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The Corona Crisis as Ultimate Stress Test-
Market Reaction to EBA´s 2020 Stress Test Postponement

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Abstract

In response to the COVID-19 outbreak, the European Banking Authority (EBA) decided to postpone its biennial 2020 stress test to 2021. The supervisory exercise was supposed to answer whether banks have sufficient capital to withstand the impact of a global economic recession. This paper investigates the stock market response to EBA´s stress test postponement and various related key events. For this purpose, the thesis employs both a standard event study and cross-sectional regressions. Overall, the market seemed to appreciate EBA´s stress test-related disclosures, as measured by significant abnormal returns around defined key events. Whereas the market approached the launch of the 2020 stress test with a prevalent positive sentiment, the trend reverted as the pandemic aggravated. In addition, the analysis of stress tested versus non-tested banks indicates that investors´ focus shifted from idiosyncratic to aggregate systemic risk for assessing the banking industry´s resilience in crisis times. Absolute abnormal returns revealed a significant cross-sectional variation for the postponement event. The regression´s results provide evidence that latter findings can be attributed to market participants updating their a priori beliefs in relation to expected stress test outcomes.

Keywords

EBA Stress Test, Financial Stability, Resilience, Event Study, Bank Regulation, COVID-19

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Abbreviations

AQR	Asset Quality Review
AAR	Average Abnormal Return
AR	Abnormal Return
BCBS	Basel Committee on Banking Supervision
CAR	Cumulative Abnormal Return
CAAR	Cumulative Average Abnormal Return
CEBS	Committee of European Banking Supervisors
CET1	Common Equity Tier 1
COVID-19	Coronavirus Disease 2019
EBA	European Banking Authority
ECB	European Central Bank
EU	European Union
FED	Federal Reserve System
FSB	Financial Stability Board
GDP	Gross Domestic Product
GFC	Global Financial Crisis
IMF	International Monetary Fund
IFRS	International Financial Reporting Standards
RWA	Risk-Weighted Asset
SSM	Single Supervisory Mechanism
SREP	Supervisory Review and Evaluation Process
SRISK	Systematic Risk Measure
UK	United Kingdom
US	United States

1. Introduction

“This time, banks are part of the solution.”

(Swedishbankers, 2020)

The COVID-19 pandemic represents an unprecedented exogenous shock to the real economy, exerting immense pressure on various industries, countries and the global financial system (FSB, 2020). In order to contain the spread of the coronavirus, the world has witnessed significant restrictions on economic activities, ultimately leading to the largest recession since the Great Depression of the 1930s.[1] To manage vulnerabilities and prevent liquidity crunches caused by the pandemic, governments took prompt action and have introduced several measures to ensure the flow of credit to the economy (Altavilla et al., 2020). Whereas insufficiently capitalised banks were the catalysator of the Global Financial Crises (GFC), financial institutions have improved their capital and liquidity situation and emerged as key players in keeping the economy afloat. Consequently, banks were able to continue their critical role as financial intermediaries and hitherto prevented an acceleration of the current crises. However, those interferences only provide temporary relief and cannot fully mitigate the risk of corporates defaulting on their credit obligation in the medium- to long term. The crisis-related liquidity pressure on corporations will gradually translate into a substantial increase in expected credit losses, raising the question about the financial system´s resilience (Mack, 2020).

To evaluate the banking system´s strength and vulnerability, stress testing has emerged as an indispensable supervisory tool gauging banks´ performance under particularly designed scenarios (Guindos, 2019). Stress tests can be described as forward-looking simulation exercises to estimate the resilience of financial institutions to hypothetical adverse macroeconomic shocks (Baudino et al., 2018). In addition to assessing the financial stability of participating banks, such exercises assist in setting prudential policies by quantifying banks´ recapitalisation needs when changing market conditions materialize (Hirtle and Lehnert, 2015); (Peura and Jokivuolle, 2004). From a regulator´s point of view, stress tests are designed to prevent institutional failure culminating in a collapse of main financial services functions (Gambetta et al., 2019). Accordingly, the European Banking Authority (EBA) coordinates and develops the common methodology for concurrent biennial pan-European stress tests (EBA,

[1] Kristalina Georgieva, IMF Managing Director, addressed the substantial negative outlook during her live speech on how to overcome the crisis (9 April 2020; see: https://www.imf.org/en/News/Articles/2020/04/07/sp040920-SMs2020-Curtain-Raiser). In its latest world economic outlook update (October 2020), the IMF forecasts a GDP fall of -8.3% for the euro area in 2020.

2016b). The authority enforces the same macroeconomic scenarios in a standardised approach to allow for the quantitative comparability and reconciliation of different perspectives.

For quite some time, public criticism has been expressed in relation to the effectiveness and informative value, questioning the rationale of supervisory stress tests (see Section 3.2). One of the crucial assumptions for stress tests to produce valuable information is the adverse scenario´s design (Kapinos et al., 2015). With the uncertain magnitude and dimensions of the COVID-19 pandemic, national supervisors face the challenge of pivoting a meaningful stress scenario. In deciding how to perform such an exercise, regulators need to consider the inherent trade-off between the supervisor´s reputation and lending implications. Li Ong and Pazarbasioglu (2014) discuss that an over-optimistic stress test may provide a false sense of security and hence undermines the credibility of regulatory and supervisory authorities. It took some time for European banking regulators to build up reputable stress tests. If the market perceives this year´s stress test as too mild, authorities´ reputation may be blackened. On the other hand, Shapiro and Zeng (2018) claim that implausibly severe stress may have a negative impact on the level of lending, conceivably exacerbating the challenge to sustain the supply of credit amidst extreme market conditions. Ergo, the market´s perception of EBA´s 2020/21 strategy will depend on the relative credibility, commitment and attributes of the stressed scenario.

There are two distinct strands of literature addressing the stress testing needs during a crisis. Following Fernandes et al. (2015), there is an increased demand for accurate information on financial conditions when markets are under systemic distress. In times of crisis, the disclosure of stress test reduces informational asymmetry through timely communication (Xoual, 2013a) and helps distinguish a good from a bad bank (Schuermann, 2014). Bouvard et al. (2015) claim that transparency is essential in adverse times, favouring unambiguous stress test disclosure. Not only market participants but also supervisors need an understanding of potential capital needs during a crisis to estimate how bad it can get to facilitate immediate action, emphasising the role of stress tests as crisis management and resolution instruments (Borio et al., 2014).

On the contrary, Anderson (2016) argues that transparent stress testing in the midst of a crisis will not ineluctably restore financial stability and could inevitably lead to a bank run if the results reveal uncovered solvency needs. Additionally, performing a stress test during uncertain times constitutes a challenging and delicate task since all attention is focused on the credibility and plausibility of the adverse scenario. Goldstein and Sapra (2013) pronounce that improperly designed tests may entail unintended negative consequences fuelling a widespread panic amongst the real economy.

Stress testing strategies during the recent crisis differ substantially among various central banks (Baudino, 2020): Halfway through the regulatory exercise, the EBA temporarily suspended the process without further ado. Shortly afterwards, the Bank of England followed the European supervisor´s example and invoked the exercise´s cancellation on the grounds of demonstrated resilience in its recent 2019 stress test. On the contrary, the Federal Reserve System (FED) insisted on its established procedures and published the initial results, although it included a superficial sensitivity analysis aiming to take account of unprecedented developments. The bank of Japan took a completely different approach in that it shifted its focus from an individual to a collective evaluation to assess COVID-19´s impact on financial institutions' resilience (Bank of Japan, 2020). Hence, instead of being intimidated by the exceptional uncertainties, the Asian regulator decided to emphasise the stress test´s role as a risk management tool. In this context, the thesis investigates the European point of view. It aims to determine the effect of EBA´s postponement announcement on the equity valuation of European banks, as well as examine how market participants reacted to various key announcements related to the 2020/21 stress test exercise. To the best of the thesis author´s knowledge, this paper is the first to analyse market reactions to EBA´s 2020 stress test attempt. In addition to contributing to above mentioned distinct streams of literature regarding stress test disclosure in adverse times, the paper addresses whether relevant information has been reflected in a priori market valuations or if the postponement has revealed new information to investors. Furthermore, the thesis contributes to the conceptual debate of the effectiveness and relevance of regulatory stress exercises. Finally, this thesis adds relevant banking insights to the growing literature discussing the Coronavirus pandemic´s overall impact on capital markets.

The remainder of the thesis is structured as follows. Chapter 2 discusses the role of regulatory requirements, followed by an analysis of previous stress test exercises. Chapter 3 provides an overview of the 2020 stress test environment and reviews the current European stress test methodology shortages. The data and methodology used are described in Chapter 4. Chapter 5 presents the empirical analysis, including several tests and critical assessments examining the results´ robustness. Finally, Chapter 6 concludes and expands on further research opportunities.

2. Theoretical Background

Policymakers and researchers have put in place a variety of potential measures attempting to quantitatively capture the state of financial stability (Gadanecz and Jayaram, 2009). In pursuit of the thesis' objectives and in the context of stress testing, the focus of this research will be on regulatory capital ratios as a measure of financial strength. Subsequently, the paper introduces a brief overview of the most important regulations ensuring that banks maintain adequate capital reserves to outlast a severe economic downturn. Next, it elaborates on capital developments and investigates how European banks have entered the crises. Those concepts will support in understanding the development of stress tests, which will be addressed in the second part of this chapter. After elucidating the general stress test methodology, previous exercises will be scrutinized reviewing practitioners´ opinions. Those reflections will serve as the foundation for the analysis of EBA´s 2020 stress test exercise.

2.1 Regulatory Framework

The banking industry is one of the most regulated ones, aiming at reducing excessive risk-taking and mitigating financial failures resulting in distorting societal effects (Matutes and Vives, 2000). Banks are obliged by regulators, as well as the market, to maintain sufficient levels of capital and liquidity to contribute to a smooth-functioning financial system. Capital compensates, on the one hand, for unexpected operational losses (going concern) and, on the other hand, to satisfy the claims of creditors in the event of insolvency (gone concern). The regulatory environment has changed profoundly and the complexity has increased over the years on how to measure capital requirements (Gadanecz and Jayaram, 2009).

The Basel Committee on Banking Supervision (BCBS), established in response to the banking crisis in the 1980s, sets international prudential guidelines to strengthen the banking system´s overall stability and soundness. Achieving this objective involves implementing rules to define a minimum capital level, considering various models to derive adequate equity requirements for different risk factors (Balthazar, 2006). In general, there has been a strong policy move to create more uniform regulatory structures and thus decrease competitive inequality amongst international banks (Trenca et al., 2016). This harmonisation allows for a uniform definition of capital requirements. To facilitate a common understanding of the basis on which stress tests are built upon, the fundamental concepts of the current Basel III regulation will be explained in the following paragraphs.

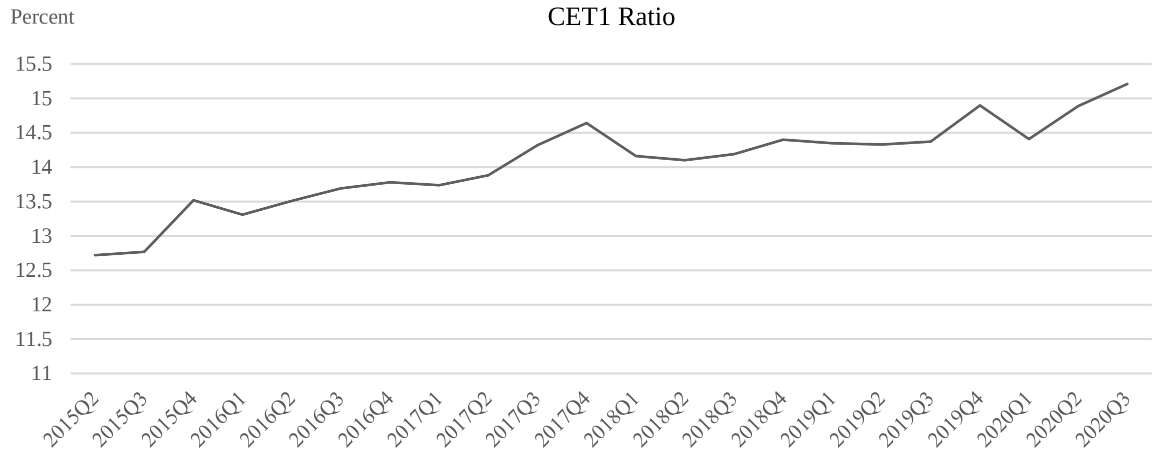
Basel III, implemented as an attempt to counteract the regulatory shortcomings exposed by the GFC, focuses on enhancing capital and liquidity requirements to achieve the overall goal of strengthening the soundness of the global banking system. To mitigate the issues of varying definitions of capital and thereby address the public scepticism towards capital ratios, Basel III introduced specific classification criteria to develop minimum capital adequacy standards (Laurens, 2012). Tightened prudential regulation is more conservative than traditional accounting measures, eventually considering only high-quality capital as regulatory capital (Financial Stability Institute, 2019). One of the most critical capital measures is the Common Equity Tier 1 (CET1), which represents the capital of the highest loss absorbency quality such as common shares, share capital and retained earnings. Besides, capital requirements consider several buffers (e.g., system risk, capital conservation, countercyclical capital buffer) to conserve an institution´s capital, offsetting temporary funding constraints and counteracting cyclicality. Consequently, banks are required to hold additional capital reserves in good times, which can be drawn down in bad times to absorb economic shocks. National supervisors have some flexibility through a supervisory review and evaluation process (SREP) to pose additional requirements for individual institutions accounting for higher-than-normal risk factors (Pillar 2 capital requirements). When a bank falls below a specified threshold (i.e., CET1 4.5%, Capital Conservation Buffer 2.5%; see Appendix 1 for more details regarding minimum requirements), safeguards apply to limit distributable dividends and bonuses, reflecting indirect management disciplinary measures (European Commission, 2013).

To calculate the amount of capital an institution needs to hold, the Basel Accords define how to weigh an institution's assets according to its risk profile. The concept of risk-weighted assets (RWA) accounts for different key risk factors, namely credit (i.e., counterpart cannot meet its debt obligation and subsequently defaults), market (i.e., possible negative impact through exposure to price fluctuations) and operational (i.e., potential losses due to inefficient processes and external events) risk. For each category, the Basel framework sets out conceptual approaches to calculate RWAs ranging from standardised over advanced to internal models. Depending on how risky a financial institution´s assets are, the more capital it is expected to hold. By way of illustration, a consumer credit that has no collateral backing is considered to be riskier and requires more equity capital than a government security.

$$CET1\ Ratio = \frac{\text{CET1 Capital (including specific buffers)}}{\text{RWA}} \tag{1}$$

Financial institutions can use two channels to adapt to changing capital requirements: To meet a rising CET 1 ratio, capital can be adjusted by either issuing new shares or retaining profits. Such measures positively impact the capital base (numerator) and increase the capital ratio if RWAs remain constant. Another option would be to cut back on lending, sell loan portfolios or reduce risky loans, i.e., to deleverage, thereby reducing RWAs. This will, ceteris paribus, increase the capital ratio for a given amount of capital.

Figure 1: Development of Common Equity Tier 1 Ratio



This figure displays the evolution of the aggregated European CET 1 ratio over time. The graph starts with 2015 Q2 since previous figures may prove misleading (inconsistent application of capital requirements) and would thus undermine the informative value. Data derived from ECB´s Statistical Data Warehouse.

Compared to the GFC, financial institutions were more resilient going into the current crisis, with capital ratios well above regulatory requirements (FSB, 2020). Figure 1 shows the improvement of the CET 1 ratio since the initial implementation of the regulatory capital reform. Although banks now hold larger capital buffers, the CET1 ratio development in the first quarter of 2020 reflects the tightening of financial conditions. Blank et al.´s (2020) conceptual framework states that in times of stress, regulators should not only focus on avoiding a credit crunch through relaxing capital requirements but simultaneously encourage financial institutions to raise new capital and prevent capital depletion[2]. Accordingly, the European Central Bank announced temporary capital relief measures in March. To ensure that the economy will eventually receive those incentive effects through continued funding, the European Central Bank (ECB) recommended a dividend and share buyback stop (ECB, 2020b).

[2] The rationale behind the framework is to incentivize banks to provide liquidity to the economy. Those actions finally aim at increasing banks´ assets ($RWA = \frac{\text{CET 1}}{\text{CET 1 ratio}}$) which can be accomplished by either decreasing the CET 1 ratio (= denominator) or increasing bank capital (= numerator).

Furthermore, the Basel Committee announced to postpone the implementation of the finalised Basel III standards[3] (sometimes referred to as Basel IV) to accommodate for current challenges (BCBS, 2020). All those remedial measures aim to promptly recapitalise financial institutions, increasing the incentive to borrow and sustain financing to the economy, ultimately supporting the system´s resilience (EBA, 2020a).

To conclude, prudential regulations have had a significant influence on improving the banking sector in terms of book equity capital, arming banks to better withstand extraordinary market shocks. Besides, capital regulations constantly evolve to incorporate various developments and lessons learned, eventually providing institutions with some flexibility to adapt to unexpected circumstances, an indispensable tool for crisis resistance. Stress tests may provide a first indication of appropriate capital levels to absorb potential losses and are thus an integral part of a bank´s risk management and supervision process (BCBS, 2009). Against this background, the following section discusses the main developments of pan-European stress testing.

2.2 EU- Stress Tests Literature Review

In the wake of the GFC, supervising authorities had been pressured to curb banks´ inherent opaqueness by providing more reliable and credible information. Even though most financial institutions already used some simulation technique themselves as part of their internal risk management, increased uncertainty fuelled the rapid evolution of comprehensive sector-wide supervisory stress testing. While the revised Basel regulations need some time to fully phase in[4], the introduction of published stress tests and hurdle rates has forced many banks to "voluntarily" improve their capital ratios even though they were not yet officially required to do so (Heynderickx et al., 2016). Stress testing is a dynamic, forward-looking process commencing with EBA´s announcement and the publication of the methodology defining a common set of one expected baseline and one plausible adverse scenario. The former represents an optimistic estimate of future macroeconomic developments, whereas the latter reflects deteriorated conditions to stress the banking industry´s performance (Baudino et al., 2018). In due time, tested banks use their own internal models adapted to EBA´s propounded framework

[3] Critiques have emerged regarding the RWA computation (see Section 3.2. "Alternatives to Stress Tests"), resulting in additional efforts to converge and harmonize prudential regulation.

[4] Before Basel Standards become effective, they first need to be translated into European law (i.e. Capital Requirement Directive and Regulation), foreseeing a considerable transition phase. For reference, Basel III was first introduced in 2010, entered into force in 2013, with full implementation by 2023.

of predefined parameters and conditional assumptions (constrained bottom-up stress test) to provide information about the respective institution´s financial health and resilience against potential shocks. European stress tests rely on a static balance sheet assumption, implying that banks do not counter distorting effects, i.e. the exercise does not account for any changes in a participant´s strategy as a response to the simulated stressful situation. The stress test´s fundamental outcome is the projected pro forma CET1 ratio under the adverse scenario at the end of a three-year stress horizon[5]. By definition, a stress test is not designed to predict or forecast how a specific bank will look like in the future but to elaborate on hypothetical forward-looking scenarios discussing how bad situations in a worst, yet realistic, case can get. After a subsequent cross-check, rigorous benchmarking, and further calibration, where necessary, the EBA publishes the results stating whether European banks demonstrate the required resilience to withstand adverse market shocks.

From a theoretical viewpoint, the adverse scenario represents a risk tail event that is very unlikely to materialize (Fernandes et al., 2015). Critics maintain that the scenario design rather reflects past than potential future developments. This, in turn, limits the reliability and context of the designed exercise and results in questioning the informativeness of produced stress test results. With the devastating disruptions caused by the COVID-19 pandemic, this issue is both quick-tempered in nature and more topical than ever. Schuermann (2014) contributes to the discussion and adds that not only the scenario design but also governmental aspects such as the reputation of the authority, the institutional framework, the granularity of information intended for public release as well as the credibility of a potential backstop play a crucial role for a stress test to be perceived as effective. Notwithstanding the foregoing, the methodology and the publication of the results release additional information about a bank´s risk profile which finds reflection in market participants´ expectations. Depending on the nature of news, the market reacts accordingly with changes in equity prices. On the one hand, investors are equipped to make better-informed decisions, ultimately impacting the individual discount rate used for valuing expected future cash flows. With improved price efficiency and reduced uncertainty costs, the risk premium may be fairly adjusted, benefiting the overall assessment of a bank´s value. On the contrary, when the results reveal a capital gap for a specific institution, share prices tend to be negatively impacted owing to dilution concerns. Investors fear that scrutinized banks either have to shed assets under unfavourable market circumstances or raise new capital caused by increased regulatory pressure. Ultimately, the disclosure of stress test results aims to

[5] To increase the adverse scenario´s significance and validity, the EBA has extended the horizon from two to three years in 2014.

increase information efficiency, promote transparency and facilitate market discipline (Crisan, 2014).

Table 1: Summary Characteristics of European Stress Tests

	2009	2010	2011	2014	2016	2018
Competent Authority	CEBS	CEBS	CEBS	EBA	EBA	EBA
Representation and Participation Criteria	60% of total assets of EU banking sector	65% of sector 50% of national sector	65% of sector 50% of national sector	70% of sector 50% of national sector	70% of sector minimum EUR 30bn in assets	70% of sector
# Participating Banks	22 groups	91	90	123	51	48
Adverse Assumptions at End of Horizon	-2.7% GDP 12.0% Unemployment	-0.4% GDP 11.0% Unemployment	0% GDP 10.5% Unemployment	0.1% GDP 13.0% Unemployment	0.7% GDP 11.6% Unemployment	0.7% GDP 9.7% Unemployment
Hurdle Rate	6% Tier 1	6% Tier 1	5% CET1	5.5% CET1	-	-
# Failed Banks	0	7	8	20	-	-
Released Data Points per Bank	-	149	3,200	12,000	16,000	17,200

Table 1 provides a first overview of the characteristics of conducted European stress tests. Besides, a detailed timeline of previous exercises is set out in Appendix 2 for reference. Owing to the emergence of nationwide regulatory stress testing, literature has increased steadily, aiming to investigate the banking sector´s resilience. The rest of this chapter addresses the historical development of introduced exercises in more depth and discusses inconclusive empirical research regarding the relevance and informativeness of supervisory stress exercises.

2.2.1. CEBS 2009

As a response to the successful launch of the US Supervisory Capital Assessment Program, Europe introduced its first regulatory stress testing program in 2009. The former Committee of European Banking Supervisors (CEBS) announced the exercise in May 2009 and presented the aggregate results four months later. The primary objective was not to assess the resilience of individual banks (sovereign territory of national authorities) but of the aggregate industry. Since the outcomes were treated rather confidential and bank-specific information remained unpublished, the market could not establish whether the limited results truly represented an assessment of European banks´ resilience, eventually emphasising the lack of transparency (Xoual, 2013b).

2.2.2. CEBS 2010

After the first exercise´s poor performance in regaining the market´s trust, recent developments provided further opportunity for incremental reforms of testing practices. The CEBS was mandated to coordinate a thorough stress test, resulting in seven banks (out of 91) not meeting the threshold in an adverse scenario described by a GDP decrease of 0.4%[6] (CEBS, 2010). Although the outcome reflected a sound European banking system even in the downturn scenario, Irish banks had to be bailed out only a few months after the publication of the results (Treanor, 2010). Blundell-Wignall and Slovik (2010) criticise that the test design had understated the threat of sovereign default by excluding most sovereign debt positions and thus the exercise did not help in deriving an understanding of real risk exposures. Xoual (2013a) argues that instead of reassuring the market, the exercise caused confusion and lacked clear objectives since regulators subsequently failed to address corrective actions. Accordingly, Nordmark and Cardinali (2011) performed a study on market price reactions and found that the 2010 results were uninformative to investors. Wall (2013) concludes that European supervisors were reluctant to impose scenarios revealing severe enough conditions to adequately verify the industry´s resilience, confirming non-existing market reactions to CEBS´ 2010 exercise.

2.2.3. EBA 2011

Since previous tests had failed to restore the confidence in the system, the EBA as regulatory successor reinforced and revised the overall methodology following the principles´ publication of the BCBS (BCBS, 2009). Drawing on lessons learned, the EBA introduced a more stringent capital definition and enhanced transparency by providing an unprecedented detailed database of information, enabling analysts to perform their own assessment of stress tests and anticipate test results (Gerhardt and Vander, 2017). As regards the methodology, the more severe adverse scenario was reflected by the amount of twenty banks initially failing to meet required capital conditions. Alves et al. (2015), Petrella and Resti (2013) found evidence of price reaction for tested banks on the results date, highlighting the information role of stress tests. Inconsistent with those findings and representing an example of mixed empirical research, Borges et al. (2019) argue that the result event per se had negligible effects on the market, whereas the announcement and methodology events provided valuable information for market participants. Once again, the results were discredited when Dexia, a bank that had previously passed the test, collapsed later that year (Pignal and Jenkins, 2011).

[6] The simulated GDP decrease was not perceived as severe enough. Specifically, the design of the stress test failed at capturing plausible tail risks (see e.g. Borges et al. (2019))

2.2.4. EBA 2014

The need for a consistent application of EU banking rules and supranational unified decision-making procedures brought about the launch of the banking union in 2012. The union seeks to ensure that European regulations are adequately implemented to preserve financial stability, remedy regulatory loopholes and promote confidence in the financial system (Baldwin et al., 2010). One of the pillars the union[7] relies on is the single supervisory mechanism (SSM), stipulating that the ECB is from now on responsible for the supervision of significant European banks. Before accepting its mandate, the ECB preliminary performed an Asset Quality Review (AQR), a thorough assessment of the banking system´s status quo, to converge and harmonise supervised banks´ financial statements. This substantial restructuring effort entailed the postponement of the stress test initially planned for 2013. Complementing the AQR, the implemented stress exercise in 2014 assisted in recapitalising weaker banks through mandatory equity issues and fostering the transition towards a uniform supervisory mechanism lead by the ECB as a supranational institution (Petrella and Resti, 2016). Even though the extensive assessment was perceived as more conclusive than previously performed European stress tests, Sahin and Haan (2016) found no market price reaction following the publication of the 2014 stress results, arguing that the outcomes had been expected by market participants. Despite some major drawbacks and limitations in the setup[8], Arnould and Dehmej (2016) concluded that adapted structural changes represent positive prospects for the future of European stress testing.

2.2.5. EBA 2016

After seven years of continuous stress testing, various capital injections and an improved operational integration established through the SSM, the EBA shifted its focus from crisis resolution- oriented to a more steering- directed function (EBA, 2016a); from peri- crisis to post- crisis stress testing. Compared to previous European stress tests, the EBA decided to no longer impose a minimum capital threshold classifying banks into a pass- or fail groups. Instead, the stress test results will be used as input for the supervisory review and evaluation process (SREP). To this end, the outcome of the stress tests becomes an integral part of a bank´s forward-looking sustainable capital planning process. While published results become less intuitive as a consequence, Quagliariello (2019) argues that it encourages market participants to engage in a more thorough analysis for deriving individual assessments of a bank´s soundness

[7] The union is built on three pillars: SSM, Single Resolution Mechanism and European Deposit Insurance Scheme
[8] Sources of criticism: use of RWA, lack of comparability, modelling of sovereign debt risk, and transitional Basel arrangements

and vulnerabilities. In terms of market reactions, Georgoutsos and Moratis (2020) show that the publication of stress test results revealed new information. The significant negative returns, observed during the publication event, may be attributed to worse than expected results and the aftermath of the “missing” pass/fail threshold. Moreover, the market experienced pervasive uncertainty caused by the UK-wide referendum in June 2016, questioning the severeness of the outlined macro scenario. Groen (2016) summarises that there is still some area of improvement for stress tests since the framework in place rather tackles already materialized problems instead of addressing forward-looking issues impacting the fundamental soundness of the banking industry in the long term.

2.2.6. EBA 2018

This exercise is predominantly driven by continuous regulatory reforms and the implementation of the new accounting rule IFRS 9. Instead of recognizing loan losses only after they had materialized, the expected credit loss model under IFRS 9 requires impairment allowances to be accounted for at the initial reporting date with subsequent regular re-evaluations to reflect anticipated changes in credit quality. Using a probability-weighted estimate, potential losses are recognized before the actual default. The new model allows for a timelier recognition of expected losses, making provisions less procyclical. This exercise has seen the most severe adverse scenario to date as regards the GDP deviation of 8.3% from the baseline scenario. However, the European Court of Auditors (2019) highlighted some of the 2018 stress test shortcomings, emphasising more concisely that the adverse scenario did not cover all relevant EU-wide systemic risks. Even though Fernandes et al. (2015) postulate that market reactions appear to get weaker as stress exercises become more established, Georgoutsos and Moratis (2020) find that the 2018 stress tests provided more information to the market than the previous exercise in 2016.

Over time, stress tests have evolved and are now an integral part of a supervising authority´s toolkit in measuring the stability and resilience of the banking industry. Depending on the market conditions, stress tests may serve different objectives (e.g. identify the size of capital gaps, reduce uncertainty, gauge vulnerabilities, etc.) and have proven useful so far (Judge, 2020). However, there are still some limitations in EBA´s proposed framework heating up the discussion about the authority´s long-term testing strategy. Henceforth, the development of the exercise´s structure has not yet been concluded and will advance to its next stage with every new round of continually improved stress tests.

3. The 2020 Stress Test and Its Environment

2020 constitutes a special year in many ways. Without diving too deep into the economic consequences of the worldwide COVID-19 pandemic, this chapter covers a basic overview of European expansionary monetary and fiscal policies to discuss some current developments for evaluating the crisis´ impact on the banking dimension and EBA´s proposed stress testing framework. In contrast to previous periods of financial turmoil, central banks almost immediately responded with support packages, guarantee schemes and operational leeway to secure the industry´s funding and provide the necessary liquidity. At the outset of the crisis, the EBA encouraged national authorities, as a step to lighten regulatory requirements, to make full use of the flexibility embedded in existing regulations (EBA, 2020b). On 18 March 2020, the ECB launched the temporary Pandemic Emergency Purchase Programme, a quantitative easing instrument to prevent the significant deterioration of financing conditions. This initiative serves to supplement already existing asset purchase programs as well as complement any supportive monetary policy measures[9].

Furthermore, national regulators adopted a less stringent supervisory stance in that it reduced the countercyclical capital buffer to 0% for almost all European banks. In addition, systemic risk buffers and bank-specific Pillar 2 requirements were relaxed to channel financial resources to the real economy[10]. Considering the accounting framework, the ECB emphasised the pragmatic interpretation of the asset quality assessment under the IFRS 9 standard to evade exaggerated procyclical effects. Consequently, the definition of default and forbearance (and therefore the recognition of loan losses) was adjusted to reflect the exceptional circumstances: The grant of payment holidays does not automatically trigger a forbearance reclassification and distressed exposures benefiting from government guarantees may not be classified as non-performing loans.

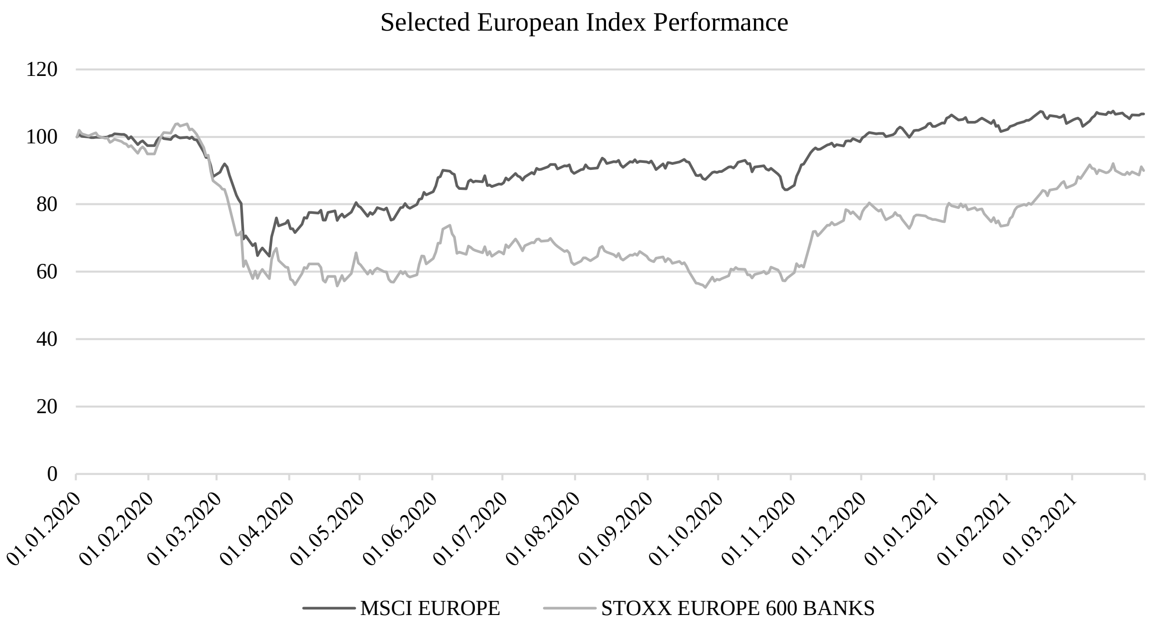
Nevertheless, those governmental policy interventions only temporarily accommodate financial stability and may ultimately result in a non-true reflection of the real banking industry´s state. Implemented measures are the reason for better-than-expected numbers in banks´ published 2020 financial statements and accompanied capital ratios (EBA, 2020c). Once

[9] The newly implemented €750 billion asset purchase program was subsequently extended to €1,850 billion and will be conducted until at least 31 March 2022 (10 December 2020; see: https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.mp201210~8c2778b843.en.html). For more details on monetary policy, please refer to ECB´s announcements.

[10] However, the development of the CET1 ratio, as shown in Figure 1, indicates a reluctance of banks to fully make use of released capital. Reasons for hesitance are, inter alia, market pressure, avoidance of unintended regulatory breaches and increased uncertainty (see discussion in Andreeva et al. (2020))

these programmes expire, banks will see a surge in both RWAs and expected losses, having a considerable negative effect on the former metrics. In Haselmann and Tröger´s (2021) paper, the authors addressed the quantitative impact on banks´ solvency in the hypothetical case of a swift unwinding of support measures. Their simulation exercise revealed the substantial deterioration of banks´ capital solvency, eventually triggering a detrimental banking crisis. Finally, the authors highlight that insufficient provisioning, in turn, fuels severe market frictions. Reported findings should be interpreted in the broader context of already existing vulnerabilities in the banking sector. The historically low interest rate environment significantly burdens financial institutions´ profitability, causing depressed margins and suboptimal returns on equity for investors. The anticipated recording of huge credit losses throughout the following periods increases the difficulty for banks to generate sustainable returns in the long term. Figure 2 provides evidence of aggravating pressure from capital markets on financial intermediaries. The lack of transparency, subdued profitability as well as poor interest rate prospects have driven the sharp correction of banking stocks, reflecting the subsequential impairment of investors´ confidence (Haselmann and Tröger, (2021).

Figure 2: Index Price Performance of Banks versus Non-Banks



This figure plots the daily index prices for each set of index constituents, normalized to 100 at 1 January 2020. Data derived from Datastream.

In correspondence to the aforementioned issue of frictions, Fernandes et al. (2015) emphasised the increased demand for accurate data describing banks´ financial health when markets are under distress. This is fundamentally where stress exercises come into play: "The stress test will help replace the cloud of uncertainty hanging over our banking system with an unprecedented level of transparency and clarity" (Geithner, 2009). As empirical findings confirm, produced insights into the financial sector´s vulnerabilities proved effective in managing financial crises. In recent years of prolonged economic growth, crisis-era stress testing somewhat fell into oblivion. With the emergence of COVID-19 as a global pandemic, the attention has shifted back to the distinct value of stress tests as a crisis-time intervention (Judge, 2020).

Deploying Schuermann´s (2016) terminology, the 2020 stress test is conducted in "wartime", where the central goal is to counter-fight rising information asymmetry and stabilise the banking system by providing reliable public information. In this sense, the objectives of crisis-time stress testing differ from the regular ones in that it takes a more macroprudential stance. In times of crisis, central banks are primarily concerned with the supervision and capital adequacy of the collective industry, preventing any spill-over effects and contagion originating from the banking system. Referring to lessons learned from the GFC, the failure of a single institution can cause a collective run on the whole banking system through monumental negative externalities. Consequently, it is of utmost importance to sustain confidence in the system and avoid any further aggravation of the present crisis.

As mentioned in the introduction, central banks have adopted different strategies in response to the COVID-19 pandemic. While the FED continued with its regular 2020 U.S. stress test exercise[11.], the EBA announced to postpone the stress tests to 2021 as to provide operational relief to banks (EBA, 2020b). This may seem like a counteractive move in restoring market confidence when reflecting on previous conclusions. However, the EBA decided on implementing an alternative European mechanism to address concerns related to banks´ robustness and secure the institutions´ role of injecting funds into the real economy. In a first step, the ECB urged financial institutions to cut dividends and share buybacks until at least Q3 2021 to maintain banks´ capital and reduce the risk of capital shortfalls. This is a critical step as the speed of economic recovery largely depends on the capitalisation of the banking sector

[11] The U.S. 2020 stress tests are based on scenario evaluations as of end 2019. The FED added a sensitivity analysis incorporating three adjusted COVID- scenarios, to account for the current crises. Previously, the FED provided bank-by-bank results but decided to deviate from its standard methodology and only report aggregate results. This change in procedure, initially aiming at minimizing distorting effects and idiosyncratic noise, provoked a particularly negative market perception (see, for example, Tarullo (2020).

(Jordà et al., 2013). Secondly, the EBA deviated from steady-state policies and introduced a system-wide COVID-19 vulnerability analysis. The rationale underpinning this switch was to provide a first indication of possible economic implications and the identification of ad-hoc vulnerabilities. Historically, the European stress test exercise stood out with its granular presentation and disclosure of information (Quagliariello, 2019). This time, the market experienced a shift from specific to more general information disclosure. Due to the exercise´s purpose and setup, the analysis was conducted top-down based on available data to reduce banks´ involvement and resources. The results were published on 28 July 2020, indicating a well-capitalised banking sector. In the aggregate, the industry shall be able to continue its role of lending to the real economy (ECB, 2020a). The more severe scenario depicts some banks taking remedial action to maintain compliance with regulatory capital requirements, with an overall capital shortfall to be contained. In the context of radical uncertainty, note that disclosed results are indicative in nature and the design cannot be directly compared to other exercises since the scenarios reflect the impact of relief measures. Third, ECB´s president assures that the authority "is committed to doing everything necessary within its mandate to help the euro area through this crisis" (Lagarde, 2020). Appropriately structured, Li Ong and Pazarbasioglu (2014) conclude that committing to a credible backstop, as in the former statement, is the bedrock of any crisis stress test. The supervisor´s presented efforts can be interpreted as a first step in paving the way for a comprehensive simulation exercise to assess the industry´s resilience to counter the crisis.

Turning to the methodological features of the postponed stress test, the overall setting needs to be adjusted to reflect current circumstances and new risk types. Baudino (2020) highlights the importance of stress tests amid systemic distress as long as the supposed framework reflects the distinct challenges the European economy is facing. In contrast to the hypothetical imposed stress behaviour deployed in 2020, which draws heavily on past events, the new 2021 scenario design ought to incorporate appropriate risk factors, such as asset deterioration and infection rates, to increase the model´s credibility and meaningfulness. Moreover, the researcher points out that "peacetime" models may not be suitable in this context due to the unique nature of the shock. Despite all, the crisis originated from the real economy, increasing the variety and difficulty to recognize shocks in addition to exploring common financial threats to financial stability. In this respect, Table 2 below gives a rough overview of some of EBA´s implemented changes. This representation does not claim to be exhaustive nor complete but shows a selection of critical variables for the reader to get a first impression of the different levels of severeness.

Table 2: Comparison of the Methodology´s Severity 2020 versus 2021

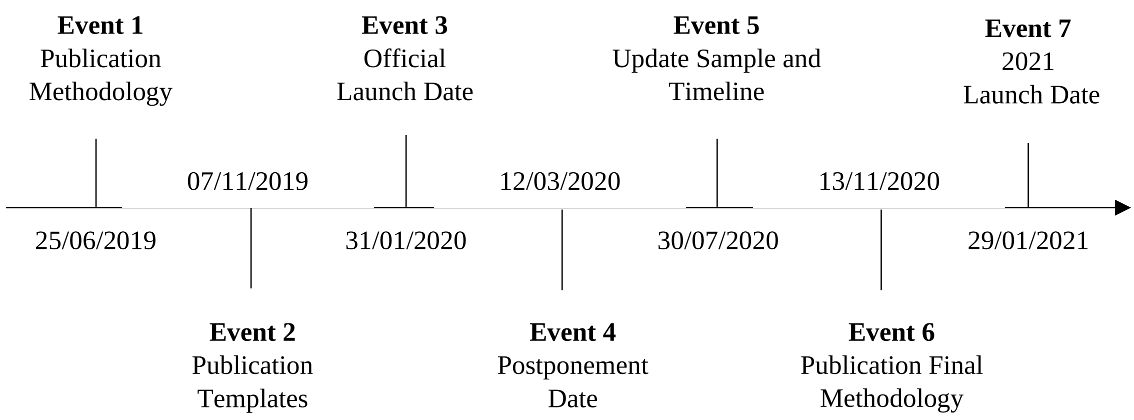
	2020	2021
Main Risk Sources	Bank profitability Asset price misalignments Slowing growth momentum	Negative pandemic impact Financial market repricing Feedback effects
Baseline Scenario at End of Horizon	GDP 1.4% Unemployment 6.1% Consumer Price Index 1.8% Stock Price Deviation 0.0%	GDP 2.3% Unemployment 7.1% Consumer Price Index 1.5% Stock Price Deviation 0.0%
Adverse Scenario at End of Horizon	GDP -0.7% Unemployment 9.9% Consumer Price Index 0.0% Stock Price Deviation -4.0%	GDP -0.2% Unemployment 12.1% Consumer Price Index 0.7% Stock Price Deviation -35.0%
Updates/ Special Considerations	Lower for longer narrative (recession for prolonged period for adverse scenario)	Information on exposures benefiting from public moratoria and guarantees (derived from COVID-19)

The depth and duration of the COVID-19 crisis have led many stakeholders to question the banking system´s resilience. Even though European supervisors have put in place many exceptional macropolitical, fiscal and monetary relief measures, those interferences were not as successful in reassuring the market (Figure 2- banking stocks have not yet been able to recover with depicted price drop still prevalent compared to the overall industry). However, those immediate policy changes hitherto prevented a systemic collapse of the banking industry. Apart from banks being better capitalised going into the crisis, Tarullo (2020) raises hopes that the soon-to-be-published stress test results will add considerable value in providing much better information on the system´s resilience. Looking ahead, the recapitalisation needs, information content and implications of the COVID-based stress test remain to be seen.

3.1 Key Dates

Stress tests are a time-consuming and laborious exercise in which supervisors reveal relevant information at various stages throughout the process. To understand the market reactions and information value of the 2020/2021 stress test, it is essential to break down the sequence of events. In the following, this section caters for a more detailed analysis of the test´s timeline, outlining events that seem relevant. Besides, the web archive of Thomson Reuters was consulted to take eventual news leakages into account. Figure 3 provides a graphical representation of the summarised timeline.

Figure 3: Timeline EBA Stress Test 2020/21



One of the first events related to the planned stress test in 2020 was the introduction of the next round of biennial stress tests, which took place during EBA´s meeting on 12 December 2018[12]. Since the EBA announced the imminent Union-wide resilience test only a month after publishing the results for the 2018 assessment, this event will, in the following, not be part of the analysis. First, estimated parameters would be biased in that they would measure the market reaction to the 2018 test as in "normal" returns. Second, the announcement did not convey any new information as the market anticipated that the EBA would perform another round of stress tests as outlined in its mandate.

On 25 June 2019, the European supervisory authority published the new draft methodology (Event 1). The provided templates served as a constructive basis for further discussions among all industry stakeholders and presented a first indicative sample list of tested banks, a tentative timeline and a detailed methodological note. The latter indicated the overall framework and a preliminary concept with minor amendments brought about by the incorporation of lessons learned and received feedback from the initiated discourse. Anyways, the draft enabled market participants to assimilate the structure and depth of the prospective stress test. After a testing phase of five weeks, the EBA published the stress test templates in the form of a comprehensive excel file on 7 November 2019 (Event 2).

The EU-wide stress test was launched on 31 January 2020 (Event 3). The official starting signal was accompanied by the release of the macroeconomic scenarios. As of now, investors received all necessary information in order to make their own calculations and derive

[12] Information on dates and publications is derived from EBA´s web archive

estimations about the resilience of individual financial institutions as well as of the European banking industry. The EBA expected to publish the outcome by the end of July.

Halfway through the data determination and during the climax of the Coronavirus outbreak, the EBA decided to postpone the stress test to 2021. Such an exercise makes great demands of a bank´s resources. As a consequence, the authority inferred that banks should instead focus on business continuity. The EBA officially decided to postpone this year´s exercise to 19 March 2020. However, various newspapers[13] and the EBA itself reported the deferment already on 12 March 2020, which will therefore be used as the date of postponement in this analysis (Event 4).

In addition to EBA´s commitment to perform a supplementary transparency exercise in response to increased market uncertainty, the authority updated the timeline and the sample of tested banks for the postponed exercise on 30 July 2020 (Event 5). On 13 November 2020, the EBA published the final methodology for the 2021 stress test along with highlighting some key differences and necessary changes to account for recent developments (Event 6). After updating the timeline once again, the EBA officially launched the new stress test on 29 January 2021, approximately one year after the launch of the initial exercise (Event 7). Results are anticipated to be published end-July 2021.

3.2 Alternative Approach to Stress Tests

Notwithstanding the significant progress in developing meaningful stress tests, the supervisor´s methodology cannot be considered to have reached a steady state (Quagliariello, 2009). To begin with, Wall (2013) criticises the use of RWA as input data in the regulatory exercise since its calculation is based on a bank´s internal models. Therefore, it can be assumed that financial institutions will use some discretion (e.g., employ models that best fit the needs of the respective organisation) in deriving optimal results under prevailing regulations. Hence, calculated figures may not reflect the “true” risk exposure amount of an institution. In addition, the application of a top-down approach allows banks to produce their own output, which may incentivise banks to window dress and adapt internal models accordingly (Quagliariello, 2019). Essentially, the benefit of data richness associated with the concurrent stress testing framework comes at the risk of information reliability.

[13] For reference, please consult e.g. Reuters, Moody´s Analytics or Handelsblatt.

Next, the exercise’s assumption of a static balance sheet may seem unrealistic in that it limits a bank´s prospect to respond to exposed stress scenarios. Various research has shown that a banks´ capital position changes in anticipation of expected stress test outcomes and throughout the stress test horizon (Magnus et al., 2019). In addition, the exercise´s structure fails to account for second-round effects, meaning that the methodology only incorporates direct consequences, neglecting any further aftereffects. As banks strongly interact with each other and the real economy, the concentration on exogenous shocks can lead to a severe underestimation of potential contagion risks (ECB, 2017).

When looking at the market perception of the European banking industry, the picture substantially deviates from the one depicted by stress tests. Whereas previous exercises attempt to demonstrate that financial institutions are well capitalised, the market trades banks´ equity at a significant discount to book value (Stickling et al., 2021). Since market prices play a vital role in a bank´s ability to obtain funding, the scenario design might overlook an essential component in determining the banking sector´s vulnerability. Acharya et al. (2017), Brownlees and Engle (2017) picked up on this observation and above-mentioned criticism to introduce a market-based stress test, the so-called Systematic Risk Measure (SRISK). The intuition behind Acharya et al.´s (2017) benchmark model is conceptually equivalent to EBA´s balance-sheet-related approach. However, the alternative reflects forward-looking market figures to determine a bank´s expected capital shortfall in the event of a crisis. Even though this alternative approach stands out in terms of simplicity, data availability and timeliness, its outcomes are detached from macroeconomic considerations (Anderson, 2016). Accounting for the increasing popularity of market-based shortfall measures and the fact that EBA´s stress test results are yet unknown, this measure will be used in the following analyses to capture the market´s sentiment in assessing the reaction to defined events[14].

Up until now, the supervisor has refused to incorporate any market-based measure into its key features (Anderson, 2016). While there is not a single theoretically perfect model, the EBA is aware of its model´s inherent limitations and addresses those in ongoing discussions surrounding the authority´s long-term testing strategy. With EBA´s focus on finding more sophisticated models in making stress test realistic and relevant, a fundamental re-design can be expected from the next round of stress tests (Magnus et al., 2019).

[14] Please refer to the Volatility Laboratory´s documentation for the calculation and methodology behind the SRISK measure (https://vlab.stern.nyu.edu/).

3.3 Research Hypotheses

This thesis aims to empirically investigate the stock market´s reaction to EBA´s stress test attempt as well as provide further insights into associated events. To fulfil this purpose, four hypotheses are formulated, which will be empirically tested in Chapter 5. Derived assumptions are based on the established understanding of stress tests, the development of their methodology and the current macroeconomic environment.

To begin with, this analysis accounts for the fact that stress tests are carried out over a considerable period of time with relevant information to be revealed throughout the process. Hence, it is assumed that EBA´s published documents find reflection in investors´ individual assessment of a bank´s capacity to withstand the pressure from a potential worsening of market conditions. However, the postponement, in particular, may trigger a mixed market sentiment. On the one hand, EBA´s decision to postpone the exercise may be seen as a necessary relief measure for banks to focus on their essential functions. In addition, without the fear of being stigmatised by the market, financial institutions may be stimulated in discussing issues with national authorities, providing a more accurate picture of current challenges. Instead of performing a rushed exercise with imprecise estimates of the crisis´ impact on the banking industry, this step may help the EBA to contain its reputation, prevent any overreaction and give the regulator more time to develop a meaningful methodology.

On the other hand, the postponement could be seen as a signal of concealing bad news from the market. Since the aggregate capital and leverage ratios as input factors have not changed much in 2020 compared to EBA´s 2018 assessment[15], Eich et al. (2020) performed a theoretical 2020 stress test based on the insights gained from EBA´s latest published stress results. They conclude that several European countries would have probably failed a diligent stress test assuming a hurdle rate of 5.5% CET1 (disregarding any political interventions). Furthermore, the EBA may have tried to shirk its responsibility, i.e. to reduce information asymmetry, and avoided taking disruptive actions such as disclosing capital shortfalls. This may be due to fears of potential backlashes and associated challenges in reassuring markets of a credible backstop. Latter findings in conjunction with the suspending of capital distribution seem to overweight the outlined benefits of the postponement. In the light of the above, a significant adverse market reaction is expected to occur on the event date.

[15] According to ECB´s supervisory banking statistics: CET 1 ratio- Q4/2017: 14.58%; Q4/2019: 14.78%; Leverage ratio- Q4/2017: 5.57%; Q4/2019: 5.68%

Hypothesis I: Information released over the course of the stress test finds reflection in market participants´ reaction, as evidenced by abnormal returns around key events. The postponement specifically triggers a significant negative market response.

Next, the thesis addresses the question of whether market reactions to EBA´s stress test spilt over to non-tested institutions. For this investigation, the timeline is divided into two periods. Events 1- 3 are conducted under normal market conditions before the World Health Organization has declared the outbreak of COVID-19 a pandemic. During this period, publications are supposed to affect the market´s assessment of individual stress tested banks. By contrast, the evaluation of untested banks is not much affected since they are not directly under EBA´s supervision. For the subsequent Events 4- 7, the macroeconomic stance gains importance; hence, the focus shifts from idiosyncratic to aggregate systemic risks. From this point on, the announcements are expected to have the same impact on stress tested banks as on other financial institutions not subject to regulatory stress testing.

Hypothesis II: In times of heightened uncertainty, the market response to outlined events does not differentiate between tested and non-tested banks.

Irrespective of whether former hypotheses hold, the next analysis dives into a thorough investigation of stress tested banks. To draw more precise conclusions, market indicators are consolidated, aiming at deriving a better understanding of observed impacts on the shareholders´ wealth. In a first step, participating banks are classified into subsamples depending on different degrees of COVID-19 severeness in the respective country as measured by the respective 14-day case notification rate. Thus, one group comprises banks incorporated in European countries experiencing more dramatic pandemic-related dynamics, while the other group might have avoided a further escalation in terms of infection rates. Even though the economic effects of COVID-19 are highly heterogeneous across Europe, countries suffering higher infection rates may face more extreme liquidity squeezes, ultimately having a negative impact on the valuation of financial institutions. In addition, the pressure on financial intermediaries to immediately provide relief measures, in the form of e.g. payment holidays, drastically increases, herewith significantly impairing a bank´s profitability prospects. This results in the proposition that greater pandemic-impacted banks experience higher negative excess returns.

The second set of subsamples adds another depth to the analysis in that it incorporates a market-based measure of risk. The SRISK figure, as presented in the previous section, helps to differentiate between banks exposed to different levels of expected capital shortfall in times of a crisis. In terms of market reaction, one may expect that the announcement of a stress exercise may trigger a detrimental effect for high-risk banks compared to low-risk banks as the former may experience more stress during the exercise, expressed as fear of “failing”. As a result, concerned banks may have to intervene by raising capital. Contrarily, the postponement event might have brought a certain sense of relief, at least in the short term. The intuition behind those assumptions is that investors reward or punish riskier banks since they are more susceptible to supervisory interventions.

Hypothesis III: Investigating two sets of subsamples, it is expected that banks confronted with a higher SRISK measure and a larger national COVID-19 impact face more negative abnormal returns.

Finally, the thesis reverts to its main research question: “How does the market react to EBA´s 2020 stress test postponement?” As previous hypotheses aim to shed some light on potential drivers by investigating differences between subgroups, the following hypothesis examines the cross-section of market reactions. The setting is designed to provide evidence for factors that may explain observed market behaviour. One would expect, for example, that abnormal returns are less extreme for better capitalised financial institutions as measured by the CET1 and leverage ratio. Overall, larger banks in terms of asset size may be less susceptible to crisis-related fluctuations as they might be deemed as “too big to fail”. Later refers to the idea that some financial organisations are of such high systemic importance that a government may take any measures to prevent the institution´s failure, ultimately reducing the respective bank´s risk of bankruptcy. In addition, more profitable banks may be less vulnerable to an expected economic downturn suggesting a relatively neutral market reaction. As a final point, investors might find EBA´s postponement announcement more relevant for riskier banks, as measured by SRISK and the ratio of non-performing loans, since the relief or signalling effect for those may be more decisive.

To sum up, there are three classes of introduced financial ratios that may be found to be important determinants in describing estimated excess returns: capital buffer & size (CET1, Leverage und Total Assets), profitability (ROE) and riskiness (SRISK and NPL/Loans). A definition of introduced characteristics can be found in Appendix 4.

Hypothesis IV: Financial institutions´ indicators of financial vulnerability have an impact on the market´s reaction to the postponement of EBA´s stress test.

4. Data & Methodology

To gauge the impact of previously defined events on the equity valuation of respective banks, this thesis employs an event study following the standard approach as outlined by Campbell et al. (1997) and MacKinlay (1997). Event studies are frequently used to measure the short-term price reactions, i.e. abnormal returns, to specific events (e.g. mergers and acquisitions, stock splits, issues of equity/debt, changes in regulatory frameworks, etc.). As such, the described methodology provides an ideal measure for evaluating the information content of EBA´s stress test attempt. In addition to analysing various related key events, the thesis investigates banks´ return behaviour by splitting the entire group of tested banks into sub-samples based on some commonalities. This procedure allows to scrutinize for cross-sectional differences and eliminates the masking of differences under aggregation; in other words, it mitigates the risk that positive abnormal returns could cancel out the negative observations of another security and vice versa. In the following, the thesis distinguishes between tested and non-tested banks, on the one hand, and, on the other hand, introduces a country-level analysis, pooling data across European states into portfolios of high- versus low-SRISK banks and coronavirus most- and less-affected states as measured by the event´s week 14-day notification rate of reported cases per capita. Apart from the portfolio approach, specific bank characteristics are examined, trying to explain the magnitude of produced outcomes. To that end, the event study´s results are used as dependent variables to run further regressions. This chapter starts with a description of the event study, then moves on to significance tests, from there to the cross-sectional regression and finishes with a representation of data sets used.

4.1 Event Study Timeline

The first step in conducting an event study is to decompose an event´s timeline and determine when to measure an event´s occurrence. According to Fama´s (1991) efficient market hypothesis, share prices reflect all available information and adjust correspondingly right after the publication of new information to incorporate investors´ most up-to-date expectations. This, in turn, translates into the conjecture that an event window of one day would be sufficient to capture an event´s holistic impact. Opposite to the prevailing theorem and to account for information leakages, on the one hand, and late responses through market closures after trading hours, on the other hand, event windows tend to vary across different studies and are often extended over several days. A challenge for the evaluated market period in 2020 is to separate stress test effects from other (macroeconomic) effects caused by the extreme uncertain market environment. Henceforth, to reduce the risk of confounding effects related to the COVID-19 pandemic, the event window´s length is narrowed down to only include the closest preceding and succeeding observations. Kothari and Warner (2006) confirm that short horizons are quite powerful as long as abnormal performances are concentrated within the event window. For this study, subsequently, and to avoid the risk of overlapping event windows, there are three windows to be evaluated aiming at fully capturing the duration of the information impact: (0), (0; +1) and (-1: +1), covering a period of 1, 2 and 3 days, respectively.

Developing further, the next step after determining the event window is to describe a "normal" period that is assumed to be not influenced by the event, hereinafter referred to as the estimation window. Historical return information is collected to anticipate the expected unconditional price performance of a financial institution´s security around the event date. To prevent a destabilising effect and biased parameters, the event itself is not included and does not overlap with the estimation window. In determining the optimal length of the estimation window, there is an inherent trade-off between the precision of estimated parameters and the data relevance that needs to be addressed. The larger the estimation window, the less the risk of additional variance resulting from possible sampling errors in estimated parameters. "Outdated" returns, however, may not reflect a bank´s recent return behaviour. Armitage (1995) balanced those aspects and proposed an estimation window of 100 to 300 trading days prior to the event using daily data.

Figure 4: Timeline Event Study

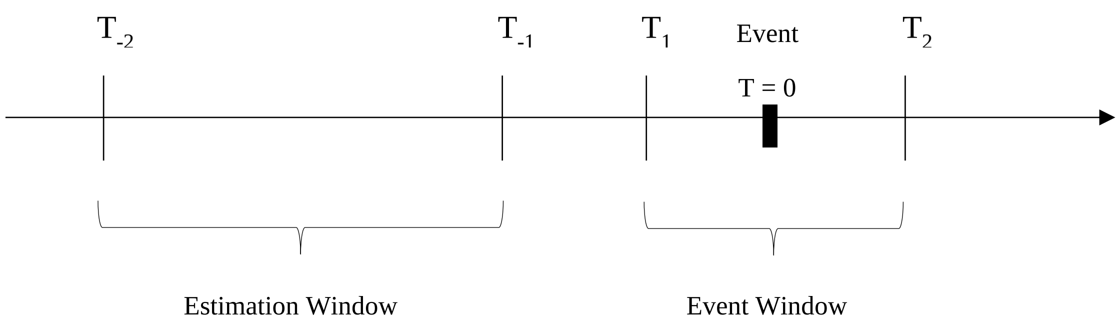


Figure 4: The estimation window, with length of $L_1 = T_{-1} - T_{-2} + 1$, estimates "normal" parameters unconditional on the event. To reduce bias in estimated returns, estimation and event window do not overlap. The event date is set at date T = 0. It is part of the event window, with length $L_2 = T_2 - T_1 + 1$, aiming at capturing an event´s total impact.

4.2 Determining a Benchmark Model and Estimating Abnormal Returns

For an event study to produce reliable results, there are two critical components to examine: the specification of a model for estimating normal returns and the measurement of abnormal returns. The study uses daily security returns to allow for a more precise and accurate measurement of abnormal returns as opposed to monthly returns (Kothari and Warner, 2006). Following the results of Corrado and Truong´s (2008) study, who found that logarithmic returns, in general, produce slightly more reliable test statistics compared to tests based on arithmetic returns, continuously compounded returns serve as the basis for calculating subsequent returns as in

$$R_{it} = \ln(\frac{P_{it}}{P_{it-1}}) \qquad (2)$$

where R_{it} is the log-return for financial institution´s security i at time t, P_{it} the closing price and P_{it-1} the closing price of the preceding day.

4.2.1 The Market Model

Before calculating the impact of an event on the bank´s equity value, there needs to be a model in place to measure the hypothetical normal returns, i.e. the return that would have been expected if the event did not occur. A variety of models have been proposed for estimating expected normal returns, which can be classified into two broad categories: statistical and economic models (MacKinlay, 1997). The Constant-Mean Return Model, the Market Model and the Market Adjusted Model, as examples of the former group, follow statistical assumptions to simulate return behaviour. Economic models, such as the Capital Asset Pricing, Arbitrage Pricing Theory and variations thereof, expand on statistical distribution in the form of behavioural assumptions on estimated parameters. According to MacKinlay (1997), there is no advantage in using more sophisticated economic models since produced results are susceptible to the model´s implicit restrictions. Following the standard procedure to calculate normal returns in the banking industry, this study employs the statistical Market Model, assuming a multivariate normal distribution, as follows

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \qquad (3)$$

with

$$E\,[\epsilon_{it}] = 0 \qquad\qquad Var\,[\epsilon_{it}] = \sigma^2{}_{\epsilon_i}$$

where R_{it} stands for the return on security i, R_{mt} respectively for the market return at time t and ϵ_{it} constitutes the zero mean random disturbance term. The equation assumes a linear relationship between each security and the market return following the model´s joint normality assumption. The MSCI Europe is used as an approximation for the market portfolio since it is designed to capture the performance of mid to large-cap European stocks and represents a well-diversified regional index. For each financial institution, parameters α and β are estimated separately via an ordinary least-squares regression over the estimation window. To ensure that estimated coefficients are neither affected by event-related returns nor by the onset of the crisis, the estimation period ranges from 2 January 2019 (T_{-2}) to 18 June 2019 (T_{-1}), ending five days before the first key event. This window of 120 days is supposed to be large enough to both produce robust test statistics and emphasise the importance of banks´ equity performance closer to the event. It is assumed that estimated parameters are constant during the estimation and event windows. The estimated normal return on the stock of bank i is in the following described as

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_i R_{mt} \tag{4}$$

where $\hat{\alpha}$ and $\hat{\beta}$ represent the ordinary least-squares regression intercept and slope estimates, respectively, of the Market Model´s coefficients.

4.2.2 Abnormal Returns

Measuring the direct change in a bank´s value associated with the event that market returns cannot explain is the next imperative step in conducting an event study. The estimated parameters from the Market Model of equation (4) are further used as a benchmark to compare against realized ex-post returns. Accordingly, abnormal returns (AR) for a given security i are calculated by subtracting the theoretical return predicted by the Market Model from the actual ex-post stock return

$$AR_{i\tau} = R_{i\tau} - \hat{R}_{i\tau} \tag{5}$$

where AR_{it} indicates the abnormal, R_{it} the actual realized and $\hat{R}_{it}$ the expected normal return unconditional on the event for security i at time t.

At this point, it is possible to perform a separate analysis on the abnormal returns of each individual security. However, Jong (2007) argues that individual results may be too noisy to derive meaningful results because observed returns demonstrate a stochastic behaviour. On average, unrelated effects are supposed to cancel out, thereby improving the informativeness of the analysis. As a consequence, ARs are to be cumulated to draw overall conclusions for defined event windows.

The aggregation is split into two parts:

(1) over time and

(2) across securities.

(1) Time-series aggregation. Depending on the chosen event window, it may be necessary to accumulate abnormal returns and capture the significant effects over the defined event window. Such cumulative abnormal returns (CAR) are derived by summing up the abnormal performance of security i from period τ_1 (start) to τ_2 (end point of the event window), where $T_1 \leq \tau_1 < \tau_2 \leq T_2$

$$(1) \quad CAR\,(\tau_1,\, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \tag{6}$$

(2) Cross-sectional aggregation. Abnormal returns of individual securities may be driven by other effects than the one to be tested. To abstract from specific cases and reduce the dependency on the return behaviour of a single stock, group CARs are investigated. The cumulative average abnormal return (CAAR) is expressed as the equally- weighted cross-sectional average of abnormal returns

$$(2) \quad \overline{CAAR}\,(\tau_1,\, \tau_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_{i\tau} \tag{7}$$

4.3 Testing procedure

This section introduces statistical tests designed to answer the question if derived abnormal performances differ significantly from zero at a specified significance level by means of hypothesis testing. Statistical tests are broadly divided into two groups- parametric and non-parametric. Previous researchers (Brown and Warner, 1985; Corrado and Truong, 2008)[16] immersed in a comprehensive examination of different test statistic performances and examined

[16] There are unquestionably many other great contributions too numerous to mention here.

statistical issues associated with each studied testing method. As indicated by the tremendous number of testing procedures, there is no single panacea to address all statistical inferences. Henceforth, it is vital to consider the critical statistical properties of selected financial institutions´ returns. To that end, three parametric and one non-parametric tests are presented to ultimately increase the power of detecting statistical significance and minimize inferred bias.

4.3.1 Parametric Test

One of the most common test statistics in event studies is the conventional t-test. The null hypothesis to be tested states that the event has no impact on a financial institution´s security on average. Thus, there are no significant cumulative abnormal returns around the event window, supporting the notion that realized returns cannot differ from predicted returns in an efficient market, as demonstrated by

$$H_0: CAAR(\tau_1, \tau_2) = 0 \tag{8}$$

Presented hypothesis is tested against the two-sided alternative suggesting the opposite

$$H_1: CAAR\ (\tau_1, \tau_2)\ \neq\ 0 \tag{9}$$

Under the restrictive assumptions that ARs are normally, independently and identically distributed, the parametric test statistic follows a Student-t distribution with N-1 degrees of freedom. To derive the t- statistics, the sample standard deviation $\hat{\sigma}$ needs to be denoted. The exact standard deviation of estimated CAARs is unknown. Since ARs are cross-sectionally uncorrelated, the cross-sectional standard deviation can be used as an approximation

$$\hat{\sigma}_{CAAR}{}^2 = \frac{1}{N-1} \sum_{i=1}^{N}(CAR_i - CAAR)^2 \tag{10}$$

The estimated standard deviation is used as an input to calculate the cross-sectional t-test

$$t_{CAAR} = \sqrt{N}\ \frac{CAAR}{\hat{\sigma}_{\ CAAR}} \tag{11}$$

Referencing to the findings of Fama et al., (1969), daily returns are seldom normal distributed. Correspondingly, the Student-t distribution no longer holds if bank returns follow a non-normal distribution (see adjusted statistics in 4.3.2). However, under the Central Limit Theorem, the distribution of daily stock returns is expected to converge to normality with increases in sample securities´ size. Since this thesis investigates the equity performance of the most relevant European banking stocks, the sample is estimated to be large enough to use the quantiles of the normal distribution as critical values. In addition, according to Brown and Warner (1985), a deviation of normality has no pronounced effect on the power to detect statistical significance and standard parametric statistics are still well-specified under the relaxation of the normal distribution assumption.

On the contrary, there are two critical assumptions that can have a significant impact on the tests´ power. (1) First, the estimated variance of returns in the estimation window is assumed to remain constant for testing the null, ignoring any potential increases during the event period. (2) Second, previously described t-statistics conjecture that abnormal returns are cross-sectionally and serially uncorrelated. Even though described issues may be reduced by aggregating individual financial institution securities into portfolios (Brown and Warner, 1985), statistically robust methods can still significantly improve test results. In the following, the standardised cross-sectional (T_{BMP}) and the cross-sectional average correlation (T_{KP}) method are introduced to develop more specific predictions and obtain appropriate tests of H_0.

(1) Event-induced variance. In periods of elevated uncertainty, which is in general the case for analysed event windows, there is a greater variability in return behaviour. Changes in volatility caused by observed events can exert severe bias and may result in an underestimation of the true cross-sectional variance. While running their Monte Carlo simulation on randomly selected equity securities, Brown and Warner (1985) found that the t-test statistics rejected the null hypothesis too often as the variance increased during the event window. To overcome the issue of event-induced variance, Boehmer et al. (1991) propose a standardised cross-sectional test building on the findings of Patell (1976), described as

$$\hat{\sigma}^2_{SCAR} = \frac{1}{N-1}\sum_{i=1}^{N}(SCAR_i - \overline{SCAR})^2 \qquad (12)$$

with

$$\overline{SCAR} = \frac{1}{N}\sum_{i=1}^{N} SCAR_i \ ;$$

$$SCAR_i = \frac{CAR_i}{\hat{\sigma}_{CAR_i}} \ ; \qquad \hat{\sigma}^2_{CAR_i} = \hat{\sigma}^2_{AR_i}\left(L_2 + \frac{L_2^2}{L_1} + \frac{\left(\sum_{t=T_1+1}^{T_2}(R_{m,t} - \overline{R_m})\right)^2}{\sum_{t=T_{-2}}^{T-1}(R_{m,t} - \overline{R_m})^2}\right)$$

where $SCAR_i$ is the standardised cumulated abnormal return for security i, $\overline{SCAR}$ the average thereof, σ_{CAR_i} the forecast error corrected standard deviation, L_2 the length of the event window, L_1 of the estimation window and $\overline{R_m}$ the average market return during the estimation window. The ratio of event (numerator of the second term in the calculation of $\sigma^2_{CAR_i}$) to estimation window variance (denominator) serves as an estimate to account for increased cross-sectional variability of bank returns.

The associated test statistic is

$$T_{BMP} = \sqrt{N}\ \frac{\overline{SCAR}}{\hat{\sigma}_{\overline{SCAR}}} \tag{13}$$

(2) Cross-sectional dependence. In the case of analysing the impact of a supervisory event on the European banking industry´s equity price reaction, both the estimation and event window are identical across all analysed banks, i.e. events coincide. When event windows essentially overlap along with the investigation of same industry companies, covariances between CARs deviate from zero and cross-sectional dependence is induced. It follows a relaxation of the assumption of independent and identically distributed CARs. This issue of event clustering has been recognized and addressed in Kolari and Pynnönen´s (2010) work. Since the formerly presented T_{BMP} does not account for potential contemporaneous correlation, the authors proposed an adaption to correct for heteroscedastic cross-correlating CARs as follows

$$T_{KP} = T_{BMP}\sqrt{\frac{1-\bar{r}}{1+(N-1)r}} \tag{14}$$

where $\bar{r}$ is the average of the cross-correlation in the estimation window. It can be easily seen from the calculation above that the adjusted statistic reduces to T_{BMP} in the case of zero cross-correlation. The higher the $\bar{r}$, the more severe the potential underestimation of the cross-sectional variance causing a more pronounced over-rejection of H_0. To derive sound evidence of the thesis´ findings, both statistics will be implemented along with the conventional t-test.

4.3.2 Non-Parametric Test

Brown and Warner (1985) demonstrate in their paper that standard parametric test statistics are generally well specified under a variety of different assumptions. Nonetheless, one size does not fit all, especially with regard to differences in returns´ properties: Corrado and Truong (2008) find that non-parametric tests provide a more robust specification compared to parametric tests using non-U.S. security market data. It has long been standard practice for event studies to use non-parametric test statistics in conjunction with previously described parametric tests to verify research findings.

In this section, the restrictive assumption of a normal distribution for CARs is relaxed. Since daily stock returns are characterized by rather fat tails, a normality approximation may induce bias and prevents the statistics from achieving proper specification. Furthermore, Jong (2007) argues that distribution-free tests may be more robust to outliers and other misspecification in the data set. As proposed in Corrado and Zivney´s (1992) work, the cross standardised rank test is employed to complement the thesis' findings. Instead of using averaged CARs in the statistics´ numerator, the test assigns a position to each CAR from lowest to highest, i.e. ranking the abnormal returns. By applying re-standardised returns, the test statistics maintain robustness against discussed issues of non-normality, variance and correlation inflation as in

$$\overline{K_{T1,T2}} = \frac{1}{L_2} \sum_{t=T_1+1}^{T_2} \overline{K}_t \tag{15}$$

with

$$\overline{K}_t = \frac{1}{N_t} \sum_{i=1}^{N_t} \frac{rank\,(CAAR_T)}{1+M_i+L_1}$$

where N_t represents the number of returns across securities, M_i the number of non-missing values and L_1 the number of non-missing return. Rank $\overline{K_{T1,T2}}$ is allocated as input for constructing the test statistic considering a multiday event period as follows

$$T_{CZ} = \sqrt{L_2} \left(\frac{\overline{K_{T1,T2}} - 0.5}{\hat{\sigma}_{\overline{K_t}}} \right) \tag{16}$$

with

$$\hat{\sigma}^2_{\overline{K_t}} = \frac{1}{L_1 + L_2} \sum_{t=T_{-2}}^{T_2} \frac{N_t}{N} (\overline{K}_t - 0.5)^2$$

4.3.3 Equality T-Test of Abnormal Performances

The next effort in understanding the market reactions of EBA´s ongoing stress test exercise is to divide the sample of tested banks into subsamples, as described in this chapter´s introduction. This analysis combines efforts to shed more light on potential drivers of abnormal returns, eventually yielding more precise inferences. Compared to previously performed tests, the hypothesis differs in that it measures the difference of average cumulative abnormal returns between portfolio group A and B.

The null hypothesis conjectures

$$H_0: CAAR_{A,t} = CAAR_{B,t} \tag{17}$$

In contrast, the alternative suggests that there is a significant difference between those groups

$$H_1: CAAR_{A,t} \neq CAAR_{B,t} \tag{18}$$

To test for statistical significance, a Welch´s Test (unequal variances t-test) is performed as follows

$$t = \frac{CAAR_{A,t} - CAAR_{B,t}}{\sqrt{\frac{\hat{\sigma}_A{}^2}{N_A} + \frac{\hat{\sigma}_B{}^2}{N_B}}} \tag{19}$$

with the corresponding calculation of the degrees of freedom v

$$v \approx \frac{\left(\frac{\hat{\sigma}_A{}^2}{N_A} + \frac{\hat{\sigma}_B{}^2}{N_B}\right)^2}{\frac{\hat{\sigma}_A{}^4}{N_A{}^2 * v_A} + \frac{\hat{\sigma}_B{}^4}{N_B{}^2 * v_B}}$$

where $v_A = N_A - 1$ is the associated degrees of freedom of the group A´s variance estimate and $v_B = N_B - 1$ of group B´s.

4.4 Cross-sectional regression

As a final step, potential explanatory factors are tested aiming at parameterizing the effects derived from previously performed analyses. The focus is on studying the date of the postponement event. This allows for a more sophisticated and in-depth analysis as to see whether defined variables may clarify the magnitude of observed market reaction. In the subsequent regression CARs are deployed as dependent variables while firm-specific characteristics serve as control variables. The regression model is specified as

$$CAR_{it} = \alpha + \gamma' X_{it} + \epsilon_{it} \tag{20}$$

where α presents the intercept, $\gamma' X_{it}$ the vector of several control variables and ϵ_{it} the error term. Selected accounting measures, which are defined in more detail in Appendix 4, are intended to capture a bank´s financial state and provide relevant cross-sectional postponement-related insights.

4.5 Descriptive Data

This section provides a description of the sample selection method and data collection process. To begin with, stress tested banks, as the central component of the performed study, were selected according to the following criteria. In a first step to ensure coherent results, the analysis excludes UK banks supposed to participate in the 2020 EU-wide stress test as they were not consistently part of the exercise (for Event 1, the EBA tentatively excluded them under the assumption that the UK will leave the EU by the end of 2019). Second, the data only covers banks subject to both the 2020 stress test attempt and the 2021 exercise. From the total sample of 48 banks, only those financial institutions listed on a stock exchange were included, reducing the sample to 30 banks. Third, participants had to be on EBA´s sample list throughout the defined timeline to promote consistency in interpreting the market response. After each consecutive step in deriving stress test outcomes, the number of assessed banks may slightly differ due to restructurings, mergers or shifts in consolidated assets. Accordingly, HSBC France was excluded since it did not appear in published templates of Event 2. Thus, the final sample consists of 29 banks, which are presented in more detail in Appendix 3. For each respective bank, daily stock market data was retrieved from Thomson Reuters Datastream.

In a next step, the thesis aims to compare tested banks´ (hereinafter referred to as "treatment" group) with non-tested banks´ excess returns ("control" group). The control sample includes financial institutions that are constituents of the Stoxx Europe 600 Banks index and are incorporated in European countries under EBA´s supervision. In this analysis, banks with incomplete data were omitted to increase the compatibility in terms of liquidity between both samples. Following, securities that recorded ≥ 100 zero-returns during the observation period are considered incomplete. This results in a control sample of 30 banks. Descriptive statistics for the final sample are reported in Table 3, including a representation of the two subsamples.

Table 3: Descriptive Statistics

	All banks	Tested Banks Treatment Group	Non-tested Banks Control Group
Number of Banks	59	29	30
Number of Observations	39,766	19,546	20,220
Minimum (Return %)	-27.392	-27.392	-27.392
Mean (Return %)	-0.053	-0.064	-0.053
Maximum (Return %)	27.244	22.014	27.244
Std. Dev. (Return %)	2.508	2.553	2.508

The second comparison on a portfolio approach comprises a set of distinct data. The first subsample portfolio of tested banks accounts for differences in COVID-19 infection rates. To classify financial institutions in two different categories (banks incorporated in countries with high versus low pandemic exposure), the analysis resorts to the European Centre for Disease Prevention and Control´s published weekly updates on reported COVID-19 cases. For the next portfolio comparison, data is obtained from the NYU Stern´s Volatility Laboratory. This information serves as the basis to divide the sample of tested banks into two groups, with the first group containing high and the second low SRISK levels. As there is only monthly information available, underlying figures derive from the university´s publication immediately preceding the occurrence of outlined events.

Finally, firm-specific variables used in the multivariate analyses for stress tested banks are collected from ECB´s website with fundamental accounting data sourced from S&P´s SNL Financial database as of 31 December 2019, the starting point of the initial 2020 stress test exercise. Missing data was hand collected from respective banks´ financial statements. Statistical properties are provided in Table 4.

Table 4: Statistical Properties of Control Variables

	CET1	Leverage	LogAssets	ROE	SRISK	NPL
Panel A: Summary Statistics						
Obs.	29	29	29	29	29	29
Mean	15.18%	6.45%	12.75	8.20%	1.88%	3.17%
Std.Dev.	2.48%	2.83%	1.06	4.78%	2.36%	1.93%
Min.	11.65%	4.24%	10.71	-8.00%	0.00%	0.40%
Max.	20.30%	17.80%	14.59	20.30%	8.94%	9.50%
Panel B: Correlation Coefficients						
CET1	1.00	0.21	-0.54	0.19	-0.51	-0.34
Leverage		1.00	-0.66	0.47	-0.44	0.41
LogAssets			1.00	-0.41	0.83	-0.13
ROE				1.00	-0.46	0.10
SRISK					1.00	-0.02
NPL						1.00

This table summarises statistical properties of variables used in the regression analysis. Appendix 4 defines all variables. Panel A presents summary statistics (number of observations, mean, standard deviation, minimum and maximum). Panel B lists the pairwise Pearson´s correlation coefficients.

5. Empirical Results

This chapter presents the empirical results structured according to developed research hypotheses outlined in Chapter 3.3. First, the methodology set forth in the previous section is used to determine abnormal market reactions aiming at answering Hypotheses 1-3. Next, the thesis proceeds with cross-sectional regressions to complete the picture and produce evidence to test Hypothesis 4. Finally, several robustness tests are presented, accompanied by a discussion of limitations.

5.1 Discussion of Hypotheses

The following four subsections provide a summary of outlined hypothesis, followed by an in-depth results analysis. A subsequent discussion will conclude with an overview of derived findings.

5.1.1 EBA´s disclosures release new information to the market

The first hypothesis postulates that the market appreciates EBA´s effort in providing stress test-related disclosures by incorporating newly derived information into its expectations, ultimately impacting tested banks´ equity valuation. While the event´s individual response direction may depend on the nature of news, the postponement event itself is expected to trigger a significant negative market reaction.

The results in Table 5 show the (C)AARs of specified event windows around defined key events. To be more conservative in interpreting the event study´s outcome, the table only reports two test statistics (a parametric test proposed by Kolari and Pynnönen (2010) and a non-parametric by Corrado and Zivney (1992)). Looking at the results of the separate events, there is an overall trend of positive market sentiment towards EBA´s news announcements. However, the signals are inconclusive for most events. Before delving into further analyses, the return behaviour of key Events 2 and 5 are investigated. The publication of stress test templates (Event 2) yields significant positive AARs of 1.78% on the event day. One possible explanation would be that the revised methodology alleviated strains on these institutions and henceforth was priced in by capital markets. In addition, EBA´s subsequent decision to include UK banks in the exercise´s sample may have strengthened the perception of a thorough stress test, addressing the interconnectedness of the financial system and ultimately reducing contagion risks.

Buoyant market expectations were reverted upon the disclosure of the updated 2021 methodology (Event 5), as demonstrated by the negative AARs of 1.8% and CAARs of 3.75% over the entire event window. This evolution may be attributable to the fact that the EBA was more conservative in deciding on the 2021 methodology than the previous 2020 exercise. Investors´ fears of larger capital shortfalls and the related consequences of forced equity issues at depressed prices might be the rationale behind observed market behaviour. In other words, the severity of the 2021 stress test may cause stronger dilution concerns since the uncertainty regarding the participants´ financial resilience in depicted downturn scenario has drastically increased.

Table 5: Market Reactions to the 2020/2021 Stress Exercise

	N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)		N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
Event 1	29				**Event 5**	29			
		-0.693%	1.070%	-0.093%			-1.830%	-2.086%	-3.750%
T_{KP}		-0.808	0.310	-0.664	T_{KP}		-1.709*	-1.429	-1.567
Z_{CZ}		-0.978	0.843	-0.333	Z_{CZ}		-1.893*	-1.471	-2.076**
Event 2	29				**Event 6**	29			
		1.779%	1.314%	1.008%			1.361%	3.700%	3.765%
T_{KP}		1.952*	1.703*	0.526	T_{KP}		1.141	1.111	0.930
Z_{CZ}		1.972**	0.809	0.415	Z_{CZ}		1.278	1.420	1.094
Event 3	29				**Event 7**	29			
		-0.429%	0.179%	0.297%			0.481%	0.274%	1.871%
T_{KP}		-0.193	0.106	0.243	T_{KP}		0.508	0.351	1.561
Z_{CZ}		-0.005	0.855	0.613	Z_{CZ}		0.674	0.326	1.112
Event 4	29								
		-0.324%	1.391%	3.148%					
T_{KP}		-0.201	0.162	0.457					
Z_{CZ}		-0.108	0.246	0.595					

This table reports the average abnormal returns (AARs) and average cumulative abnormal returns (CAARs) over defined event windows. Figure 3 in Chapter 3.1 defines all events. Excess returns are estimated using the Market Model and are tested against the null hypothesis that (C)AARs are zero. N indicates the number of observed banks. The rows labelled T_{KP} and Z_{CZ} present the test statistics based on the parametric test proposed by Kolari and Pynnönen (2010) and Corrado and Zivney´s (1992) non-parametric test. ***, **, and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Surprisingly, the postponement itself (Event 4) did not entail a significant market reaction in either direction. Hereupon, one may conclude that the event per se is performance neutral and the investors´ sentiment is driven by overall movements captured in the market portfolio. Conversely, when looking at the average CARs on national levels (see Appendix 5), there are substantial differences between individual countries´ reactions. For instance, the stress tested Hungarian bank experienced the most extreme AR of -14.95%, while supervised Austrian banks counterweighted with estimated AARs of 6.2%. These findings imply a pronounced cross-country variation among the sample of stress tested financial institutions. In addition, observed variability in abnormal returns for specific banks may serve as a fundamental basis for subsequent discussions of Hypotheses 3 and 4.

As demonstrated in this event´s case, the standard event study methodology is netting out significant positive against substantial negative reactions. Due to exemplified offsetting effects, a direction neutral measure is introduced to address the presented conceptual "shortcoming" and further validate results achieved so far. Reverting to Flannery et al.´s (2015) empirical work, Table 6 exhibits average absolute ARs. Following their approach in testing for statistical significance, the measure of |(C)AARs| during the event period is compared to its average value over the estimation period.

Table 6: Absolute Market Reactions to the 2020/2021 Stress Exercise

	N	|AAR| (0)	|CAAR| (0, +1)	|CAAR| (-1, +1)		N	|AAR| (0)	|CAAR| (0, +1)	|CAAR| (-1, +1)
Event 1	29				**Event 5**	29			
		1.159%	2.996%	4.204%			1.871%	2.852%	4.761%
p-Value		0.777	0.001	0.008	p-Value		0.003	0.039	0.005
Event 2	29				**Event 6**	29			
		1.917%	2.535%	3.718%			1.628%	4.263%	5.588%
p-Value		0.00	0.247	0.254	p-Value		0.017	0.023	0.016
Event 3	29				**Event 7**	29			
		1.709%	2.577%	3.298%			1.156%	2.019%	3.873%
p-Value		0.299	0.580	0.890	p-Value		0.805	0.240	0.359
Event 4	29								
		4.631%	7.747%	11.292%					
p-Value		0.000	0.000	0.000					

This table reports the average absolute abnormal returns |AARs| and average absolute cumulative abnormal returns |CAARs| over defined event windows. The definition of presented events can be found in Figure 3. N indicates the number of observed banks. P-values are based on a standard t-test while results for |(C)AARs| are tested against their average values in the estimation window.

Table 6 provides evidence that the netting effect seems to be a crucial factor when investigating the postponement event. Derived results confirm previous findings of excess returns around Event 2 (at least for |AAR|) and Event 5. Event 4 shows the largest absolute excess returns, indicating that the postponement revealed some information to the market. Moreover, Events 1 and 6 seem to have triggered a significant abnormal market reaction when considering absolute returns. At this point, no further inferences are drawn on significant |(C)AARs| since the thesis reverts to events at issue when testing hypotheses 2- 4.

While the initial analysis of (C)AARs only provided limited support of significant market reactions to the publication of EBA´s disclosures, |(C)AARs| reflect are more affirmative position towards varifying Hypothesis I. In summary, the findings reveal that the regulator´s announcements resulted in a considerable variation in stress tested banks´ stock price for the majority of events. It can thus be emphasised that the supervisory´s exercise continued to provide relevant information to the capital market. All in all, stress tests play a major role in reassuring investors and find reflection in the markets´ assessment of the banking industry´s resilience.

5.1.2 During the crisis, the market prioritises the assessment of the overall banking sector

Hypothesis 2 states that the market differentiates between tested and non-tested banks in normal periods as the expected exercise´s outcome may only entail capital adjustments for specific stress test participants. However, with the emergence of COVID-19, the banking sector´s resilience as a whole moves into the centre of investors´ attention. As a result, EBA´s publications affect the aggregate industry without drawing any distinction between those two groups.

In anticipation of the analysis of accumulated event periods (normal versus crisis time), separate events are first investigated to derive a better understanding of market patterns. The postponement announcement (Event 4) has a substantial negative impact on the control group compared to the treatment group, as shown in Table 7. While the difference for the event window [0, +1] is not statistically significant, the other two windows provide strong evidence of rejecting the null hypothesis at the 5% significance level. Taking account of the crisis´ acceleration, a possible explanation may be that tested banks better handle a short-term liquidity crunch due to their characteristics of being much larger in terms of total assets and market capitalisation than the control group. As such, they might better benefit from macroeconomic policy interventions and have easier access to additional capital market funding. While investors´ perception of the control group´s risk might have changed because of the tightening of credit conditions reflected by a significant negative CAARs(-1, +1) of 2.99%, the relief related to the postponement, as expressed in positive CAARs(-1, +1) of 3.15%, might have driven the equity valuation of the treatment group.

Table 7: Market Reactions Tested versus Non-Tested

	N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)		N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
Event 1					**Event 5**				
Control	30	-0.820%	-0.347%	-0.792%	Control	30	-1.061%	-0.095%	-0.893%
Treatment	29	-0.693%	1.070%	-0.093%	Treatment	29	-1.830%	-2.086%	-3.750%
p-Value		0.699	0.003	0.178	p-Value		0.077	0.003	0.001
Event 2					**Event 6**				
Control	30	1.071%	1.043%	1.180%	Control	30	1.084%	4.061%	5.174%
Treatment	29	1.779%	1.314%	1.008%	Treatment	29	1.361%	3.700%	3.765%
p-Value		0.046	0.607	0.781	p-Value		0.600	0.747	0.260
Event 3					**Event 7**				
Control	30	0.292%	0.726%	0.125%	Control	30	0.636%	1.083%	1.962%
Treatment	29	-0.429%	0.179%	0.297%	Treatment	29	0.481%	0.274%	1.871%
p-Value		0.301	0.438	0.821	p-Value		0.666	0.094	0.869
Event 4					**Pooled Event 1 - 3**				
Control	30	-4.432%	-1.577%	-2.988%	Control	90	0.181%	0.474%	0.171%
Treatment	29	-0.324%	1.391%	3.148%	Treatment	87	0.219%	0.854%	0.404%
p-Value		0.013	0.121	0.017	p-Value		0.904	0.256	0.536
Pooled Event 1 - 4					**Pooled Event 4- 7**				
Control	120	-0.972%	-0.039%	-0.619%	Control	120	-0.943%	0.868%	0.813%
Treatment	116	0.083%	0.989%	1.090%	Treatment	116	-0.078%	0.820%	1.258%
p-Value		0.034	0.056	0.015	p-Value		0.081	0.940	0.591

This table presents an analysis of differences between banks subject to EBA´s stress test ("Treatment") versus those that are not ("Control") over the event windows (0), (0,+1) and (-1, +1). N indicates the number of observed banks for each group. Events 1-4 are related to the postponed 2020 exercise whereas Events 5-7 address the new exercise in 2021. Since non-parametric tests did not derive any other conclusions, only p-values for Welch´s adjusted t-test of unequal variances are displayed.

Stress test participants recorded less negative and more positive excess returns for Event 1 (75 basis points better average performance) and Event 2 (27 bps). The trend of (C)AARs to be in favour of tested banks reverses at the time of the postponement. The update of the new exercise in 2021 (Event 5) causes significant negative excess returns for the treatment group. This may be due to increased market pressure and investors' fear of dilution in the case of conditional capital increases. For Events 6 and 7, there is only limited evidence of differences between the group´s stock market reaction. In general, there are two possible interpretations for the latter observations. Either those events provided insufficient additional information to allow for discrimination that has not yet been priced in or it may serve as a first indication that the assessment of the overall industry´s risk is prevalent in times of crisis.

In contrast to the outlined hypothesis, there is no significant difference of (C)AARs between both subsamples when investigating pooled data for Events 1-3 (normal period). Still, one can see that the market responded to EBA´s disclosure more in favour of the treatment group, albeit statistically insignificant. An explanation for these findings could be that untested banks were in aggregate affected the same way by the introduction of the 2020 exercise, while stress participants enjoyed a bit more of the premium associated with the benefits of stress testing. Even though the results do not fully support the first part of the hypothesis, incorporating data from Event 4 confirms the substantial deviation in terms of market reaction to the postponement event. The second part of the hypothesis addresses the market´s behaviour during crisis time. For pooled Events 4-7, there is no substantial divergence in the market´s valuation of both groups when including the event day´s succeeding observations. This may be interpreted as evidence for the market´s perception of the increased importance of systemic risks during the COVID-19 pandemic.

Conclusively, findings somehow negate that investors make pre-crisis distinctions among described groups of banks. However, the postponement and the launch of the 2021 stress test trigger substantially different market reactions for respective groups while the direction changes from the former to the latter event. In aggregate, described significant observations cancel each other out, eventually contributing to the market´s expected indifferent attitude towards stress test participants and non-tested banks during a crisis period. For the purpose of assessing the informative value of EBA´s announcement, it is concluded that the supervising authority revealed new information to the market as demonstrated by the occurrence of statistically significant differences in market reactions throughout the exercise´s process.

When interpreting the results, it should be kept in mind that observed dissimilarities are not the pure consequence of EBA´s stress test disclosures. Instead, one must consider the fundamental differences between the treatment and control group. Whereas stress test participants account for almost 70% of European banking assets, the contribution in terms of asset size from the control group is far smaller. For a more in-depth discussion of the impact of a company´s size factor, please refer to Fama and French (1993) conceptual paper.

5.1.3 Subsamples help in explaining observed market behaviour

As illustrated in Chapter 5.1.1, there is significant evidence of cross-country variation in the capital market´s reaction to EBA´s publications for stress test participants. The first part of Hypothesis 3 implies that a country´s pandemic exposure sheds light on how the market responded to disclosed announcements in crisis times to further investigate aspects related to national differences.

To allow for a comprehensive analysis and render intentional findings, the results from Event 4 onwards are presented. In testing the former proposition, the group of stress tested banks is split into two subsets based on market information in the form of COVID-19 case notifications per capita as an indication of a country´s specific pandemic-related impact. Starting with the postponement event, banks are categorised into either a high or a low impact portfolio depending on the country´s infection numbers per institution. Regularities in the formation of groups cannot be detected except for the case of Swedish financial institutions, which continuously form part of the high-impact group. Table 8 shows the results of performed analysis.

Table 8: Market Reactions COVID-19 Impact

	N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)		N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
Event 4					**Event 6**				
High Impact	14	-0.500%	1.785%	4.736%	High Impact	15	1.014%	1.955%	2.003%
Low Impact	15	-0.159%	1.024%	1.666%	Low Impact	14	1.733%	5.569%	5.652%
p-Value		0.876	0.754	0.363	p-Value		0.211	0.072	0.089
Event 5					**Event 7**				
High Impact	15	-2.011%	-2.846%	-4.859%	High Impact	14	0.664%	0.105%	2.107%
Low Impact	14	-1.637%	-1.272%	-2.563%	Low Impact	15	0.310%	0.432%	1.651%
p-Value		0.478	0.058	0.051	p-Value		0.538	0.655	0.638

This table presents an analysis of differences between banks with greater exposure to pandemic-related issues (“High Impact”) versus those that experience less severe implications (“Low Impact”), as measured by a country´s COVID-19 case notifications per capita. N indicates the number of observed banks for each group. Since non-parametric tests did not derive any other conclusions, only p-values for Welch´s adjusted t-test of unequal variances are displayed.

Event 4 does not produce significantly different market reactions for any event window. These findings are in line with the intuition that European countries experienced the same adverse short-term challenges associated with the newly discovered infectious disease at the onset of the crisis. However, with different countries adopting individual strategies, there is evidence of territorial differences in CAARs at the 10% significance level for Event 5 and

Event 6. While the more affected group exhibits more negative returns for the former and less favourable for the latter event, the difference between the groups climaxed from AAR(0) 37 bps (72 bps) to a divergence of CAAR(-1,+1) 230 bps (350 bps) for Event 5 (Event 6). The rationale behind the worse performing high-impact group may be that they might have been hit harder by the degree of conservativeness in EBA´s 2021 methodology. In addition, investors may be concerned about the capability of higher pandemic-impacted banks to provide necessary immediate relief measures. Again, Event 7 shows no conclusive evidence, neither for the separate groups in isolation nor for the difference between those. The outcome of the analysis confirms the hypothesis on high-impact banks exhibiting more negative (less positive) excess returns than the lower-impacted group.

Next, the thesis´ attention is drawn to market estimates of expected capital shortfalls. The second part of the hypothesis claims that banks for which the market anticipates higher capital shortfalls in crisis time experience significantly different returns during EBA´s stress test exercise. Appendix 6 summarises the evolution of the SRISK measure for stress tested banks on a country level. Referenced table served as the basis to form relevant subsamples. While there is no shift in an institution country´s risk perception, i.e. French banks recorded the highest potential shortfalls throughout the exercise, there is a substantial increase in estimated capital inadequacy from Event 4 to Event 5. This observation can be attributed to strained financial prospects and the broad-based uncertainty regarding the banking industry´s resilience.

When it comes to interpreting the market´s behaviour, the results as outlined in Table 9 seem rather inconclusive at first. Only Event 1 and Event 2 show a statistically significant difference between high-risk and lower-risk banks, measured on the basis of SRISK. While the apparent variety regarding the group´s market reaction is in line with the proposed hypothesis, the direction is somehow different from what was expected. The response in both cases is driven by superior returns for the subgroup associated with a higher risk measure. Instead of the market´s anticipated fear of high SRISK banks "failing" the stress test exercise, the positive reaction may be attributable to prospective efforts for riskier banks to adjust their lending practices to reduce RWAs in anticipation of the forthcoming external evaluation of an institution´s resilience in a downturn scenario.

The observed trend continued until the occurrence of the postponement event. Despite the insignificance of depicted group differences, the overall tendency for high SRISK banks to respond more positively to the postponement may be interpreted as an encouraging market signal. Market participants may find the scenario of a bank run caused by potential severe stress test results less likely. Furthermore, investors might appreciate the release of constrained resources in order for banks to channel funding to the real economy.

Once the spread of the virus began to accelerate, the market seemed to not differentiate between banks´ overall riskiness. Even though one may think that high-risk banks would suffer more in adverse times, the neutral market sentiment may imply that investors´ expectations had already been priced in such that EBA´s publication in crisis time did not modify market participants´ opinion.

Table 9: Market Reactions High versus Low SRISK

	N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)		N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
Event 1					**Event 5**				
High SRISK	14	-0.375%	1.863%	0.490%	High SRISK	14	-1.609%	-1.919%	-3.964%
Low SRISK	15	-0.991%	0.329%	-0.637%	Low SRISK	15	-2.036%	-2.241%	-3.551%
p-Value		0.236	0.024	0.095	p-Value		0.421	0.714	0.741
Event 2					**Event 6**				
High SRISK	14	2.203%	1.774%	1.989%	High SRISK	14	1.551%	3.470%	3.187%
Low SRISK	15	1.383%	0.885%	0.093%	Low SRISK	15	1.183%	3.914%	4.304%
p-Value		0.132	0.107	0.026	p-Value		0.519	0.820	0.597
Event 3					**Event 7**				
High SRISK	14	0.146%	0.735%	1.197%	High SRISK	14	0.267%	0.118%	1.788%
Low SRISK	15	-0.966%	-0.340%	-0.543%	Low SRISK	15	0.681%	0.420%	1.949%
p-Value		0.337	0.312	0.119	p-Value		0.481	0.680	0.862
Event 4									
High SRISK	14	0.836%	2.002%	5.042%					
Low SRISK	15	-1.406%	0.821%	1.380%					
p-Value		0.307	0.627	0.274					

This table presents an analysis of differences between banks that are expected to experience a high capital shortfall during crisis time ("High SRISK") versus those that that face a smaller capital loss ("Low SRISK") over the event windows (0), (0,+1) and (-1, +1). N indicates the number of observed banks for each group. Since non-parametric tests did not derive any other conclusions, only p-values for Welch´s adjusted t-test of unequal variances are displayed.

In general, findings appear to partially confirm Hypothesis 3. Nevertheless, separating banks into contrasting risk groups provided relevant cross-country insights into the market´s sentiment towards stress test-related disclosures. Accordingly, the more prevalent positive high SRISK market response to the postponement may express investors´ feeling of relief. Note that regulatory authorities introduced a variety of monetary policies around the postponement event, as described in Chapter 3. Therefore, findings must be interpretated as a joint reaction- the observed behaviour emerges from the interaction of market forces related to both the announcement of the postponement and other supervisory interventions. As a consequence, it cannot be said which effect might have been stronger or if they, in the most extreme case, have offset each other. In overall terms, the authorities' relief announcements provided comfort to the market and might have prevented widespread panic amongst financial investors.

5.1.4 Excess returns are greater for banks with certain characteristics

To complete the interpretation of Event 4´s market effects, this section describes findings related to factors that may have had an impact on estimated excess returns. Financial ratios were selected with the aim of describing a bank´s variability in (capital) size, profitability and riskiness. Designated characteristics are expected to explain the market´s return behaviour at least in part. Whereas the former hypothesis scrutinised cross-country differences of stress test participants, Hypothesis 4 investigates the level of cross-bank variability as a response to EBA´s postponement announcement.

Referring to the descriptive statistics in Table 4, stress participants show a considerable variation in their cross-sectional characteristics. A striking difference can, for example, be seen in European banks´ performance indicator ROE: The figure ranges from a negative 8% to a positive 20%. The CET1 ratio, however, captures the homogeneity in bank´s financial buffers since most institutions record a ratio between 12-15%. Subsequently, control variables were checked whether they are embedded into each other to reduce the risk and limitation caused by multicollinearity issues. Used variance inflation factors indicate that there is no need to eliminate any presented variables.

The relationship between control variables and excess returns is reported in Table 10. The first three columns (1)- (3) inspect individual characteristics that might be informative in assessing abnormal returns. The last column of the table comprises all relevant factors. Turning to observations (1) and (2), the coefficients of risk characteristics CET1 and ROE are statistically significant at the 10% and 5% level, respectively. The sign of both factors implies an inverse relationship between capital/ profitability ratios and estimated CAARs around the postponement event. Hence, institutions with less capital buffers and depressed profitability prospects were likely to experience more positive excess returns. While the market might have expected such institutions to fail a thorough stress test exercise, investors are consequently updating their a priori beliefs and reverse outcome expectations. On the contrary, the market reaction for banks that were expected to perform well in the exercise was put off. The same reasoning holds for the SRISK measure; the opposite sign can be explained in the variable´s definition (higher SRISK/low CET1 = higher expected shortfall in downturn scenario).

Finally, characteristics of (capital) size, profitability and risk are combined into a single multivariate regression (4). Even though there is no individual factor that can be considered statistically significant, the coefficients show consistency in their respective signs. To conclude, cross-sectional variation can be attributed to investors updating their expectations. Banks that show better financial ratios cannot benefit from the expected positive exercise´s outcome, whereas banks with lower chances of passing the stress test were not confronted with consequences in the short term.

Table 10: Regression Output for Postponement Event

	(1)	(2)	(3)	(4)
	CAAR (0, +1)	CAAR(0, +1)	CAAR(0, +1)	CAAR(0, +1)
(Capital-) Size				
CET1	-1.421*			-.963
	(.724)			(.808)
Leverage	-.932			-1.063
	(.714)			(.848)
LogAssets	.003			-.006
	(.022)			(.033)
Profitability				
ROE		-.79**		-.405
		(.327)		(.377)
Riskiness				
SRISK			1.616**	.39
			(.661)	(1.235)
NPL			.829	1.078
			(.81)	(.962)
_cons	.275	.096***	-.025	.316
	(.383)	(.031)	(.033)	(.487)
Observations	29	29	29	29
R-squared	.316	.178	.211	.403

This table summarises the regression output for the postponement event. CAARs (0, +1) are used as dependent variables and is estimated using the Market Model. Observations include the stress test participants´ sample of 29 banks. Appendix 4 defines all control variables. Standard errors are in parentheses; ***, **, and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

5.2 Robustness Check

As the model´s robustness is the bedrock for deriving meaningful results, the thesis pursues a threefold objective of validating derived empirical results, as summarised in Table 11.

Test statistics. To address the first component, the thesis introduced and applied a battery of statistical tests. For a discussion of advantages and limitations, please refer to Chapter 4.3. Where appropriate, only the most obvious findings were further emphasised. On top, presented results in various subgroups were subsequently cross-checked against test statistics with less restrictive assumptions.

Parameter adjustment. Before reviewing the usefulness of the Market Model in this setting, estimated market parameters need to be accounted for. To reduce the risk of misspecifications due to biased sample data, the length of the estimation window is expanded to cover a period of 250 days preceding the occurrence of Event 1 (1). This increases the return´s sample size and may provide a better estimation of actual parameters.

Model adjustment. The choice of an estimation model is a critical input factor to investigate the market´s assessment of the stress test´s information value. This study encompasses a two-factor model to account for regional differences related to the COVID-19 outbreak, incorporating stock price indices for each jurisdiction (2). The purpose of using a multifactor model is to reduce the variance of the estimation error and thereby increase the model´s R^2 over the single-factor Market Model. However, since MacKinlay (1997) argues that the marginal explanatory power of additional factors is limited, the following adjustment for investigating the results‘ robustness reverts to a more straightforward model (3). The modification constrains the Market Model´s intercept to zero and ß to one. As historical beta estimates may not be a realistic proxy to use in this uncertain context, the adopted model better reflects the current environment.

Table 11: Robustness Checks

	(1)			(2)			(3)		
	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
Event 1									
	-0.76%	0.92%	-0.25%	-0.42%	0.89%	0.61%	-0.84%	0.76%	-0.49%
T_{KP}	-0.98	0.37	-0.89	-0.58	0.33	0.09	-1.00	0.15	-0.96
Z_{CZ}	-1.20	0.81	-0.49	-0.69	0.86	0.62	-1.05	0.86	-0.35
Event 2									
	1.74%	1.18%	0.84%	1.13%	0.43%	0.49%	1.66%	1.01%	0.61%
T_{KP}	2.09**	1.80*	0.55	1.84*	1.39	0.83	1.88*	1.56	0.34
Z_{CZ}	2.08**	0.66	0.26	1.50	0.10	0.08	1.98**	0.69	0.32

Event 3									
	-0.55%	0.01%	0.01%	0.18%	0.24%	0.81%	-0.64%	-0.16%	-0.25%
T_{KP}	-0.29	-0.03	0.02	0.20	0.28	0.73	-0.30	-0.06	-0.05
Z_{CZ}	-0.15	0.83	0.43	0.56	0.62	0.98	-0.06	0.74	0.40
Event 4									
	-1.84%	-0.04%	1.53%	1.55%	1.30%	3.24%	-2.17%	-0.42%	1.05%
T_{KP}	-0.75	-0.27	0.33	0.36	0.25	0.87	-0.76	-0.39	0.20
Z_{CZ}	-0.74	-0.13	0.37	0.40	0.11	0.83	-0.79	-0.13	0.37
Event 5									
	-2.09%	-2.47%	-4.15%	-0.79%	-0.85%	-1.88%	-2.21%	-2.68%	-4.43%
T_{KP}	-2.32**	-1.84*	-1.87*	-1.74*	-0.83	-2.14**	-2.02**	-1.63	-1.72*
Z_{CZ}	-2.34**	-1.90*	-2.52**	-1.12	-0.66	-1.72*	-2.13**	-1.66*	-2.24**
Event 6									
	1.32%	3.76%	3.73%	1.20%	2.90%	3.39%	1.25%	3.63%	3.51%
T_{KP}	1.30	1.28	1.01	1.37	1.11	1.10	1.09	1.07	0.87
Z_{CZ}	1.42	1.64	1.23	1.47	1.40	1.39	1.33	1.59	1.23
Event 7									
	0.26%	0.07%	1.65%	0.46%	-0.36%	0.66%	0.15%	-0.10%	1.40%
T_{KP}	0.32	0.16	1.45	0.58	-0.02	0.72	0.20	0.07	1.28
Z_{CZ}	0.42	0.15	1.04	0.54	-0.62	0.12	0.48	0.20	1.04

This table reports the average abnormal returns (AARs) and average cumulative abnormal returns (CAARs) over defined event windows for different settings. For (1), excess returns are estimated using the Market Model with an estimation window of 250 days. For (2), a two-factor model, which in addition incorporates a national index, is used. For (3), market parameters are set to α=0 and β=1. Observations include the stress test participants´ sample of 29 banks. Figure 3 in Chapter 3.1 defines all events. The rows labelled T_{KP} and Z_{CZ} present the test statistics based on the parametric test proposed by Kolari and Pynnönen (2010) and Corrado and Zivney´s (1992) non-parametric test. ***, **, and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Taking the output of Table 9 into account, neither the specification of the benchmark model nor the investigation of potential measurement bias in estimated parameters resulted in a considerable deviation from derived results. Hence, there is sufficient evidence that results can be considered robust in the thesis´ framework.

5.3 Limitations

The presented methodology is subject to a number of underlying assumptions. In the following, three conceptual issues are further discussed.

First, inferences with event-date. A challenge for capturing the short-term shareholder reaction is to separate the stress testing impact from any other possible industry jitter. Market prices incorporate various data (e.g., monetary policy interventions, financial decisions, corporate announcements, ...). Correspondingly, a thorough news screening was performed at the very beginning of this paper´s analysis. The screenings´ findings were incorporated and have led to the adjustment of Event 4´s date (deviation from EBA´s official postponement disclosure). Furthermore, the event window was set to only incorporate days immediately following/ preceding EBA´s announcement to mitigate the risk of any confounding effects. Even though it cannot be ruled out that the market reactions may reflect other concurrent events, the thesis´ settings provide an optimal framework for documenting obtained results under the given conditions. In addition, outcomes were interpreted to reflect the unprecedented uncertainty and the capital market´s increased sensitivity.

Second, nonsynchronous trading. Thin trading can cause distortion in the statistical output of an event study as prices do not reflect all available information and thus violate the assumption of effective markets (Corrado and Truong, 2008). The use of infrequent daily data may cause the slope estimate of the Market Model to be downward biased. Maynes and Rumsey (1992) revert to the issue of distorted estimates as a result of nonsynchronous trading and propose different methodologies to improve the accuracy of regression results. As part of the initial analysis, zero-value returns were investigated. The data shows that of the examined securities, only a minor fraction of zero-returns. To reduce the risk of misspecification, four banks were ultimately excluded from the sample of untested banks. Even though this step resulted in a lower number of observed returns, the overall efficiency has increased due to better comparability between tested and non-tested banks in terms of sample size. In combination with the use of log- returns, those measures assisted in overcoming non-stationary issues.

Third, measurement error. For assessing abnormal returns, each bank´s parameters are estimated according to a specified methodology. Irrespective of inherent limitations in various models to calculate excess returns, the MSCI Europe does not fully represent the market portfolio but only serves as a proxy. Besides potential estimation errors, caution must be exercised when using stock market indicators to estimate an event´s informative value. The observed capital market´s reaction may only be an expectation of the equity effect, with the "ultimate" price effect to be revealed at some point in the future. Finally, note that the results are limited to listed European banks and do not reflect the whole sample of stress test participants.

6. Conclusion

Despite the sharp drop in banks´ stock prices at the onset of the COVID-19 crisis (Figure 2), financial institutions have continued to resist the rising pressure from capital markets and emerging pandemic-related consequences. Even though monetary policy support measures played a substantial role in preventing a financial turmoil, banks made a significant positive contribution to eventually support economic recovery. Compared to the GFC, major improvements in intermediators´ capital ratios have made such an evolution of banks possible which would have been inconceivable without the groundwork of the European banking union and mandatory supervisory stress testing. While at this point in time, no inferences regarding EBA´s stress test outcomes can be made, the market´s reactions to related exercise disclosure can provide some relevant insights into the market´s assessment of the resilience of the banking system.

When looking at the overall market sentiment towards EBA´s 2020/2021 stress test exercise, there is evidence of notable trend movements. During the launch of the 2020 stress test exercise, the market approached expected outcomes with a general positive attitude. This may be due to the market´s perception of a fair stress test, on the one hand, and, on the other hand, reduced potential contagion risks. However, with the worsening of the situation, investors´ fear of capital shortfalls and dilution concerns grew such that the sentiment reversed. The subsamples formed on the basis of COVID-19 case notifications provided additional insights into the experienced setback. As expected, the higher pandemic-impacted group exhibited more adverse market behaviour since liquidity issues might have been more prevalent for latter banks.

Next, the thesis investigated whether non-tested European banks benefited from EBA´s published disclosures. During "normal" periods, stress test participants may be able to collect some premium for participating in the exercise but nevertheless, there is no significant difference between those groups. On the contrary, stress tested banks experienced substantial headwinds in times of crisis. Over the accumulated event period, observed divergences balanced out, which could serve as evidence that investors care more about the aggregated industry than idiosyncratic risks during the COVID-19 pandemic.

Focusing on the postponement event, an analysis of absolute market reactions provided a first indication of substantial cross-sectional variation in the market´s equity valuation of stress tested banks. In addition, the comparison of stress test participants with European banks that did not participate showed that the market valued the characteristics of the former group, as equity valuations indicate. Inspecting factors that might explain investor´s behaviour, the results reveal that investors updated their a priori expectations. Reflecting on previous discussion, it can be concluded that the stress test attempt and related key events were considered relevant by the capital market. Even though the results have not yet been published, investors found EBA´s disclosures informative and responded with significant abnormal market reactions.

As indicated in the introduction, the postponed 2021 stress test results will not be released until the end of July 2021. Accordingly, the thesis does not span the entire EBA´s EU-wide 2020/2021 stress cycle. Incorporating the 2021 results´ publication would contribute to the thesis´ efforts to understand the market´s perception of the banking sector´s resilience. In addition, it would be of analytical interest to see whether the market had expected some banks to experience severe financial issues in the depicted downturn scenario. Hence, the comparison between well-capitalised and struggling banks as indicated by EBA´s result disclosure is subject to further research.

Another potential research focus may involve comparing the different stress test approaches central banks adopted during the recent crisis and its potential degrees of varying impacts on the capital market. Besides the differences in authorities´ stress testing strategies, the thesis touches upon monetary policy interventions, which can be used for further research. One might, for example, be interested in studying banks´ reluctance to reduce their capital buffers or to investigate banks´ lending behaviour during COVID-19.

Finally, this paper is limited to the evaluation of equity price reactions to stress test-related disclosures. Since stockholders only present a share of total capital market participants, the analysis can also be extended to incorporate bondholders. This may provide additional insights into the market´s assessment of European banks´ default probabilities.

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Appendix

Appendix 1 Capital Requirements

The Basel III accord consists of three pillars, enabling a multi-dimensional approach to develop international minimum standards for capital, liquidity and leverage ratios (European Commission, 2013):

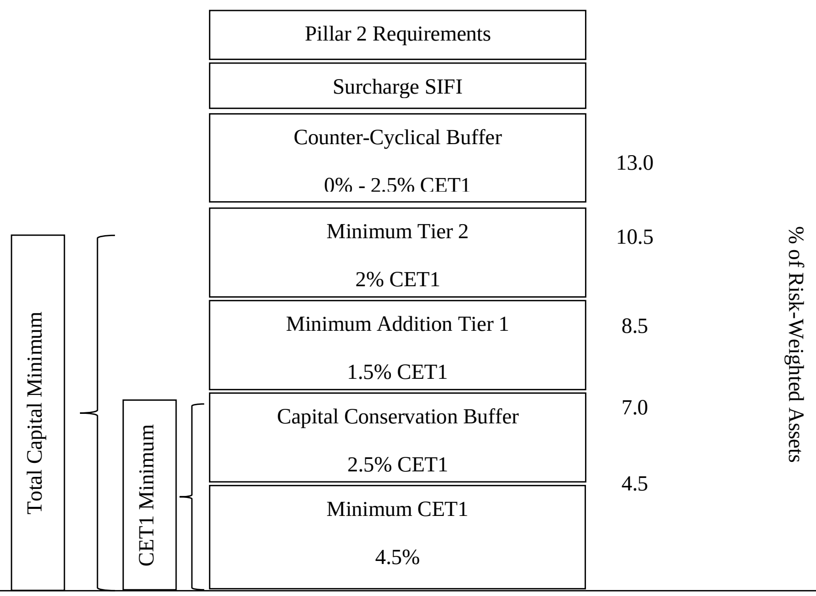
Pillar 1- Minimum capital requirements. The first pillar defines the quantitative regulatory minimum requirements by providing directions for the measurement of credit, market and operational risk. Under the current Basel accord, all banks are required to hold 8% of their own funds as a minimum capital requirement against risk-weighted assets. This 8% can be further decomposed in
- 4.5% of Common Equity Tier 1 capital (equity of highest quality),
- 1.5% Additional Tier 1 capital (perpetual debt capital that has the characteristics of equity + hybrid instruments that can be converted into equity when a trigger event occurs), as well as,
- 2.0% of Tier 2 capital (supplementary capital, which is composed of items such as revaluation reserves, undisclosed reserves, hybrid instruments and subordinated term debt).
On top of the minimum capital requirement, additional types of capital adequacy buffers are in place, such as the capital conservation buffer (2.5% of CET 1), institutional contra-cyclical buffer (0-2.5% of CET 1), system risk buffer (3.0% of CET 1) as well as – where applicable – a buffer for globally and other systemically-important institutes (0-3.5% of CET 1) to improve the stability of the financial sector.

Pillar 2- Supervisory review process. This pillar covers the internal capital adequacy assessment and management review practices which are critical tools of a bank's internal risk management. For banks to determine the appropriate amount of capital, it is first necessary to identify and evaluate a variety of risk sources (e.g., pension, liquidity, strategic and income risk). This assessment, in connection with implications derived from the EBA´s supervisory stress test, helps set individual levels of minimum capital and liquidity. After reviewing the internal capital adequacy process, the banking supervisor formulates an opinion on whether Pillar 1 capital requirements reflect a bank´s overall risk profile or if additional measures (e.g., capital increase) are needed to offset a specific bank´s vulnerabilities.

Pillar 3- Market discipline. The third pillar addresses the issues of transparency concerning the bank's risk position (i.e. scope of application, risk management, detailed information on equity capital, etc) and promotes comparability within the banking sector. Banks have to provide market participants with an objective picture of a bank's risk exposure and capital adequacy. Through the true-and-fair public disclosures of financial statements and specific risk reports, the third pillar aims to ensure market discipline and incentivize sound risk management.

The figure below gives an overview of described capital requirements and contributes to the understanding of the European CET1 development as illustrated in Figure Appendix 1 Capital Requirements. For the sake of completeness, it should be noted that a bank may wish to maintain capital resources well in excess of its regulatory minimum for the following reasons: high earnings retention, the perceived advantages associated with high economic capital (e.g., protection of a valuable charter), acquisition plans, minimize the risk of breaching regulations, external market pressure or the anticipation of a crisis.

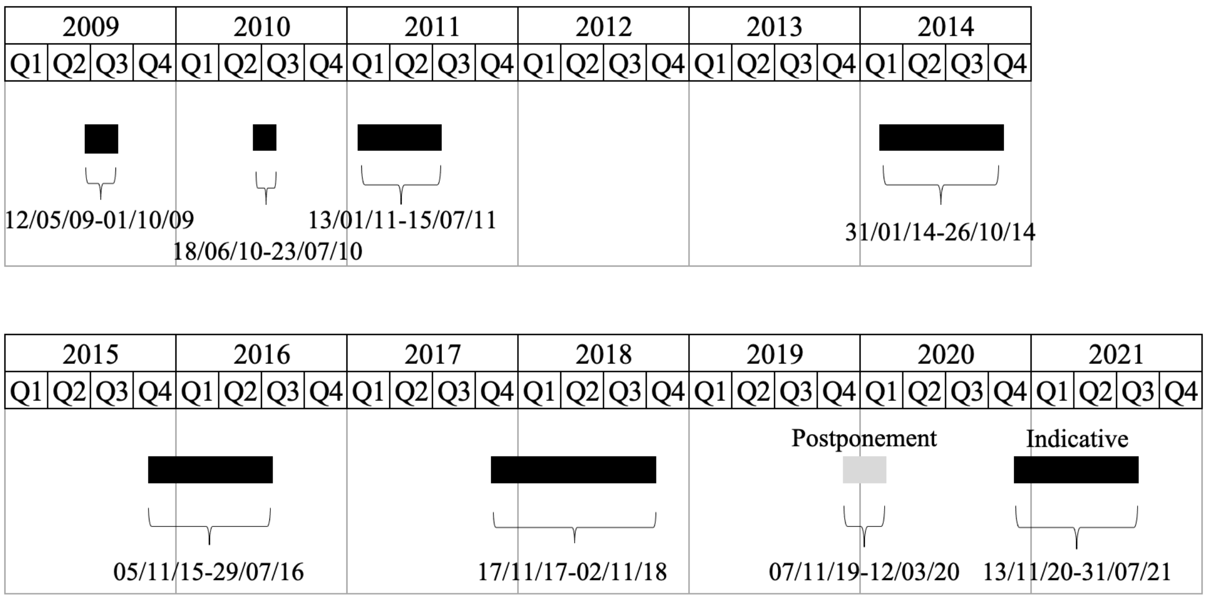
Figure Appendix 1 Capital Requirements



Notes: CET1 = Common Equity Tier 1, SIFI = Systemically Important Financial Institution

Appendix 2: Timeline European Stress Tests

Figure Appendix 2: Timeline European Stress Tests



This figure depicts the timeline of European stress tests. The starting date is defined as the exercises´ official launch date whereas the end is marked with publication of the results. The grey box refers to the postponement exercise and ends with the official announcement thereof. The last box is considered indicative since results are not yet available. All data is taken from EBA´s website.

Appendix 3: Sample Overview of Stress-Tested Banks

Table Appendix 3: Sample Overview of Banks in 2020/2021 Stress Test

Country	Banks	Listed Shares	Participation in 2020	Participation in 2021
AT	Erste Group Bank AG	Yes	Yes	Yes
AT	Raiffeisen Bank International AG	Yes	Yes	Yes
BE	Belfius Banque	No	Yes	Yes
BE	KBC Groupe	Yes	Yes	Yes
DE	Bayerische Landesbank	No	Yes	Yes
DE	Commerzbank AG	Yes	Yes	Yes
DE	Deutsche Bank AG	Yes	Yes	Yes
DE	DZ BANK AG Deutsche Zentral-Genossenschaftsbank	No	Yes	Yes
DE	Landesbank Baden-Württemberg	No	Yes	Yes
DE	Landesbank Hessen-Thüringen	No	Yes	Yes
DE	Norddeutsche Landesbank*	No	Yes	No
DE	Volkswagen Bank GmbH	No	Yes	Yes
DK	Danske Bank A/S	Yes	Yes	Yes
DK	Jyske Bank A/S	Yes	Yes	Yes
DK	Nykredit Realkredit A/S	No	Yes	Yes
ES	Banco Bilbao Vizcaya Argentaria, S.A.	Yes	Yes	Yes
ES	Banco de Sabadell, S.A.	Yes	Yes	Yes

ES	Banco Santander, S.A.	Yes	Yes	Yes
ES	BFA Tenedora de Acciones, S.A.	No	Yes	Yes
ES	CaixaBank, S.A.	Yes	Yes	Yes
FI	Nordea Bank Abp	Yes	Yes	Yes
FI	OP Osuuskunta	No	Yes	Yes
FR	BNP Paribas	Yes	Yes	Yes
FR	Confédération Nationale du Crédit Mutuel	No	Yes	Yes
FR	Groupe BPCE	No	Yes	Yes
FR	Groupe Crédit Agricole	Yes	Yes	Yes
FR	HSBC France*	Yes	Yes	Yes
FR	La Banque Postale	No	No	Yes
FR	Société Générale S.A.	Yes	Yes	Yes
HU	OTP Bank Nyrt.	Yes	Yes	Yes
IE	AIB Group plc	Yes	Yes	Yes
IE	Bank of Ireland Group plc	Yes	Yes	Yes
IT	Banco BPM SpA	Yes	Yes	Yes
IT	Banco Monte die Paschi di Siena S.p.A	Yes	No	Yes
IT	Iccrea Banca S.p.A	Yes	No	Yes
IT	Intesa Sanpaolo S.p.A.	Yes	Yes	Yes
IT	UniCredit S.p.A.	Yes	Yes	Yes
IT	Unione di Banche Italiane Società per Azioni	No	Yes	Yes
NL	ABN AMRO Group N.V.	Yes	Yes	Yes
NL	BNG Bank N.V.	No	Yes	Yes
NL	Coöperatieve Rabobank U.A.	No	Yes	Yes
NL	ING Groep N.V.	Yes	Yes	Yes
NL	Nederlandse Waterschapsbank N.V.	No	Yes	Yes
NO	DNB BANK ASA	Yes	Yes	Yes
PL	Bank Polska Kasa Opieki SA	Yes	Yes	Yes
PL	Powszechna Kasa Oszczednosci Bank Polski SA	Yes	Yes	Yes
PT	Caixa Geral de Depósitos, SA	No	Yes	Yes
SE	Länsförsäkringar Bank AB	No	Yes	Yes
SE	SBAB Bank AB	No	Yes	Yes
SE	Skandinaviska Enskilda Banken	Yes	Yes	Yes
SE	Svenska Handelsbanken	Yes	Yes	Yes
SE	Swedbank	Yes	Yes	Yes
UK	Barclays Plc**	Yes	No	No
UK	HSBC Holdings Plc**	Yes	No	No
UK	Lloyds Banking Group Plc**	Yes	No	No
UK	The Royal Bank of Scotland Group Plc**	Yes	No	No

This table provides an overview of banks included in the stress tested sample. Notes: AT = Austria, BE = Belgium, DE = Germany, DK = Denmark, ES = Spain, FI = Finland, FR = France, HU= Hungary, IE = Ireland, IT =Italy, NL = Netherlands, NO= Norway, PL= Poland, PT = Portugal, SE = Sweden. Banks with * were excluded from the final sample since they were not consistently on the list of to be tested banks (Norddeutsche Landesbank was excluded in January, HSBC France in November). ** denotes UK banks which are not part of the analysis because of the subsequent exclusion of UK banks from the EBA stress test as a response to the Brexit referendum. All data is taken from EBA´s disclosures.

Appendix 4 : Definition Variables for Regression

Table Appendix 4: Variable Definitions

Variable Name	Definition	Source
CET1	Common Equity Tier 1 / Risk Weighted Assets (in %)	ECB Pillar 3 Information Disclosure
Leverage	Tier 1 Capital/ Total Consolidated Assets in %	ECB Pillar 3 Information Disclosure
LogAssets	Log (Total Assets)	Capital IQ
ROE	Return on Equity (in %) = Net Income / Equity	Capital IQ
SRISK	Systematic Risk Measure (in %)	NYU V-Lab
NPL	Non-Performing Loans/ Gross Outstanding Loans (in %)	Capital IQ

Appendix 5: Extract from Country Analysis for the Postponement Event

Table Appendix 5: Country-Specific Postponement Reactions

Country	N	AAR (0)	CAAR (0, +1)	CAAR (-1, +1)
AT	2	6.20%	5.41%	5.94%
BE	1	-4.22%	-4.48%	-1.73%
DE	2	5.68%	6.20%	6.28%
DK	2	2.42%	0.18%	0.17%
ES	4	-0.49%	1.57%	6.31%
FI	1	-2.35%	-5.13%	-5.07%
FR	3	4.32%	7.85%	12.94%
HU	1	-14.95%	-3.75%	-11.51%
IE	2	4.78%	2.96%	6.53%
IT	3	1.71%	9.54%	16.38%
NL	2	-6.70%	-7.65%	-6.06%
NO	1	2.56%	4.89%	1.78%
PL	2	-8.97%	-6.57%	-11.31%
SE	3	-4.45%	-3.57%	-2.82%

This table reports the average abnormal returns (AARs) and average cumulative abnormal returns (CAARs) over defined event windows for the postponement event on a country basis. AT = Austria, BE = Belgium, DE = Germany, DK = Denmark, ES = Spain, FI = Finland, FR = France, HU= Hungary, IE = Ireland, IT =Italy, NL = Netherlands, NO= Norway, PL= Poland, PT = Portugal, SE = Sweden.

Appendix 6: SRISK Measure per Country

Table Appendix 6: List of countries with capital shortfall under SRISK measure

Country	SRISK Event 1	SRISK Event 2	SRISK Event 3	SRISK Event 4	SRISK Event 5	SRISK Event 6	SRISK Event 7
FR	89,604	87,554	78,611	80,653	102,141	110,747	107,495
DE	51,906	51,860	51,114	50,257	52,781	53,112	52,697
ES	22,929	23,932	25,122	25,983	32,480	36,269	33,722
IT	25,240	24,590	20,332	21,648	25,563	31,979	29,107
NL	18,827	19,547	19,936	21,143	29,147	31,060	29,076
DK	12,075	12,793	12,416	12,389	14,405	15,671	14,989
FI	16,361	19,316	14,976	13,560	20,514	19,107	16,811
SE	5,565	5,853	5,263	3,984	7,866	8,565	6,546
AT	5,013	5,734	4,714	4,915	7,996	8,953	7,811
BE	3,290	1,526	43	1,357	5,313	7,224	5,560
IE	982	1,122	2,667	3,080	5,085	4,739	4,413
NO	438	1,790	1,057	-874	4,526	6,446	24
PL	-2,618	-2,273	-1,516	-1,276	598	1,751	705
HU	-4,173	-3,295	-4,554	-5,099	-2,629	-2,033	-4,199
ALL	22,111	22,297	20,803	21,129	27,048	29,664	27,652

This tables provides an overview of the average development of the SRISK measured in $ millions per country. Notes: AT = Austria, BE = Belgium, DE = Germany, DK = Denmark, ES = Spain, FI = Finland, FR = France, HU= Hungary, IE = Ireland, IT =Italy, NL = Netherlands, NO= Norway, PL= Poland, SE = Sweden. All data is derived from NYU V-Lab´s Website.