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A Comparative Analysis of Market and Regulatory Risk Measures in European Banking in 2011 and 2021

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Abstract

This thesis compares market-based and regulatory risk measures in European banking by replicating Acharya, Engle, and Pierret's (2014) analysis for the 2011 sovereign debt crisis and extending it to the 2021 COVID-19 pandemic. Results confirm that, in 2011, market metrics like SRISK outperformed regulatory risk-weighted assets (RWA) in predicting realized volatility. By 2021, post-Basel III reforms improved the predictive power of regulatory measures, while pandemic-era interventions distorted market signals. The disconnect between market and regulatory measures persists, but its implications have inverted: regulatory metrics offered more robust signals of systemic risk during the COVID-19 pandemic

Keywords: systemic risk, stress testing, risk-weighted assets, Basel III, COVID-19, European banking

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1. Introduction

The financial crisis of 2007-2009 exposed severe weaknesses in the international banking system. In response to this crisis, regulators worldwide began prioritizing macroprudential supervision and stress-test scenarios. These stress tests use hypothetical scenarios that specify different macroeconomic downturns to assess not only the resilience of individual banks but also the stability of the financial system as a whole, or systemic risk (Acharya et al. 2010; Acharya, Engle, and Pierret 2014). In Europe, these tests are led by the European Banking Authority (EBA), with the first being published in 2010. Their main objective is to assess the ability of the banks tested to absorb possible shocks on credit and market risks (Committee of European Banking Supervisors 2010). However, the efficacy of these regulatory tests has been a subject of intense discussion and scrutiny.

One of the most notable critiques of these post-crises European stress testing is by Acharya, Engle, and Pierret (2014, hereafter AEP), where they showed a significant disconnect between EBA risk assessment in stress tests and their own measure SRISK. Brownlees and Engle (2017) define SRISK as the expected capital shortfall of a bank given a significant and long-term market decline. The main way SRISK differs from the official EBA stress tests is that it is based on leverage instead of risk-weighted assets, that often treat sovereign debt as risk-free. AEP (2014) found that, in 2011, SRISK was a much superior predictor of realized volatility than risk-weighted measures; in fact, these two metrics had opposing results: banks declared safe by the EBA's model often were deemed undercapitalized according to SRISK measures. Essentially, they found that EBA's reliance on Risk-Weighted Assets (RWA) produced capital shortfall estimates that were uncorrelated with the true realized volatility of European banks in a period of crisis.

Following the global financial crisis, the European banking sector has gone through significant changes. The Basel III Framework, introduced in 2017 by the Basel Committee, is a direct response to this, as it addresses many of the shortcomings found in the previous frameworks. One of the key changes was reducing the variability of RWAs, as the Committee found that there was a concerning level of variability in how each bank calculated its RWAs. Another key change was the introduction of a simple, non-risk-based leverage ratio as a supplementary measure to the risk-based capital requirements (Basel Committee on Banking Supervision 2017).

The question is, how well have these reforms succeeded? This thesis asks whether the changes made in Basel III, and therefore in how EBA conducts its stress tests, resolved the flaws identified by AEP (2014). More clearly, are regulatory and market-based measures still extremely uncorrelated after the 2017 reform? And if they are, which risk metric provides a better prediction of realized volatility after a period of economic stress?

To answer this question, in this study, I examine the post-reform framework in the context of the COVID-19 crisis, since it represents a fundamentally different macroeconomic environment from the period studied by AEP (2014). The analysis uses data from the 2021 EBA stress test, the first major stress test conducted after the start of the pandemic, to assess whether the structural disconnect between regulatory and market-based measures has persisted in the post-Basel III era. The study adopts a replication and extension approach, first reproducing the 2011 results and then evaluating whether the same relationships hold a decade later under vastly different market conditions.

2. Literature Review

2.1 The European Banking Sector

To better understand the European stress tests, it is first important to understand how the European financial system works, specifically when compared to other advanced economies like the United States. As noted by Messori (2019), while non-financial firms in the US rely heavily on capital markets, the Euro area remains characterized by a "bank-centric" model. Where the external financing of the real economy is dominated by bank credit, this structural reliance creates specific vulnerabilities, most notably the "sovereign-bank nexus". This dynamic acts as a vicious cycle: deteriorating sovereign creditworthiness reduces the value of bank assets, forcing government bailouts that only serve to further weaken the state (Acharya, Drechsler, and Schnabl 2014).

2.2 Regulatory Measurement of Systemic Risk

In this thesis, I explore the fundamental disagreement between how supervisors and the market measure risk. On the one hand, the EBA assigns assets weights based on their perceived risk (RWA). While on the other hand, market-based measures like SRISK capture the real-time assessment of leverage and asset quality.

Acharya and Steffen (2014) were some of the first to expose how deep this disconnect goes. They argued that regulatory stress tests often underestimate risk, since they rely too much on risk weights that banks can “hack” to mask their true leverage. In their analysis, the RWA capital ratios were uncorrelated with realized volatility, instead, a simple leverage ratio was a far better predictor of financial distress (Acharya, Engle, and Pierret 2014).

The Basel III framework was the direct response to these failures. It was implemented in Europe via the 2019 "Banking Package" (CRR II and CRD V), with the goal of addressing the

dangerous variability in risk weights (European Parliament 2019). One of the crucial changes for this study was how this new framework transformed the Leverage ratio from a monitoring tool into an enforced requirement. Since June 2021, EU banks have been required to keep a Tier 1 leverage Ratio of at least 3% (European Parliament and Council 2019).

2.3 The 2021 Stress Test Environment

The 2021 EBA stress test took place under very unique economic conditions. The 2011 stress test followed the aftermath of the 2008 crisis, which originated from excess financial leverage, while the COVID-19 pandemic was a shock to the economy caused by medical necessity. Baldwin and Weder di Mauro (2020) describe how economic activity was suspended to contain the virus, creating a scenario distinct from previous financial recessions. This changed the nature of credit risk. Yin, Han, and Wong (2022) show that risk metrics shifted from "long-range" to "short-range" dependence, meaning historical default correlations broke. Borrower survival depended less on their business model and more on government support.

To stop this freeze from causing a credit crunch, European authorities passed the "CRR Quick Fix" (Regulation (EU) 2020/873). This regulation directly changed the capital data used in this thesis. First, it let banks "add back" to their CET1 capital a large part of the increased provisions required under IFRS 9. Also, the regulation let banks exclude central bank money from the leverage ratio denominator. This allowed them to absorb liquidity injections without breaking the new 3% leverage constraint. (European Parliament and Council 2020).

2.4 Fiscal and Monetary Interventions

Payment moratoria and public guarantee schemes heavily obscured the credit quality of bank assets in 2021. The EBA (2020) guidelines permitted banks to grant "payment holidays" to borrowers without classifying the loans as defaulted or forborne. Consequently, reported Non-Performing Loan (NPL) ratios remained historically low at approximately 2.3% despite the

severe economic contraction (EBA 2021b). However, the risk did not disappear; asset deterioration was hidden in "Stage 2" loan allocations, creating a large volume of latent credit risk that regulatory capital metrics did not fully capture (EBA 2021b).

Simultaneously, massive loan guarantee schemes effectively substituted corporate credit risk with sovereign credit risk, deepening the sovereign-bank nexus. The ESRB (2021) noted that these schemes mobilized hundreds of billions of euros in new lending across the euro area. Furthermore, the ECB's recommendation to suspend dividends until September 2021 lowered bank equity values by approximately 7% compared to non-financial firms (Andreeva et al. 2021). Since SRISK relies on market capitalization, this regulatory suppression of stock prices suggests a direct distortion of the market data used in this thesis. High volatility during this period may thus reflect a prohibition on payouts rather than fundamental insolvency risk.

2.5 Identification of the Research Gap

Despite extensive literature on SRISK, there is limited evidence assessing whether Basel III reforms reduced the disconnect between market and regulatory measures under the unique conditions of the pandemic. This study fills that gap by replicating the AEP (2014) framework using 2021 data. It explicitly tests whether the "regulatory disconnect" persists in an environment characterized by binding leverage constraints and massive public intervention, evaluating whether the structural flaws of 2011 have been resolved or simply obscured.

3. Methodology

The first step in the process was to repeat a few of the same tests presented in AEP (2014). More specifically, the Realized Volatility Regressions table, the figure showing SRISK plotted against the Disclosed capital shortfall in the EBA, and lastly the two figures where the capital shortfall estimates SRISK under V-Lab stress scenario are plotted against (a) "absolute" risk-based capital shortfall estimates in the EBA 2011 stress test, and (b) the alternative leverage-based capital shortfall estimates for the EBA 2011 stress test.

While there were 90 total participating banks in the 2011 EBA stress test, only 53 of those also had SRISK data available on V-Lab, which is in line with the sample used originally by AEP (2014). A complete list of the banks included in the final sample is provided in **Appendix A**. However, three banks, most notably, the Agricultural Bank of Greece (ATEbank), were excluded from the regression analysis because the necessary book-to-market data were not publicly available, preventing their inclusion in the study. One bank, Allied Irish Banks plc, did not have v-lab data available, but did have book-to-market data.

Data on regulatory and financial metrics were gathered from the European Banking Authority (EBA) 2011 Capital Exercise, while market-based risk measures were gathered from NYU Stern's Volatility Laboratory (V-Lab). Book-to-Market ratios were collected from individual bank financial reports. This approach provides a precise measure of market risk during the COVID-19 crisis period.

The next step was to apply those same tests to 2021, using data from a sample of 53 banks. Of those, 32 had available V-lab data and public financial information, which are provided in **Appendix B.**

A. Realized Volatility Regression (Table 1)

Unlike in AEP (2014), it was not possible to calculate realized volatility for the 2011 bank sample using historical daily stock returns due to data limitations. Instead, I made an approximation of the Realized Volatility using the root mean square of the GARCH volatility of the period available on the V-Lab website.

$$\boldsymbol{RV_{i,t,W}} = \sqrt{\frac{\mathbf{1}}{\boldsymbol{W}} \sum_{\boldsymbol{t+1}}^{\boldsymbol{t+1+W}} (\boldsymbol{GARCH})^{\mathbf{2}}} \qquad (\mathbf{1})$$

For the 2021 analysis, historical closing prices were available. Therefore, the realized volatility was calculated directly as the standard deviation of daily log returns over the six months following the EBA stress test publication date. Specifically, the daily log returns (R_t) were calculated as: (eq1)

$$\boldsymbol{R_t} = \mathbf{ln}\left(\frac{\mathbf{P_t}}{\mathbf{P_{t-1}}}\right) \qquad (\mathbf{2})$$

Where P_t is the adjusted closing price on day t. The Realized Volatility (RV) was then derived using the standard deviation of the sum of these returns:

$$\boldsymbol{RV_{i,t,W}} = \sqrt{\frac{\mathbf{1}}{\boldsymbol{W}} \sum_{\boldsymbol{t+1}}^{\boldsymbol{t+1+W}} \left(\boldsymbol{r_{it}} - \boldsymbol{\bar{r}_{it,W}}\right)^{\mathbf{2}}} \qquad (\mathbf{3})$$

Using this Realized Volatility as a constant, I replicated the cross-sectional OLS regression model used by AEP (2014) to evaluate the predictive power of the three key independent variables: V-Lab Risk Weight, the Tier 1 Leverage Ratio (T1LVGR), and the Regulatory Risk Weight (EBA RW). The Book-to-Market ratio is included as a control variable to account for differences in valuation. Following standard academic practice, this paper reports statistical significance at the 5% and 1% levels.

The cross-sectional regression specification is defined as follows:

$$\boldsymbol{RV_i = \alpha + \beta_1 VLabRW_i + \beta_2 T1LVGR_i + \beta_3 EBARW_i + \beta_4 BTM_i + \epsilon_i} \quad (4)$$

The V-Lab Risk Weight is calculated following the approach outlined by AEP (2014). It provides a market-based estimate of the risk weight that would satisfy the capital requirement under the V-Lab stress scenario. This new risk weight captures the extent to which a bank's market value is expected to fall under the V-lab stress scenario. Because it is grounded in market data, it can be directly compared to the regulatory risk weight calculated from risk-weighted assets.

It is written as:

$$\mathbf{V-lab\ risk\ weight} = (\mathbf{1} - (\mathbf{1} - \mathbf{k}) * \mathbf{LRMES})^{-\mathbf{1}}, \quad (5)$$

Where k is the V-lab prudential capital ratio of 5,5%, and LRMES (Long-Run Marginal Expected Shortfall) is collected from V-lab. It measures the expected percentage decline in a bank's equity if the global market experiences a severe downturn (a 40% decline in the World Equity Index) over a six-month period.

B. Capital Shortfall Measures

To better visualize the disconnect between market and regulatory assessments of risk, this paper calculates three measures of capital shortfall estimates for each bank. These measures form the basis for the scatter plots shown in **Figures 1 and 2**.

First, I replicated the Disclosed Capital Shortfall used in EBA stress tests. This estimate is calculated as the difference between the minimum capital a bank must hold and the bank's actual capital. It is capped at zero, meaning banks with excess capital are shown as having zero shortfall. The formula is:

$$\boldsymbol{Disclosed\ Shortfall} = \mathbf{max}(\mathbf{0}, [\boldsymbol{k'} * \boldsymbol{RWA_s} - \boldsymbol{Capital_s}]), \quad (6)$$

Where $\boldsymbol{k'}$ represents the prudential capital ratio threshold (set as 5,5%). The RWA_s and $Capital_s$ are, respectively, the risk-weighted assets and the capital level of the bank at the end of the stress-test scenario. Unlike previous years, there was no predefined capital threshold in the EBA stress test; therefore, I set it to 5,5% to align with the threshold used in V-lab.

However, as noted by AEP (2014), the zero bound can mask significant differences between banks. Banks that are well-capitalized beyond the minimum required level all appear identical, with a shortfall of zero, even though their actual capital buffers can differ substantially. Calculating the "absolute" capital shortfall ($\boldsymbol{k' * RWA_s - Capital_s}$) allows for a more comprehensive comparison between capital adequacy and SRISK. And allows us to verify whether, similarly to AEP (2014), banks with the highest V-lab shortfalls remain the most well capitalized in 2021.

Lastly, I calculated the leverage-based capital shortfall, where total assets are used instead of risk-weighted assets, and k is the prudential ratio used in V-lab (5,5%):

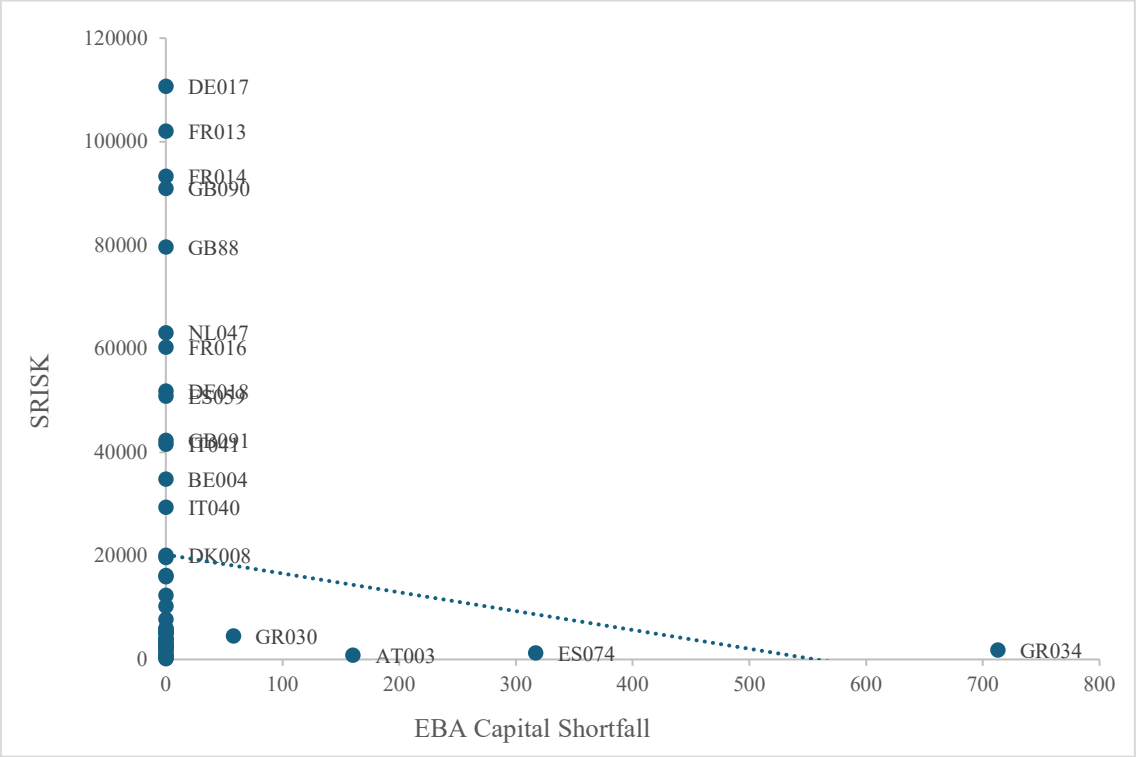
$$\boldsymbol{Capital\ Shortfall\ (TA) = k * TA_s - Capital} \qquad (7)$$

4. Results

This section presents the comparative analysis between systemic risk measures, market and regulatory, across two very distinct crisis periods. Section 4.1 reports the results of the replication of the 2011 European Sovereign Debt Crisis to validate the methodology against the findings of AEP (2014). Section 4.2 extends this analysis to the 2021 COVID-19 pandemic to evaluate whether the relationship between market and regulatory risk measures has evolved.

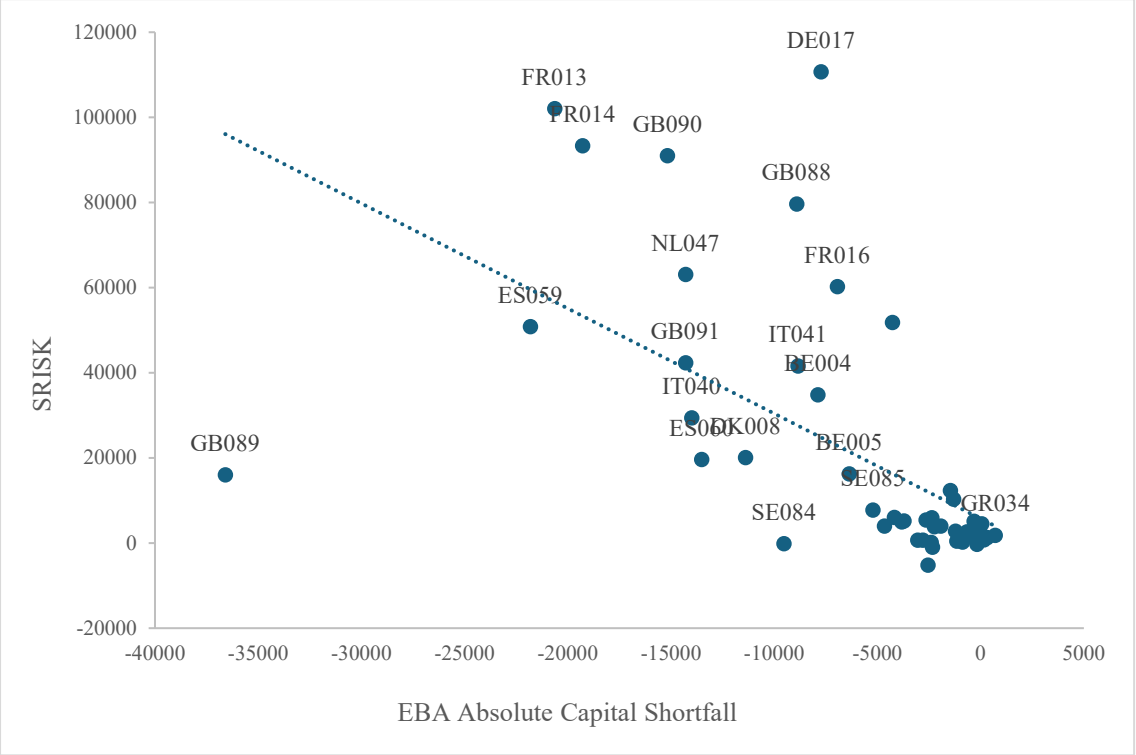
4.1. The 2011 Sovereign Debt Crisis – Replication

Figure 1: 2011 - EBA Disclosed Capital Shortfalls vs. SRISK. SRISK under V-lab stress test, data from December 2011 (vertical axis), plotted against the disclosed capital shortfall estimates (eq. 6) from the 2011 EBA stress test (in € millions)



Consistent with AEP (2014), there seems to be a weak negative correlation between the two variables. As shown in the figure, several banks with high SRISK values actually reported zero capital shortfalls in the official EBA stress test. Most notably, Deutsche Bank (DE017) exhibited the highest reported SRISK value in the sample, while having zero disclosed capital shortfall. However, the Agricultural Bank of Greece, or ATEbank (GR034), had the highest disclosed shortfall while having a comparatively low V-lab capital shortfall SRISK. This highlights the disconnect between market and regulatory perspectives when it comes to the assessment of systemic risk.

Figure 2: 2011 – EBA "Absolute" Capital Shortfalls vs. SRISK. SRISK under V-lab stress test, data from December 2011 (vertical axis), plotted against the "absolute" capital shortfall estimates from the 2011 EBA stress test (in € millions). Shortfalls are expressed in positive numbers, and excesses in negative numbers.



In Figure 2, the zero bound on EBA capital shortfalls is removed, allowing us to observe the correlation also between capital excesses and SRISK. Here, capital excesses appear as negative shortfall values.

Although the correlation remains negative, it paints a clearer picture than Figure 1. Notably, both Deutsche Bank (DE017) and HSBC (GB089) had zero disclosed shortfall. However, the figure shows that HSBC held the largest capital excess (€36,6bn) alongside a relatively low SRISK, while Deutsche Bank had only a modest excess (€7,7bn) but exhibited the highest SRISK in the sample. But despite these outliers, most banks still follow the overall trendline.

Figure 3: 2011 – EBA "Absolute" leverage-based Shortfall vs. SRISK. SRISK under V-lab stress test, data from December 2011 (vertical axis), plotted against the alternative, leverage-based "absolute" capital shortfall estimates (eq. 7) (in € millions).

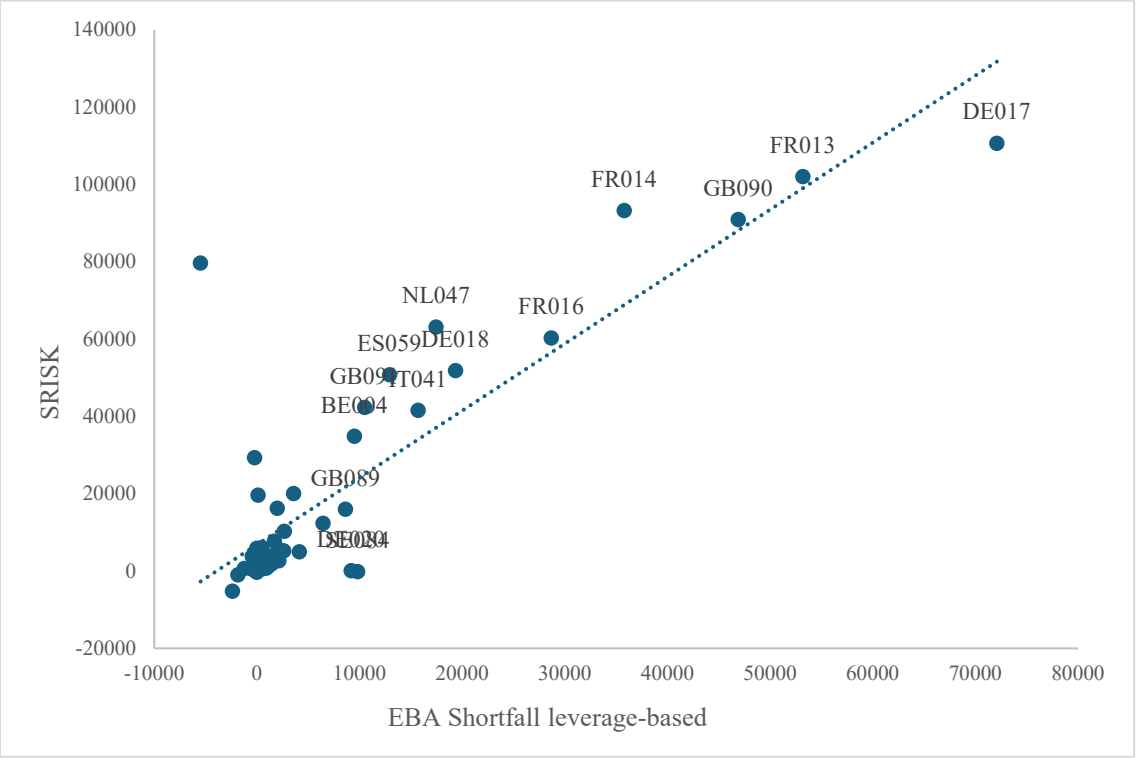


Figure 3 shows the "absolute" leverage-based shortfall. Here, the official regulatory capital shortfall estimates, which are derived using risk-weighted assets, are traded for simpler leverage-based shortfall estimates, which use total assets. And unlike the previous figures, this results in a strong positive correlation with SRISK.

As observed in the scatter plot, the disconnect seen in Figures 1 and 2 disappears. Banks with higher SRISK now also exhibit greater capital shortfalls when using this alternative leverage-based standard. As an example, we can use Deutsche Bank (DE017) and BNP Paribas (FR013), both of which have the two largest SRISK and leverage-based shortfalls. This suggests that the previously observed weak and negative correlation was driven primarily by regulatory risk weights, which masked the true leverage risk of these systemically important institutions.

Table 1: 2011 – Realized Volatility regressions. Dependent variable: six-month estimated realized volatility (eq. 1) using V-lab GARCH volatility after the disclosure of the EBA stress test in July 2011. EBA risk weight is a simple ratio of risk-weighted assets to total assets at the end of the stress test scenario. EBA T1LVGR (Tier 1 leverage ratio) is the ratio of Tier 1 capital to total assets for the same period. Statistical significance: * at 5% level and ** at a 1% level. White's heteroskedasticity-consistent standard errors are in parentheses. Sample size: 51.

	Intercept	3,644**	-0,541	4,233**	4,185**	-0,021	-0,385
		(0,343)	(1,164)	(0,878)	(0,792)	(1,582)	(1,71)
	Book-To-Market	0,233*	0,194*	0,219*	0,221*	0,184	0,188
		(0,097)	(0,096)	(0,106)	(0,095)	(0,103)	(0,099)
V-lab	V-Lab RW (eq. 5)		2,270**			2,229**	2,297**
			(0,616)			(0,629)	(0,672)
EBA	T1LVGR			-10,146		-7,658	-11,458
				(12,24)		(12,626)	(19,467)
EBA	EBA RW				-0,879		0,748
					(1,244)		(2,074)
	F-statistic	5,76*	11,17**	3,89*	2,84	8,52**	6,65**
	R-squared Adj.	0,167	0,255	0,159	0,155	0,245	0,231

To formally test the predictive power of these different measures, Table 1 reports the results of a cross-sectional regression of Realized Volatility (RV) on multiple risk metrics. The model follows the methodology in Acharya et al. (201 AEP (2014), regressing the realized volatility of equity returns following the 6 months after the stress test, against the pre-stress risk measures (V-lab Risk weights, Tier 1 Leverage Ratio, and Regulatory Risk Weights).

As detailed in the Methodology section, this regression was made with an approximation of realized volatility derived using GARCH volatility instead (eq. 1) due to data availability. The sample size (51) also diverges from the original study (53), also due to the same data availability issues. One of the banks excluded from this OLS was the Agricultural Bank of Greece, or ATEbank (GR034), an institution that not only had the largest disclosed capital

shortfall out of the banks used in this study but faced severe distress during late 2011 and early 2012. In July, ATE Bank was dissolved, its operating license was revoked, and it was split into two parts: its viable operations were transferred to Piraeus Bank, while its remaining assets were sent to a "bad bank" for liquidation (Schaefer-Brown 2024, 219).

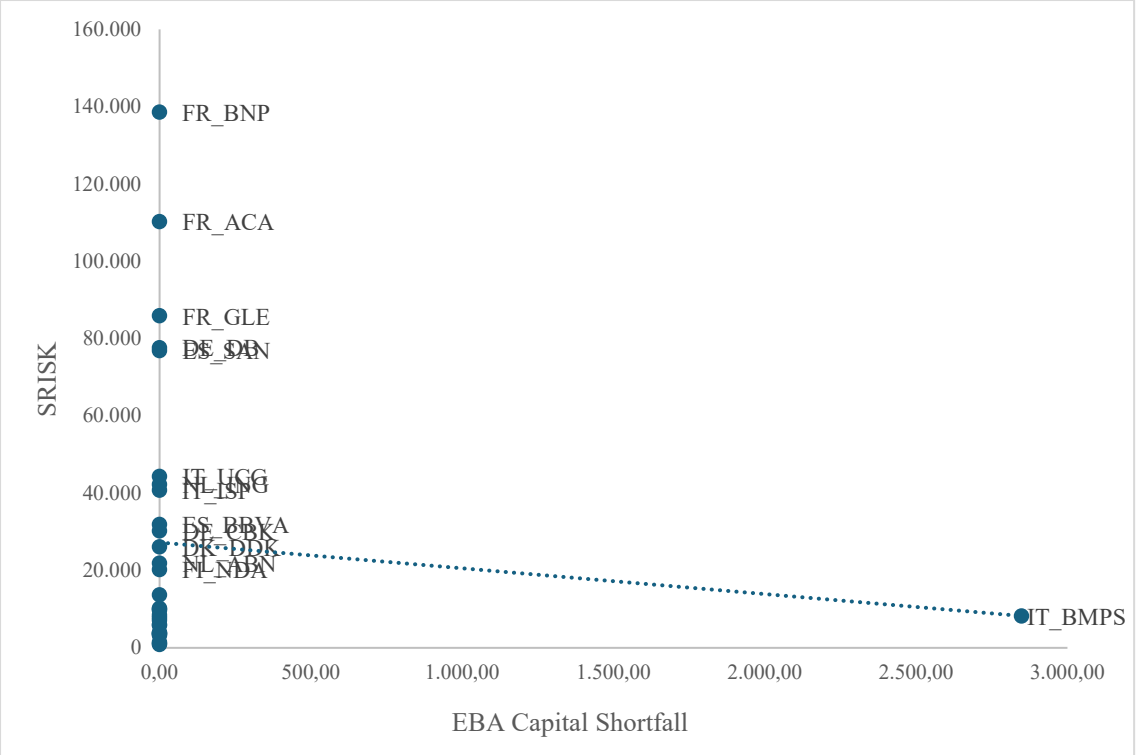
Therefore, the combination of these two constraints likely explains the divergence between the results of this replication and the results found in AEP (2014). In the original study, book-to-market, V-lab risk weight, and T1LVGR were all statistically significant. In the replication, however, only V-lab Risk weight remained significant at a 1% level with a coefficient of 2,297. The T1LVGR shows the expected negative sign (implying that higher capital reduces risk) but does not reach statistical significance. EBA RW, as in the original study, remains statistically insignificant.

These results still collectively validate the premise of AEP (2014), that during the 2011 crisis, market-based measures provided a clearer signal of systemic risk than the complex regulatory ratios relied upon by supervisors.

4.2. The 2021 COVID-19 Pandemic – Extension

Figure 4: 2021 - EBA Disclosed Capital Shortfalls vs. SRISK. SRISK under V-lab stress test, data from December 2021 (vertical axis), plotted against the disclosed capital shortfall estimates (eq. 6) from the 2021 EBA stress test (in € millions).

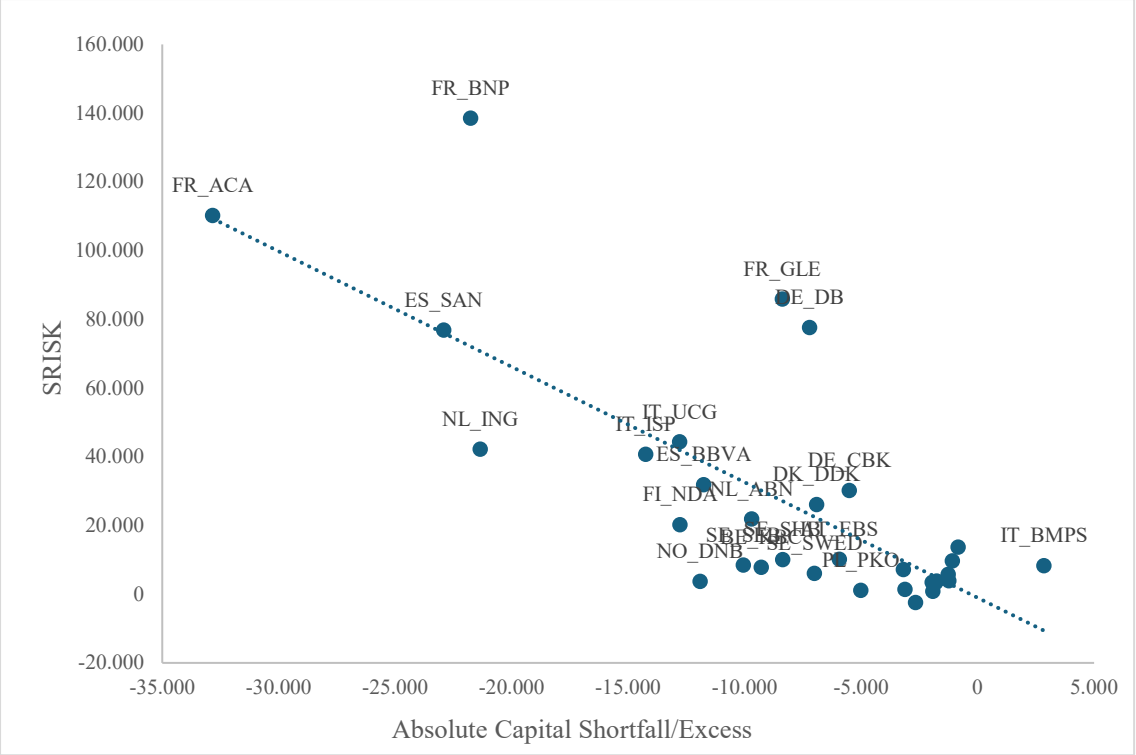
Figure 4 illustrates the relationship between SRISK and EBA's disclosed capital shortfall for the 2021 sample. Consistent with Figure 1, the two measures exhibit a very weak negative correlation. Most banks, except for one, reported zero disclosed capital shortfalls in the official EBA stress test, even those with high SRISK values. The only bank that did report any disclosed capital shortfalls was Banca Monte dei Paschi di Siena S.p.A. (IT_BMPS), but it had a lower SRISK value in comparison (€8,26bn).



These results confirm that the disagreement between the market and regulatory assessment of risks persists even a decade later.

Figure 5: 2021 – EBA "Absolute" Capital Shortfalls vs. SRISK. SRISK under V-lab stress test, data from December 2021 (vertical axis), plotted against the "absolute" capital shortfall estimates from the 2021 EBA stress test (in € millions). Shortfalls are expressed in positive numbers, and excesses in negative numbers.

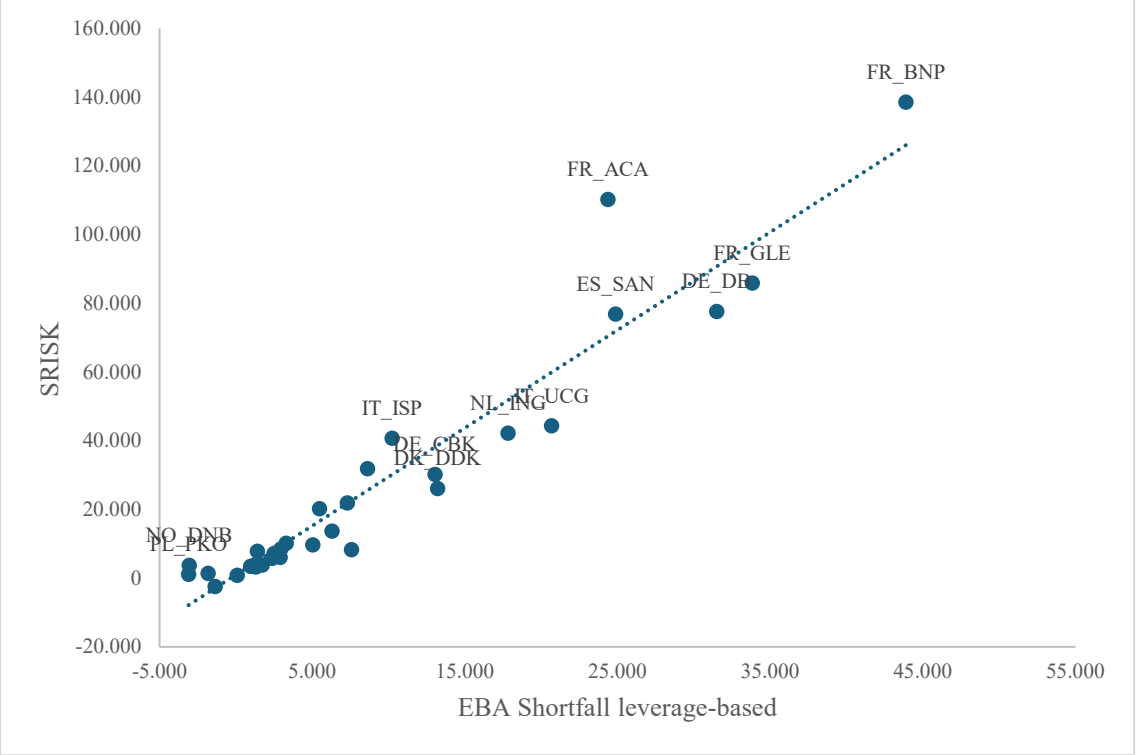
Figure 5 is the replication of Figure 2 in 2021, where the zero-bound constraint of the disclosed capital shortfalls is removed, allowing a better comparison between SRISK and EBA capital requirements.



These results were also consistent with their 2011 counterpart. The relationship between the two remains highly negative and significant (-0,658). As SRISK values increase, the capital excesses also increase, meaning banks that the EBA stress test scenario viewed as "safer" were viewed as riskier according to V-lab market measures. For example, Groupe Crédit Agricole (FR_ACA) had the second largest SRISK value (€ 110 bn) yet also had the largest capital excess (€ 32,8bn) of the banks analyzed. Therefore, Figure 5 illustrates this disconnect between the market-based V-lab measures and regulatory measures even more clearly.

Figure 6: 2021 – EBA "Absolute" leverage-based Shortfall vs. SRISK. SRISK under V-lab stress test, data from December 2021 (vertical axis), plotted against the alternative, leverage-based "absolute" capital shortfall estimates (eq. 7) (in € millions).

Figure 6 uses the alternative leverage-based capital shortfall estimates instead of the risk-weighted assets-based ones reported on the EBA stress test results. It is a comparison to Figure 3 in the 2011 replication.



As in 2011, SRISK continues to show a strong and statistically significant positive correlation with the leverage-based shortfall measure in 2021 (0,966). This supports AEP's (2014) argument that simple leverage ratios are more closely aligned with market-based risk indicators than regulatory risk-weighted measures. Unlike the mismatch observed when using risk-weighted assets (Figure 4), the leverage-based measure yields a clear and consistent relationship between regulatory and market assessments. This suggests that the differences between the two approaches stem from the mechanics of risk-weighting rather than from differences in banks' actual capital positions.

Table 2: 2021 – Realized Volatility regressions. Dependent variable: six-month realized volatility (eq. 3) after the disclosure of the EBA stress test in July 2021. EBA risk weight is a simple ratio of risk-weighted assets to total assets at the end of the stress test scenario. EBA T1LVGR (Tier 1 leverage ratio) is the ratio of Tier 1 capital to total assets for the same period. Statistical significance: * at 5% level and ** at the 1% level. White's heteroskedasticity-consistent standard errors are in parentheses. Sample size: 31.

(a) Direct extension of the 2011 reproduction, including univariate and multivariate models

		1	2	3	4	5	6
	Intercept	1,440**	1,347**	0,845**	0,852**	0,596	0,546
		(0,1)	(0,457)	(0,213)	(0,163)	(0,559)	(0,523)
	Book-To-Market	0,186**	0,184**	0,282**	0,204**	0,280**	0,219**
		(0,05)	(0,052)	(0,049)	(0,049)	(0,048)	(0,067)
V-Lab	V-Lab RW		0,048			0,116	0,117
			(0,232)			(0,218)	(0,205)
EBA	T1LVGR			8,951**		9,304**	2,155
				(3,077)		(3,355)	(5,982)
EBA	EBA RW				1,376**		1,224
					(0,348)		(0,716)
	F-test	13,89**	7,159**	16,61**	16,38**	11,65**	11,11**
	R-squared Adj.	0,361	0,34	0,444	0,511	0,432	0,485

Table 2 reports the OLS estimates from the cross-sectional regression of six-month realized volatility following the July 2021 EBA stress-test disclosure. The dependent variable is realized volatility as defined in Equation (3). The regression includes four independent variables: Book-to-Market, V-Lab Risk Weight, Tier 1 Leverage Ratio (T1LVGR), and the EBA Risk Weight. Unlike the previous figures, the results of this regression for 2021 differ significantly from the 2011 replication and AEP's (2014) original findings. In 2021, Book-to-Market was the most consistent predictor of volatility. It remains the only coefficient to remain both positive and statistically significant at the 1% level across all six specifications (Columns 1–6). This contrasts with the performance for the V-lab Risk Weight, which had previously been positive and significant in all columns in my replication and the original 2014 study. In this sample, it finds no statistical support. Even in the univariate specification (Column 2), the V-Lab measure is statistically insignificant, showing no correlation with realized volatility.

Additionally, in contrast with the original AEP (2014) results, EBA Risk Weights exhibits a significant predictive power, at a 1% confidence level, when tested in isolation. Tier 1 Leverage Ratio, on the other hand, had shown statistical significance in the original study at a 5% level (although not in this paper's replication). In this 2021 extension it stayed positive and significant, however statistical confidence went up to a 1% level. This indicates that

individually, both balance sheet leverage and regulatory risk assessments contained relevant information regarding potential volatility.

Critically, this significance disappears when examining the full multivariate model (Column 6). When all risk measures are included simultaneously, the coefficient for Tier 1 Leverage drops substantially (from 8.951 to 2.155), and the EBA Risk Weight coefficient decreases to 1.224. Neither variable meets the 5% significance level when in combination. Thus, in the final model, only the intercept and Book-to-Market ration statistical significance, suggesting that the explanatory power of leverage and regulatory weights overlaps significantly in the 2021 sample.

To address and understand these possible overlaps between Tier 1 Leverage ratio and EBA risk-weights, I extended the regression to include a couple more models to check for possible overlapping of information.

(b) Robustness checks using pairwise specifications to test for overlapping information

		7	8
	Intercept	0,628	0,797**
		(0,431)	(0,19)
	Book-To-Market	0,199**	0,221**
		(0,049)	(0,066)
V-Lab	V-Lab RW	0,11	
		(0,195)	
EBA	EBA RW	1,405**	1,223
		(0,362)	(0,716)
EBA	T1LVGR		1,806
			(5,767)
	F-test	12,37**	14,32**
	R-squared Adj.	0,5	0,495

In column 5 of Table 2(a), T1LVRG remained statistically significant at a 1% level; therefore, as a comparison I decided to test EBA risk weights against all other variables, excluding T1LVRG. The results in column 7 show that, with the exclusion of T1LVRG, EBA RW maintained a positive and significant coefficient (1,405) at the 1% confidence level.

Lastly, I decided to test another model (column 8), this time including both EBA measures, RW, and T1LVRG, while excluding the V-lab RW. In this case, both lost their statistical significance while maintaining their positive coefficients.

5. Discussion

5.1. Validating the 2011 "Regulatory Disconnect"

The results of the 2011 replication strongly corroborate the findings of Acharya, Engle, and Pierret (2014). Consistent with their original study, this analysis confirms that during the sovereign debt crisis, regulatory RWAs were statistically insignificant predictors of realized stock volatility. On the other hand, the V-Lab Risk Weight was proved to be a robust indicator of distress, while the Tier 1 Leverage Ratio, although still positive, did not achieve statistical significance in my replication.

This discrepancy, as mentioned in section 4, is likely caused by differences in methodology due to data limitations. More specifically, the use of GARCH volatility to derive an approximation of realized volatility instead of actual return data, and the exclusion of key distressed banks, such as ATEbank.

However, despite these minor differences, the results still validate the core critique of the pre-Basel III framework, that RWA-based regulatory capital ratios were effectively separate from the market's reality. By allowing banks to assign zero risk weights to sovereign debt and relying on the assessment of static balance sheet data, the EBA 2011 stress test failed to identify the true accumulation systemic risk in the market, that was otherwise caught by the V-lab risk weight. This shows that this disconnect was a verifiable flaw that left supervisors blind to the growing instability of major European banks.

5.2. The 2021 Evolution: Basel III Reforms

By extending the analysis to 2021 stress test, the results show a critical finding regarding how this disconnect evolved. In the main multivariate model (Table 2, Column 6), when all risk measures are included simultaneously, there is a loss in statistical significance for both Tier 1 Leverage Ratio and EBA Risk Weight. However, the two extra models (Columns 7 and 8), acted as a robustness check, and they confirm that this result comes from redundancy of information, not lack of predictive power. When tested individually (Columns 3 and 4) or in restricted models (Columns 5 and 7), both T1LVGR and EBARW were significant predictors of volatility.

This overlapping of information implies that the changes in Basel III might have caused a conversion between the content of regulatory risk weights and the simple leverage ratio. This can be interpreted as positive outcome, as it suggests the new mandatory Leverage Ratio was effective in limiting the divergences seen in 2011. This aligns with one of the main goals of Basel III, constraining risk-weighted capital measures by introducing the leverage ratio (Basel Committee on Banking Supervision 2017). The regulatory framework enforced a leverage floor that maintained a clear correlation with realized volatility, even when market signals were distorted.

5.3. The Persistence of the Disconnect and the Failure of Market Signals

While the predictive power of regulatory EBA measures has clearly improved, the negative correlation between market (SRISK) and regulatory Capital Shortfalls remains, as shown in Figures 4 and 5, which shows clearly how opposingly they see reality. However, in 2021 this disconnect appears to come from an unreliability of market signals, whereas in 2011 it had been from regulators missing risks.

In 2011, the V-Lab Risk Weight was the superior predictor of volatility, in 2021 this relationship inverted: the V-lab Risk Weight lost their statistical significance, while EBA Risk Weight became significant and T1LVGR remained significant. This suggests the "disconnect" persists because the market view was distorted by pandemic-era interventions, not because regulators are blind.

The V-lab RW calculation, as highlighted in eq. (5), relies heavily on market equity values. The ECB dividend ban mechanically decreased stock prices, introducing noise that didn't necessarily correlate with insolvency risk. Andreeva et al. (2021) suggests that this policy decreased bank values by roughly 7% when compared to non-financial firms. Also, the massive government guarantees pushed the worst-case risks from banks to the state, tying banks and governments more closely together, or deepening the sovereign-bank nexus. Acharya, Drechsler, and Schnabl (2014) note that these bailouts shift credit risk to the sovereign, and ESRB (2021) confirms that these programs covered hundreds of billions of euros. Therefore, the "market view" became less informative than the "regulatory view."

5.4. The SRISK Paradox: Correlation vs. Prediction

Finally, it is necessary to address what appears to be a contradiction between Figure 6 and the regression results. Figure 6 illustrates a high positive correlation (0,966), reported in Appendix E, between SRISK and the "alternative" Leverage-based shortfall, yet the V-Lab Risk Weight fails to predict volatility in the regression (Table 2).

This discrepancy arises from the distinction between size and signal. SRISK is scaled by Total Assets, which means it is size dependent, same as the "alterative" leverage shortfall (eq. 7). V-lab RW, used in the regression, however, normalizes for size in order to isolate the market's assessment of incremental risk. The loss of significance of this signal in 2021 therefore

indicates not a breakdown in systemic risk ranking, but a muting of real-time market pricing under pandemic-era guarantee schemes.

6. Conclusion

The main objective of this thesis was to answer whether the "regulatory disconnect" identified by AEP (2014) regarding European stress tests has continued after the implementation of Basel III. By replicating their methodology for the 2011 EBA stress test and then extending it to the 2021 exercise, this study provides a comparative assessment of how regulatory capital adequacy aligns with market-based risk measures over a decade of reform.

The results of the 2011 replication clearly confirm the original critique: regulatory metrics failed to predict risk, while market measures were more robust. This reaffirms that the pre-Basel III framework was structurally flawed, as it relied on static risk weights that blinded supervisors to systemic risk accumulation.

The extension to 2021 reveals a fundamental inversion of signal quality. The central contribution of this thesis is to show that Basel III reforms successfully improved the predictive power of regulatory metrics, while pandemic-era interventions simultaneously degraded the predictive power of market signals.

While the "regulatory disconnect" has structurally persisted, meaning regulatory and market measures remain negatively correlated and assess risk differently, the implication of this disconnect has fundamentally changed. In 2011, the disconnect existed because regulators ignored risk. By 2021, the new regulatory framework proved robust: both the risk-sensitive EBA Risk Weights and the Tier 1 Leverage Ratio successfully predicted volatility over the six months following the test. On the contrary, market-based measures did not outperform

regulatory metrics. Massive state guarantees and dividend bans effectively neutralized market discipline, introducing significant noise into market pricing and rendering standard metrics like SRISK statistically insignificant.

In summary, over the course of a decade, the core weakness of the banking system shifted: in 2011, the regulators were blind; in 2021, the markets were blinded. This emphasizes the success of the post-crisis reforms in creating a robust regulatory frameworks that outperformed distorted market signals during the unique stress of the pandemic era.

6.1 Directions for Future Research

Future research should examine whether the "regulatory disconnect" resurfaces as the pandemic support measures are fully unwound and market pricing mechanisms normalize. Additionally, as suggested by Messori (2019), future frameworks must expand beyond traditional banking groups to capture systemic risks migrating into the non-bank financial sector.

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Appendix A – 2011 Bank Sample

Bank Code	Bank Name	V-Lab	Book to Market
AT001	Erste Bank Group (EBG)	Yes	1,92
AT002	Raiffeisen Bank International (RBI)	Yes	2,79
AT003	Oesterreichische Volksbank AG/Immigon Portfolioabbau AG	Yes	0,14
BE004	DEXIA	Yes	13,10
BE005	KBC BANK	Yes	2,96
CY006	MARFIN POPULAR BANK PUBLIC CO LTD	Yes	1,35
CY007	BANK OF CYPRUS PUBLIC CO LTD	Yes	4,27
DE017	DEUTSCHE BANK AG	Yes	1,97
DE018	COMMERZBANK AG	Yes	3,22
DE019	Landesbank Baden-Württemberg	-	-
DE020	DZ BANK AG/ DVB Bank	Yes	-
DE021	Bayerische Landesbank	-	-
DE022	Norddeutsche Landesbank -GZ	-	-
DE023	Hypo Real Estate Holding AG München	-	-
DE024	WestLB AG Düsseldorf	-	-
DE025	HSH Nordbank AG Hamburg	-	-
DE027	Landesbank Berlin AG	Yes	-
DE028	DekaBank Deutsche Girozentrale. Frankfurt	-	-
DE029	WGZ BANK AG Westd, Geno, Zentralbk, Ddf	-	-
DK008	DANSKE BANK	Yes	1,86
DK009	Jyske Bank	Yes	1,52
DK010	Sydbank	Yes	1,46
DK011	Nykredit	-	-
ES059	BANCO SANTANDER S.A.	Yes	1,60
ES060	BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BBVA)	Yes	1,25
ES061	BFA-BANKIA	-	-
ES062	CAJA DE AHORROS Y PENSIONES DE BARCELONA	-	-
ES063	EFFIBANK	-	-
ES064	BANCO POPULAR ESPAÑOL, S.A.	Yes	2,71
ES065	BANCO DE SABADELL, S.A.	Yes	1,54
ES066	CAIXA D'ESTALVIS DE CATALUNYA, TARRAGONA I MANRESA	-	-
ES067	CAIXA DE AFORROS DE GALICIA, VIGO, OURENSE E PONTEVEDRA	-	-
ES068	GRUPO BMN	-	-
ES069	BANKINTER, S.A.	Yes	1,17
ES070	CAJA ESPAÑA DE INVERSIONES, SALAMANCA Y SORIA, CAJA DE AHORROS Y MONTE DE PIEDAD	-	-
ES071	GRUPO BANCA CIVICA	-	-
ES072	CAJA DE AHORROS Y M.P. DE ZARAGOZA, ARAGON Y RIOJA	-	-
ES073	MONTE DE PIEDAD Y CAJA DE AHORROS DE RONDA, CADIZ, ALMERIA, MALAGA, ANTEQUERA Y JAEN	-	-
ES074	BANCO PASTOR, S.A.	Yes	1,81
ES075	GRUPO BBK	-	-
ES076	CAIXA D'ESTALVIS UNIO DE CAIXES DE MANLLEU, SABADELL I TERRASSA	-	-
ES077	CAJA DE AHORROS Y M.P. DE GIPUZKOA Y SAN SEBASTIAN	-	-

ES078	GRUPO CAJA3	-	-
ES079	BANCA MARCH, S.A.	-	-
ES080	CAJA DE AHORROS DE VITORIA Y ALAVA	-	-
ES081	CAJA DE AHORROS Y M.P. DE ONTINYENT	-	-
ES082	COLONYA - CAIXA D'ESTALVIS DE POLLENSA	-	-
ES083	CAJA DE AHORROS DEL MEDITERRANEO	-	-
FI012	OP-Pohjola Group	Yes	0,97
FR013	BNP PARIBAS	Yes	2,05
FR014	CREDIT AGRICOLE	Yes	14,43
FR015	BPCE	-	-
FR016	SOCIETE GENERALE	Yes	3,17
GB088	ROYAL BANK OF SCOTLAND GROUP plc/Natwest Group PLC	Yes	3,69
GB089	HSBC HOLDINGS plc	Yes	1,17
GB090	BARCLAYS plc	Yes	16,00
GB091	LLOYDS BANKING GROUP plc	Yes	2,58
GR030	EFG EUROBANK ERGASIAS S.A.	Yes	0,42
GR031	NATIONAL BANK OF GREECE	Yes	4,04
GR032	ALPHA BANK	Yes	0,18
GR033	PIRAEUS BANK GROUP	Yes	9,04
GR034	AGRICULTURAL BANK OF GREECE S.A. (ATEbank)	Yes	-
GR035	TT HELLENIC POSTBANK S.A.	Yes	3,05
HU036	OTP BANK NYRT.	Yes	0,93
IE037	ALLIED IRISH BANKS PLC	-	2,82
IE038	BANK OF IRELAND	Yes	0,14
IE039	IRISH LIFE AND PERMANENT/Permanent TSB	Yes	11,08
IT040	INTESA SANPAOLO S.p.A	Yes	2,22
IT041	UNICREDIT S.p.A	Yes	6,09
IT042	BANCA MONTE DEI PASCHI DI SIENA S.p.A	Yes	-
IT043	BANCO POPOLARE - S.C.	Yes	3,09
IT044	UNIONE DI BANCHE ITALIANE SCPA (UBI BANCA)	Yes	3,23
LU045	BANQUE ET CAISSE D'EPARGNE DE L'ETAT	-	-
MT046	BANK OF VALLETTA (BOV)	Yes	1,96
NL047	ING BANK NV	Yes	2,22
NL048	RABOBANK NEDERLAND	-	-
NL049	ABN AMRO BANK NV	-	-
NL050	SNS BANK NV	-	-
NO051	DnB NOR Bank ASA	Yes	1,02
PL052	POWSZECHNA KASA OSZCZEDNOSCI BANK POLSKI S.A. (PKO BANK POLSKI)	Yes	0,57
PT053	CAIXA GERAL DE DEPÓSITOS, SA	-	-
PT054	BANCO COMERCIAL PORTUGUÊS, SA (BCP OR MILLENNIUM BCP)	Yes	5,07
PT055	ESPÍRITO SANTO FINANCIAL GROUP, SA (ESFG)	Yes	2,72
PT056	Banco BPI, SA	Yes	0,41
SE084	Nordea Bank AB (publ) /Nordet	Yes	1,09
SE085	Skandinaviska Enskilda Banken AB (publ) (SEB)	Yes	1,24
SE086	Svenska Handelsbanken AB (publ)	Yes	0,84
SE087	Swedbank AB (publ)	Yes	0,95
SI057	NOVA LJUBLJANSKA BANKA D.D. (NLB d.d.)	-	-
SI058	NOVA KREDITNA BANKA MARIBOR D.D. (NKBM d.d.)	-	-

Appendix B – 2021 Bank Sample

Bank Code	Bank Name	V-Lab	Book-to-Market
AT_RBI	Raiffeisen Bank International AG	Yes	1,96
AT_EBS	Erste Group Bank AG	Yes	0,93
BE_KBC	KBC Group NV	Yes	0,81
BE_BEL	Belfius Banque SA	-	-
DE_DZ	DZ BANK AG Deutsche Zentral-Genossenschaftsbank	-	-
DE_LBBW	Landesbank Baden-Württemberg	-	-
DE_DB	Deutsche Bank AG	Yes	2,45
DE_CBK	COMMERZBANK Aktiengesellschaft	Yes	3,82
DE_BYLB	Bayerische Landesbank	-	-
DE_HELA	Landesbank Hessen-Thüringen Girozentrale	-	-
DE_VW	Volkswagen Bank	-	-
DK_DDK	Danske Bank	Yes	1,75
DK_JB	Jyske Bank	Yes	1,60
DK_NYK	Nykredit Realkredit	-	-
ES_SAN	Banco Santander S.A.	Yes	1,24
ES_BBVA	Banco Bilbao Vizcaya Argentaria S.A.	Yes	1,28
ES_SAB	Banco de Sabadell S.A.	Yes	4,09
ES_BKT	Bankinter, S.A.	Yes	1,28
FI_OP	OP Osuuskunta	-	-
FI_NDA	Nordea Bank Abp	Yes	0,94
FR_BNP	BNP Paribas	Yes	1,76
FR_ACA	Groupe Crédit Agricole	Yes	1,58
FR_SOC	Société générale S.A.	Yes	3,55
FR_CM	Confédération Nationale du Crédit Mutuel	-	-
FR_BPCE	Groupe BPCE	-	-
FR_HSBC	HSBC Continental Europe	-	-
FR_LBP	La Banque Postale	-	-
HU_OTP	OTP Bank Nyrt.	Yes	0,60
IE_BIRG	Bank of Ireland Group plc	Yes	1,90
IE_AIBG	AIB Group plc	Yes	2,10
IT_UNI	UniCredit S.p.A.	Yes	2,05
IT_BMPS	Banca Monte dei Paschi di Siena S.p.A.	Yes	5,26
IT_ISP	Intesa Sanpaolo S.p.A.	Yes	1,46
IT_BPM	Banco BPM S.p.A.	Yes	3,14
IT_MED	Mediobanca - Banca di Credito Finanziario S.p.A.	Yes	0,55
NL_ABN	ABN AMRO Bank N.V.	Yes	2,04
NL_BNG	BNG Bank N.V.	-	-
NL_NWB	Nederlandse Waterschapsbank N.V.	-	-
NL_ING	ING Groep N.V.	Yes	1,29
NL_RABO	Coöperatieve Rabobank U.A.	-	-
NO_DNB	DNB Bank Group	Yes	0,79
PL_PKO	Powszechna Kasa Oszczednosci Bank Polski SA	Yes	0,96
PL_PEKAO	Bank Polska Kasa Opieki SA	Yes	1,05
PT_BCP	Banco Comercial Português, SA	Yes	3,08

PT_CGD	Caixa Geral de Depósitos, SA	-	-
SE_SEB	Skandinaviska Enskilda Banken — group	Yes	0,77
SE_SWED	Swedbank — group	Yes	0,89
SE_SHB	Svenska Handelsbanken — group	Yes	0,85
SE_SBAB	SBAB Bank AB – group	-	-
SE_LF	Länförsäkringar Bank AB (publ)	-	-

Appendix C

2021 Disclosed Capital Shortfall/Excess Rank Correlations with V-Lab SRISK	
Coefficient	*-0,0486*
N	32
T-stat	0,26668
DF:	30
p-value	0,79

Appendix D

2021 Absolute Capital Shortfall/Excess Rank Correlations with V-Lab SRISK	
Coefficient	-0,657624633
N	32
T-stat	4,781281888
DF:	30
p-value	0,00

Appendix E

2021 Absolute leverage-based Capital Shortfall/Excess Rank Correlations with V-Lab SRISK	
Coefficient	0,96664223
N	32
T-stat	20,6711766
DF:	30
p-value	0,00