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Foreign banks and the doom loop

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WORKING PAPER

Foreign banks and the doom loop

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Foreign Banks and the Doom Loop*

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Abstract

This paper explores whether foreign banks stabilise or destabilise lending to the real economy in the presence of sovereign stress in the domestic economy and abroad. In this context, the presence of foreign intermediaries poses a fundamental, yet unexplored, trade-off. On the one hand, domestic sovereign shocks are broadly inconsequential for the lending capacity of foreign banks, given that their funding conditions are not hampered by such shocks. On the other, these intermediaries may react more harshly than domestic banks to a deterioration in local loan risk and demand conditions, or import shocks from their own sovereign. We exploit granular and confidential data on euro area banks operating in different countries to assess this trade-off. Overall, it is found that, under certain conditions, the presence of foreign lenders stabilises lending, thus mitigating the doom loop.

JEL classification: E5, G21

Keywords: Sovereign stress, International banks, Lending activity.

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1 Introduction

The “sovereign-bank nexus”, or “doom loop”, has been at the centre of the economic and policy debate in advanced economies, in particular since the 2010-2012 European sovereign debt crisis. When the sovereign debt market experiences periods of stress, the lending capacity of local banks tends to be impaired. The resulting credit crunch leads to a deterioration of the economy, which eventually ends up exacerbating the stress in the sovereign debt market even further.¹ Recently, the Covid-19 crisis has been accompanied by government interventions all around the globe via massive guarantee programmes for the banking sector, with possible risk of reactivation of the loop between the public sector and banks. This risk is also amplified by the fact that domestic banks have absorbed a large portion of the additional supply of government securities, reflecting the sizeable increases in the government debt-to-GDP ratio observed in advanced economies during the crisis.²

In this paper, focusing on the euro area, we explore whether an integrated banking system characterised by the presence of cross-border banks would help to absorb idiosyncratic shocks in sovereign debt markets, thus supporting the provision of credit to non-financial corporations. Indeed, the implications for the sovereign-bank nexus of a banking sector populated by foreign institutions are far from trivial. Several channels are at work and all need to be assessed.

First, a “*loan supply channel*” is at play. Following an increase in domestic sovereign stress, this channel works through a deterioration of the funding capacity of domestic banks (but not of foreign banks). Indeed, given that the domestic sovereign is perceived as the ultimate explicit or implicit guarantor of local bank liabilities, when its creditworthiness worsens, so does the ability of domestic banks to raise funds. Moreover, a decline in the valuation of government bonds adversely affects bank capital and liquidity positions due to the banks’ exposure to the domestic sovereign and in relation to the wide utilisation of government securities as collateral in secured liquidity and funding transactions. With regard to foreign banks, sovereign stress in host countries is largely inconsequential for their lending capacity, given that their liabilities are guaranteed by other governments and their holdings of sovereign bonds are typically very

¹See, among others, [Lane \(2012\)](#), [Acharya et al. \(2014\)](#), [Battistini et al. \(2014\)](#), [Angelini et al. \(2014\)](#), [Fahri and Tirole \(2019\)](#), [Anderson et al. \(2020\)](#).

²Between 2019 and 2021, the government debt-to-GDP ratio increased by about 15 and 20 percentage points of GDP in the euro area and the US, respectively. This rise was in large part absorbed by the domestic banking sector, especially in some countries (e.g., Italy). While interest rates on government securities have been low in this period, this situation may create risks of a reactivation of the doom loop in case of future interest rate hikes.

small.³ Therefore, according to these mechanisms, the presence of foreign banks should be beneficial in terms of the mitigation of the sovereign-bank nexus. At the same time, foreign banks may export negative shocks from their own sovereign sector to the host country, via their consolidated balance sheets (see, e.g., [Fillat et al., 2018](#)). This could imply less credit to the host country (deleveraging) but also, in some cases, a lending increase, which would reflect a “flight-to-quality” mechanism. Thus, while it seems to be uncontroversial that a country populated only by domestic banks would be highly exposed to sovereign stress originating in the same country, the effects of also having foreign banks in that system is *a priori* unclear according to this channel.

A second channel of transmission works through *borrower-specific* factors, instead of lender-specific factors. This channel has a “standard” *demand* component and a *risk* component, related to the perceived creditworthiness of borrowers. The first component suggests a drop in the demand for new loans on the part of the borrowers, given the deteriorated economic situation following a shock in their own sovereign market ([Bocola, 2016](#)). Indeed, when the sovereign debt market worsens, so does the economy at large. This is due, among other factors, to the fact that confidence fades, investment and consumption plans are delayed, and that the government might be forced into contractionary policies in order to restore trust in the sustainability of public finances. The second (risk-related) component implies that foreign intermediaries may react more aggressively to a deterioration in the local economic situation ([Albertazzi and Bottero, 2014](#)), including when it is due to an outbreak of domestic sovereign tensions. Indeed, funds from international investors tend to be prone to sudden stops, which is well known since the seminal contribution of [Calvo \(1998\)](#). All else being equal, the stronger this effect, the more detrimental the presence of foreign lenders for the doom loop. It is crucial to point out that this channel, which we refer to as “*loan demand and risk channel*” or simply “*loan demand channel*”, originates from a deterioration of the borrower’s risk profile. This clearly distinguishes it from the supply channel which operates via a worsening in banks’ intermediation capacity.

While a growing body of the literature focuses on the supply channel of transmission, and a few papers have investigated the demand channel, no attempt has been made to simultaneously and consistently assess them and to study the role of foreign banks in this context, which is what we do in this paper. This is interesting for three main reasons. First, it allows us to derive some insights on the benefits (and costs) of having a banking system populated by foreign intermediaries. This has potentially

³Such holdings are on average less than 0.5% of their total assets for euro area banks (see, e.g., [Altavilla et al., 2017](#)).

very relevant policy implications especially for the EMU, which is still characterised by an incomplete banking union, but also for several emerging market economies, which typically feature a large presence of foreign intermediaries. Second, we can identify the relative importance of both channels for lending activity. Third, and more broadly, this exercise is an indirect assessment of the fundamental trade-off in finance between the benefits of relationship-lending (as postulated in the seminal contributions by [Sharpe, 1990](#); [Rajan, 1992](#); [von Thadden, 2004](#)), and of an armlength but more diversified set of lenders (as in [Detragiache et al., 2000](#), and [Ongena and Smith, 2000](#)). We perform such an assessment looking at a specific shock, such as that materialising in the sovereign debt markets.

In the literature, the sovereign-bank nexus is typically analysed based on the correlation between sovereign yields and lending in a given country. However, this does not allow to isolate the role of foreign banks and to disentangle the supply and demand channels of transmission. These channels depend on borrower-specific and lender-specific conditions, which affect domestic and cross-border banks differently. In this paper, we propose a novel identification approach, exploiting information on lending from cross-border banks in *home* and *host* countries. Our identification strategy crucially hinges on distinguishing between sovereign stress in the home and host country. This is captured by idiosyncratic movements in the 10-year government bond yield of the home country of the cross-border banking group and the 10-year government bond yield of the host country sovereign in which such intermediary operates through foreign subsidiaries. The key identification assumption is that the home sovereign yield of cross-border banks affects their foreign lending only through the loan supply channel, while the host sovereign yield affects the local lending of foreign cross-border banks only through the loan demand channel.

Our empirical approach relies on the use of a unique and granular database including monthly bank-level information on lending activity in each euro area country, for a representative sample of intermediaries including all main cross-country banking groups operating in the euro area. The sample covers the period July 2007-April 2018.

Our main findings suggest that, first, both the loan supply and loan demand channels are relevant drivers of lending activity. In particular, the loan supply channel explains about 20% of lending growth variation over time, while the demand channel accounts for approximately 17%. Second, we find that, on average, cross-border intermediaries deleverage foreign positions in case of stress in their home sovereign. However, when the exposure to the home sovereign is high, cross-border banks increase lending to the host countries, which could be interpreted as a result of flight-to-quality

or diversification strategies. Third, as regards the demand channel, our results indicate that foreign banks react more harshly to sovereign stress in the host countries. Overall, we show that - based on a stylised mean-variance model - a large share of foreign lenders in the host economy is preferable when the variance of foreign sovereign shocks is lower relative to that of domestic sovereign shocks.

The remainder of the paper is structured as follows. Section 2 reviews the related literature, Section 3 presents the data and some descriptive statistics, Section 4 illustrates the empirical methodology, Section 5 shows our results and Section 6 assesses the overall benefits of a more diversified banking sector. Finally, Section 7 concludes.

2 Related literature

Our paper contributes to a growing literature that studies the effects of sovereign stress on lending activity. Most studies analyse the *loan supply channel* and, especially, the role of sovereign exposures in the transmission mechanism.

Several of these papers focus on the European sovereign debt crisis of 2010-2012. For example, [Popov and Van Horen \(2015\)](#) study the syndicated lending of European banks during that period and show that foreign sovereign stress affected negatively the lending of banks with sizeable holdings of government debt of stressed-countries relative to banks less exposed to that debt. [Altavilla et al. \(2017\)](#) illustrate that sovereign exposure considerably amplifies the transmission mechanism of sovereign stress to lending, especially in stressed countries. The banks in stressed-countries contracted both their domestic and foreign lending in response to an increase in domestic sovereign stress, and the higher their sovereign exposure, the more this is true. [Bofondi et al. \(2018\)](#), focusing on the Italian banking sector only, show that Italian banks tightened their credit supply and increased lending rates following the sovereign debt crisis more than foreign banks whose head institution resided in countries that were less exposed to sovereign stress. [De Marco \(2019\)](#) finds that losses on sovereign debt held by banks lead to a cut in lending supply to financially-constrained firms, both in stressed and non-stressed countries, and the higher the share of short-term funding of the banks, the more this is true. In a similar vein, [Acharya et al. \(2018\)](#) show that value impairment in banks' exposures to sovereign debt triggered by the sovereign debt crisis and the risk-shifting behavior of weakly capitalized banks significantly reduced the probability of firms being granted new syndicated loans. [Bottero et al. \(2020\)](#) highlight that the shock to the banks' sovereign portfolio caused by the 2010 Greek bailout was passed on to Italian firms through a credit contraction. This was particularly the case for banks

with a lower capital and less stable funding. Finally, [Correa et al. \(2016\)](#) find that US branches of euro area cross-border banks reduced their lending to U.S. firms due to the strong liquidity shock generated by depositors' bank run during the European Sovereign debt crisis.⁴

Other papers focus on different sets of countries or sample periods. For example, [Giannetti and Laeven \(2012\)](#) highlight that foreign lenders, when hit by shocks that negatively affect bank wealth in their home market, have a tendency to rebalance their portfolio away from host markets to their domestic market. However, they do not focus explicitly on the transmission of sovereign shocks. Moreover, [Adelino and Ferreira \(2016\)](#) study the causal effect of bank credit rating downgrades on the supply of bank lending, for a panel of advanced and emerging economies. They find that banks with ratings at the sovereign bound reduce their lending significantly more than otherwise similar banks whose ratings are not at the sovereign bound following a sovereign downgrade. Finally, [Gennaioli et al. \(2018\)](#) provide evidence on the relationship between government bond holdings and the sovereign-bank nexus using a large bank-level dataset which comprises 20 sovereign default episodes in 17 countries between 1988 and 2012. The authors find systematic evidence of a negative relationship between sovereign holdings and lending during sovereign defaults, and show that pre-crisis government bond holdings are strong predictors of a decline in bank lending.

A smaller share of the literature has focused on the *loan demand channel* of sovereign stress transmission, but only in isolation to the loan supply channel. One of the first studies on the borrower specific determinants of sovereign stress transmission is [Arteta and Hale \(2008\)](#). This paper shows that sovereign crises in emerging markets were followed by a decline in foreign credit to domestic private firms in the non-financial sector. Moreover, [Albertazzi and Bottero \(2014\)](#) find that, in the post-Lehman collapse, foreign lenders contracted their credit supply to the same firm more than domestic banks, in response to the increase in credit risk and the deterioration of economic conditions that followed the collapse. More recently, [Arellano et al. \(2020\)](#) suggest that sovereign stress may be transmitted to firms not only via a credit supply crunch, but also endogenously through a contraction in the demand of labour input and intermediate good on the side of the borrowers, which therefore cut their demand for new loans.

Altogether, it emerges that the lending (supply) channel of transmission has been

⁴[Żochowski, Franch and Nocciola \(2021\)](#) explore the role of foreign banks but in another dimension, i.e., the cross-border propagation of prudential regulation in the euro area. They find that domestic banks reduce lending after the tightening of capital requirements in other countries. They also find that foreign affiliates increase lending following the tightening of sector-specific capital buffers in the countries where their parent banks reside.

studied in several papers by controlling for the demand channel (and vice versa). However, to the best of our knowledge, there are no papers which simultaneously estimate these two channels in the same framework, and assess the role of foreign banks in this context. In this paper, we propose a unified framework to study the transmission of sovereign shocks from both home and abroad through these two channels, which is needed in order to identify the role of foreign lenders for the provision of credit to the private sector.

3 Data

Our analysis is based on two unique and proprietary ECB monthly datasets, for 326 euro area banks: the “Individual Balance Sheets Items” dataset (IBSI) and the “Individual MFI Interest Rates” dataset (IMIR). The data used here cover the period from June 2007 to April 2018, and include bank-level observations on loan volumes, loan rates and sovereign exposures of each bank. These data are then complemented with data on sovereign yields, macroeconomic and financial variables which are obtained from Thomson Reuters, Datastream, Bureau van Dijk (Bankscope) and ECB sources (see data Appendix).

Table 1 presents the country statistics for the 326 intermediaries in our dataset. In particular, the second column reports the total number of banks operating in each euro area country. Not surprisingly, most banks are in the biggest Eurozone countries, i.e., Germany, France, Italy, and Spain. The key group in our analysis is composed by euro area cross-border banks (Column 3). This group is split into domestic head banks which have at least one subsidiary in another euro area country (Column 4). For example, Unicredit in Italy, which has subsidiaries in several other euro area countries. The other sub-group of cross-border banks includes foreign subsidiaries of euro area banks (Column 5). For example, in Germany, Unicredit controls HypoVereinsbank, which is therefore counted as a foreign cross-border bank in that country. Once cross-border banks are accounted for, the remaining banks in column (2) of Table 1 are: i) individual domestic banks, which are not cross-border, ii) domestic subsidiaries, iii) foreign banks owned by banking groups resident outside the euro area (e.g., American or British banking groups). We refer to this residual group as “non cross-border” banks (i.e., the difference between column 2 and column 3).

The sample comprises 77 euro area cross-border banks, which is about 24% of the overall dataset. The cross-border dimension of the sample is crucial to our identifying strategy in that it allows us to differentiate between sovereign stress which generates

Table 1: Distribution of euro area banks

Countries	All banks	Cross-border banks		
		all	domestic	foreign
	(2)	(3)	(4)	(5)
Austria	14	0	0	0
Belgium	13	5	2	3
Cyprus	7	2	0	2
Estonia	5	2	0	2
Finland	18	0	0	0
France	41	13	9	4
Germany	68	10	7	3
Greece	8	3	3	0
Ireland	17	4	0	4
Italy	38	11	7	4
Latvia	7	3	0	3
Lithuania	5	3	0	3
Luxembourg	14	3	0	3
Malta	4	1	0	1
Netherlands	15	4	1	3
Portugal	6	0	0	0
Slovakia	5	1	0	1
Slovenia	7	2	0	2
Spain	34	10	6	4
Total	326	77	35	42

Note: The table reports the total number of banks operating in each euro area country (Column 2). Some of these banks are also cross-border banks (Column 3): these are domestic cross-border banks which have at least one subsidiary in another euro area country (Column 4) and subsidiaries of foreign euro area banks in that country (Column 5). Note that the panel is unbalanced. Thus, 326 refers to the overall number of banks used in the empirical analysis, which does not mean that all these banks are present in all years covered in the sample (2007-2018). *Source:* ECB's IBSI and IMIR dataset.

in the home country of the head bank and in the host countries where the foreign subsidiaries operate.

Before moving to the description of the econometric methodology, in Table 2 we show a few summary statistics for some key variables in our dataset. Cross-border and non cross-border banks are, on average, quite similar along different dimensions. However, non cross-border banks show a higher level of home sovereign exposure, which is explained by the fact that typically these are small domestic banks, with a less diversified portfolio. Non cross-border banks also display a higher average loan growth, and somewhat higher capital and liquidity ratios.

Table 2: Summary Statistics

Sample	Mean	S.D.	N
Cross-border			
Loan volume growth	0.5	6.0	6838
Home sovereign exposure	3.2	2.7	5309
Capital ratio	11.1	3.4	6495
Liquidity ratio	14.2	9.1	6838
Non cross-border			
Loan volume growth	0.8	4.9	20572
Home sovereign exposure	4.9	5.0	12446
Capital ratio	13.1	7.6	15128
Liquidity ratio	15.6	16.2	20572
Total			
Loan volume growth	0.8	5.2	27410
Home sovereign exposure	4.4	4.9	17755
Capital ratio	12.5	6.7	21623
Liquidity ratio	15.2	14.8	27410

Note: The table reports the mean, standard deviation (S.D.) and total number of observations (N) of the main variables used in the empirical analysis: the 3-month growth rate of loans to non-financial institutions, banks' exposure to domestic (home) sovereign securities as a ratio of main assets, the capital and liquidity ratios. All variables are expressed as percentages. These indicators are grouped for cross-border banks and non cross-border banks. *Source:* ECB's IBSI and IMIR dataset.

4 Empirical methodology

We exploit the cross-border dimension of our dataset to separate, for each bank, the variation in the lending activity specific to the lender country (or head bank) characteristics, on the one hand, and the borrower country characteristics, on the other (see [Khwaja and Mian, 2008](#), [Amiti and Weinstein, 2018](#), for a similar approach). Then, we identify the loan supply channel of the sovereign stress transmission as arising from the lender-specific characteristics and the loan demand channel as arising from the borrower-specific characteristics. The key identifying assumption is that idiosyncratic developments in the host country in which a foreign subsidiary operates will not affect the lending activity of the head bank in its home country. Idiosyncratic developments in the home country which affect the funding conditions of the banking group, however, can propagate to the lending activity of a foreign subsidiary. This allows us to isolate movements in the lending activity of a foreign subsidiary which are due to changes in the funding conditions of the banking group, on the one hand, and to changes in demand factors of the host country, on the other.

In the baseline setup, $L_{b(i),j,t}$ corresponds to the annualised 3-months growth rate of loan volumes to non-financial corporations of bank b from home country i operating in host country j at time t . Note that, in the empirical analysis, we consider both $i = j$, i.e., lending in the home country, and $i \neq j$, i.e., lending in host countries. In order to

identify the loan supply channel of the sovereign stress transmission, we estimate the following equation:

$$L_{b(i),j,t} = \alpha_{j,t} + \beta S_{i,t-1} + \gamma X_{i,t-1} + \xi_{b(i),j,t} \quad (1)$$

where $\alpha_{j,t}$ are *host* country-time fixed effects, and $S_{i,t-1}$ is the 10-year sovereign yield of the *home* country i where the head bank originates. We include the lag of $S_{i,t}$ to allow for a gradual pass-through of sovereign stress to lending. In addition, $X_{i,t-1}$ includes the capital ratio and the liquidity ratio at the consolidated level of bank $b(i)$ to control for regulatory and other factors which might affect lending on top of the sovereign yields. Host country-time fixed effects $\alpha_{j,t}$ capture all the observable and unobservable time-varying characteristics of the host country in which bank $b(i)$ operates, i.e., borrower-specific factors affecting its lending in the host country (see [Khawaja and Mian, 2008](#)). These include the macroeconomic and financial market developments of the host country, such as the movements in its sovereign yield. Thus, β isolates the effect of changes in the *home* sovereign yield, $S_{i,t-1}$, on the lending activity of bank $b(i)$ in the *host* country j , controlling for group-level characteristics, and for the correlation between the home and the host sovereign yields.

Let us provide a concrete example: suppose that bank $b(i)$ is a foreign subsidiary of BNP Paribas, whose head institution resides in France, and which operates in Italy. In this case, $\alpha_{j,t}$ refer to Italy-specific fixed effects and thus capture the variation in bank $b(i)$'s lending caused by developments that are specific to the borrower country (Italy). In turn, $S_{i,t-1}$ refers to the sovereign yield on the 10-year French bond, and thus to the sovereign stress generated in the home country (France) of BNP Paribas. This approach is substantially different from that which is typically proposed in the literature, in that we allow the shock to be generated in a different country from the one in which the bank operates. Thus, we isolate a pure supply effect deriving by the worsening of the funding conditions at the banking group level. In this way, the identification of the loan supply channel of the sovereign stress transmission is sharper compared with previous studies in the literature.

In order to identify the loan demand channel of sovereign stress transmission, we use the following equation:

$$L_{b(i),j,t} = \alpha_{i,t} + \beta S_{j,t-1} + \gamma X_{j,t-1} + \xi_{b(i),j,t} \quad (2)$$

where again $L_{b(i),j,t}$ is the lending of bank b from home country i which operates in host country j , $\alpha_{i,t}$ are the *home* country-time fixed effects, $S_{j,t-1}$ is the 10-year sovereign

yield of the *host* country, and $X_{j,t-1}$ includes industrial production and unemployment as macro-level controls of the host country to capture any business cycle developments which may affect local demand conditions. We also consider a more restrictive specification in which we include head bank-time fixed effects, defined as $\alpha_{h(i),t}$, replacing $\alpha_{i,t}$. This allows us to isolate directly the head bank-specific characteristics and thus track more precisely any changes in the funding conditions of the banking group of bank b . The fixed effects $\alpha_{i,t}$ (and $\alpha_{h(i),t}$) capture all observable and unobservable time-varying home country-specific (head bank-specific) characteristics. Thus, they control for the lender specific factors affecting the lending of bank $b(i)$ in the host country j , including the deterioration of funding conditions at the banking group level as a consequence of sovereign stress in the home country. Therefore, β isolates the effect of a change in the sovereign yield of the *host* country, $S_{j,t-1}$, on lending activity of bank $b(i)$ in the host country j , controlling for the loan supply channel and the potential correlation between the home and the the host yield.

5 Results

This section presents the main results of our empirical analysis. It is divided into two subsections which illustrate the effects of the sovereign stress transmission on the growth rates of loan volumes to non-financial corporations through, respectively, the loan supply and the loan demand channel.⁵

5.1 Loan supply channel

In Table 3, we present the baseline results for the regression (1). Estimation is carried out through a fixed-effects panel regression approach, where standard errors are clustered at the host country and time level. The regression reported in the first column includes host country-time fixed effects and a lag of the dependent variable as the only control for the entire set of banks in the sample, i.e., both cross-border and non cross-border banks (as reported in Column 2 of Table 1). The second column adds capital and liquidity ratios as further controls, and the third column restricts the sample to cross-border banks only. The number of observations is high. Even in the most restrictive case (Column 3), we have more than five thousands data points.

We find a negative and statistically significant effect of an increase in sovereign stress on lending volumes through the loan supply channel, which is also fairly stable

⁵In Appendix A, we also report our findings on the effects of the sovereign stress on the (bank-specific) lending rates to non-financial corporations, as driven by the two channels.

Table 3: Supply channel effects on growth rates of loans

	(1)	(2)	(3)
	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$
$S_{i,t-1}$	-0.440***	-0.446***	-0.403***
	(-4.78)	(-4.84)	(-3.55)
Only cross-border banks	no	no	yes
Controls	no	yes	yes
R ²	0.150	0.161	0.269
Adjusted R ²	0.0851	0.0830	0.0742
F	39.64	22.25	6.922
N	23343	18605	5388

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $L_{b(i),j,t}$ is the annualised 3-month growth rate of loan volumes to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{i,t-1}$ is the three-months moving average of the 10-year sovereign yield of country i in month $t - 1$. Column (1) includes a lag of the dependent variable as unique control, whereas Columns (2) and (3) include the capital ratio and the liquidity ratio at the consolidated level in month $t - 1$ as additional controls. Standard errors are clustered at the host country and time level.

across the different specifications. The magnitude of this effect is economically relevant. A 100 basis points increase in the domestic sovereign yield leads to an average decrease in loan growth of about 0.40-0.45 percentage points. This channel accounts for about 20% of the standard deviation of the loan growth, suggesting that the loan supply channel is an important determinant of credit volatility. In Table 3 and the following Tables, we do not show estimates for the control variables, for sake of space. They are available upon request.

The loan supply channel of sovereign stress transmission may depend on whether the head bank (or the banking group) is highly exposed to home sovereign debt (see, e.g., [Altavilla et al., 2017](#); [Bottero et al., 2020](#)) or whether the subsidiary is domestic or foreign. Therefore, in Table 4, we augment the baseline specification - as reflected in Column (2) of Table 3, which includes all banks, and Column (3), which includes only cross-border banks - in order to account for sovereign exposure and the (domestic vs. foreign) lenders' origin. To this end, we add the following set of controls to the baseline specification of Table 3: the first set of controls includes a dummy that takes value one if the home and host countries of bank $b(i)$ are the same, i.e., $I(i = j)$, and its interaction with the home 10-year sovereign yield $S_{i,t-1}$. The second set of controls includes the domestic sovereign exposure of the head bank of bank $b(i)$, i.e., $E_{h(i),t-1}^i$, its interaction with $I(i = j)$, and a three-way interaction between $S_{i,t-1}$, $I(i = j)$ and

$E_{h(i),t-1}^i$. Specifically, we estimate the following equation:

$$\begin{aligned}
L_{b(i),j,t} = & \alpha_{j,t} + \beta_1 S_{i,t-1} + \beta_2 I(i = j) + \beta_3 S_{i,t-1} * I(i = j) + \\
& + \beta_4 E_{h(i),t-1}^i + \beta_5 S_{i,t-1} * E_{h(i),t-1}^i + \\
& + \beta_6 I(i = j) * E_{h(i),t-1}^i + \\
& + \beta_7 S_{i,t-1} * I(i = j) * E_{h(i),t-1}^i + \gamma X_{i,j,t-1} + \xi_{b(i),j,t} ,
\end{aligned} \tag{3}$$

The first two columns of Table 4 add only $I(i = j)$ and its interaction with $S_{i,t-1}$ to the specifications of Columns (2) and (3) of Table 3. We observe a more negative coefficient associated to the home sovereign yield. However, $\hat{\beta}_1$ has a different interpretation than $\hat{\beta}$ of Table 3: it is now the coefficient associated to an increase in home sovereign stress conditional on bank $b(i)$ operating in a foreign country. For the sample including only cross-border banks (Column 2), we observe a positive and significant $\hat{\beta}_3$. This means that, on average, foreign banks cut lending more than domestic ones, for which we observe a smaller effect, as reflected by the sum of the coefficients $\hat{\beta}_1$ and $\hat{\beta}_3$. Put differently, this suggests that when cross-border banks deleverage due to a worsening of funding conditions in their home country, they do so in particular in foreign countries. While international spillovers of sovereign stress have already been emphasised in some papers (e.g. [Correa et al., 2016](#)), the stronger deleveraging operated on foreign assets is novel in the literature.

Columns (3) and (4) of Table 4 add home sovereign exposure at the head bank level $E_{h(i),t-1}^i$ and its interaction with $S_{i,t-1}$ to the baseline specification. In this case, $\hat{\beta}_1$ represents the effects of sovereign stress on lending conditional on the head bank having no home sovereign exposure. We do not find *prima facie* evidence of a strengthening of the loan supply channel if sovereign exposure is higher, as reflected in a $\hat{\beta}_5$ coefficient not statistically different from zero. This refers to the overall sample of banks. However, the picture substantially changes when we distinguish between the domestic and foreign origin of banks for the full sample (Column 5) and for the sample of cross-border banks (Column 6). In practice, we add the dummy $I(i = j)$, its interaction with $S_{i,t-1}$ and a three-way interaction term between $E_{h(i),t-1}^i$, $S_{i,t-1}$ and $I(i = j)$. In this case, the interpretation of the coefficients and the overall effect of sovereign stress on lending is less trivial. The coefficient $\hat{\beta}_1$ reflects the effect of the sovereign stress conditional on being a foreign subsidiary and the head bank having no home sovereign exposures. In line with the findings reported in Columns (1) to (4), the coefficient is negative and significant across the different specifications. The estimated coefficients of the interaction between the domestic bank dummy and sovereign yields, i.e., $\hat{\beta}_3$, and of

Table 4: Supply channel effects conditional on sovereign exposure and domestic vs. foreign origin of the head bank

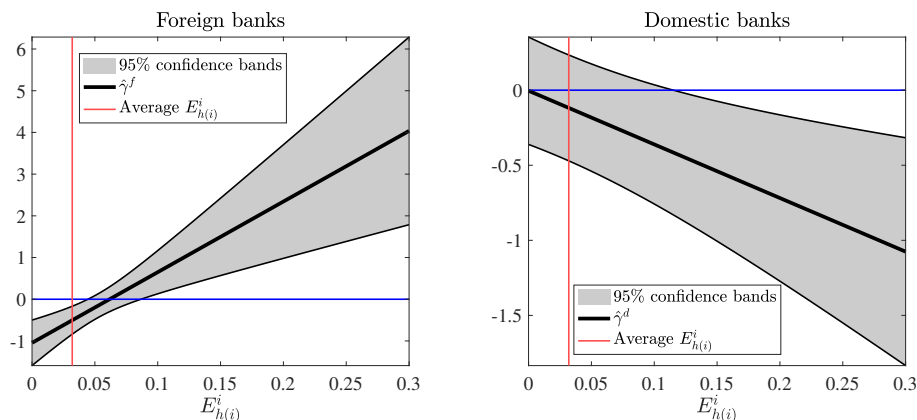
	(1)	(2)	(3)	(4)	(5)	(6)
	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$
$S_{i,t-1}$	-0.503*** (-4.04)	-0.599*** (-4.26)	-0.477*** (-4.05)	-0.355** (-2.42)	-0.879*** (-3.20)	-1.045*** (-3.76)
$I(i = j)$	-0.144 (-0.47)	-1.972*** (-3.76)			-1.695** (-2.50)	-3.185*** (-3.88)
$S_{i,t-1} * I(i = j)$	0.0703 (0.66)	0.551*** (2.93)			0.575** (2.32)	1.042*** (3.83)
$E_{h(i),t-1}^i$			-3.794* (-1.88)	-1.821 (-0.26)	-25.01** (-2.26)	-41.21*** (-3.24)
$S_{i,t-1} * E_{h(i),t-1}^i$			0.0475 (0.18)	-0.255 (-0.18)	10.31** (2.36)	16.94*** (3.69)
$I(i = j) * E_{h(i),t-1}^i$					22.73** (2.06)	53.91*** (3.91)
$S_{i,t-1} * I(i = j) * E_{h(i),t-1}^i$					-10.48** (-2.39)	-20.51*** (-4.50)
Only cross-border banks	no	yes	no	yes	no	yes
Controls	yes	yes	yes	yes	yes	yes
R ²	0.161	0.271	0.176	0.232	0.177	0.236
Adjusted R ²	0.0829	0.0766	0.0790	0.0510	0.0801	0.0557
F	15.87	8.299	7.000	3.413	4.606	5.609
N	18605	5388	12888	4718	12888	4718

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $L_{b(i),j,t}$ is the annualised 3-month growth rate of loan volumes to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{i,t-1}$ is the three-months moving average of the 10-year sovereign yield of country i in month $t - 1$. $I(i = j)$ is a dummy that equals 1 if bank $b(i)$ is domestic in country j (i.e. $i = j$) and 0 otherwise. $E_{h(i),t-1}^i$ is the domestic (country i) sovereign exposure of the head bank $h(i)$ of bank $b(i)$. Columns (1) to (7) include a lag of the dependent variable, the capital ratio and the liquidity ratio in month $t - 1$ as controls. Standard errors are clustered at the host country and time level.

Figure 1: Effect of the loan supply channel for cross-border banks depending on their home sovereign exposure



Note: The figure shows the percentage point effect on lending in the host country following a 100 b.p. increase in the home sovereign yield, depending on the degree of exposure to the home sovereign ($E_{h(i),t-1}^i$). The coefficient $\hat{\gamma}^f$ (left chart) captures lending by foreign cross-border banks, while the coefficient $\hat{\gamma}^d$ (right chart) lending by domestic cross-border banks. The red vertical line corresponds to the average home sovereign exposure in the sample.

interaction between sovereign exposures and sovereign yields, i.e., $\hat{\beta}_5$, are positive and significant. The former coefficient shows that, in response to an increase in home sovereign stress, and conditional on the head banks having no sovereign exposure, domestic lenders cut their lending in the home country less than foreign ones. This is consistent with the findings of Column (2). The latter coefficient suggests that, when home sovereign stress increases, a higher home sovereign exposure of foreign subsidiaries reduces the contraction in lending volumes in the host country. If domestic sovereign exposures of the head bank are large (i.e., above about 6% of total assets), foreign banks actually increase their lending in the host country where they operate following negative developments in the home country’s sovereign yield. We can interpret this finding, which is new in the literature, as a “flight-to-quality” phenomenon. Finally, we observe a negative and significant coefficient for the three-way interaction term $\hat{\beta}_7$, especially for the sample with only cross-border banks (Column 6). This shows that domestic lenders contract lending more in the home country the higher their home sovereign exposure.

We summarize these results in Figure 1, where we report the overall effect of an increase in sovereign stress through the loan supply channel for domestic and foreign cross-border lenders by varying their exposure to domestic (i.e., home) sovereign debt. This effect depends on the domestic sovereign exposure of the head bank. We construct

$\hat{\gamma}^f$ and $\hat{\gamma}^d$, based on the estimated coefficients reported in Column (6) of Table 4:

$$\begin{aligned}\hat{\gamma}^f &= \hat{\beta}_1 + \hat{\beta}_5 E_{h(i)}^i \\ \hat{\gamma}^d &= \hat{\beta}_1 + \hat{\beta}_3 + (\hat{\beta}_5 + \hat{\beta}_7) E_{h(i)}^i\end{aligned}$$

and make domestic sovereign exposures $E_{h(i)}^i$ vary in the range $[0, 0.3]$, where 0 represents no exposure and 0.3 indicates a 30% share of domestic sovereign debt relative to main assets. We choose 30% as an upper bound as it corresponds to the largest sovereign exposure observed in our sample of cross-border banks. The coefficient $\hat{\gamma}^f$ represents the percentage points effect on lending in the host country by foreign cross-border banks, following a 100 basis points increase in the home sovereign yield. The coefficient $\hat{\gamma}^d$ represents the effect on the lending by domestic cross-border banks. The two charts display substantially different patterns. The left chart suggests that, for the average foreign cross-border bank in our sample (as represented by the red vertical line), there is a contraction of lending in the host country following an increase in sovereign stress in the home country. Lending in the host country still shrinks, though to a lesser degree, for home sovereign exposure between 3% and about 6%. However, if home sovereign exposure is higher than 6%, we observe a strong, positive, and significant expansion of lending in the host country. For example, for an exposure of around 15%, our findings suggest that the growth rate of lending in the host country rises by about 1.5 percentage points. The picture is substantially different when we focus on domestic cross-border banks (right chart), for which the coefficient is negative, and significant for levels of domestic sovereign exposure higher than 10%.

All in all, we document an important role of the loan supply channel of sovereign stress transmission for lending activity, which also depends on sovereign exposure and on the (domestic vs. foreign) lenders' origin.

5.2 Loan demand channel

Here, we report the results on the loan demand channel as a driver of lending activity. Table 5 presents the results for the baseline regression (2). The first column includes home country-time fixed effects and a lag of the dependent variable as the only control for the entire set of banks in the sample, i.e., both cross-border and non cross-border (Column 2 of Table 1). Columns (2) to (4) also include industrial production and the unemployment rate as additional controls to capture business cycle developments. The third and fourth column restrict the sample to only cross-border banks. The fourth column replaces the home country-time fixed effects with head bank-time fixed effects,

i.e., $\alpha_{h(i),t}$.

Table 5: Demand channel effects on growth rates of loans

	(1)	(2)	(3)	(4)
	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$
$S_{j,t-1}$	-0.259*** (-3.50)	-0.411*** (-4.66)	-0.371*** (-3.08)	-0.376*** (-2.81)
$\alpha_{i,t}$	yes	yes	yes	no
$\alpha_{h(i),t}$	no	no	no	yes
Only cross-border banks	no	no	yes	yes
Controls	no	yes	yes	yes
R ²	0.146	0.147	0.176	0.263
Adjusted R ²	0.0717	0.0720	0.0172	0.00842
F	38.31	21.03	2.602	3.333
N	23702	23702	5775	5137

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $L_{b(i),j,t}$ is the annualised 3-month growth rate of loan volume to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{j,t-1}$ is the three months moving average of the 10-year sovereign yield of country j in month $t - 1$. Column (1) includes a lag of the dependent variable as unique control. Columns (2), (3) and (4) include industrial production and unemployment in month $t - 1$ as additional controls, Columns (1) to (3) have home-country fixed-effects, while Columns (4) has fixed-effects at the head-bank level. Standard errors are clustered at the host country and time level.

We find a negative and statistically significant effect of an increase in sovereign stress in the host country on lending growth through this channel across the different specifications. In particular, the estimated coefficients are very similar when macroeconomic controls are included (Columns 2 to 4), regardless if we focus on cross-border banks only or use head bank-specific fixed effects.

In terms of the size of this channel, we note that a 100 basis points increase in the 10-year sovereign yield of the host country leads to an average decrease in loan growth of around 0.4 percentage points. This accounts for approximately 17% of the standard deviation of loan growth, slightly less than for the loan supply channel (which was about 20%).⁶

Similarly to the loan supply channel, the loan demand channel of sovereign stress transmission could depend on the fact that lenders are domestic or foreign, and on sovereign exposures. However, in this context, the sovereign exposure that matters is the one to the *host* country where the bank operates, because the sovereign exposure to

⁶In Appendix B, we perform an IV regression, based on the Greek sovereign debt crisis which is used as an exogenous source of variation for yields in other fragile euro area countries, to assess the robustness of the loan demand channel of sovereign stress transmission.

the home country is already controlled for by head bank-time fixed effects. We expect this channel to be not very powerful as head banks and their subsidiaries tend to hold relatively few host country sovereign securities (see, e.g., [Altavilla et al., 2017](#)). Finally, the loan demand channel could depend on whether the host country was under stress in the sovereign debt market, in the analysed sample, or not. Specifically, we divide the sample and include a group of “stressed” countries, composed by Cyprus, Greece, Ireland, Italy, Portugal, Slovenia, and Spain. These are the countries which have been affected the most by the European sovereign debt crisis of 2011-2012 (see, e.g., [Lane, 2012](#)). To account for these different factors, we extend the baseline specification (2) as follows:

$$\begin{aligned}
L_{b(i),j,t} = & \alpha_{h(i),t} + \beta_1 S_{j,t-1} + \beta_2 I(i = j) + \beta_3 S_{j,t-1} * I(i = j) + \\
& + \beta_4 E_{b(i),t-1}^j + \beta_5 S_{i,t-1} * E_{b(i),t-1}^j + \\
& + \beta_6 I(i = j) * E_{b(i),t-1}^j + \\
& + \beta_7 S_{j,t-1} * I(i = j) * E_{b(i),t-1}^j + \gamma X_{i,j,t-1} + \xi_{b(i),j,t},
\end{aligned} \tag{4}$$

where $\alpha_{h(i),t}$ is the head-bank fixed effect, $I(i = j)$ is a local lender dummy that takes value one if the home and host countries of bank $b(i)$ are the same. We then include its interaction with the *host* 10-year sovereign yield $S_{j,t-1}$, the host sovereign exposure of the bank $b(i)$, i.e., $E_{b(i),t-1}^j$, its interaction with $S_{j,t-1}$ and $I(i = j)$, and a three way interaction between $S_{j,t-1}$, $I(i = j)$ and $E_{b(i),t-1}^j$.⁷

The first column of Table 6 presents the estimation results in which we include only the local lender dummy, $I(i = j)$, and its interaction with the host country sovereign yield, $S_{j,t-1}$. The second column focuses on cross-border banks that operate only in stressed countries. The interaction coefficient $\hat{\beta}_3$ is positive and significant across specifications. This suggests that local lenders decrease credit less than foreign ones when sovereign stress in the host country increases. Quantitatively, these results suggests that following a 100 basis points increase in the host sovereign yield, lending via foreign banks contracts by 0.4 percentage points and by 0.1 percentage points via domestic banks (Column 1). Interestingly, if we focus on the sample of cross-border banks that operate in only stressed host countries, we observe a larger positive and significant $\hat{\beta}_3$ and a more negative coefficient $\hat{\beta}_1$ (Column 2). It seems therefore that foreign banks cut lending strongly in response to host country stress, even more so if the borrower country is stressed. This result confirms the view prevailing in international finance that foreign investors tend to be more flighty (see, e.g., [Caballero and Simsek,](#)

⁷Note that when $i = j$, equation (4) still differs from equation (3) because it includes head-bank fixed effects instead of country-specific fixed effects.

Table 6: Demand channel effects conditional on sovereign exposure and domestic vs. foreign origin of the head bank

	(1)	(2)	(3)	(4)	(5)	(6)
	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$
$S_{j,t-1}$	-0.406*** (-3.09)	-2.349*** (-4.15)	-0.318** (-2.50)	-2.312*** (-4.06)	-0.409*** (-2.60)	-2.138*** (-3.68)
$I(i = j)$	-0.814** (-2.04)	-3.162* (-1.81)			-1.209* (-1.93)	-2.410 (-0.97)
$S_{j,t-1} * I(i = j)$	0.306** (2.29)	0.935** (2.18)			0.416** (2.19)	0.450 (0.72)
$E_{b(i),t-1}^j$			16.47*** (4.75)	-1.267 (-0.18)	7.413 (1.19)	5.830 (0.26)
$S_{j,t-1} * E_{b(i),t-1}^j$			-3.275** (-2.35)	-3.298** (-2.07)	-0.900 (-0.36)	-8.626 (-1.43)
$I(i = j) * E_{b(i),t-1}^j$					16.71** (2.37)	-13.99 (-0.59)
$S_{j,t-1} * I(i = j) * E_{b(i),t-1}^j$					-4.166 (-1.50)	7.759 (1.22)
Stressed j	no	yes	no	yes	no	yes
R ²	0.177	0.263	0.179	0.286	0.181	0.290
Adjusted R ²	0.0178	0.00806	0.0203	0.0558	0.0213	0.0582
F	2.467	2.265	6.958	7.568	5.317	5.003
N	5775	5137	5775	2514	5775	2514

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $L_{b(i),j,t}$ is the annualised 3-months growth rate of loan volumes to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{j,t-1}$ is the three months moving average of the 10-year sovereign yield of country j in month $t - 1$. $I(i = j)$ takes value 1 if the lender is local and 0 if the lender is foreign. $E_{b(i),t-1}^j$ is the host (country j) sovereign exposure of bank $b(i)$ in month $t - 1$. All regressions include a lag of the dependent variable, industrial production and unemployment in month $t - 1$ as additional controls. Standard errors are clustered at the host country and time level.

2020).

Columns (3) and (4) of Table 6 present the results when we extend the baseline specification to account for the host country sovereign exposure of the particular bank $b(i)$ and its interaction with the sovereign yield of the host country j . Column (3) includes all banks, while Column (4) only the stressed borrower countries. The coefficient $\hat{\beta}_1$ represents the effects of sovereign stress on lending conditional on the bank holding no sovereign exposures to the host country. We observe a negative and significant coefficient for the different specifications. The magnitude of the estimated coefficient in the third column is similar to the one of Table 5. This is not surprising, however, as host sovereign exposure is expected to play a small role in the transmission. As before,

the magnitude of the effects of the sovereign stress through the loan demand channel turns out to be bigger when we focus on the stressed host countries (Column 4). The interaction coefficient $\hat{\beta}_5$ is negative and significant: the higher the exposure in host sovereign bonds, the stronger the lending cut in response to the sovereign stress in that country.

In the last two columns, we also include the local lender dummy, the interaction term with $S_{j,t-1}$ and, additionally, a three-way interaction term between the host sovereign exposure of the bank, the sovereign yield and the dummy $I(i = j)$. By introducing all the interaction terms, we observe, again, a negative and significant $\hat{\beta}_1$ across the different specifications. In this context, $\hat{\beta}_1$ is the effect of an increase in sovereign stress in the host country conditional on being a foreign lender with no sovereign exposure in the host country. The effect of the host sovereign yield is again stronger for stressed countries (Column 6). The local lender interaction term is positive and significant only when both stressed and non-stressed countries are included, while $\hat{\beta}_5$ becomes insignificant for both specifications. In general, these results suggest that, when local lender dummies are introduced, the role of host sovereign exposure becomes negligible for the transmission of sovereign stress through the demand channel.

6 Is a diversified banking system overall beneficial?

The overall assessment on the role of foreign banks in stabilising the domestic banking sector in the presence of sovereign stress needs two elements. One is the set of elasticities to the sovereign shocks, which is provided in the previous analysis. One general result is that foreign lenders tend to react more strongly to sovereign yield shocks, both in terms of lending supply when the shock originates in their home country, and in terms of reaction to local demand shocks in the host country. At the same time, funding conditions for foreign banks are not affected by shocks occurring in the host sovereign debt market, and thus the loan supply channel is inactive in the presence of such shocks.

A second element is a model for the stochastic processes underlying the realisation of the sovereign shocks in each economy. A stylised mean-variance model, calibrated with the parameters from the empirical analysis, is proposed here to show under which conditions a higher share of foreign banks is preferable, depending on the relative variance of domestic vs. foreign sovereign shocks.

Let ϵ^d and ϵ^f be the sovereign stress shocks in the domestic and foreign country respectively, which can be interpreted as changes in the sovereign yield in the two

countries. We assume that the shocks are normally distributed $\epsilon^d \sim N(0, \sigma_d^2)$ and $\epsilon^f \sim N(0, \sigma_f^2)$. The shocks are assumed to be uncorrelated, reflecting the conceptual framework of our empirical analysis, which controls for the correlation between sovereign yields via fixed effects. Let ΔL be the lending change in the domestic country in response to sovereign stress that originated both in the domestic economy and abroad. It will depend on the share of foreign lenders operating in an economy, which is defined as ϕ , and on the elasticities to the sovereign shocks estimated in the empirical analysis. In particular, changes in lending will evolve according to:

$$\Delta L = \epsilon^d((1 - \phi)\alpha + \phi\beta) + \epsilon^f(\phi\gamma) \quad (5)$$

where α is the sum of supply and demand channel elasticity to a domestic shock by domestic banks (from Column (1) in Table 4 and Column (1) in Table 6, respectively), β is the demand channel elasticity to a domestic shock by foreign banks (from Column (1) in Table 6). Note that the supply channel is inactive for foreign banks, when the shock hits the host country. Finally, γ is the supply channel elasticity to a foreign shock by foreign banks (from Column (1) in Table 4). This is an important element in the analysis, because foreign banks may export (to the host country) shocks which are originated in their home (foreign) country. The expected value of ΔL is then given by:⁸

$$E(\Delta L) = E(\epsilon^d)((1 - \phi)\alpha + \phi\beta) + E(\epsilon^f)(\phi\gamma) \quad (6)$$

Notice that $E(\Delta L) = 0$ as we assume normality of the shocks.

The variance of ΔL is given by:

$$var(\Delta L) = \sigma_d^2((1 - \phi)\alpha + \phi\beta)^2 + \sigma_f^2(\phi\gamma)^2 \quad (7)$$

Similarly to other portfolio problems in finance (see, e.g., [Markowitz and Todd, 2000](#)), we can frame the problem in terms of a “social planner” who wants to maximise expected lending and minimise the variance of lending and, to that aim, chooses the “optimal” share of foreign banks ϕ . Specifically, we consider the following problem:

$$\begin{aligned} \max_{\phi} \quad & E(\Delta L) - a * var(\Delta L) \\ \text{subject to} \quad & 0 \leq \phi \leq 1 \end{aligned} \quad (8)$$

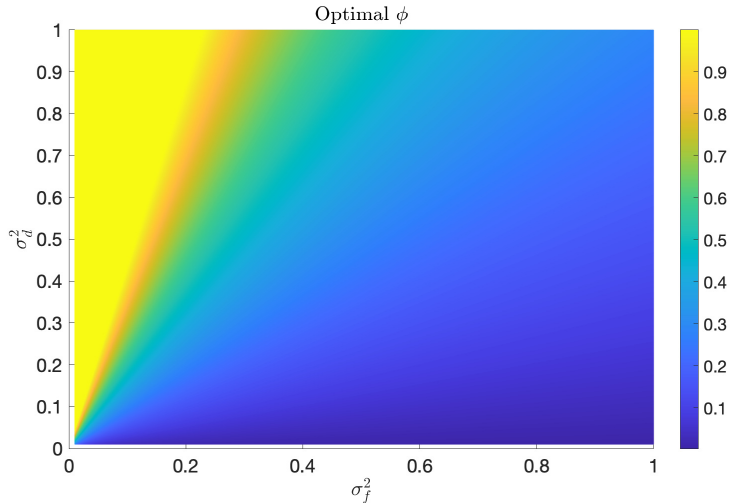
for a given value a , which weights the relative importance of lending variance.⁹

⁸Note that estimation uncertainty from the regression results in Table 4 and 6 is not taken into account here.

⁹The value of a is irrelevant for the exercise based on normally distributed shocks, because $E(\Delta L)$

We solve the problem above for the share of foreign banks in the domestic economy, ϕ , conditional to all combinations of σ_d^2 and σ_f^2 in the interval $[0,1]$ and report in Figure 2 the optimal values ϕ^* . The yellow region in Figure 2 indicates a combination of variances for which an economy populated only by foreign banks is optimal. The figure suggests that, when the variance of the foreign sovereign shocks is relatively low, a high share of foreign banks is preferable. In the extreme case in which the variance of such shocks is zero, it will always be optimal to have an economy populated by *only* foreign banks because they will be completely unaffected by shocks that originated in their own country. Put differently, a large share of foreign lenders in the host economy is always preferable conditional on domestic sovereign shocks only. In general, as long as the variance of foreign shocks increases relative to that of domestic shocks, it will be progressively less convenient to have a large share of foreign banks in the local economy.

Figure 2: Optimal ϕ^* with normally distributed sovereign shocks



Note: The figure shows the optimal share of foreign banks in the local economy, ϕ^* , for given levels of the variance of domestic (σ_d^2) and foreign sovereign shocks (σ_f^2), where such shocks are assumed to be normally distributed and centered around zero. The yellow region indicates a combination of variances consistent with an environment populated by only foreign banks, while in the dark blue region it would be optimal to have only domestic banks.

7 Conclusions

This paper offers new insights into the transmission of sovereign stress to lending to non-financial corporations, focusing on the role of cross-border banks. In contrast to

in equation (8) is zero. In Appendix C, we show the robustness of the exercise to shocks distributed as binomial. In that case, the value of a will affect the optimisation problem. We choose in an ad-hoc way a to be equal to 0.5, the results are broadly robust to other values of that parameter.

existing research, we explore the implications of sovereign shocks originating both in the domestic economy and abroad, and how they transmit to lending in the domestic economy via local banks and foreign ones.

We identify two channels through which these shocks propagate: a loan supply channel, which affects the funding conditions of banks, and operates through their balance sheets; and a loan demand channel, which depends on borrower characteristics.

Our results indicate that both the loan supply and the loan demand channels of transmission are quantitatively relevant. Each of them explains about 20% of lending variation over time, suggesting that both channels are important determinants of credit volatility. Moreover, we find that, on average, cross-border banks respond to an increase in sovereign stress in their home country mainly by deleveraging foreign positions. However, when home sovereign exposure is particularly high, these banks tend to increase lending in the host country, which can be interpreted as a flight-to-quality phenomenon. In addition, as regards the demand channel, our results indicate that foreign banks react more harshly to sovereign stress in the host countries.

We summarise our results in a stylised mean-variance model, calibrated with the parameters from the empirical analysis. The fundamental assumption is that the supply channel is inactive for foreign banks, because their funding conditions are not affected by stress in the host country sovereign. It turns out that, when the variance of foreign sovereign shocks is low relative to that of domestic sovereign shocks, a large presence of foreign lenders mitigates the sovereign-bank nexus, thus resulting in a sustained provision of credit in the presence of domestic sovereign stress.

Altogether, these findings suggest that a geographically diversified banking system might support the creation of a fully-fledged Banking Union for the Eurozone by alleviating the sovereign-bank nexus.

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Data Appendix

Data used in the empirical analysis

Variable	Unit	Transformation	Source
(1)	(2)	(3)	(4)
Loans to NFC	million of euro	3-months growth rate	IBSI
Loan rate to NFC	percent	3-months moving average	IMIR
Yield on 10-year govt. bond	percent	3-months moving average	Reuters
Capital ratio	percent	level	Van Dijk (Bankscope)
Liquidity ratio	percent	level	IBSI
Industrial production	index	3-months growth rate	Datastream
Unemployment	percent	level	Datastream

Note: Data are retrieved from the sources reported in Column (4), including two the ECB's confidential dataset: the Individual Balance Sheets Items dataset (IBSI) and the individual MFI interest rates (IMIR). In the IBSI dataset, bank-level loan growth rates are computed taking into account reclassifications and value adjustments. In the IMIR dataset, loan rates to NFC are bank-level averages for new loans. Before running the empirical analysis, data are transformed according to what reported in Column (3).

Additional results

A Loan rates

A.1 Supply channel effects on loan rates

We report here our findings for the supply side regression (1), where we use as dependant variable the (bank-specific) loan rate to non-financial corporations. Table A1 reports results when we use the same independent variables as in Table 2.

Table A1: Supply channel effects of sovereign stress on loan rates to NFC

	(1)	(2)	(3)
	$R_{b(i),j,t}$	$R_{b(i),j,t}$	$R_{b(i),j,t}$
$S_{i,t-1}$	0.244***	0.206***	0.0646
	(3.30)	(2.72)	(0.67)
Cross-border banks only	no	no	yes
Controls	no	yes	yes
R ²	0.941	0.937	0.963
Adjusted R ²	0.936	0.931	0.953
F	7022.9	2539.5	3548.2
N	21500	16851	4691

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $R_{b(i),j,t}$ is the annualised 3-months loan rate to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{i,t-1}$ is the 3-months moving average of the 10-year sovereign yield of country i in month $t - 1$. Column (1) includes a lag of the dependent variable as unique control, whereas Columns (2) and (3) include, additionally, the capital ratio and the liquidity ratio as additional controls. Standard errors are clustered at the host country and time level.

We find a positive and significant effect of a change in sovereign yields on loan rates for for the regressions reported in Column (1) and (2). Interestingly, the effect is still positive but not statistically significant once we control for host country-time fixed effects and restrict the focus on cross-border banks only.

A.2 Demand channel effects on loan rates

We also report our findings for the demand side regression (2), for loan rates to non-financial corporations. Table A2 reports results for regression where we use the same independent variables as in Table 5.

Across the different specifications, we find a strongly positive and significant effect of sovereign stress transmission to lending rates through the demand channel. Unlike the case of growth rates of loan volumes, the demand channel is significantly more important than

the supply one when focusing on loan rates. Interestingly, the demand channel effect on loan rates can be interpreted as driven by two components. On the one hand, according to the pure “demand” component of this channel, we would expect both loan volumes and loan rates to decrease when credit demand decreases due to an increase in sovereign stress. On the other, according to the “credit risk” component of this channel, we would expect loan volumes and loan rates to move in opposite directions, as this channel is driven by the supply of credit of banks (even though not through a deterioration of funding conditions). The positive and significant effect of an increase in sovereign stress of loan rates suggests that the risk component is relatively more important than the demand component. This could not be seen by simply looking at loan volumes, for which both channels imply a clear decrease.

Table A2: Demand channel effects of sovereign stress on loan rates to NFC

	(1)	(2)	(3)	(4)
	$R_{b(i),j,t}$	$R_{b(i),j,t}$	$R_{b(i),j,t}$	$R_{b(i),j,t}$
$S_{j,t-1}$	0.495*** (6.31)	0.535*** (5.01)	0.393*** (3.27)	0.536*** (3.84)
$\alpha_{i,t}$	yes	yes	yes	no
$\alpha_{h(i),t}$	no	no	no	yes
Cross-border banks only	no	no	yes	yes
Controls	no	yes	yes	yes
R ²	0.941	0.941	0.938	0.943
Adjusted R ²	0.935	0.935	0.926	0.921
F	6694.6	3464.2	1528.3	1634.7
N	21743	21743	5058	4526

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $R_{b(i),j,t}$ is the annualised 3-month loan rate to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{j,t-1}$ is the three months moving average of the 10-year sovereign yield of country j in month $t - 1$. Column (1) includes a lag of the dependent variable as unique control, whereas Columns (2) to (4) include, additionally, industrial production and unemployment in month $t - 1$ as additional controls. Standard errors are clustered at the host country and time level.

B IV regressions

Here, we present a robustness exercise for our loan demand channel equation (2), based on a simple IV regression. We focus on that channel only as our definition of the supply side is less affected by a possible reverse causality problem. In fact, in that framework, the shock originates in a different country than the one in which the bank operates and we believe this is largely rules out possible endogeneity problems.

As instrumental variable, we use the Greek sovereign yield interacted for a dummy with

value 1 for the period from April 2010 to December 2011, which corresponds with the peak of the Greek sovereign crisis, and 0 otherwise. The idea is to isolate more effectively exogenous movements in the sovereign yield of other European countries, which is arguably the case when we focus on the contagion from Greece to those countries in that period. We focus on stressed countries only (Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain) because the first stage coefficients would not be interpretable if using the whole set of 19 euro area countries. Indeed, due to flight to quality, one may expect that stress in the Greek sovereign market would reduce - rather than increase - the yields in the core countries. We perform four exercises, which are presented in Table B1.

Table B1: Demand channel effects in an IV regression

	(1)	(2)	(3)	(4)
	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$	$L_{b(i),j,t}$
$S_{j,t-1}$	-0.185**	-0.184***	-0.232***	-0.229***
	(-2.05)	(-2.02)	(-4.78)	(-5.08)
Cross-border banks only	yes	yes	no	no
$\alpha_{h(i)}$	no	yes	no	yes
N	2766	2766	9812	9812

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable $L_{b(i),j,t}$ is the annualised 3-months growth rate of loan volumes to non-financial corporations of bank $b(i)$ that operates in country j in month t . $S_{i,t-1}$ is the three months moving average of the 10-year sovereign yield of country i in month $t - 1$, which is instrumented with the Greek yield for the same month. Regressions include a lag of the dependent variable as unique control. Standard errors are clustered at the host country and time level.

The first column presents a simple IV regression of the growth rate of loan volumes on the host country sovereign yield where the sample is restricted to stressed host countries and cross-border banks only. In line with our baseline results, the coefficient is negative and statically significant at the 1% confidence level. In the second column, we add head-bank fixed effects in order to better control for the supply side.¹⁰ Again, the coefficient turns out to be negative and highly significant. In columns three and four we perform the same exercise of the first two columns, but for the entire banking sample in stressed host countries (including cross border and non cross-border banks). Across different specifications, the coefficients of a sovereign stress increase are negative and always highly statistically significant.

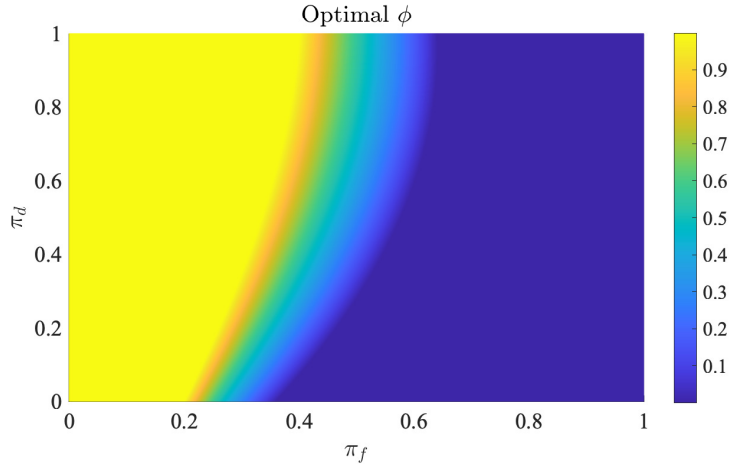
¹⁰We cannot include head bank-time fixed effects, because in this case we could not use the Greek sovereign yield as an instrument, as it varies over time.

C Diversification exercise with binomially distributed shocks

We report here a robustness exercise to the one of Section 6 where, instead of assuming that the sovereign shocks ϵ^d and ϵ^f are normally distributed and centered around zero, we assume that they follow binomial distribution, with values 0 and 1. The optimisation problem is identical to the one in (8), but now the term $E(\Delta L)$ is not zero.

Similarly to Figure 2, the yellow region in Figure C1 indicates a combination of variances for which an economy populated by only foreign banks is optimal. Consistently with the findings of Section 6, Figure C1 suggests that, when the variance of the foreign sovereign shocks is low (in this case, below 0.2), a high share of foreign banks is preferable.

Figure C1: Optimal ϕ^* with binomial shocks



Note: The figure the optimal share of foreign banks in the local economy, ϕ^* , for given levels of the variance of domestic (σ_d^2) and foreign sovereign shocks (σ_f^2), where such shocks are assumed to be follow a binomial distribution with values 0 and 1.