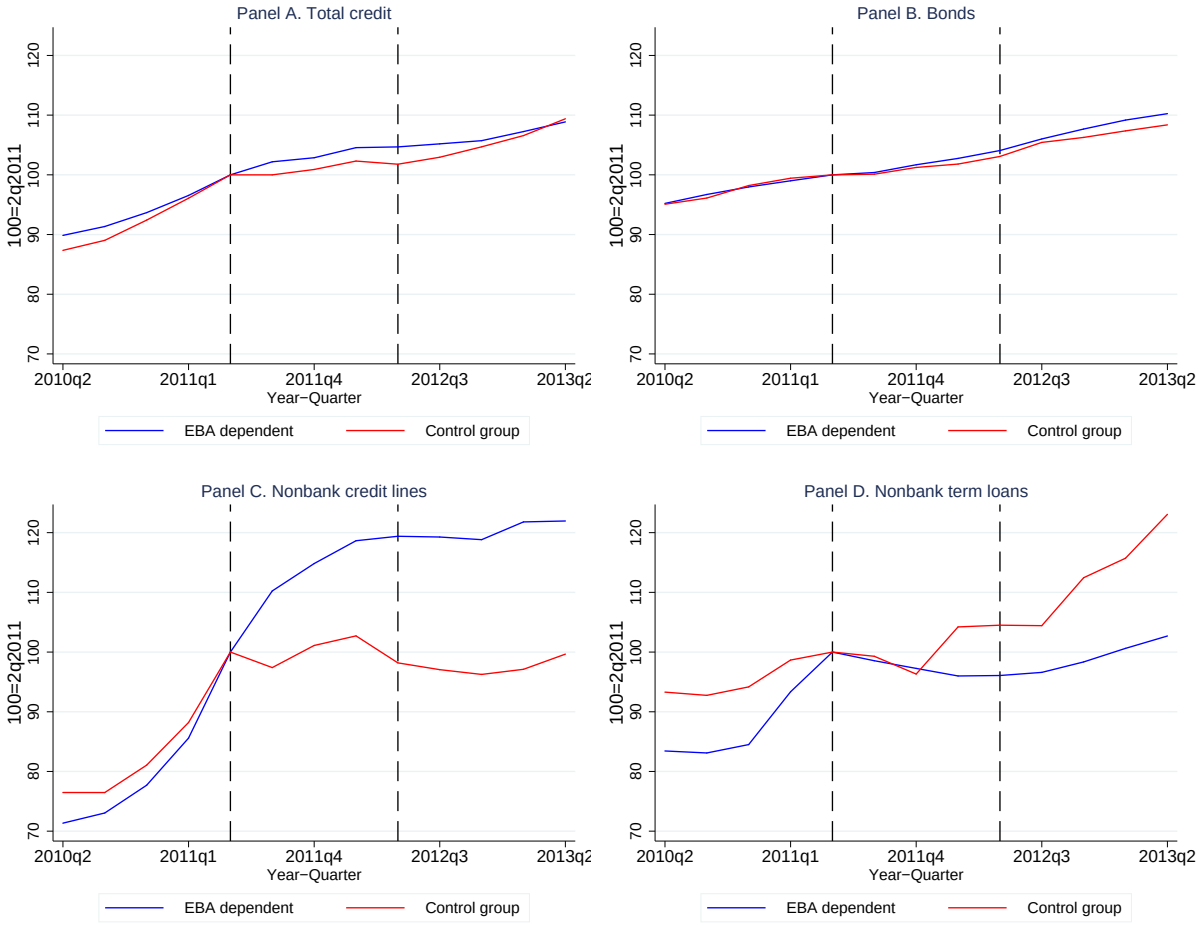

Figure 7: **Non-bank credit, US firms:** This figure shows the stock of total credit (panel A), which is the sum of bank and non-bank credit; and the three components of non-bank credit: bond markets (panel B), non-bank term loans (panel C), and non-bank credit lines (panel D). Each panel depicts firms dependent on EBA banks (more than half of the loans vis-á-vis them, blue line) and the control group (red line), four quarters before (2011Q2) and after (2012Q2) the EBA capital exercise. The two dashed vertical lines in each panel mark 2011Q2 and 2012Q2, the quarters immediately before and after the capital exercise.

access to these sources. We hypothesize that the latter may happen, as lack of previous experience prevents firms accessing the bond market (Hale and Santos (2008)). Similarly, the evidence suggests that lack of previous lending relationships limits access to credit lines (Berger and Udell (1995)). Empirically, we analyze the evolution of bonds, non-bank term loans, and non-bank credit lines for two subsets of firms: those which had previous access to each source of finance (the intensive margin, Panel A in Table 5), and those which had no

Table 5: **Intensive and extensive borrowing margin:** All specifications are estimated using the difference-in-differences estimator. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

Panel A. Recurrent borrowers, intensive margin: The sample of firms includes only those with outstanding bonds (column 1), and non-bank loans (columns 2 and 3), as of 2011Q2.

	(1) Bond	(2) NonBank-Term	(3) NonBank-Lines
Total assets (log)	2.82**	−0.80	2.95
	(2.10)	(−1.03)	(1.49)
Tangible assets	0.02	0.38	0.14
	(0.19)	(0.88)	(0.37)
Post	0.04	0.62*	0.10
	(0.89)	(1.70)	(0.72)
Post*Treated	0.10**	−0.39	0.80***
	(2.54)	(−1.02)	(3.45)
Observations	2506	2559	2559
Number of clusters	662	679	679
R-squared	0.977	0.901	0.828

Panel B. Inexperienced borrowers, extensive margin: The sample of firms includes only those without outstanding bonds (column 1), and non-bank loans (columns 2 and 3), as of 2011Q2.

	(1) Bond	(2) NonBank-Term	(3) NonBank-Lines
Total assets (log)	0.03	0.01	0.04
	(0.74)	(0.05)	(0.16)
Tangible assets	−0.00	0.03	0.03
	(−0.01)	(0.72)	(1.19)
Post	0.02*	0.03	−0.03
	(1.78)	(0.98)	(−1.27)
Post*Treated	−0.01	0.04	0.03
	(−0.59)	(0.71)	(1.05)
Observations	853	800	800
Number of clusters	245	228	228
R-squared	0.142	0.109	0.358

prior market experience (the extensive margin, Panel B in Table 5). We find that that firms with previous experience increase their borrowing, relative to the control group. Specifically, borrowing through credit lines from non-banks increase by 80%, relative to the control group. The raise in bond borrowing was 10%. Panel B shows that treated companies without previous bond market access (column 1), or non-bank borrowing (columns 2 and 3), are not able to improve their borrowing relative to the control group. The main message is that the additional growth of non-bank credit line we identify for treated firms, relative to control firms, holds for firms that have been able to tap public markets in the past.

6 Robustness checks

6.1 EBA dependency

In our main results, we define treated firms as those that have more than half of their outstanding loans from European banks vis-à-vis EBA-affected banks. To ensure that the results are not driven by the way we split our sample, we use a continuous variable ($Share_i^{EBA}$) to indicate treatment.[20] The modified equation we estimate is the following:

$$F_{it}^X = \alpha_i + \beta_1 Share_i^{EBA} + \beta_2 Post_t + \beta_3 Share_i^{EBA} * Post_t + \beta_4 Controls_{it} + \varepsilon_{it} \qquad (6.1)$$

Table 6 shows the results. Panel A reports the analysis when we use total bank credit, bank term loans, and credit lines in turn as dependent variables (columns 1, 2, and 3, respectively). The results are broadly consistent with the ones we obtain using the categorical variable, and indicate that the contraction in bank credit concentrates in credit lines. In

[20]This variable is firm specific and time invariant, so it is absorbed by the firm fixed effects.

Table 6: **Alternative measure of EBA-bank dependency:** All specifications are estimated using the difference-in-differences estimator. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

Panel A. International impact of bank deleveraging

	(1) Bank-Loans	(2) Bank-Term	(3) Bank-Lines
Total assets (log)	0.23	−0.27	0.56
	(0.48)	(−0.53)	(0.65)
Tangible assets	0.04	−0.05	0.11
	(0.50)	(−0.56)	(0.88)
Post	0.19***	0.37***	0.08
	(2.63)	(2.78)	(1.08)
Post=1 × EBAShare	−0.21**	−0.27*	−0.17*
	(−2.40)	(−1.74)	(−1.66)
Observations	3235	3235	3235
Number of clusters	875	875	875
R-squared	0.896	0.910	0.848

Panel B.non-bank credit to US firms

	(1) Bond	(2) Nonbank-Term	(3) NonBank-Lines
Total assets (log)	2.42**	−0.77	3.05
	(2.06)	(−0.99)	(1.57)
Tangible assets	−0.01	0.24	0.09
	(−0.18)	(0.89)	(0.39)
Post	0.05	0.45**	0.16
	(0.93)	(2.01)	(1.24)
Post=1×EBAShare	0.06	−0.27	0.50**
	(1.46)	(−1.14)	(2.36)
Observations	3235	3235	3235
Number of clusters	875	875	875
R-squared	0.977	0.902	0.832

Panel B we summarize the main findings of the impact of firms' reliance on non-bank credit. Column 1 reports the impact on bond financing, and columns 2 and 3 non-bank term loans and credit lines. The results confirm the main analysis. Relative to control firms, treated firms increase their borrowing from non-bank credit lines. There are no notable differences

in terms of bond financing, or non-bank term loans. In sum, our results are robust to an alternative definition of the treated group.

6.2 Timing: the European debt crisis

One potential concern about the EBA capital exercise is that the contraction of bank credit (and subsequent expansion of non-bank loans) for EBA-dependent firms may reflect the impact of the European debt crisis on banks' lending policies. To better isolate how bank capital requirements related to sovereign-debt problems affect the flow of credit, we create a new measure of EBA dependency that excludes loans from GIIPS banks. The rationale stems from the fact that the sovereign debt crisis most affected banks in the periphery of Europe, which experienced deleveraging pressures during the first half of 2011 (Farinha et al. (2019)). Thus, we create a new measure of EBA dependency that excludes loans from GIIPS banks, $Share_i^{EBA-Ex}$:

$$Share_i^{EBA-Ex} = \frac{\sum_{q=2010Q2}^{2011Q2} F_{i,q}^{B-EBA-Ex}}{\sum_{q=2010Q2}^{2011Q2} F_{i,q}^{B-EU}} \tag{6.2}$$

$Share_i^{EBA-Ex}$ takes higher values for firms exposed to banks in the non-GIIPS countries. We estimate the following equation:

$$F_{it}^X = \alpha_i + \beta_1 Share_i^{EBA-Ex} + \beta_2 Post_t + \beta_3 Share_i^{EBA-Ex} * Post_t + \beta_4 Controls_{it} + \varepsilon_{it} \tag{6.3}$$

We rerun all the regressions using the new measure of EBA dependency, which excludes the above-mentioned loans. We report the results in Table 7. We find that our main results hold, and we conclude that the contraction in bank credit, as well as the

Table 7: **Timing: European debt crisis:** All specifications are estimated using the difference-in-differences estimator. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

Panel A. International impact of bank deleveraging

	(1) Bank-Loans	(2) Bank-Term	(3) Bank-Lines
Total assets (log)	0.24	−0.26	0.58
	(0.51)	(−0.52)	(0.66)
Tangible assets	0.05	−0.04	0.12
	(0.62)	(−0.51)	(0.98)
Post	0.13***	0.22**	0.08
	(2.70)	(2.55)	(1.45)
Post*Treated	−0.14**	−0.05	−0.19**
	(−2.09)	(−0.49)	(−2.14)
Observations	3359	3359	3359
Number of clusters	907	907	907
R-squared	0.895	0.908	0.848

Panel B.non-bank credit to US firms

	(1) Bond	(2) NonBank-Term	(3) NonBank-Lines
Total assets (log)	2.42**	−0.78	2.99
	(2.06)	(−1.02)	(1.56)
Tangible assets	−0.01	0.22	0.10
	(−0.14)	(0.87)	(0.44)
Post	0.04	0.35*	0.14
	(1.03)	(1.87)	(1.37)
Post*Treated	0.08**	−0.13	0.64***
	(2.16)	(−0.59)	(3.19)
Observations	3359	3359	3359
Number of clusters	907	907	907
R-squared	0.977	0.901	0.833

increase in non-bank loans, reflects how bank capital requirements affect the flow of credit rather than the impact of the European debt crisis.

6.3 Unrated firms

Next we aim at confirming that our findings are not driven by differences in ratings between treated and control firms. This can be one potential concern, as the risk-weight of corporate loans depend on the rating of the borrower.[21]

We recover Standard and Poor's and Moody's credit ratings in 2013Q11. Our sample includes firms of different rating categories, but the group of unrated firms is the only large enough to run a subsample estimation. The number of cross-sectional units decreases substantially, and the sample includes only 475 firms.

The results, reported in Table 8, remain largely unchanged, as we find that a decrease in borrowing of treated firms relative to the control group. This is underscored by the negative and statistically significant interaction term $Post{*}Treated$ in column 3 of Panel A, which reflects a 22% decrease. We also find that treated firms increase their borrowing through non-bank credit lines, relative to the control group. In column 3 of Panel B, the interaction term is positive and statistically significant, and signals a strong increase of 42/%. We conclude that our main findings hold when we use a sample of unrated firms.

6.4 Other tests

As an additional test, we run the models without the firm-level attributes (total assets and the tangible assets ratio), as their inclusion reduces the number of firms covered due to missing values. This test allows us to analyze the full set of cross-sectional units. The results-not shown for the sake of brevity-confirm our conclusions.

[21]Specifically, the risk-weights by rating are: AAA to AA-, 20%; A+ to A-, 50%; BBB+ to BB-, 100%; below BB-, 150%; and unrated firms, 100%.

Table 8: **Unrated borrowers:** All specifications are estimated using the difference-in-differences estimator. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

Panel A. International impact of bank deleveraging

	(1) Bank-Loans	(2) Bank-Term	(3) Bank-Lines
Total assets (log)	0.14	0.55	−0.14
	(0.18)	(1.41)	(−0.11)
Tangible assets	0.06	−0.11	0.19
	(0.66)	(−1.19)	(1.29)
Post	0.16**	0.07	0.23**
	(2.06)	(0.76)	(2.24)
Post*Treated	−0.13	−0.01	−0.22*
	(−1.47)	(−0.05)	(−1.79)
Observations	1765	1765	1765
Number of clusters	475	475	475
R-squared	0.884	0.904	0.857

Panel B.non-bank credit to US firms

	(1) Bond	(2) NonBank-Term	(3) NonBank-Lines
Total assets (log)	1.09*	1.03	5.27
	(1.90)	(1.12)	(1.42)
Tangible assets	0.03	0.03	0.07
	(0.61)	(0.13)	(0.26)
Post	0.07**	0.01	0.03
	(2.27)	(0.03)	(0.15)
Post*Treated	0.03	0.04	0.42*
	(0.66)	(0.12)	(1.81)
Observations	1765	1765	1765
Number of clusters	475	475	475
R-squared	0.988	0.954	0.780

7 Implications

7.1 Impact on firms' capital structure

Next, we explore if firms' capital structure changes as a result of banks' deleveraging pressures, and non-bank financial intermediaries gain prominence relative to banks. To address this issue, we modify our dependent variables, and construct ratios of debt liabilities to total assets. We winsorize them at 1 and 90%. [22]

We present results in table 9. In Panel A we find that treated US firms reduce the proportion of bank credit lines to total assets. To ascertain the magnitude, we find that the introduction of the capital exercise led to a decline in bank loans relative to total debt by 12 percentage points. Further, in column 3 of Panel B we show that after the EBA capital exercise firms increase the fraction of credit lines arranged from non-bank financial intermediaries, as a fraction of their total debt. The effect is economically meaningful because after the policy, non-bank debt rises by 23 percentage points. Finally, in column 1 we do not find a significant changes in firms' bond financing relative to total debt.

The majority of credit lines are provided by investment banks, which have strong maturity mismatches between asset and liabilities.[23]. We conclude that corporates' access to liquidity may end up being more uncertain, since intermediaries with shorter-term liabilities are more vulnerable (Cornett et al. (2011)) to simultaneous runs in short-term liabilities and credit line drawdowns (Ivashina and Scharfstein (2010)).

[22] We choose the 90th percentile since the ratios are bounded at zero and are highly non-normal.

[23] Few of the rest of lenders in the non-bank group, which include private equity firms, insurance companies, pension funds, CLOs, Business Development Companies, extend them.

Table 9: **Firms' capital structure:** All specifications are estimated using the difference-in-differences estimator. Post equals 1 for observations in the post-EBA period. All regressions include firm fixed effects. The figures in parentheses are robust t-statistics. The standard errors are clustered at the firm level. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

Panel A.non-bank credit to US firms

	(1) Bank-Loans	(2) Bank-Term	(3) Bank-Lines
Total assets (log)	−0.12**	−0.12	−0.13*
	(−2.03)	(−1.55)	(−1.72)
Tangible assets	0.08	−0.07	0.16*
	(0.60)	(−0.43)	(1.69)
Post	0.01	0.02	0.00
	(0.19)	(0.32)	(0.08)
Post*Treated	−0.09	−0.06	−0.12*
	(−1.53)	(−0.65)	(−1.92)
Observations	3359	3359	3359
Number of clusters	907	907	907
R-squared	0.770	0.797	0.755

Panel B.non-bank credit to US firms

	(1) Bond	(2) NonBank-Term	(3) NonBank-Lines
Total assets (log)	−0.34***	−0.15	−0.06
	(−3.49)	(−1.12)	(−0.31)
Tangible assets	0.04	−0.01	0.13
	(0.44)	(−0.02)	(0.94)
Post	0.08**	0.02	−0.17*
	(2.24)	(0.12)	(−1.68)
Post*Treated	0.00	0.00	0.23*
	(0.09)	(0.00)	(1.87)
Observations	3359	3359	3359
Number of clusters	907	907	907
R-squared	0.932	0.780	0.718

7.2 Financial intermediation in the US

Since European banks are important in the US corporate loan market, the EBA capital exercise had the potential to modify its structure and boost the share of non-bank financial

intermediaries. Now we examine if the EBA capital exercise allowed non-bank financial intermediaries to gain importance in the US corporate loan market, relative to EBA banks, exploring their evolution in the league table of syndicated loans to US corporations.[24]

League tables rank lead arrangers in loan markets according to the number, or the total amount of loans. Lower values (a higher position in the ranking) indicate that a lender is important in the US corporate loan market.

To test our hypothesis, we construct a panel of top 50 lead arrangers in the US corporate loan market, tracking them in four periods of time (from-to): 2009Q3-2010Q2,2010Q3-2011Q2,2011Q4-2012Q3,2012Q4-2013Q3. By defining this narrow window exactly around the EBA capital exercise, we seek to isolate other contemporaneous changes in the demand for finance, and other supply factors. Next, we classify lenders in three groups: EBA banks, other banks, and non-bank lenders. Finally, we estimate the following equation:

$$Rank_{it} = \alpha_i + \beta_1 EBA_i * Post_t + \beta_2 non - bank_i * Post_t + \varepsilon_{it} \tag{7.1}$$

where $Rank_{it}$ is the ranking in the league table of lender i at time t. It ranges between 1 (most important lender) to 50. α_i denotes the lender fixed-effects. EBA_i equals 1 for banks subject to the EBA capital exercise, and 0 otherwise. $non - bank_i$ equals 1 for non-bank lenders, and 0 otherwise. $Post_t$ equals 1 for observations in the two periods after the EBA capital exercise, and 0 otherwise. ε_{it} is the disturbance term.

The results in Table 10 indicate that EBA banks lost importance in the US corporate loan market after the capital exercise, as the sign of the interaction term between $Post_t$ and EBA_i is positive in column 1 (which ranks lenders by number of loans) and in column 2

[24]This is not covered in our previous analysis, as we only examined the funding structure of the sample of US corporates that had loans vis-á-vis EBA banks (and this sample represents only a fraction of the US corporate loan market).

Table 10: **League table of lead arrangers in the US corporate loan market** The ranking ranges between 1 (most important lender) to 50 (least important). A negative sign signals that the importance in the ranking has increased. All specifications are estimated using the difference-in-differences estimator. EBA bank equals 1 if the bank was subject to the EBA requirements, and 0 otherwise. non-bank equals 1 if the lender is a non-bank. Post equals 1 for observations in the post-EBA period. In column 1 the dependent variable is a ranking based on the number of loans. In column 2 the ranking is constructed using the total amount arranged by the lender. All regressions include lender fixed effects. The figures in parentheses are robust t-statistics. Statistical significance is denoted at 1% (***), 5% (**) and 10% (*).

	(1) Count	(2) Amount
Post=1*EBA bank=1	2.28*	2.52**
	(1.89)	(2.38)
Post=1*Nonbank lender=1	0.74	−1.86*
	(0.64)	(−1.92)
Observations	197	197
Number of clusters	58	58
R-squared	0.000	0.000

(which ranks them by the total amount). Non-bank lenders gain importance according to the total amount lent (column 2), as the sign of the interaction term is positive and statistically significant in column 2. In addition, they remain similar, in terms of the number of loans, which suggests that they engage in larger transactions.

Therefore, the evidence is not inconsistent with a change in the structure of the U.S. corporate loan market due to the EBA capital exercise: it appears that, as EBA banks retrenched, non-bank lenders filled the void. However, we acknowledge that the rise (decline) of non-banks (EBA banks) could also be related to other contemporaneous changes in supply and demand.

8 Conclusion

Using a cross-country sample of bank-dependent public firms from several advanced economies, we study the global impact of banks' deleveraging pressures on corporate borrowing. For identification we examine how US firms' liabilities vis-à-vis banks, non-bank lenders, and bond markets, evolve after the European Banking Authority (EBA) increased capital requirements on a consolidated level in 2011.

We find that after the EBA capital increase, US firms experienced a decline in cross-border bank credit. This reflected the impact of foreign creditors' deleveraging, which is not surprising given the banks' "financial home bias". Yet, when we distinguish among different types of credit, we find that the reduction concerned only credit line commitments. In contrast, term loans remained resilient. Finally, we find that US firms were able to smooth the shock by securing credit lines from US investment banks, and did not increase their borrowing from corporate bond markets.

Our results suggest that non-bank financial institutions are able to smooth shocks in cross-border financing. The general lesson is that a diversified loan market may be key to achieving a robust structure for corporate financing.

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UN, EC, IMF, OECD and WB: 2008, *System of national accounts 2008*, United Nations.

A Data appendix

A.1 Definition of the variables used

- *Bank Loans*: is the stock of outstanding loans from banks.
- $Non-bank\ loans$: is the stock of outstanding loans from non-bank financial intermediaries.
- *Bonds*: is the stock of outstanding bonds.
- *Credit*: sum of outstanding stock of loans from banks, from non-banks, and bonds.
- *Creditline*: is the stock of outstanding credit lines (including undrawn).
- *Termloan*: is the stock of term loans.
- *EBA Share*: is denoted by the stock of outstanding loans to EBA banks, relative to the total stock of loans vis-á-vis European banks.
- *Treated*: is a dummy that equals 1 if half the firm's bank loans are from banks subject to EBA requirements, and 0 otherwise.
- *Post*: is a dummy that equals 1 for quarters 2012Q3 -2013Q4 (post-exercise), and 0 for quarters 2010Q2 -2011Q2 (pre-exercise).
- *Total Assets*: denotes the logarithm of firms' assets (in USD millions).
- *Leverage*: is the ratio of firms' total debt to total assets.
- *Tangible Assets*: is the ratio of firms' net property, plant and equipment to total assets.
- *Current Ratio*: is defined as short-term assets (<1 year) to liabilities.

- $EBITDA\ 1 year growth$: growth in EBITDA, year-over-year.
- $Altman's\ z-score$: is the z-score following Altman (1968)).

A.2 Sample selection

We use data drawn from different sources. We gather from Refinitiv SDC Platinum the universe of 245,881 syndicated loans, and 220,531 bonds issued by nonfinancial corporations. To identify nonfinancial corporations we use the Thompson Reuters Business Classification (TRBC) definition, leaving aside financial and government bond issuers and loan borrowers.[25] We obtain from Refinitiv Eikon the hierarchical structure and sectoral classification of each of the entities involved in every syndicate loan and bond (immediate lender and immediate borrower of the borrower and lender). For all these entities, and their immediate and ultimate parents, we obtain the country of incorporation, and the NAICS and TRBC codes.[26] In order to retrieve entities' reference data from Refinitiv Eikon we use mapping tables between the SDC CUSIP and their Thompson Reuters Permanent ID.

We use the deal-level data to enhance the capital structure that firms disclose in their financial statements. To disentangle bank from non-bank loans, we follow Gropp et al. (2018) and define a full list of loan creditors of each firm in each quarter. We use this information to assess which firms are bank-dependent, and whether they had lending relationships with banks that were selected into the EBA capital exercise.[27]

[25]Since we use the TRBC schema at its highest level, we expect it to be very similar to other business classification schemas. The filter drops bonds and loans issued by entities whose ultimate parent company is financial, or affiliated to a government.

[26]NAICS stands for the North American Industry Classification Scheme, which superseded the SIC in 1987. The NAICS maps the UN International Standard Industrial Classification of All Economic Activities (ISIC). Refinitiv provides the NAICS for non-US firms as well.

[27]Unlike Gropp et al. (2018), we use the Refinitiv SDC syndicated loan data, and not Dealscan, since the former allows a better integration into Refinitiv Eikon (eg obtaining sectoral classifications, hierarchical structure, or country of incorporation). We do not expect major differences in loan coverage between SDC and Dealscan. Both databases include a similar number of loans, and are distributed by Refinitiv.

Of the 1.4 million bank-firm-loan shares in our data, we identify 375,316 distinct bank*firm pairs.[28] To compute the total amount of loans granted by EBA-affected banks, we estimate the fraction of the total loans granted by European banks. We obtain the list of banks subject to the additional capital requirements from the EBA report (EBA (2011)). Following Ivashina and Scharfstein (2010), we split pro-rata the total amount lent by lead arrangers among each of them; beforehand, we split the loan amount pro rata between lead arrangers and other participants.[29]

Table A.1: **Degree on dependency on EBA banks, 2011Q3:** The table presents the fraction of outstanding loans vis-á-vis banks subject to the EBA capital exercise, relative to total outstanding loans vis-á-vis other European banks.

	Share distribution				Treated	
	Mean	p25	p50	p75	No	Yes
Total	68	45	82	100	786	2,044
EU	71	50	80	100	289	888
US	66	33	82	100	441	974
Other developed	71	50	87	100	56	182

[28] We identify a total of 1.7 million lender-firm-shares, but 0.3 million are non-bank firm shares.
[29] Lenders' shares are often unavailable in Refinitiv SDC data.

B Credit lines: stylized facts

Credit lines represent around half of the syndicated loans originated by banks (Figure B.1, Panel A).

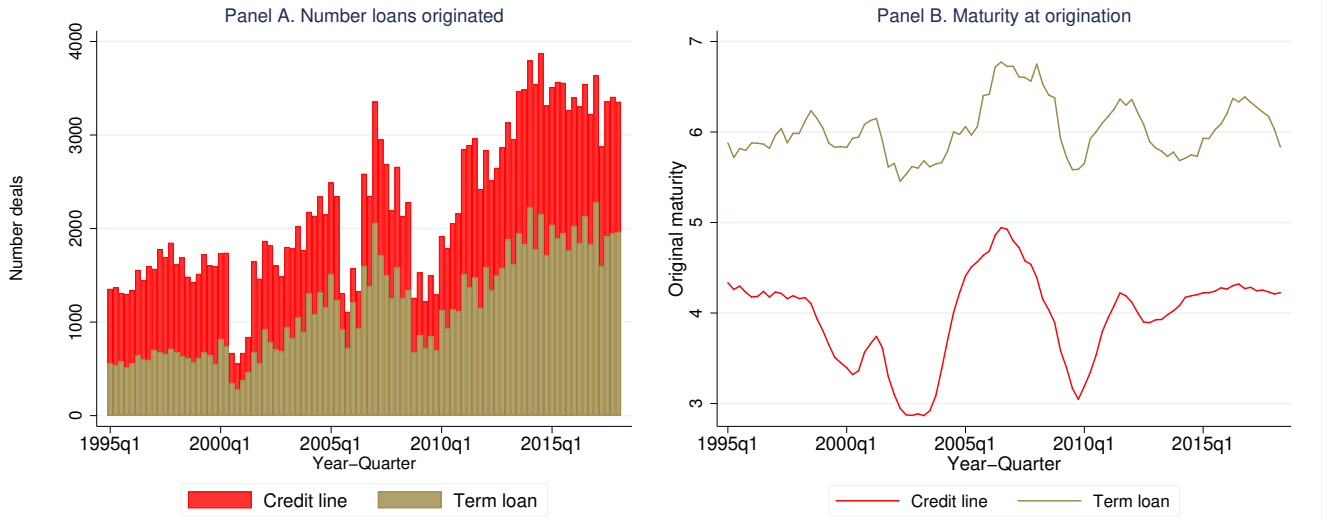

Figure B.1: **Credit lines and term loans at origination:** This figure shows the number of loans originated per quarter (panel A), and the original maturity (panel B), for term loans and credit lines.

Credit lines have shorter maturities than term loans (Figure B.1, Panel B), which reflects they often fund working capital and are rarely used to finance capital expenditures (Figure B.2). Many firms also arrange them to secure liquidity and exploit business opportunities as they arise (Lins et al. (2010)). For this reason in many instances companies do not detail at origination the intended use of credit lines, and described they are arranged for "general corporate purposes".

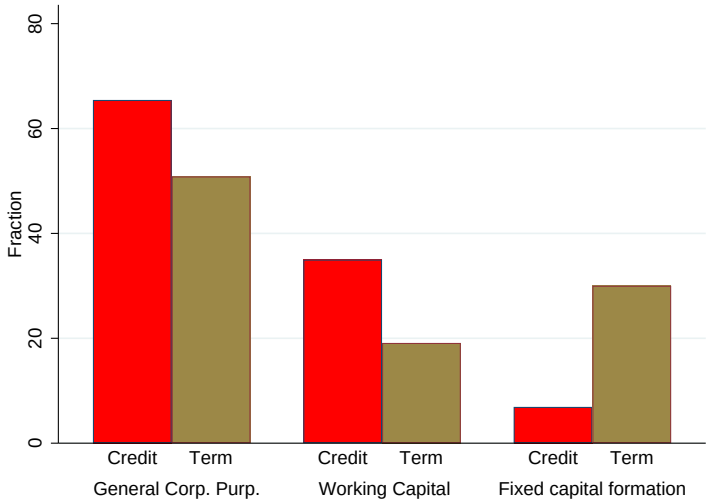

Figure B.2: **Use of proceeds, by loan type:** This figure shows the use of proceeds of term loans and credit lines, grouped into three categories: general corporate purposes, working capital, and fixed capital formation. Loans secured for refinancing or to finance buyouts are not included.

C Sectoral classification of consolidated financial groups

In the paper we consolidate lenders at the ultimate parent level. We depart from this principle in a few cases, and consolidate up to the second highest level, if the ultimate parent is the government (NAICS code 92, Public Administration), a charity (NAICS 81321, Grant making and Giving Services), or a holding company (NAICS code 551112, Investment Holding Companies; NAICS code 523920, Investment Management and Fund Operators; NAICS code 55, Management of Companies and Enterprises).

The practical question we face is how to define the sectoral classification of these consolidated financial groups.[30] This is particularly difficult in the case of US financial intermediaries, as are complex and have many affiliates (Cetorelli and Goldberg (2014),

[30]Our unit of analysis are the consolidated financial groups, so by construction our approach is different from the one followed in the Financial Accounts which focus on institutional units. These are "...an economic entity that is capable, in its own right, of owning assets, incurring liabilities and engaging in economic activities and in transactions with other entities". For this reason, our classification cannot be reconciled either from the one used in the FSB reports on Non-bank financial intermediation, which use Financial Accounts as starting point.

Goldberg and Meehl (2019)), which often belong to different subsectors. Our decision is to to use the sectoral classification of the parent company, and specifically the NAICS subsector, which we obtain from Refinitiv Eikon. The reason is that the sectoral classification of the parent company reflects the main activity of the group, as the "The principal activity of an economic entity is the activity that contributes most to the value added of the entity[..]" (quoted from the UN et al. (2008), which provides the ISIC guidelines in which the NAICS system is based).

Following this criteria, the majority of the lenders are financial companies (code 52 "Finance and Insurance"), and in the following subsectors: Credit Intermediation and Related Activities (subcode 522); Securities, Commodity Contracts, and Other Financial Investments and Related Activities (subcode 523); Insurance Carriers and Related Activities (subcode 524); Funds, Trusts, and Other Financial Vehicles (subcode 525). We define banks as the financial intermediaries belonging to NAICS subsector 522, with most of them belonging to the subsubsector of commercial banking (NAICS 5221). Non-bank financial intermediaries are companies belonging to subsectors 523, 524, and 525.[31]

Bank loans constitute three quarters of the term loans in the syndicated loan market (Panel A, Figure C.1) and credit lines (Panel B). Non-bank financial institutions arrange the remaining one quarter, with investment banks (NAICS code 523) accounting for the bulk.[32] Other types of non-bank financial institutions have a residual role, in particular in the origination of credit lines.

[31]Many consolidated financial groups classified in the banking sector have non-bank affiliates, and the other way around (Cetorelli and Goldberg (2014)). For example, US banks have non-bank affiliates, and we treat as bank loans the deals they arrange. Similarly, loans arranged by bank affiliates of investment banks are treated as non-bank loans.

[32]NAICS code 523 encompasses investment banks (subsubsector 52311) and other entities involved in securities brokerage (subsubsector 52312), and commodity contract dealers (subsubsector 52313). In practice investment banks are the only institutions active in the syndicated loan market.

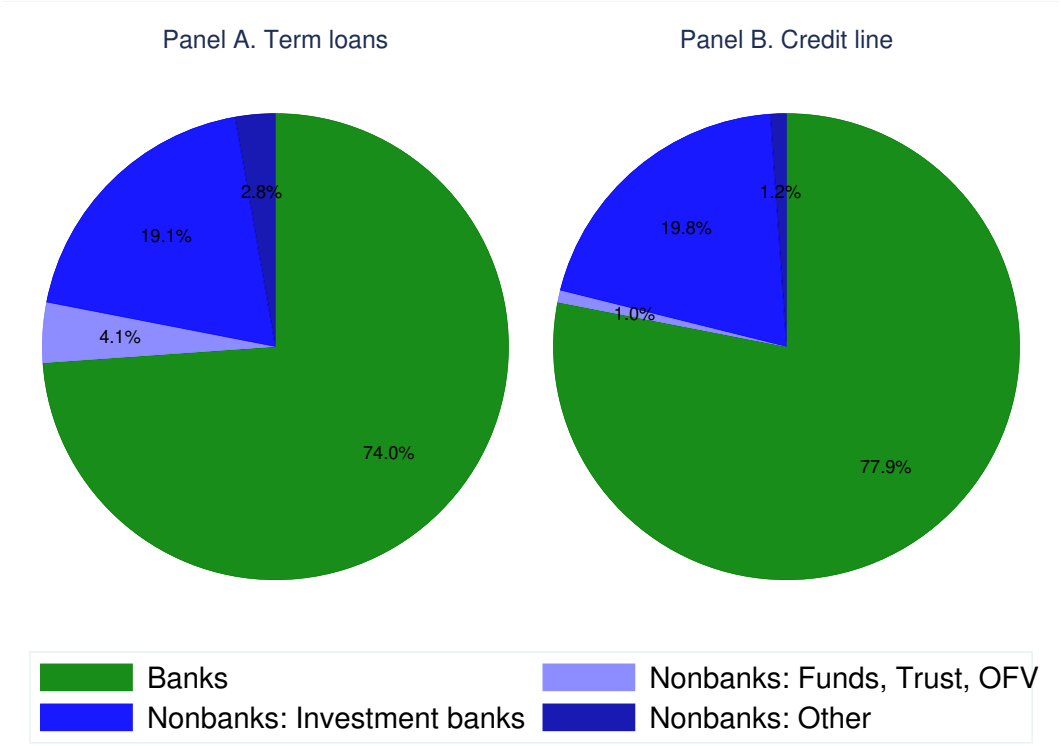

Figure C.1: **Classification of loans' lead arrangers, by loan type:** This figure shows the fraction of loans originated by type of lender: banks; broker-dealers; trusts, funds, and other financial vehicles; and other. Panel A shows the breakdown for term loans, and Panel B for credit lines.

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