The effects of the EBA's stress testing framework on banks' lending

Ahmed, Kasim; Calice, Giovanni

Economic Modelling

DOI:
10.1016/j.econmod.2023.106624

E-pub ahead of print: 01/03/2024

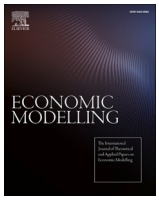
Publisher's PDF, also known as Version of record

Economic Modelling 132 (2024) 106624

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.journals.elsevier.com/economic-modelling



The effects of the EBA's stress testing framework on banks' lending☆

Kasim Ahmed [a], Giovanni Calice [b,*]

[a] Loughborough Business School, Loughborough University, LE11 3TU, United Kingdom
[b] Bangor Business School, Bangor University, LL57 2DG, United Kingdom

ARTICLE INFO

Handling Editor: Sushanta Mallick

JEL classification:
JEL
G20
G21
G28

Keywords:
Stress test
Macroprudential policy
EU banking system
Bank lending
Credit risk

ABSTRACT

This paper investigates the impact of the European Banking Authority (EBA)'s supervisory stress tests on bank lending. Using a sample of 282 European banks over the period 2006–2018, we find that stress-tested banks experience higher credit risk and reduce lending for specific loan types. In particular, due to country heterogeneities, we find that the contraction in lending is more pronounced for stress-tested banks in the GIIPS region. Our results also suggest that the elevated credit risk of highly-exposed stress-tested banks can be a driving factor of a reduction in bank lending. Consequently, prudential measures requiring banks to hold higher capital buffers are justified to contain credit risk shocks.

1. Introduction

Since the aftermath of the 2008–2009 global financial crisis, there has been a renewed debate on the banking system's resilience to withstand shocks. The crisis exposed the financial system's fragility due to the mismanagement of subprime mortgages. Thus, banking regulators have moved to enforce stricter regulations and capital requirements on the industry in an effortto enhance the international regulatory framework.

In this context, the improved framework, enacted via the Basel III Accords, highlights the inadequacies of the internal stress testing exercises, a standard risk management tool to assess credit risk (BCBS, 2009). Banks employ stress testing exercises to evaluate any possible adverse shock against their balance sheets. The outcome of the exercises provides information on banks' capital adequacy to regulators with an outlook of the bank's performance. However, during the crisis, the stress testing exercises failed to effectively assess risk and the ability of the banks to absorb large losses and continue to operate 'business as usual'. Therefore, the reformed regulations aimed to enhance the stress testing process for both banks and authorities.

This paper investigates the effects of supervisory stress tests conducted by the European Banking Authority (EBA) for a sample of large European Union (EU) banks. First, we examine the effects of supervisory stress testing on bank lending. The recent evidence suggests that the exercises may reduce lending, as shown for the U.S (Acharya et al., 2018, among others) and the UK (Ahmed and Calice, 2022).

We argue that the motivation behind the stress-tested banks' decision to reduce bank lending is to mitigate potential credit risk problems, as first suggested by Acharya et al. (2018). Therefore, in a second step, we examine whether stress testing affects credit risk.

From a methodological viewpoint, to our knowledge, this paper is the first to jointly use two methodologies to examine the effect of stress testing on credit risk and bank lending. In the spirit of Acharya et al. (2018), we employ the difference-in-differences approach to examine the lending and credit risk behaviour between stress-tested and non-stress tested banks. Furthermore, we employ the stress test exposure methodology using data from the EBA (Cortés et al., 2020).

We make four main contributions to the literature.

First, given the systemic importance of the EU banking system, we focus on a single financial jurisdiction. To our knowledge, we provide the first systematic assessment of the European banking system by addressing the effect of five stress testing exercises conducted over the

☆ We are grateful to the Editor and an anonymous referee for their very useful comments and suggestions.
* Corresponding author.
E-mail addresses: k.ahmed2@lboro.ac.uk (K. Ahmed), G.Calice@bangor.ac.uk (G. Calice).

https://doi.org/10.1016/j.econmod.2023.106624
Received 10 February 2023; Received in revised form 7 December 2023; Accepted 11 December 2023
Available online 20 December 2023

period 2010–2018. Therefore, we depart form recent studies that examine the impact of stress testing for only one or two exercises (Kok et al., 2023; Konietschke et al., 2022).

Second, we address the effect of stress testing on credit risk by using non-performing loans as a proxy, as existing studies document that banks reduce lending to curb credit risk. However, in the literature, to the best of our knowledge, there is no study that has yet investigated empirically this hypothesis.

Third, we extendthe identification strategy by jointly using two methodologies. Specifically, we employ the difference-in-differences methodology and stress test exposure specification. Fourth, we address possible differences in bank lending behaviour and credit risk among countries by grouping our banks into GIIPS (Greece, Ireland, Italy, Portugal and Spain) and non-GIIPS countries.

We arrive at several interesting results. First, we provide evidence that stress-tested banks reduce lending for specific loan types, as shown by the difference-in-differences specification. For instance, the corporate loans by the stress-tested banks fall by 24 p.p. relative to non-stress tested banks, as illustrated in Fig. 1. Second, using the stress-test exposure specification, our results show that highly-exposed banks reduce consumer loans and increase their share of bank loans. Hence, our evidence indicates that the stress testing framework leads highly-exposed banks to reduce riskier loan types (consumer loans).

In a second step, we measure the change in credit risk by analysing non-performing loans and show that stress-tested banks experience higher credit risk.

In addition, we conjecture that due to the vast size of the EU banking system, there are noticeable sovereign credit risk differences aacross countries. Therefore, we also control for the banks that are based in the GIIPS (Greece, Italy, Ireland, Portugal, and Spain) region. Overall, we find that stress-tested banks from the GIIPS region reduce loans and are subject to higher levels of credit risk.

Our findings highlight several policy implications. Although the stress testing framework main goal is to uphold financial stability, we show that it that it may inadvertently reduce corporate and consumer loans, thereby severaly disrupting economic activity. The result may seem undesirable, but some empirical evidence suggests that other banks substitute the stress-tested banks and become primary lenders (Cortés et al., 2020; Chen et al., 2017). Notably, the banking and finance literature has documented a reduction in the effectiveness of stress testing as a macroprudential regulatory tool in recent years. Nonetheless, our analysis yields mixed results, as our evidence demonstrates a reduction in the effectiveness of the stress tests for certain loan types. Consequently, regulators must remain vigilant on the effectiveness of the stress testing framework.

The results of stress-tested banks based in the GIIPS region show that banks reduce loans and face higher levels of credit risk. Regulators may thus need to consider whether the implementation of the stress testing framework can be developed to be more lenient for the banks domiciled in the GIIPS region.

The rest of the paper is organised as follows. Section 2 reviews the related literature on the effects of stress testing on bank lending and credit risk which primarily focuses on the U.S. Section 3 and Section 4 outline the data and methodology, respectively. In Section 5, we present our empirical results. Section 6 provides the robustness tests and some policy recommendations are discussed. Finally, Section 7 concludes.

2. Literature review

In the context of the U.S. financial system, there has been a noticeable reduction in credit for small businesses. Since the financial crisis, Cortés et al. (2020) find that stress-tested banks reduce lending to small businesses due to the risk of the loan type. Consequently, this may cause knock-on effects on the economy concerning reduced investment and economic output (Doerr, 2019). In addition, stress-tested banks normally raise the interest rate on loans for small businesses if the bank is located in the same region as the businesses. Furthermore, Cortés et al. (2020) provide further evidence that aggregate lending is unaffected as smaller banks begin to substitute the stress-tested banks and become primary lenders.[1] For the jumbo mortgage market, Calem et al. (2020) argue that prudential policies implemented since the crisis, including the stress testing framework, have instigated a reduction in the origination of jumbo mortgage loans. In particular, they show differences in the behaviour of the stress-tested banks, as banks that hold lower ex-ante capital before the stress test are more likely to reduce loans relative to banks with sufficient capital. In line with Cortés et al. (2020), Calem et al. (2020) also find that when stress-tested banks reduce lending, smaller banks replace the banks and fill the gap in providing credit. Similarly, Acharya et al. (2018) document the impact of the stress testing regime and find evidence that stress-tested banks increase the loan spreads and simultaneously seek to reduce loans to the economy. More specifically, there is an observable reduction in lending for commercial real estate loans and consumer loans such as credit card loans. Regarding the influence of stress testing over time, Acharya et al. (2018) posit that the earliest stress tests were more influential in instigating a reduction in bank lending.

Connolly (2017) assesses the effect of the earliest stress test (Supervisory Capital Assessment Programme) on lending between stress-tested banks and non-financial firms. In essence, if the stress-tested banks have established links with firms they lend to before the crisis, then after the crisis, the banks continue to increase loans to the same firm. However, one caveat is that inadequately capitalised banks will reduce lending relative to sufficiently capitalised banks. In a theoretical model, Shapiro and Zeng (2020) posit that regulators can influence bank lending behaviour through their decision-making. In sum, the regulators that administer the stress tests can either choose to pass or fail the participating banks, and their decision-making signals the regulator's behaviour. If the regulator fails the bank, it makes the regulator appear stricter, and the decision to pass the bank makes them appear lenient. As a result, banks that fail the stress testing reduce lending and invest in alternative assets.

Benbouzid et al. (2022) examine the effects of macroprudential policy on bank credit risk. Using a dataset of CDS of 70 banks for 25 countries over the period 2010–2019, the authors find that capital-based macro-prudential measures significantly reduce bank credit risk. In addition, they provide evidence that counter-cyclical capital buffers tightening decrease banks CDS spreads.

Ahmed and Calice (2022) examine the UK banking system and similarly document a reduction in bank loans to the economy. The authors suggest that banks that fail the stress test will reduce bank loans compared to banks which pass the stress test.

In a recent paper, Kok et al. (2023) examine the effects of stress testing on credit risk for banks that participate in the EBA's exercises. The results indicate that the stress tests improve the banks' credit risk profile. The authors view this as an exercise that serves as a disciplining tool to enhance credit risk. Furthermore, the effectiveness of the disciplining tool can be supported by more intensive supervisory scrutiny, where banks that are more scrutinised exhibit a reduced credit risk profile. Importantly, to our knowledge, Kok et al. (2023) are the first to suggest that there are causal effects between mitigating credit risk and reduced lending for the EU banking system. The paper suggests that as stress-tested banks seek to improve their credit risk profile, this can be achieved by reducing lending. One caveat of the findings is that the paper bases its conclusions only on the 2016 EBA exercise, which may weaken the significance of the results.

Similarly, Konietschke et al. (2022) find supporting evidence to

[1] In relation to the small business loans, Chen et al. (2017) document that the criticism of smaller banks becoming primary lenders is that there is a time lag in providing loans when they replace the larger banks. In addition, the loan terms may be unfavourable.

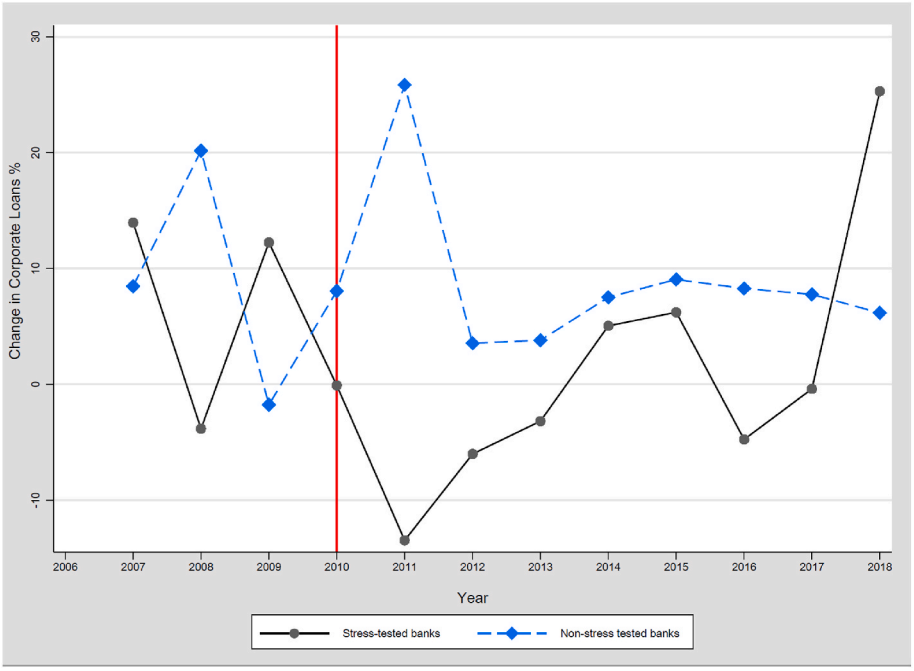


Fig. 1. Change in corporate loans.

suggest that the stress-tested banks from the EU region will also reduce bank lending to mitigate credit risk by ensuring they have a strong capital base. Furthermore, the authors highlight that stress-tested banks primarily cut back on risky lending and allocate credit to safer loan types, such as households. Although stress-test banks allocate funds to safer loan types, this occurs at the expense of lower profitability.

Since the SSM (Single Supervisory Mechanism) launch in the EU, Fiordelisi et al. (2017) find that the newly introduced supervisory framework has inadvertently shifted lending behaviour for the largest banks. Due to their national or global reach, the SSM targets the EU's largest banks as they are deemed systemically important institutions. Although the mechanism is viewed as an additional risk management tool to gauge the banking system's resilience, the authors document that the banks subject to the SSM oversight will reduce bank lending relative to alternative banks supervised by their national authorities. The rationale behind the largest banks' reduction in lending is to improve their capital position in preparation for the Comprehensive Assessment exercise.

3. Data

We collect data for the 2006–2018 period from the Orbis Bank Focus (formerly known as Bankscope) database. This database provides data on the characteristics of the EU banks. Furthermore, we employ the World Bank data on macroeconomic variables such as unemployment and GDP. In relation to the sample size, we include banks above the 10 billion euros threshold. This threshold is similar to the threshold used in the emerging banking literature examining the relationship between stress-tested and non-stress tested banks (Cornett et al., 2020; Ahmed and Calice, 2022).

We ensure that all the banks included in our sample are represented by their consolidated balance sheets for each banking group. This practice follows the EU stress testing framework methodology, whereby all participating banks must report their banking activities on the highest consolidation basis, including data of their respective subsidiaries (Committee of European Banking Supervisors, 2010).[2] Accordingly, we delete any subsidiary of a bank when its parent company is included in the sample. Finally, after cleaning the data and removing banks with insufficient data, we obtain a final sample of 282 banks.

For the sample of the 282 banks, one challenge was to overcome the issue of segregating the sample of banks into one of the two groups because stress-tested banks might have participated in the EBA stress tests at least once during the period 2010–2018.[3]

From 2010 detailed and disaggregated data on the selection of EU banks and the subsequent outcome of the exercise has been publicly disclosed by the EBA. The main advantage is that disaggregated information on the names of the participating banks, the initial capital ratio and the post-capital ratio of banks against the stress tests are publicly released. Such detailed information is useful to capture the effect of the stress test on a bank's capability to withstand a shock. Naturally, the data can be exploited to ascertain the effect of stress testing, as we demonstrate in the second methodological approach.

Since the 2010 stress tests, there have been changes in the number of banks participating in each stress test, where the largest number of banks (123 banks) were tested in the 2014 stress test, and the smallest number of banks (48 banks) in 2018. Certain banks may have been stressed at least once and then removed from the tests for several different reasons, such as inactivity or mergers and acquisitions.

It is important to note that selecting the criteria for banks included in the group of stress-tested banks is somewhat challenging. To alleviate this problem, we follow the selection criteria adopted by Borges et al. (2019), who analyse the market reaction to the EU stress testing

[2] See Cerutti and Schmieder (2014) who suggest that bank stress testing should account for unconsolidated data, thus stressing the subsidiary of banks in isolation.

[3] The first EU stress test was introduced in 2009 and developed by the Committee of European Banking Supervisors (CEBS), although the stress test was limited in nature, and does not include details of the names of the banks that participated in the test. Therefore, no information on capital ratios is available for the banks.

exercises. The authors implement an event study methodology for three stress testing frameworks (2010, 2011, and 2014) and consider a sample of banks participating in all three stress tests. In other words, the participating banks in their sample have been stressed yearly since the start of the EU stress testing framework, where data is publicly disclosed.

Yet, in our setting, we depart from Borges et al. (2019). First, we include banks that have been stressed in all five stress testing frameworks. However, for the more recent stress tests, banks from Greece and Portugal are not included in the 2016 stress test. In addition, Portuguese banks are not included in the 2018 stress test, but the Greek banks re-enter the stress test and are stressed separately from the main cluster of banks due to regulatory purposes.[4] However, we include these banks from these countries in our sample to corroborate our identification strategy that analyses GIIPS (Greece, Ireland, Italy, Portugal and Spain) banks that are particularly vital to understand possible differences when considering the EU banks.

Finally, the number of stress-tested banks include 39 banks from 16 countries[5]. These banks participate in every stress test (including the Greek and Portuguese banks) and their allocation in the group is conditional on banking data available from the Orbis Bank Focus database. All remaining banks in the sample are allocated to the non-stress tested banks group, which represents our control group for the difference-in-differences identification strategy.

The primary data concerning the performance against the stress tests are reported by the EBA, which publishes official documents such as methodologies, frequent questions and answers, and the results of the stress tests. The information is utilised for the second stage of the methodological approach, which helps construct the stress test exposure variable. All related documents are publicly available on the ECB webpage.[6]

In the first step, we analyse the effect of stress testing on bank lending. To this end, we examine the impact of the exercise on total loans, mortgage loans, corporate loans, consumer loans, and bank loans.

In the second step, we contribute to the literature by examining the effect of the exercises on credit risk. In a seminal paper, Acharya et al. (2018) find that stress-tested banks reduce lending to mitigate credit risk.

To test this hypothesis, we examine the changes in credit risk due to stress testing and assess if there are potentially statistically significant results. Specifically, we use the non-performing loan ratio as a proxy for credit risk and assess the impact on banks that participate in the EU stress tests. The robustness results section also provides additional credit risk proxies.

4. Methodology

In this section, we discuss the methodology on the effects of stress testing on bank lending for two groups of banks (stress-tested and non-stress tested banks) and within stress-tested banks.

First, we analyse the effects of stress testing on bank lending using a difference-in-differences approach. The approach examines the lending behaviour between stress-tested and non-stress tested banks across two periods, pre-treatment and post-treatment.

As a second methodological approach, we develop a stress test exposure variable, which Cortés et al. (2020) similarly employ to study the impact of stress testing on small business lending. The stress test exposure variable calculates the difference between the capital ratio of the participating bank at the beginning of the stress test and the post-capital ratio. As a result, we observe only the stress-tested banks to investigate heterogeneity among financial institutions.

To construct the difference-in-differences model, we first create two groups: the stress-tested and the non-stress tested banks. For the treatment group of banks, we have designated the 39 stress-tested banks that are selected following the criteria outlined in the data section of the paper. Another component of the difference-in-differences specification that must be identified is the treatment period concerning the beginning period of the EBA stress testing. For the treatment period, we have designated a dummy variable as 1 for the years 2010–2018, which can alternatively be viewed as the post-stress period. The pre-treatment period identifies, therefore, the remaining years, 2006–2009.[7]

Our methodology also develops triple difference-in-differences interactions to test for further heterogeneities among stress-tested banks. More precisely, we consider the impact of failing the stress test and being a part of the GIIPS region. Equation (1) outlines our applied econometric model, where i, j, and t are defined as the bank, country, and period, respectively. The coefficient B_3 outlines the difference-in-differences interaction of interest. Besides the primary model, we slightly modify the equation to capture the effect of a bank resulting in inadequate capital (a proxy for failing the stress test) and the effect of being a member of the GIIPS countries that are stress-tested. The B_4 coefficient shown in equations (2) and (3) outline the triple difference-in-differences interaction for the banks with inadequate capital and a stress-tested bank that is based within the GIIPS countries, respectively. In the literature, there is a vast body of research on the effectiveness of the stress testing toolkit as a prudential tool. The evidence for the U.S. financial system shows that the stress test's significance has diminished over time and that was more influential during the early stress testing years. To test this assumption, we explore the dynamic effect of stress testing in subsequent models.

$$\begin{aligned} \textit{Loan Type Growth / Credit Risk}_{\,i,j,t} &= \beta_0 + \beta_1\, \textit{Bank Specific Variables}_{i,j,t-1} \\ &+ \beta_2\, \textit{Macro Variables}_{t-1} + B_3\, \textit{Stress Tested Bank}_i * \quad \textit{Post Stress Period}_t \\ &+ \alpha_1\, \textit{Bank Fixed Effects}_i + \quad \alpha_2\, \textit{Time Fixed Effects}_t + \varepsilon_{i,j,t} \end{aligned} \tag{1}$$

$$\begin{aligned} \textit{Loan Type Growth / Credit Risk}_{i,j,t} &= \beta_0 + \beta_1\, \textit{Bank Specific Variables}_{i,j,t-1} \\ &+ \beta_2\, \textit{Macro Variables}_{t-1} + B_3\, \textit{Stress Tested Bank}_i * \quad \textit{Post Stress Period}_t \\ &+ B_4\, \textit{Stress Tested Bank}_i * \quad \textit{Post Stress Period}_t * \textit{Inadequate capital}_i \\ &+ \alpha_1\, \textit{Bank Fixed Effects}_i + \quad \alpha_2\, \textit{Time Fixed Effects}_t + \varepsilon_{i,j,t} \end{aligned} \tag{2}$$

$$\begin{aligned} \textit{Loan Type Growth / Credit Risk}_{i,j,t} &= \beta_0 + \beta_1\, \textit{Bank Specific Variables}_{i,j,t-1} \\ &+ \beta_2\, \textit{Macro Variables}_{t-1} + B_3\, \textit{Stress Tested Bank}_i * \quad \textit{Post Stress Period}_t \\ &+ B_4\, \textit{Stress Tested Bank}_i * \quad \textit{Post Stress Period}_t * \textit{GIIPS}_j \\ &+ \alpha_1\, \textit{Bank Fixed Effects}_i + \quad \alpha_2\, \textit{Time Fixed Effects}_t + \varepsilon_{i,j,t} \end{aligned} \tag{3}$$

[4] The results of the Greek banks that are stressed in 2018 are publicly released by the ECB, and the information presented concerns four Greek banks that were have been included since the inception of the EU stress tests. Furthermore, the same format concerning the release of the stress test results is presented in excel files: https://www.bankingsupervision.europa.eu/press/pr/date/2018/html/ssm.pr180505.en.html.

[5] In further robustness tests, we increase the stress testing group to include all the banks that have been participated in the EBA exercises at least once, conditional on the bank being available from Orbis Bank Focus. We find that the results are similar and robust. This is further discussed in the robustness section.

[6] For the results of the EU stress test from 2009 to 2018, see https://eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing.

[7] The EU stress tests first occurred in 2009 and were administered by the Committee of European Banking Supervisors. However, the stress test was small in scope and did not explicitly release the names of the banks that were included in the stress test, which means that no detailed results cannot be used for empirical analysis. Therefore, we highlight 2010 as our first year of the stress test in which detailed statistics of participating banks were made available to the public.

We explore the effects of stress testing on bank lending, and our empirical evidence in the U.S. and UK indicates the exercises cause a reduction in lending. Acharya et al. (2018) are the first paper to postulate that stress-tested banks reduce bank lending to mitigate credit risk issues. However, the authors do not produce econometric models to support their hypothesis.

We test the hypothesis and investigate the effects of stress testing on credit risk by substituting the dependent variable.

In the second methodology, we apply the stress test exposure of banks or its variation, which has been first adopted by Cortés et al. (2020), who use the variable to assess the effects of stress testing. We report three different variables for the stress test exposure variable based on the CET1 capital exposure, Tier 1 capital exposure, and Total capital exposure made available by the EBA (represented in ratio form).

Note that we remove the control group banks that are included in the first methodological approach. We solely focus on the 39 stress-tested banks that are part of the total sample of banks. The objective is to evaluate heterogeneities among stress-tested banks and if these heterogeneities affect bank lending practices and credit risk.[8]

In essence, for the stress test exposure variable, we calculate the exposure as the difference between the capital ratio before and after the stress test. We hypothesise that if banks are highly exposed to the stress test (greater reduction in capital due to the adverse shock), there is a significant effect on bank lending behaviour and credit risk. With regard to the econometric analysis, we use a dummy variable for the group of stress-tested banks. Banks designated as 1 are highly exposed to the stress test (above the median of the stress test exposure). Banks that are designated as 0 are less exposed to the stress test. Equations (4) and (5) follow the same econometric model as the difference-in-differences model. Nonetheless, we substitute the difference-in-differences interaction and use the stress test exposure to control for possible heterogeneities among stress-tested banks.

Moreover, we hypothesise that inherent differences among the highly-exposed stress-tested banks may persist. We, therefore, control for the effect of banks being highly-exposed and originating from GIIIPS countries. As in the previous section, we conjecture that highly exposed banks and those based in the GIIPS region will perform worse than their counterparts.

$$\begin{aligned} \textit{Loan Type Growth / Credit Risk}_{i,j,t} &= \beta_0 + \beta_1\, \textit{Bank Specific Variables}_{i,j,t-1} \\ &+ \beta_2\, \textit{Macro Variables}_{t-1} + \beta_3\, \textit{Stress Test Exposure Median}_{\,i,j,t-1} \\ &+ \alpha_1\, \textit{Bank Fixed Effects}_i + \alpha_2\, \textit{Time Fixed Effects}_t + \varepsilon_{i,j,t} \end{aligned} \tag{4}$$

$$\begin{aligned} \textit{Loan Type Growth / Credit Risk}_{i,j,t} &= \beta_0 + \beta_1\, \textit{Bank Specific Variables}_{i,j,t-1} \\ &+ \beta_2\, \textit{Macro Variables}_{t-1} + \beta_3\, \textit{Stress Test Exposure Median}_{\,i,j,t-1} \\ &+ \beta_4\, \textit{Stress Test Exposure Median}_{\,i,j,t-1} * \textit{GIIPS}_{\,j} \\ &+ \alpha_1\, \textit{Bank Fixed Effects}_i + \alpha_2\, \textit{Time Fixed Effects}_t + \varepsilon_{i,j,t} \end{aligned} \tag{5}$$

5. Empirical results

In the first stage of the empirical regressions concerning the difference-in-differences approach, we examine the effect of stress testing on bank lending.

Table 2 and Table 3 report the main dependent variables: total loans, mortgage loans, corporate loans, consumer loans, and bank loans. Three model specifications for each dependent variable are presented, including varying stress testing specifications. We include the baseline difference-in-differences interaction for the main model specification (1).

For nearly all the model specifications, we do not find statistically significant results for the effect of stress testing on bank lending(except for corporate loans, where the effect of stress testing on bank lending leads to a fall in corporate lending by approximately 24 p.p. relative to the control group included in our sample). Acharya et al. (2018) document similar results but focus on two different loan types: commercial real estate and consumer and industrial loans. The authors find that the U.S. stress-tested banks reduce lending for these loan categories relative to non-stress tested banks. Furthermore, Acharya et al. (2018) suggest that reducing a particular type of loan mitigates credit risk issues that would potentially arise if banks were to engage in risky lending. This aligns with the decrease in corporate lending by stress-tested banks seeking to mitigate elevated credit risk. This finding also mirrors the reduction in corporate loans of UK banks presented in Ahmed and Calice, 2022.

Next, we modify the difference-in-differences approach to create a triple difference-in-differences interaction. We include the effect of a stress-tested bank falling under the 5.5% CET1 capital threshold, which can be interpreted as a bank holding inadequate capital. One motivation to include this interaction is to measure banks that may have failed if the subsequent EU stress tests included a pass/fail threshold (hurdle rate[9]). The results for the triple difference-in-differences interaction are reported in model (2). Yet again, we find no statistically significant results for most of the loan types. However, there are statistically significant results for corporate loans. Banks that fall below the 5.5% CET1 threshold reduce lending by roughly 22 p.p. relative to banks that have CET1 capital ratios that are above the 5.5% threshold.

Importantly, this demonstrates that there are heterogeneities among stress-tested banks, which suggests that the stress test results can influence a bank's lending decision.

In line with the impact of U.S. stress tests, Acharya et al. (2018) also document that failing a stress test can trigger a reduction in bank lending. Specifically, the authors show that failed banks will reduce consumer and industrial loans closely linked to corporate loans as reported in Table 2.

The reduction of corporate loans by the stress-tested banks is discussed by Casey and O'Toole (2014), who examine corporate loans originating from banks across 11 EU countries. The authors document that there has been a shift in corporate lending since the financial crisis in the EU area, where banks have been adopting strategies to reduce corporate loans. In contrast, this may seem undesiderable for firms that seek loans for various purposes. Casey and O'Toole (2014) show that firms pursue other means to source funds, such as relying on trade credit to fund business activity. The reduction in corporate loans may be viewed as a negative effect. However, the reduction in corporate loans does not necessarily assume that firms will be largely affected by the contraction in banks lending, as other substitutes, such as trade credit, are accessible.

Furthermore, we find that banks that fall below the 5.5% CET1 ratio reduce bank loans by approximately 15 p.p. compared to banks above the 5.5.% CET1 ratio threshold. Undercapitalized banks alter their lending strategy and seek to cut back on bank loans. Failing a stress test can often play a pivotal role in stress-tested banks' future decision-making, as banks may face greater scrutiny from capital markets, where negative reactions can affect a bank's equity returns and earnings, (Morgan et al., 2014). The fall in profits, coupled with a negative market reaction, may exacerbate problems, and might ultimately lead to a reduction in lending.

Failing the stress test can warrant further scrutiny by the markets, as

[8] See for example, Liu et al. (2019) who document the difference in lending behaviour among stress-tested banks when taking into account the monetary policy regime.

[9] See for example, the BoE's stress testing frameworks that provides the methodology and results of the UK stress-tested banks which highlights the hurdle rates (pass/fail thresholds) that banks are expected to meet.

Table 1
Summary statistics.

Variable	Description	Observations	Mean	Std. Deviation	Min	Max
Dependent Variables						
Total loans change	Percentage change between the current and previous year.	2,440	2.02	15.85	−40.47	87.66
Mortgage loans change	Percentage change between the current and previous year.	960	6.28	31.98	−42.94	233.98
Consumer loans change	Percentage change between the current and previous year.	1,348	5.11	40.78	−66.24	283.25
Corporate loans change	Percentage change between the current and previous year.	1,236	6.52	45.24	−76.84	325.96
Bank loans change	Percentage change between the current and previous year.	2,409	3.87	49.79	−79.83	251.63
Credit Risk (NPL Ratio)	Impaired loans over gross loans.	2,517	4.97	7.09	0.00	45.02
Credit Risk (Loan Loss Provisions Ratio)	Loan loss provisions over total loans.	2,399	0.67	1.03	0.00	6.41
Credit Risk (Loan Loss Reserves Ratio)	Loan loss reserves over gross loans.	2,637	2.68	3.09	0.01	18.07
Independent Variables						
Size	Natural log of the banks' total assets.	2,778	10.70	1.52	8.12	14.39
Profitability	Profit over total assets. Similarly known as return on assets (ROA).	2,740	0.42	0.75	−2.82	2.62
Credit risk (NPL Ratio)	Impaired loans over gross loans.	2,517	4.97	7.09	0.00	45.02
Efficiency	Operating expenses over total assets.	2,739	1.63	1.07	0.08	6.53
Capital	Equity over total assets.	2,740	7.72	4.27	1.08	26.28
Liquidity	Liquid assets over total assets.	2,741	31.38	15.67	6.70	83.95
Funding	Customer deposits over total assets.	2,710	46.56	21.96	0.43	89.78
Economic conditions (Unemployment)	The unemployment rate for the EU jurisdiction.	3,666	9.20	1.34	7.20	11.32
Economic conditions (Bank Rate)	Euro interest rate set by the ECB.	3,666	1.08	1.33	0.00	4.00
Stress Testing Terms						
Stressed Bank	Dummy variable designated as 1 for the 39 EU stress-tested banks (treatment group) and 0 for the remaining banks (control group).	3,666	0.14	0.35	0	1
Post Stress Period	Time dummy variable designated as 1 for 2010–2018 (post-stress test) and 0 for 2006–2009 (pre-stress test).	3,666	0.69	0.46	0	1
GIIPS	Dummy for the banks from Greece, Ireland, Italy, Portugal and Spain.	3,666	0.22	0.41	0	1
Inadequate Ratio (Failed)	Designated as 1 for banks that fall below 5.5% ratio.	3,666	0.00	0.04	0	1
Stress test exposure CET1 - Median	Designated as 1 for above-median of the Stress test CET1 exposure, and 0 otherwise	146	0.50	0.50	0	1
Stress test exposure Tier 1 - Median	Designated as 1 for above-median of the Stress test Tier 1 exposure, and 0 otherwise	185	0.50	0.50	0	1
Stress test exposure Total Capital - Median	Designated as 1 for above-median of the Stress test Total Capital exposure, and 0 otherwise	185	0.50	0.50	0	1

the release of the stress tests results may reveal the performance of banks under a potential adverse scenario. Naturally, the effect of failing or being deemed to hold insufficient capital can cause long-lasting damage to the weaker banks. This may encourage banks to focus on improving their capital adequacy ratios: thus, banks may seek to reduce risky loans. Goncharenko et al. (2018) find that such a release of results can be detrimental and more harmful to large systemically important banks.

Furthermore, Kok et al. (2023) provide a rationale on why there is an observable trend in the reduction of lending for the European banking system. The authors document that stress-tested banks seek to mitigate credit risk issues as the stress testing framework serves as a monitoring tool. To mitigate credit risk, the participating banks will reduce bank lending, especially to small-medium-sized firms. Small-medium sized firms are associated with a higher risk.As such, we observe a reduction in corporate lending as shown in Table 2. In a related paper, Konietschke et al. (2022) examine the EU banking system and provide evidence that stress testing has caused a reduction in bank lending by the participating banks. Interestingly, Konietschke et al. (2022) corroborate the findings of our paper and show that the decrease in bank lending is noticeable for riskier loan types.

The final variation of the triple difference-in-differences interaction focuses on a set of stress-tested banks in GIIPS countries. The effect of stress testing on bank lending for the GIIPS countries is provided by model (3). In this stage of the empirical analysis, we find no significant results for stress-tested banks from GIIPS countries.

The strand of the banking and finance literature that focuses on stress testing argues that the stress testing frameworks may have been more effective during the inception of the stress tests following the global financial crisis (Calem et al., 2020; Acharya et al., 2018, among others). Therefore, we employ the difference-in-differences methodology to examine the dynamic effects of stress testing in the earlier periods.

Table A1 (model 1) reports the effect of each stress testing framework since the inception of the EU stress tests that began in 2009. For 2011, we find that total loans decreased by approximately 4.9 p.p., suggesting that the earliest stress tests significantly affected the stress-tested banks. Surprisingly, we find no-significant results for the decline in total loans until 2018, which shows a reduction of nearly 5.5 p.p. in total loans.

Next, we turn our attention to mortgage loan origination. Remarkably, we find an increase in mortgage originations relative to the banks in the control group for the earliest stress testing years. For example, for the first 2010 stress test that includes a richer set of results, we find that the stress-tested bank increases mortgage loans by 27.2 p.p. In the next stress testing year, there is also an increase in mortgage lending by 28 p. p. and 21 p.p. in 2011 and 2013, respectively. A possible explanation for this result may be related to changes in financial regulation of the U.S. banking system. Chakraborty et al. (2020) argue that during the financial crisis, the FED engaged in quantitative easing which mainly targeted the purchase of MBS (Mortgage-backed securities). Chakraborty et al. (2020) note that a number of banks sought to originate more mortgage lending while reducing commercial lending. Given the purchase programme conducted by the FED, banks across the globe might have had incentives to originate additional mortgage lending. Furthermore, Konietschke et al. (2022) document that EU banks reduced risky lending and allocated funding to safer loan types.

This finding corroborates the evidence for the U.S. administered stress tests, highlighting that bank lending decisions were most influential in the earliest stress test, and the effect of the exercises has weakened over time (Calem et al., 2020; Acharya et al., 2018).

There is a decrease in two stress testing years of corporate loans,

Table 2
EU Stress Testing on Bank Lending – Difference in Differences Specification.
The table reports the effect of the EBA's supervisory stress testing on bank lending, using the difference-in-differences specification. The dependent variables are total loans, mortgage loans, and corporate loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and Euro bank rate). All the control variables are lagged by one period. The Stress Bank EBA variable is a dummy variable designated as 1 for 39 banks and 0 for the remaining banks. The Post Stress Period EBA is a time dummy variable and is designated as 1 for 2010–2018 and 0 for 2006–2009. The ST Failed (inadequate capital) variable is a dummy variable that is designated as 1 for the banks that fall below the 5.5% CET1 threshold, post-stress test, and 0 for banks that are above the threshold. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main difference-in-differences interaction. Model (2) includes all controls, the main difference-in-differences interaction, and the triple difference-in-differences to control for the effects of failing (inadequate capital) the stress test. Model (3) includes all control variables, the main difference-in-differences interaction, and an alternative triple difference-in-differences to control for the effect of being a stress-tested bank that originates from the GIIPS region. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Total loans change %			Mortgage loans change %			Corporate loans change %		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Stress Bank EBA * Post Stress Period EBA	−1.78	−1.70	−0.33	−2.51	−2.51	−2.80	−24.31***	−24.15***	−20.44**
	(2.09)	(2.09)	(2.32)	(13.18)	(13.19)	(14.61)	(8.56)	(8.55)	(8.49)
Stress Bank EBA * Post Stress Period EBA * ST Failed		−4.12			0.43			−22.12***	
		(5.38)			(7.67)			(8.09)	
Stress Bank EBA * Post Stress Period EBA * GIIPS			−3.98			1.12			−12.87
			(3.17)			(9.08)			(10.33)
Size	−12.23***	−12.22***	−12.17***	−26.02***	−26.02***	−25.99***	−36.99***	−36.83***	−37.55***
	(2.81)	(2.81)	(2.81)	(8.64)	(8.65)	(8.62)	(8.20)	(8.27)	(8.55)
Profitability	0.20	0.16	0.14	−1.96	−1.95	−1.95	−2.62	−2.96	−2.72
	(0.86)	(0.86)	(0.86)	(2.19)	(2.21)	(2.20)	(2.40)	(2.42)	(2.43)
Credit risk	−0.16	−0.16	−0.13	−0.76**	−0.75**	−0.76**	−0.40	−0.46*	−0.37
	(0.10)	(0.10)	(0.10)	(0.31)	(0.31)	(0.32)	(0.24)	(0.25)	(0.24)
Efficiency	0.09	0.08	0.06	−2.91	−2.90	−2.89	−0.85	−0.89	−1.30
	(1.39)	(1.39)	(1.39)	(4.88)	(4.88)	(4.84)	(4.91)	(4.89)	(5.09)
Capital	−0.03	−0.03	−0.03	1.16	1.16	1.15	1.33	1.35	1.35
	(0.39)	(0.39)	(0.39)	(1.45)	(1.45)	(1.45)	(0.84)	(0.84)	(0.85)
Liquidity	0.18**	0.18**	0.19**	0.70**	0.70**	0.70**	1.20***	1.21***	1.21***
	(0.07)	(0.07)	(0.07)	(0.29)	(0.29)	(0.30)	(0.32)	(0.33)	(0.33)
Funding	0.17**	0.18**	0.18**	−0.33	−0.33	−0.33	0.45	0.46	0.47
	(0.09)	(0.09)	(0.09)	(0.27)	(0.27)	(0.27)	(0.32)	(0.32)	(0.32)
Economic conditions (Unemployment)	−0.00	−0.01	−0.01	−3.86	−3.86	−3.85	−1.39	−1.36	−1.40
	(1.11)	(1.11)	(1.11)	(2.75)	(2.75)	(2.75)	(5.35)	(5.35)	(5.35)
Economic conditions (Bank Rate)	3.28***	3.29***	3.31***	−0.12	−0.12	−0.13	−4.35	−4.26	−4.18
	(0.80)	(0.80)	(0.80)	(2.30)	(2.31)	(2.37)	(4.26)	(4.24)	(4.32)
Constant	120.45***	120.51***	119.68***	322.40***	322.45***	322.06***	351.53***	349.40***	357.41***
	(34.89)	(34.90)	(34.95)	(99.41)	(99.68)	(98.66)	(113.26)	(114.09)	(116.08)
Observations	2,232	2,232	2,232	909	909	909	1,173	1,173	1,173
R-Squared	0.12	0.12	0.12	0.11	0.11	0.11	0.06	0.07	0.06
Number of banks	259	259	259	140	140	140	183	183	183
Bank fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

when corporate loans decline by 34 p.p. and 21 p.p. for 2011 and 2016, respectively. One reason behind the fall in corporate lending in 2011 is examined by Petrella and Resti (2013), who document the benefits and improvements of the 2011 EU stress test. The authors advocate that the 2011 stress test was more influential and stronger in terms of the structure of the stress testing framework, as more granular data on the banks were released relative to the 2010 stress test. The data allows for greater analysis and is more informative for the public and markets; hence, the banks may have reckoned necessary to cut back on corporate lending for this year.

While we have attempted to relate our results to existing studies, it is important to note that direct cross-comparison is not possible. Candelon and Sy (2015) uncover variations between stress testing programmes, such as the EU and US exercises. The authors suggest that the structure of the stress tests by each regulator cannot be compared as they differ each year.

Petrella and Resti (2013) discuss the shortcomings of the 2010 stress test, which was regarded as having a marginal impact on EU banks, and the market reaction that was initially anticipated. The limitation of the first stress test was chiefly attributable to the data, which was less granular. To alleviate the limitations of the 2010 stress test, the 2011 stress test provided the markets with more granular disaggregated information, which caused a stronger market reaction and allowed greater scrutiny and insight into the banks' balance sheet in the case of an adverse shock. Petrella and Resti (2013) argue that stress tests cannot be viewed as similar each year. Thus, it is of fundamental importance to acknowledge that the effect of stress tests on bank lending decisions may not show similar findings every year[10].

Finally, we conduct a dynamic analysis of the differences among the stress-tested banks which is conditional on the banks' geographical location. Our main argument is that stress-tested banks from alternative regions across the EU will behave differently due to several circumstances.

Table A1 (model 2) reports statistically strong results for the stress-tested banks from the GIIPS countries. We find a decrease in total loans from the first year by approximately 14 p.p. compared to the

[10] To corroborate the claim, there are several papers that find for the U.S. stress tests. Notably, the first round of stress tests was the most effective, with SCAP 2009 stress testing being viewed as the exercise that caused a stronger market reaction. See for example, Neretina et al. (2015).

Table 3
EU Stress Testing on Bank Lending – Difference in Differences Specification.
The table reports the effect of the EBA's supervisory stress testing on bank lending, using the difference-in-differences specification. The dependent variables are consumer loans and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and Euro bank rate). All the control variables are lagged by one period. The Stress Bank EBA variable is a dummy variable designated as 1 for 39 banks and 0 for the remaining banks. The Post Stress Period EBA is a time dummy variable and is designated as 1 for 2010–2018 and 0 for 2006–2009. The ST Failed (inadequate capital) variable is a dummy variable that is designated as 1 for the banks that fall below the 5.5% CET1 threshold, post-stress test, and 0 for banks that are above the threshold. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main difference-in-differences interaction. Model (2) includes all controls, the main difference-in-differences interaction, and the triple difference-in-differences to control for the effects of failing (inadequate capital) the stress test. Model (3) includes all control variables, the main difference-in-differences interaction, and an alternative triple difference-in-differences to control for the effect of being a stress-tested bank that originates from the GIIPS region. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Consumer loans change %			Bank loans change %		
	(1)	(2)	(3)	(1)	(2)	(3)
Stress Bank EBA * Post Stress Period EBA	−0.26	−0.22	−2.37	−5.91	−5.63	−8.68
	(8.41)	(8.41)	(8.26)	(6.21)	(6.25)	(7.69)
Stress Bank EBA * Post Stress Period EBA * ST Failed		−10.73			−14.77***	
		(11.69)			(4.75)	
Stress Bank EBA * Post Stress Period EBA * GIIPS			6.29			7.43
			(11.89)			(9.84)
Size	−21.44**	−21.40**	−21.20**	−10.23	−10.23	−10.31
	(10.16)	(10.17)	(10.41)	(6.29)	(6.29)	(6.27)
Profitability	1.29	1.13	1.34	0.51	0.35	0.60
	(2.19)	(2.24)	(2.21)	(1.97)	(2.01)	(1.99)
Credit risk	−0.60	−0.63	−0.61	0.40*	0.40*	0.36
	(0.60)	(0.61)	(0.61)	(0.23)	(0.23)	(0.23)
Efficiency	−3.75	−3.77	−3.56	1.70	1.68	1.76
	(4.52)	(4.51)	(4.70)	(2.52)	(2.52)	(2.52)
Capital	1.54	1.53	1.52	−1.02	−1.04	−1.01
	(1.53)	(1.52)	(1.53)	(0.65)	(0.65)	(0.65)
Liquidity	0.20	0.20	0.20	−1.02***	−1.02***	−1.03***
	(0.32)	(0.32)	(0.32)	(0.23)	(0.23)	(0.23)
Funding	−0.42	−0.41	−0.42	0.12	0.12	0.12
	(0.36)	(0.36)	(0.36)	(0.24)	(0.24)	(0.24)
Economic conditions (Unemployment)	−2.29	−2.28	−2.28	−0.53	−0.55	−0.51
	(5.00)	(5.01)	(5.01)	(4.82)	(4.82)	(4.82)
Economic conditions (Bank Rate)	−4.61	−4.58	−4.63	0.15	0.18	0.10
	(3.18)	(3.19)	(3.18)	(2.01)	(2.02)	(2.02)
Constant	265.26*	264.65*	262.75*	150.00*	150.24*	151.03*
	(145.38)	(145.51)	(147.57)	(87.04)	(87.02)	(86.66)
Observations	1,280	1,280	1,280	2,215	2,215	2,215
R-Squared	0.03	0.03	0.03	0.03	0.03	0.03
Number of banks	195	195	195	259	259	259
Bank fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

stress-tested banks from the remaining countries. Moreover, we find that the total loans for the GIIPS stress-tested banks continued to reduce lending for consecutive years.

Mortgage loan originations show a similar relationship, due to a decline in mortgage lending since the start of the stress testing regime. There is a 25 p.p. reduction in mortgage lending compared to non-GIIPS stress-tested banks in 2010, and the magnitude is very similar across all years.

Finally, we can see that the GIIPS stress-tested banks cut back on corporate lending relative to non-GIIPS banks, and this effect is quantitatively much stronger than the alternative loan types discussed above. For instance, the decline in corporate loans is by roughly 66 p.p. in 2009 and 2018. Thus, our evidence indicates that the onset of the financial crisis may have negatively impacted on corporate loans, which was further amplified for the stress-tested banks that are active in the GIIPS region.

The results shown are instrumental and provide very noteworthy insights into the observable differences for stress-tested banks across the EU. Our results clearly show that stress-tested banks do not behave similarly. We find that stress-tested banks may take different managerial decisions for lending. Overall, our evidence supports the notion of differences among stress-tested banks across different countries, which has important policy implications.

In this section, our aim is to disentangle the effect of stress testing on credit risk. Acharya et al. (2018) suggest that the rationale behind the stress-tested banks' decision to reduce bank lending is to mitigate a bank's credit risk profile. Nonetheless, the drawback of their analysis is that they do not test this hypothesis and question the validity of their assumption. Consequently, we complement their study by assessing whether stress testing affects credit risk.

Empirically, we implement the difference-in-differences strategy but utilise the dependent variables for credit risk proxied by the non-performing loan ratio.[11]

Table 4 reports the effect of stress testing on the non-performing loans ratio. Model (1) presents the primary difference-in-differences interaction. We find statistically significant results, as stress-tested banks exhibit an increase in the non-performing loan ratio by 2 p.p. compared to non-stress tested banks. Acharya et al. (2018) suggest that

[11] Further robustness tests account for different proxies of credit risk of the bank in question, and are reported in the Robustness tests section below.

Table 4
EU Stress Testing on Credit Risk – Difference in Differences Specification.
The table reports the effect of the EBA's supervisory stress testing on credit risk, using the difference-in-differences specification. The dependent variable is the non-performing loan ratio. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and Euro bank rate). All the control variables are lagged by one period. The Stress Bank EBA variable is a dummy variable designated as 1 for 39 banks and 0 for the remaining banks. The Post Stress Period EBA is a time dummy variable and is designated as 1 for 2010–2018 and 0 for 2006–2009. The ST Failed (inadequate capital) variable is a dummy variable that is designated as 1 for the banks that fall below the 5.5% CET1 threshold, post-stress test, and 0 for banks that are above the threshold. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main difference-in-differences interaction. Model (2) includes all controls, the main difference-in-differences interaction, and the triple difference-in-differences to control for the effects of failing (inadequate capital) the stress test. Model (3) includes all control variables, the main difference-in-differences interaction, and an alternative triple difference-in-differences to control for the effect of being a stress-tested bank that originates from the GIIPS region. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Non-performing loans ratio %		
	(1)	(2)	(3)
Stress Bank EBA * Post Stress Period EBA	2.44**	2.39**	−0.92
	(1.22)	(1.21)	(0.58)
Stress Bank EBA * Post Stress Period EBA * ST Failed		2.66	
		(1.85)	
Stress Bank EBA * Post Stress Period EBA * GIIPS			9.03***
			(2.37)
Size	0.22	0.22	0.12
	(1.03)	(1.04)	(0.96)
Profitability	−3.06***	−3.03***	−2.79***
	(0.43)	(0.43)	(0.43)
Efficiency	−1.03***	−1.03***	−0.94***
	(0.39)	(0.39)	(0.33)
Capital	0.60***	0.60***	0.57***
	(0.18)	(0.18)	(0.17)
Liquidity	−0.03	−0.03	−0.04
	(0.03)	(0.03)	(0.03)
Funding	−0.06**	−0.06**	−0.07**
	(0.03)	(0.03)	(0.03)
Economic conditions (Unemployment)	0.67***	0.67***	0.68***
	(0.26)	(0.26)	(0.25)
Economic conditions (Bank Rate)	−0.14	−0.14	−0.19
	(0.21)	(0.21)	(0.20)
Constant	−1.45	−1.51	0.06
	(12.72)	(12.75)	(11.73)
Observations	2,261	2,261	2,261
R-Squared	0.30	0.30	0.35
Number of banks	261	261	261
Bank fixed effects	YES	YES	YES
Time fixed effects	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

banks reduce their loans to mitigate potential credit risk issues. By contrast, our results show that the stress-tested banks experience greater credit risk problems than non-stress tested banks.

In Model (2), we include the effect of the stress-tested banks that are deemed to have inadequate capital levels via the triple difference-in-differences interaction. However, we do not find statistically significant results.

To account for the stress-tested banks that are located in GIIPS countries, we use an alternative triple difference-in-differences interaction in model (3) and find statistically significant results that mainly corroborate our findings reported in the loan growth subsection. We see an increase in credit risk by 9 p.p. for the GIIPS stress-tested banks, thus suggesting noticeable differences among stress-tested banks.

Moreover, we also perform a dynamic analysis of each year after the stress testing regime for the non-performing loan ratio, to evaluate the significance of the results over the period. Table A2 (model 1) reports the dynamic analysis of each year after the first stress testing period. We find significant results for most of the years since the inception of the exercises. Specifically, for 2011 and 2012, the non-performing loans ratio for the stress-tested banks relative to the non-stress tested banks increase by 1.88 p.p. and 1.94 p.p., respectively. Furthermore, for 2013 and 2014, the results indicate an increase in the non-performing loans ratio for the stress-tested banks.

Table A2 (model 2) presents the dynamic results of the stress-tested banks headquartered in the GIIPS countries. The results confirm the strong results for the GIIPS stress-tested banks. For every year since the inception of the stress testing exercises, the GIIPS stress-tested banks' non-performing loans ratio is higher than the non-GIIPS stress-tested banks. For example, in 2009, the non-performing loan ratio is 1.37 p.p. higher than the other stress-tested banks. Furthermore, we find that the magnitude of the non-performing loan ratio increases significantly throughout all the periods relative to the 2009 period. In 2014, the non-performing loan ratio is 14.22 p.p. higher than banks from non-GIIPS countries. More importantly, the results illustrate fundamental differences across stress-tested banks and discernible heterogeneity among banks.

The second stage of the empirical analysis centres on the effect of stress testing by constructing the stress test exposure variable.[12] To perform this analysis, we isolate the 39 stress-tested banks from the total sample of banks discussed above. To assess heterogeneity levels among stress-tested banks, we compare banks with a high-stress test exposure against a low-stress test exposure. We argue that banks with a high-stress test exposure will significantly reduce lending relative to low-stress test exposure banks, as these banks are in a difficult financial position due to the adverse scenario.

Table A3 reports the results of the effects of the stress test exposure. We first consider the Total capital ratio, which is recorded and publicly disclosed in all EBA stress testing frameworks from the start of the stress tests. Table A3 includes two model specifications for each dependent variable of interest. Model (1) shows banks designated as those with a high-stress test exposure for the Total capital variable. We can see that these clusters of banks reduce the total capital ratio by 5.22 p.p. relative to those with a low-stress test exposure. Therefore, we can conclude that the stress test heavily affects the weaker-performing banks.

Model (2) includes a bank being designated as having a high-stress test exposure and belonging to the GIIPS region. It turns out that there are no statistical differences between high-exposure GIIPS banks and the remaining banks. Additionally, the statistical significance of the first stress test exposure variable diminishes.

With respect to mortgage loans, we find statistically significant results between the two groups of stress-tested banks included in the high-stress test exposure. The results show that for a highly exposed bank in the GIIPS region, mortgage loan originations decline by roughly 14 p.p. relative to non-GIIPS domiciled banks. Interestingly, the effect of stress testing for mortgage originations reveals contrasting findings. There are heterogeneities among stress-tested banks, indicating that the bank's country of origin could be a crucial element in determining the change in loans. Therefore, this evidence clearly shows differences among stress-tested banks that could be influenced by other factors, such as the region where the bank operates.

We find statistically significant results for banks loan change for the high-stress test exposure, meaning that banks that fare worse from the stress test will increase bank loans by 14 p.p. compared to banks with

[12] Recall, the stress test exposure is calculated as the difference between the capital ratio of the bank before entering the stress test and after the stress test.

low-stress test exposure. The behaviour of these groups of banks that increase bank loans by 14 p.p. compared to low-stress exposure banks may be due to a 'flight to quality' for these banks, which may be inclined to build up the of less-risky assets on their balance sheets.

Tables 5 and 6 present the results by examining slight variations of the stress testing exposure variable. Therefore, Table 5 offers an alternative perspective on the effect of stress testing compared to the previous table by focusing on the Tier 1 capital ratio. In regards to consumer loan lending, banks designated as being highly exposed to the stress test with respect to their Tier 1 ratio reduce consumer loans by approximately 14 p.p. compared to less exposed banks. The results may suggest that these banks curb their lending, as consumer lending may pose a greater risk, which in hindsight, can adversely impact these banks.

Strikingly, there is evidence of a shift in behaviour by highly-exposed stress-tested banks, as these banks increase their share of bank lending by roughly 12 p.p. In addition, we find that discernible differences persist among stress-tested banks that are highly exposed. Highly-exposed banks in the GIIPS set of countries cut back on bank loans by 20 p.p. Additionally, stress-tested banks that are highly exposed as defined by the Tier 1 ratio may adopt different lending strategies to mitigate credit risk concerns. Banks decide to opt for a safer loan portfolio (by choosing to increase bank loans).

We now apply the same econometric strategy but construct our stress test exposure variable to reflect the effect of stress testing on bank lending via the changes in the CET1 ratio. A disadvantage of using the CET1 ratio is that the earliest stress testing framework (2010) did not include the ratio for each participating bank in the respective stress test, thus limiting the number of data observations (relative to the Total capital and Tier 1 ratio). With this caveat in mind, we report the effect of stress testing on bank lending by examining the CET1 ratio in Table 6. Yet, we do find evidence of a change in consumer lending growth by banks that are highly exposed to the stress test. Highly-exposed banks reduce consumer lending by approximately 13 p.p. This result provides strong evidence of differences among stress-tested banks, as highly-exposed banks alter lending behaviour compared to less exposed banks. Similar to the results reported in Table 5, we also find that highly-exposed banks increase their bank loan originations by approximately 19 p.p.

In this section, we analyse the impact of highly-exposed banks on credit risk, using the total capital ratio, the Tier 1 ratio, and the CET1 ratio. Overall, the results show no statistically significant differences between highly-exposed stress-tested and less exposed banks (Table 7, model (1)).

In Model (2), there are differences between GIIPS and non-GIIPS banks that are highly-exposed. GIIPS banks experience a rise in credit risk compared to non-GIIPS banks by 3.5 p.p. Unsurprisingly, the result aligns with the findings in Table 4, which shows that GIIPS-domiciled stress-tested banks experience greater credit risk problems. This

Table 5

EU Stress Testing on Bank Lending – Stress Test Exposure – Above - Difference in Tier 1 Capital.

The table reports the effect of the EBA's supervisory stress testing on bank lending, using the stress test exposure specification. The dependent variables are total loans, mortgage loans, corporate loans, consumer loans, and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and Euro bank rate). All the control variables are lagged by one period. The stress test exposure concerning Tier 1 capital, is defined as the difference between the pre-stress test Tier 1 capital ratio and the post-stress test Tier 1 capital ratio. The stress test exposure – above, is designated as 1 for the banks that are above the median for stress test exposure. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main stress test exposure - above variable. Model (2) includes all controls, the main stress test exposure - above variable, and the main stress test exposure - above variable with GIIPS interaction. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Stress test exposure – Above - Difference in Tier 1 capital	−1.70	−1.38	0.10	1.17	14.13	5.46	−14.06**	−15.30**	11.75*	18.78**
	(2.53)	(2.36)	(2.21)	(2.47)	(14.77)	(10.28)	(5.30)	(5.93)	(6.82)	(7.54)
Stress test exposure – Above - Difference in Tier 1 capital * GIIPS		−0.94		−4.12		25.12		3.30		−20.38*
		(4.13)		(4.28)		(20.29)		(5.05)		(11.91)
Size	−18.82***	−18.82***	−37.44*	−39.31*	−26.08	−27.10	−38.42***	−38.88***	0.43	0.33
	(6.49)	(6.44)	(20.53)	(20.75)	(37.91)	(32.65)	(10.89)	(10.66)	(27.59)	(24.86)
Profitability	2.53	2.63	3.75	4.36	2.33	−0.32	−2.69	−3.06	1.97	3.99
	(1.64)	(1.79)	(2.76)	(2.84)	(7.58)	(8.90)	(3.32)	(3.34)	(6.45)	(7.17)
Credit risk	0.25	0.27	−0.11	−0.06	0.64	0.62	0.11	0.11	0.33	0.84
	(0.20)	(0.23)	(0.53)	(0.54)	(0.85)	(0.81)	(0.60)	(0.59)	(0.88)	(0.92)
Efficiency	−3.11	−3.12	−4.31***	−4.48***	1.52	3.53	−27.63***	−27.42***	−4.08	−4.31
	(2.02)	(2.00)	(1.42)	(1.40)	(6.68)	(5.70)	(2.94)	(2.99)	(3.24)	(3.09)
Capital	−1.95***	−2.02**	−3.33***	−3.48***	0.14	0.98	−4.55**	−4.45**	−4.54	−5.97
	(0.69)	(0.75)	(0.77)	(0.79)	(2.81)	(3.66)	(2.04)	(2.01)	(4.93)	(4.85)
Liquidity	0.23	0.23	0.28	0.34	0.88	0.74	1.06	1.04	−0.44	−0.32
	(0.19)	(0.20)	(0.37)	(0.38)	(1.17)	(1.11)	(0.65)	(0.65)	(0.97)	(0.93)
Funding	−0.30	−0.29	−0.99*	−1.01*	−1.19	−1.61	0.86*	0.80*	−0.75	−0.63
	(0.26)	(0.27)	(0.56)	(0.55)	(2.40)	(2.39)	(0.48)	(0.46)	(0.99)	(0.95)
Economic conditions (Unemployment)	−0.67	−0.66	−0.30	−0.24	6.33	5.17	−7.00*	−7.23*	−1.67	−1.47
	(0.96)	(0.96)	(1.56)	(1.57)	(6.76)	(5.97)	(3.76)	(3.73)	(4.78)	(4.79)
Economic conditions (Bank Rate)	−5.46*	−5.48*	−1.98	−1.85	−3.06	−7.70	−35.05*	−35.80*	11.53	11.22
	(2.96)	(2.96)	(4.29)	(4.25)	(21.97)	(20.47)	(20.02)	(20.00)	(11.56)	(11.32)
Constant	265.78***	265.47***	545.06*	567.78*	277.99	316.66	569.03***	579.49***	78.61	74.58
	(93.35)	(92.95)	(276.26)	(279.09)	(496.51)	(432.64)	(168.82)	(164.22)	(382.76)	(346.69)
Observations	149	149	80	80	85	85	90	90	145	145
R-Squared	0.16	0.16	0.53	0.54	0.11	0.15	0.54	0.54	0.12	0.14
Number of banks	39	39	27	27	30	30	33	33	38	38
Bank fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6
EU Stress Testing on Bank Lending – Stress Test Exposure – Above - Difference in CET1 Capital.
The table reports the effect of the EBA's supervisory stress testing on bank lending, using the stress test exposure specification. The dependent variables are total loans, mortgage loans, corporate loans, consumer loans, and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and Euro bank rate). All the control variables are lagged by one period. The stress test exposure concerning CET1 capital, is defined as the difference between the pre-stress test CET1 capital ratio and the post-stress test CET1 capital ratio. The stress test exposure – above, is designated as 1 for the banks that are above the median for the stress test exposure. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main stress test exposure - above variable. Model (2) includes all controls, the main stress test exposure - above variable, and the main stress test exposure - above variable with GIIPS interaction. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Stress test exposure – Above - Difference in CET1 capital	−1.05	0.77	−3.87	−2.08	27.45	16.81	−12.63*	−16.78*	18.75***	22.50***
	(2.29)	(2.78)	(3.20)	(2.92)	(21.24)	(13.39)	(7.34)	(9.36)	(6.36)	(5.82)
Stress test exposure – Above - Difference in CET1 capital * GIIPS		−5.29		−5.77		31.79		13.35		−10.55
		(3.96)		(5.20)		(22.45)		(8.32)		(10.13)
Size	−30.42**	−28.23**	−47.55**	−46.59**	−34.83	−46.04	−39.00***	−44.96***	−12.71	−8.50
	(14.41)	(13.07)	(22.15)	(20.68)	(43.64)	(42.44)	(13.78)	(15.03)	(22.03)	(20.87)
Profitability	4.97**	5.33**	3.48	3.94	9.34	8.32	−4.25	−4.68	9.42	10.14
	(2.00)	(2.11)	(2.57)	(2.73)	(9.20)	(8.78)	(3.89)	(3.72)	(5.65)	(6.04)
Credit risk	0.34	0.34	−0.26	−0.22	1.13	1.15	0.47	0.51	0.66	0.64
	(0.47)	(0.45)	(0.46)	(0.46)	(1.33)	(1.26)	(0.73)	(0.71)	(1.05)	(1.03)
Efficiency	−3.89*	−3.73	−4.85***	−4.67***	7.29	8.53	−25.01***	−24.61***	−3.86	−3.56
	(2.30)	(2.22)	(1.75)	(1.57)	(7.50)	(7.24)	(3.49)	(3.50)	(3.77)	(3.77)
Capital	−2.75*	−2.87*	−1.27	−1.46	−0.95	−0.07	−4.26**	−3.95*	−5.29*	−5.48*
	(1.58)	(1.57)	(1.40)	(1.40)	(3.89)	(4.60)	(2.08)	(2.06)	(2.86)	(2.81)
Liquidity	0.14	0.13	0.85**	0.83**	0.23	0.50	0.60	0.67	−0.31	−0.30
	(0.29)	(0.29)	(0.39)	(0.37)	(1.08)	(1.11)	(0.45)	(0.46)	(0.90)	(0.90)
Funding	−0.63	−0.55	−0.88	−0.81	−3.00	−3.82	1.05	0.68	−0.47	−0.30
	(0.43)	(0.40)	(0.56)	(0.49)	(3.34)	(3.32)	(0.65)	(0.75)	(0.88)	(0.83)
Economic conditions (Unemployment)	−0.78	−0.52	−0.46	−0.26	6.06	4.59	−7.32*	−7.99*	0.99	1.56
	(1.20)	(1.18)	(1.60)	(1.58)	(6.13)	(5.31)	(4.27)	(4.16)	(4.97)	(4.82)
Economic conditions (Bank Rate)	−6.27**	−6.05**	−2.26	−2.15	−6.94	−8.09	0.18	−0.70	2.90	3.36
	(2.94)	(2.96)	(2.77)	(2.82)	(10.29)	(9.94)	(5.10)	(5.31)	(5.27)	(5.17)
Constant	435.98**	402.56**	638.74**	622.95**	485.05	661.53	567.45**	660.63***	198.51	132.84
	(194.27)	(174.99)	(296.51)	(274.60)	(618.51)	(602.97)	(212.23)	(233.06)	(316.73)	(297.74)
Observations	110	110	73	73	79	79	84	84	107	107
R-Squared	0.32	0.34	0.55	0.56	0.15	0.20	0.51	0.54	0.14	0.15
Number of banks	39	39	27	27	30	30	33	33	38	38
Bank fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

finding is also confirmed by the dynamic analysis shown in Table A2, in which all years show statistically significant results.

The effect of stress testing on credit risk is defined by the Tier 1 capital ratio reported in Table 7. The estimates from Model (3) and (4) indicate a rise in credit risk of thehighly-exposed stress-tested banks as proxied by the non-performing loans ratio. Specifically, credit risk for highly exposed banks increases by 1.8 p.p. compared to their counterparts. Consequently, this result seems to suggest that stress testing exercises cause further issues for banks participating in the EBA stress testing framework. Model (4) addresses the differences between highly-exposed banks that are GIIPS and non-GIIPS domiciled. Interestingly, the results reveal structural differences between these two sets of banks, as GIIPS banks experience a rise in credit risk by 3.4 p.p. Hence, this result confirms our hypothesis that stress-tested banks are not homogenous. Indeed, we find evidence of country-specific results in the EU area.

6. Robustness tests and policy recommendations

We focus on two alternative proxies of credit risk for robustness checks: loan loss provisions and loan loss reserves ratio.[13]

By using the difference-in-differences approach, we find that the loan loss provisions ratio for stress-tested banks increases relative to non-stress tested banks, which contradicts Acharya et al. (2018). In addition, we document differences among stress-tested banks in EU countries. We observe an increase in thei loan loss provisions ratio and loan loss reserve ratio of the GIIPS stress-tested banks.

We further break down the main stress testing difference-in-differences specification to assess if there are important differences between the control group and treatment bank across each year since the beginning of the stress testing programme (dynamic analysis). There has been an evident increase in credit risk issues for the stress-tested banks for the majority of the years. The robustness testsresults suggest that the loan loss provisions and the loan loss reserves ratio change for all the banks and are statistically significant for nearly all years. Hence, the results strongly oppose the notion that the effectiveness of the stress testing framework as a policy tool has diminished over time, as suggested by Acharya et al. (2018).

As expected, there emerge also inherent differences between GIIPS stress-tested banks and non-GIIPS stress-tested banks in the dynamic analysis. Note that these findings align with the results reported in the main section of our empirical results. Our stress-tested group that includes 39 banks may be prone to bias, as we exclude banks that have not been examined in the sample period. Certain banks may have been included in four or less exercises. Therefore, we increase the selection

[13] Results are available on request.

Table 7
EU Stress Testing on Bank Lending – Stress Test Exposure – Above - Difference in Capital.
The table reports the effect of the EBA's supervisory stress testing on bank lending, using the stress test exposure specification. The dependent variables are total loans, mortgage loans, consumer loans, corporate loans, and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and the Euro bank rate). All the control variables are lagged by one period. The stress test exposure concerning three capital ratios is defined as the difference between the pre-stress test capital ratio and the post-stress test capital ratio. The stress test exposure – above, is designated as 1 for the banks that are above the median for the stress test exposure. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all controls and the main stress test exposure - above variable. Model (2) includes all controls, the main stress test exposure - above variable, and the main stress test exposure - above variable with GIIPS interaction. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Non-performing loans ratio %					
	(1)	(2)	(3)	(4)	(5)	(6)
Stress test exposure – Above - Difference in Total capital	0.88	−0.25				
	(0.56)	(0.67)				
Stress test exposure – Above - Difference in Total capital * GIIPS		3.50**				
		(1.71)				
Stress test exposure – Above - Difference in Tier 1 capital			1.80**	0.45		
			(0.73)	(0.60)		
Stress test exposure – Above - Difference in Tier 1 capital * GIIPS				3.39*		
				(1.73)		
Stress test exposure – Above - Difference in CET1 capital					−0.10	0.19
					(0.67)	(0.78)
Stress test exposure – Above - Difference in CET1 capital * GIIPS						−0.85
						(1.42)
Size	5.22	3.96	5.62	4.70	3.11	3.45
	(4.52)	(4.51)	(4.67)	(4.84)	(4.75)	(4.76)
Profitability	−4.70***	−4.61***	−4.63***	−4.64***	−2.73**	−2.68**
	(1.21)	(1.19)	(1.19)	(1.16)	(1.22)	(1.16)
Efficiency	−0.66	−0.67	−0.66	−0.61	−0.47	−0.45
	(0.51)	(0.49)	(0.48)	(0.48)	(0.44)	(0.44)
Capital	2.00***	2.09***	2.04***	2.15***	2.60***	2.58***
	(0.57)	(0.56)	(0.56)	(0.54)	(0.51)	(0.49)
Liquidity	0.09	0.08	0.09	0.06	0.15	0.14
	(0.08)	(0.08)	(0.08)	(0.07)	(0.09)	(0.09)
Funding	−0.02	−0.10	−0.03	−0.08	−0.05	−0.03
	(0.12)	(0.12)	(0.13)	(0.13)	(0.14)	(0.13)
Economic conditions (Unemployment)	1.37***	1.08***	1.59***	1.36***	1.08***	1.12***
	(0.35)	(0.38)	(0.41)	(0.39)	(0.26)	(0.30)
Economic conditions (Bank Rate)	2.24**	1.88*	2.89***	2.73***	3.26***	3.29***
	(0.97)	(0.99)	(0.85)	(0.85)	(0.76)	(0.78)
Constant	−85.31	−63.29	−92.73	−76.97	−60.18	−65.41
	(62.24)	(60.60)	(64.65)	(65.96)	(64.62)	(65.12)
Observations	149	149	149	149	110	110
R-Squared	0.47	0.51	0.49	0.52	0.62	0.62
Number of banks	39	39	39	39	39	39
Bank fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

sample of stress-tested banks in our treatment group and include banks that have participated at least once in the exercises. We develop a new stress-testing group that includes 82 banks. The inclusion of the banks in this larger group is dependent on the banks being available in Orbis Bank Focus and above the 10 BN EUR threshold. The empirical results are similar to the baseline model and are robust. In addition, the baseline model excludes 2009 as a treatment year. Note that when we include 2009 in the treatment period, the results are mixed. We also conduct further robustness tests such as the parallel trend assumption for the difference-in-differences model.

Our main results indicate that the introduction of the stress testing regime has affected bank lending of the set of the EU stress-tested banks. More generally, stress-tested banks have been adopting lending practices that are conservative in principle. We find that the cluster of stress-tested banks reduce loans.

More precisely, stress-tested banks have noticeably reduced corporate loans relative to non-stress tested banks. In addition, the results suggest that the stress testing exercise leads to a reduction in consumer loans. This clearlyunderscores that the exercises have met their objective of prudentially examining banks against an adverse stress case scenario. However, an unintended effect is a reduction in the volume of lending, which may instigate knock-on effects for the economy, such as reduced investment, thus inhibiting economic growth. Recall that the regulator's objective is to ensure that banks hold sufficient capital levels to absorb future losses, which ultimately upholds financial stability, a key objective of the stress tests.

In this paper, we address the effects of stress testing on credit risk following the notion that the main reason banks cut back on lending is to manage credit risk issues. Yet, on the contrary, our evidence indicates that stress-tested banks face greater credit risk challenges, as shown by the set of EU banks included in our analysis. A key policy implication of our results is that while the stress tests are important macroprudential policy tools, banks exhibit higher credit risk problems, which may indirectly affect the objectives of the exercises. Thus, regulators must ensure that credit risk problems are appropriately managed (Risk Management Hypothesis).

We hypothesise that there are heterogeneities across the spectrum of the stress-tested banks. We also classify the stress-tested banks into two different regions: GIIPS countries and non-GIIPS countries. When we control for this, we find statistical results showing that GIIPS stress-

tested banks reduce lending more substantially and face higher credit risk issues than their counterparts. This distinction is critical because stress-tested banks behave differently due to different characteristics. Thus, it would be desirable that future research investigates additional determinants that may affect the behaviour of stress-tested banks. This paper, to our knowledge, is the first to empirically assess the impact of a bank's geographical location as an important determinant. Stress testing practices should be subject to revisions that may mitigate credit risk issues in certain areas. Our empirical evidence suggests that leniency considerations in the stress testing exercises (removing hurdle rates) and not failing certain banks, especially in the GIIPS region, can be beneficial to stress-tested banks (Shapiro and Zeng, 2020).

7. Conclusion

This paper contributes to the emerging literature that analyses the impact of stress testing on bank lending and credit risk. Specifically, we focus on a set of EU stress-tested banks that must undergo bi-annual stress tests that the EBA coordinates.

This paper is the first to incorporate two different methodological approaches by analysing the differences among the stress-tested banks (stress test exposure) and between the stress-tested and non-stress tested banks (difference-in-differences specification).

Concerning the difference-in-differences specification, we report statistically significant results to suggest that stress-tested banks reduce corporate loans relative to non-stress tested banks. Furthermore, we conduct a dynamic analysis of the stress-tested banks, examining bank lending behaviour for each year. We findcompelling evidence indicating that for corporate loans, the stress testing exercises have mainteined their effectiveness over time.

The second methodological approach restricts the total sample of banks to only the stress-tested banks. The key motive is to assess noticeable differences among stress-tested banks. We construct a stress test exposure variable to support the approach, dividing up banks into two groups. The first group comprises banks that are highly exposed to the stress (greater reduction in the capital ratio) and the alternative group banks that are less exposed. We find that highly exposed stress-tested banks seek to reduce consumer loans, thus revealing the influential impact of stress testing on bank lending.

The literature suggests that the banks' decisions to adjust lending may be linked to credit risk problems. Banks cut back on lending to mitigate credit risk. To confirm this hypothesis, we conduct additional analysis. Notably, our empirical results indicate that stress-tested banks experience greater credit risk problems.

Moreover, we conjecture that not all stress-tested banks in our sample behave similarly, and there may be underlying factors that influence lending practicess. . We provide significant and robust finding for the stress-tested banks domiciled in the GIIPS region. Indeed, stress-tested GIIPS banks reduce more substantially lending than their counterparts.

It is important to note that a new strand of the banking and finance literature investigates the effects of the exercises on bank lending decisions. Notice that these studies solely focus on the US banking system.

All in all, the results of this paper shed light on the potential trade-off between a contraction in bank lending (which can affect economic growth) and financial stability.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix

Table A1

EU Stress Testing on Bank Lending – Year by Year (GIIPS) – Difference in Differences Specification. The table reports the dynamic effect of the EBA's supervisory stress testing on bank lending, using the difference-in-differences specification. The dependent variables are total loans, mortgage loans, corporate loans, consumer loans, and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and the Euro bank rate). All the control variables are lagged by one period. The Stress Bank EBA variable is a dummy variable designated as 1 for 39 banks and 0 for the remaining banks. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. The Post Stress Period for each year changes, and examines the first year of stress testing, until the most current period. For example, the Post Stress Period 2009 is designated as 1 for 2009 and 0 for the remaining years. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all variables.

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Stress Bank EBA * Post Stress Period 2009	−1.65	3.91	41.66	58.81	28.34	50.07*	17.35	24.89	1.62	−4.34
	(4.53)	(6.03)	(31.05)	(38.73)	(23.49)	(29.90)	(23.13)	(25.37)	(10.60)	(11.28)
Stress Bank EBA * Post Stress Period 2010	−1.05	3.34	27.24**	34.72**	−0.61	6.82	11.25	14.62	6.26	4.22
	(3.41)	(4.13)	(12.81)	(13.75)	(13.62)	(13.81)	(10.17)	(9.69)	(10.69)	(13.07)
Stress Bank EBA * Post Stress Period 2011	−4.85*	−0.54	28.06**	27.11**	−33.99*	−18.59	−20.37	−25.37	−8.58	−22.72**
	(2.85)	(3.00)	(13.18)	(13.00)	(19.05)	(16.25)	(23.28)	(23.69)	(11.57)	(11.01)
Stress Bank EBA * Post Stress Period 2012	−1.89	−0.30	10.19	17.34	−15.24	1.32	8.96	9.45	−7.30	−12.50
	(3.25)	(3.17)	(11.39)	(11.75)	(12.12)	(10.36)	(16.78)	(18.73)	(9.84)	(11.50)
Stress Bank EBA * Post Stress Period 2013	0.49	1.66	20.54*	24.12**	−11.82	−10.03	10.91	6.61	−15.05	−12.48
	(3.01)	(3.19)	(11.18)	(11.54)	(11.46)	(12.14)	(14.75)	(14.26)	(9.12)	(10.82)
Stress Bank EBA * Post Stress Period 2014	−0.34	3.18	13.58	21.03*	−7.07	1.87	13.30	13.73	−5.21	−13.55
	(3.69)	(4.76)	(10.77)	(11.62)	(10.53)	(10.03)	(14.71)	(14.64)	(9.52)	(11.88)
Stress Bank EBA * Post Stress Period 2015	−1.50	2.63	9.54	19.04*	−10.41	−8.01	6.24	8.65	−6.03	−12.83
	(3.24)	(3.32)	(10.92)	(11.46)	(13.61)	(11.05)	(14.53)	(14.09)	(10.19)	(12.47)
Stress Bank EBA * Post Stress Period 2016	−3.17	0.18	7.84	15.85	−20.85*	−8.26	12.10	10.58	−0.26	−2.28
	(3.01)	(3.43)	(10.91)	(11.26)	(11.28)	(11.87)	(15.15)	(14.89)	(10.42)	(13.02)
Stress Bank EBA * Post Stress Period 2017	−3.50	−0.23	8.96	16.88	−14.77	−5.06	9.26	13.05	−9.58	−12.70

(continued on next page)

Table A1 (*continued*)

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	(2.78)	(3.10)	(10.68)	(10.92)	(10.63)	(10.66)	(15.61)	(16.23)	(8.79)	(10.45)
Stress Bank EBA * Post Stress Period 2018	−5.51*	−1.20	1.19	9.01	10.41	35.50	9.95	25.38	−2.83	−5.61
	(3.14)	(3.35)	(10.34)	(10.78)	(17.74)	(28.16)	(17.65)	(22.02)	(11.15)	(13.45)
Stress Bank EBA * Post Stress Period 2009		−14.34**		−57.03		−65.79**		−19.78		14.90
* GIIPS		(6.51)		(36.04)		(28.41)		(23.67)		(17.21)
Stress Bank EBA * Post Stress Period 2010		−11.38**		−25.02*		−25.19*		−8.49		4.70
* GIIPS		(4.93)		(13.81)		(14.59)		(13.83)		(16.85)
Stress Bank EBA * Post Stress Period 2011		−11.30***		4.92		−48.20**		17.71		37.37*
* GIIPS		(4.14)		(21.37)		(19.65)		(19.77)		(19.93)
Stress Bank EBA * Post Stress Period 2012		−3.64		−22.82*		−47.01***		0.32		13.04
* GIIPS		(6.56)		(12.46)		(13.88)		(20.25)		(16.92)
Stress Bank EBA * Post Stress Period 2013		−2.63		−15.34		−16.01		10.45		−8.02
* GIIPS		(5.81)		(13.22)		(16.13)		(17.03)		(12.37)
Stress Bank EBA * Post Stress Period 2014		−9.48		−25.87**		−30.93**		−0.54		21.67
* GIIPS		(5.78)		(12.87)		(13.85)		(17.46)		(13.91)
Stress Bank EBA * Post Stress Period 2015		−11.00*		−30.54**		−14.88		−4.86		17.43
* GIIPS		(6.02)		(13.17)		(24.44)		(17.98)		(17.07)
Stress Bank EBA * Post Stress Period 2016		−8.76**		−26.27**		−38.82**		5.47		4.42
* GIIPS		(4.40)		(12.01)		(15.90)		(18.46)		(17.53)
Stress Bank EBA * Post Stress Period 2017		−8.47**		−26.03**		−32.03**		−7.12		7.36
* GIIPS		(3.77)		(13.00)		(14.48)		(19.17)		(13.80)
Stress Bank EBA * Post Stress Period 2018		−11.46**		−26.40**		−66.48**		−33.34		6.48
* GIIPS		(4.61)		(12.35)		(30.71)		(25.03)		(19.06)
Constant	126.74***	121.11***	340.02***	323.80***	296.04***	299.16***	257.47*	242.80	143.87	148.30
	(36.37)	(35.86)	(99.52)	(95.96)	(111.62)	(114.10)	(151.80)	(153.33)	(92.26)	(92.77)
Observations	2,232	2,232	909	909	1,173	1,173	1,280	1,280	2,215	2,215
R-Squared	0.12	0.13	0.13	0.14	0.08	0.09	0.03	0.04	0.03	0.03
Number of banks	259	259	140	140	183	183	195	195	259	259
Bank fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Table A2EU Stress Testing on Credit Risk – Year by Year (GIIPS) – Difference in Differences Specification. The table reports the dynamic effect of the EBA's supervisory stress testing on credit risk, using the difference-in-differences specification. The dependent variable is the non-performing loan ratio. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and the Euro bank rate). All the control variables are lagged by one period. The Stress Bank EBA variable is a dummy variable designated as 1 for 39 banks and 0 for the remaining banks. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. The Post Stress Period for each year changes, and examines the first year of stress testing, until the most current period. For example, the Post Stress Period 2009 is designated as 1 for 2009 and 0 for the remaining years. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Non-performing loans ratio %	
	(1)	(2)
Stress Bank EBA * Post Stress Period 2009	0.07	−0.54
	(0.51)	(0.59)
Stress Bank EBA * Post Stress Period 2010	0.47	−0.03
	(0.52)	(0.57)
Stress Bank EBA * Post Stress Period 2011	1.88**	0.04
	(0.80)	(0.62)
Stress Bank EBA * Post Stress Period 2012	1.94**	−0.40
	(0.97)	(0.63)
Stress Bank EBA * Post Stress Period 2013	3.81**	−0.43
	(1.52)	(0.75)
Stress Bank EBA * Post Stress Period 2014	3.83**	−1.44*
	(1.88)	(0.80)
Stress Bank EBA * Post Stress Period 2015	2.49	−2.54***
	(1.67)	(0.84)
Stress Bank EBA * Post Stress Period 2016	2.31	−2.02**
	(1.51)	(0.90)
Stress Bank EBA * Post Stress Period 2017	2.13	−2.14***
	(1.72)	(0.78)
Stress Bank EBA * Post Stress Period 2018	3.31*	−1.05

(*continued on next page*)

(*continued*)

	Non-performing loans ratio %	
	(1)	(2)
	(1.70)	(0.74)
Stress Bank EBA * Post Stress Period 2009 * GIIPS		1.37**
		(0.64)
Stress Bank EBA * Post Stress Period 2010 * GIIPS		1.09*
		(0.61)
Stress Bank EBA * Post Stress Period 2011 * GIIPS		4.70***
		(1.48)
Stress Bank EBA * Post Stress Period 2012 * GIIPS		6.18***
		(1.87)
Stress Bank EBA * Post Stress Period 2013 * GIIPS		11.24***
		(3.03)
Stress Bank EBA * Post Stress Period 2014 * GIIPS		14.22***
		(3.84)
Stress Bank EBA * Post Stress Period 2015 * GIIPS		13.69***
		(3.26)
Stress Bank EBA * Post Stress Period 2016 * GIIPS		11.67***
		(2.80)
Stress Bank EBA * Post Stress Period 2017 * GIIPS		11.38***
		(3.52)
Stress Bank EBA * Post Stress Period 2018 * GIIPS		11.60***
		(3.30)
Constant	−3.79	0.07
	(12.82)	(10.96)
Observations	2,261	2,261
R-Squared	0.31	0.39
Number of banks	261	261
Bank fixed effects	YES	YES
Time fixed effects	YES	YES
Control variables	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Table A3

EU Stress Testing on Bank Lending – Stress Test Exposure – Above - Difference in Total Capital. The table reports the effect of the EBA's supervisory stress testing on bank lending, using the stress test exposure specification. The dependent variables are total loans, mortgage loans, corporate loans, consumer loans, and bank loans. The explanatory variables include Size of the bank (natural log of total assets), Profitability (Return on Assets), Credit Risk (non-performing loan ratio), Efficiency (operating expenses over total assets), Capital (equity over total assets). The Liquidity variable (liquid assets over total assets), and the Funding variable (customer deposits over total assets). For the macroeconomic variables, we include two Economic conditions variables (proxied by the Unemployment rate and the Euro bank rate). All the control variables are lagged by one period. The stress test exposure concerning Total capital, is defined as the difference between the pre-stress test Total capital ratio and the post-stress test Total capital ratio. The stress test exposure – above, is designated as 1 for the banks that are above the median for the stress test exposure. The GIIPS variable is designated as 1 for Greece, Ireland, Italy and Spain, and 0 for the remaining countries. Model (1) includes all the controls and the main stress test exposure - above variable. Model (2) includes all controls, the main stress test exposure - above variable, and the main stress test exposure - above variable with GIIPS interaction. Bank fixed effects and time fixed effects are controlled for in all models but are not reported. All models include clustered standard errors, which are reported in parentheses. Table 1 reports the description and summary statistics for all the variables.

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Stress test exposure – Above - Difference in Total capital	−5.22**	−3.48	−5.36	−0.53	21.45	3.75	0.97	3.03	10.02	14.34*
	(2.39)	(2.46)	(3.18)	(2.44)	(20.21)	(9.56)	(4.32)	(5.04)	(7.41)	(7.80)
Stress test exposure – Above - Difference in Total capital * GIIPS		−5.96		−14.42**		44.00		−5.07		−14.27
		(3.59)		(6.11)		(31.97)		(4.89)		(13.12)
Size	−19.15***	−18.28***	−36.87*	−38.33**	−34.59	−43.88	−37.52***	−36.40***	−2.89	−1.03
	(5.89)	(5.46)	(19.09)	(16.71)	(45.17)	(43.68)	(11.52)	(11.55)	(26.51)	(25.63)
Profitability	2.70*	3.07*	3.94	4.81*	3.48	1.94	−3.81	−3.64	2.04	2.91
	(1.57)	(1.63)	(2.54)	(2.42)	(7.48)	(7.98)	(3.52)	(3.55)	(6.41)	(6.78)
Credit risk	0.28	0.41*	−0.12	−0.09	0.85	1.05	0.13	0.10	0.44	0.75
	(0.20)	(0.21)	(0.50)	(0.45)	(1.01)	(1.18)	(0.63)	(0.63)	(0.88)	(0.90)
Efficiency	−2.87*	−2.84*	−4.11***	−4.30***	5.34	4.57	−26.56***	−26.45***	−4.33	−4.28
	(1.59)	(1.59)	(1.16)	(1.04)	(6.50)	(6.51)	(3.84)	(3.91)	(3.74)	(3.80)
Capital	−2.03***	−2.38***	−3.48***	−3.40***	0.14	−0.33	−3.88**	−3.82**	−4.95	−5.77
	(0.70)	(0.73)	(0.85)	(0.91)	(2.61)	(3.21)	(1.77)	(1.81)	(4.89)	(4.79)
Liquidity	0.21	0.22	0.34	0.46	0.97	0.86	0.91	0.93	−0.41	−0.38
	(0.18)	(0.18)	(0.35)	(0.38)	(1.12)	(0.96)	(0.60)	(0.62)	(0.97)	(0.94)
Funding	−0.26	−0.17	−0.99*	−0.79*	−1.58	−2.67	0.74	0.87	−0.76	−0.54
	(0.25)	(0.26)	(0.50)	(0.39)	(2.57)	(2.74)	(0.49)	(0.52)	(0.96)	(0.99)
Economic conditions (Unemployment)	−0.63	−0.40	−0.34	0.40	4.66	1.65	−4.23	−3.79	−3.26	−2.67
	(0.92)	(0.90)	(1.30)	(1.16)	(4.90)	(3.70)	(3.51)	(3.66)	(4.47)	(4.49)
Economic conditions (Bank Rate)	−7.70**	−7.33**	−7.81	−2.31	5.04	−17.16	−21.97	−19.39	9.90	10.83
	(3.08)	(3.02)	(5.87)	(5.26)	(21.62)	(21.79)	(18.02)	(18.43)	(11.66)	(11.68)

(*continued on next page*)

Table A3 (*continued*)

	Total loans change %		Mortgage loans change %		Corporate loans change %		Consumer loans change %		Bank loans change %	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Constant	270.45***	253.96***	541.30**	538.22**	402.49	611.45	521.64***	495.62***	139.02	101.59
	(85.57)	(80.36)	(254.07)	(217.35)	(599.43)	(635.29)	(172.80)	(176.27)	(365.87)	(359.33)
Observations	149	149	80	80	85	85	90	90	145	145
R-Squared	0.20	0.22	0.56	0.62	0.14	0.24	0.49	0.49	0.11	0.12
Number of banks	39	39	27	27	30	30	33	33	38	38
Bank fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

References

Acharya, V.V., Berger, N.A., Roman, A.A., 2018. Lending implications of the U.S. bank stress tests: costs or benefits? J. Financ. Intermediation 34, 58–90.

Ahmed, K., Calice, G., 2022. The effects of supervisory stress testing on bank lending: examining large UK banks. J. Bank. 24 (2), 228–247.

Basel Committee on Banking Supervision (BCBS), 2009. Principles for Sound Stress Testing Practices and Supervision. Bank for International Settlements.

Benbouzid, N., Kumar, A., Mallick, S.K., Sousa, R.M., Stojanovic, A., 2022. Bank credit risk and macro-prudential policies: role of counter-cyclical capital buffer. J. Financ. Stabil. 63, 101084.

Borges, M.R., Mendes, J.Z., Pereira, A., 2019. The value of information: the impact of European Union bank stress tests on stock markets. Int. Adv. Econ. Res. 25, 429–444.

Calem, P., Correa, R., Lee, S.J., 2020. Prudential policies and their impact on credit in the United States. J. Financ. Intermediation 42.

Candelon, B., Sy, A.N.R., 2015. How Did Markets React to Stress Tests? International Monetary Fund. Working paper.

Casey, E., O'Toole, C.M., 2014. Bank lending constraints, trade credit and alternative financing during the financial crisis: evidence from European SMEs. J. Corp. Finance 27, 173–193.

Cerutti, E., Schmieder, C., 2014. Ring fencing and consolidated banks' stress tests. J. Financ. Stabil. 11, 1–12.

Chakraborty, I., Goldstein, I., Mackinlay, A., 2020. Monetary stimulus and bank lending. J. Financ. Econ. 136, 189–218.

Chen, B.S., Hanson, S.G., Stein, J.C., 2017. The Decline of Big-Bank Lending to Small Business: Dynamic Impacts on Local Credit and Labor Markets. Working paper.

Committee of European Banking Supervisors, 2010. Aggregate Outcome of the 2010 EU Wide Stress Test Exercise Coordinated by CEBS in Cooperation with the ECB.

Connolly, M.F., 2017. The Impact of Stress Testing on Banking Lending: Evidence from the SCAP. Working paper.

Cornett, M.M., Minnick, K., Schorno, P.J., Tehranian, H., 2020. An examination of bank behaviour around Federal Reserve stress tests. J. Financ. Intermediation 41, 100789.

Cortés, K., Demyanyk, Y., Li, L., Loutskina, E., Strahan, P.E., 2020. Stress tests and small business lending. J. Financ. Econ. 136, 260–279.

Doerr, S., 2019. Unintended Side Effects: Stress Tests, Entrepreneurship, and Innovation. Bank for International Settlements. Working paper.

Fiordelisi, F., Ricci, O., Lopes, F.S.S., 2017. The unintended consequences of the launch of the single supervisory mechanism in europe. J. Financ. Quant. Anal. 52, 2809–2836.

Goncharenko, R., Hledik, J., Pinto, R., 2018. The dark side of stress tests: negative effects of information disclosure. J. Financ. Stabil. 37, 49–59.

Kok, C., Müller, C., Ongena, S., Pancaro, C., 2023. The disciplining effect of supervisory scrutiny in the EU-wide stress test. J. Financ. Intermediation 53, 101015.

Konietschke, P., Ongena, S., Marques, A.P., 2022. Stress tests and capital requirement disclosures: do they impact banks' lending and risk-taking decisions?. In: ECB Working Paper Series No 2679/July 2022.

Morgan, D.P., Peristiani, S., Savino, V., 2014. The information value of the stress test. J. Money Credit Bank. 46, 1479–1500.

Neretina, E., Sahin, C., Haan, J.D., 2015. Banking Stress Test Effects on Returns and Risks. Working Paper. De Nederlandsche Bank.

Petrella, G., Resti, A., 2013. Supervisors as information producers: do stress tests reduce bank opaqueness? J. Bank. Finance 37, 5406–5420.

Shapiro, J., Zeng, J., 2020. Stress Testing and Bank Lending. Working Paper.

Liu, E., Niepmann, F. and Schmidt-Eisenlohr, T., 2019. The effect of US stress tests on monetary policy spillovers to emerging markets.