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Sovereign credit – A major determinant of bank credibility?

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Abstract

The following study attempts to investigate and highlight the effects changes within sovereign credit default swap (CDS) spreads have upon changes within CDS spreads on banks located within the sovereign. A sample of 47 banks situated over 11 countries has been used for the purpose of this paper, studying the effects following the global financial crisis from 2008-2023. This investigation provides an overview of the sovereign-bank relationship following the aftermath of major regulatory and macroeconomic changes with regards to sovereign and bank risk-taking. Using random effects panel regressions within GLS models, the ensuing results indicate the importance of sovereign credibility upon the credibility of its banking sector.

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Introduction

If the impact on investor expectations following the Credit Suisse collapse have anything to say regarding global financial markets, it is that the role of a bank is absolutely pivotal to the heart-line of a healthy economy.

Financial institutions, especially banks, play a major role in the functioning of modern day financial and economic systems. They play a key role in money transmission mechanisms and act as important financial intermediaries for the efficient functioning of financial markets (ECB, 2023). Therefore, it is clear that they are important for modern day economic systems in the increasingly globalized world we live in today.

However, the importance of banks in modern day society can also be a double-edged sword. As we have seen in several occasions in the past, such as in the global financial crisis of 2008 or more recently, the banking sector crisis in early 2023 (Barth, 2015), banks can sometimes be regarded as 'too big to fail'. This scenario can occur when banks big enough to systemically affect preexisting economic structures fail, and the fallout from the collapse of such a bank would prove to be catastrophic for the economy. In these scenarios, governments or other state-run institutions can be forced to 'bail out' such failing banks at heavy cost to taxpayers in order to keep failing banks afloat, to ensure the integrity of domestic financial systems (Frattiani, 2011).

Therefore, there are clear incentives for governments and economists to ensure the efficient and reliable functioning of their respective domestic banking system. As highlighted by the example of the 2008 crisis, a key reason for the severity of the crisis were the financial risks and mismanagement of sub-prime mortgage derivatives by major banks (Karamitrou, 2014). To avoid having to pay such taxpayer funded bailouts for problems largely created by the banks themselves, several regulatory frameworks such as the Basel III framework were created as regulatory tools to ensure a minimum level of liquidity and solvency within the banking sector (BIS, 2017).

Such measures to ensure the safety and credibility of the banking sector are imperative. However, even with these measures in place, the 2023 banking crisis highlighted that even with regulation in place, banks are prone to collapse within certain scenarios (Bloomberg, 2023). Therefore, it is imperative to understand the reasons behind bank collapses, and what factors come into play when analyzing the credibility of a bank and its ability to pay off its obligations.

These banks are subject to regulations by their respective governments and monetary institutions, and often have their policies and freedom of credit closely tied to bureaucratic decisions. This can be seen in the Eurozone following 2009, where a worsening in sovereign credibility, especially in the ensuing Eurozone debt crisis, was coupled with higher bank funding costs for Eurozone banks within overlapping periods (Zhorayev, 2020). One possible explanation for such an event occurring would be the effects of the debt crisis faced by the European sovereigns 'trickling down' to their domestic banks in the form of higher funding costs due to the worsened ability of sovereigns in a fiscally weaker state to help the financial system in times of economic crisis.
Therefore, there is a distinct possibility that the credibility of domestic banks can be dependent on the credibility of the sovereign that the bank is situated in.

Therefore, it is possible that a decrease in the credibility of a sovereign may also be correlated to a decrease in the credibility and funding conditions of the domestic banks situated within the sovereigns. The dependency of banks on the credibility of their sovereigns was highlighted in the paper by Stanga (2011). Following this, it is important to understand the relationship banks share in their creditworthiness relative to the sovereigns they are situated in, leading to the question being asked "To what extent do perception of sovereign credit risks affect credit risks of banks situated within those sovereigns?"

Therefore, this paper will directly study the effects sovereign risk credibility has on the risk credibility of banks situated within those sovereigns. This will be done by collecting panel data of CDS spreads from several major banks situated within multiple European countries, and comparing them with panel data obtained from the CDS spreads of the sovereigns within which the banks will be situated in. This will be done via regression analyses further

elaborated within the methodology section of this paper, with the aim being to obtain further knowledge on these effects, alongside whether the magnitude of these effects change over the analyzed time period of 2008-2023. The general structure of the paper will be the deposition of the data used, the methodology within which the data will be transformed and analyzed, the interpretations of the results of the analysis, and a discussion regarding the practical considerations which may be created due to the results of this paper.

This paper therefore attempts to test these scenarios. If a significant effect is indeed found, it can lead to a variety of policymaking implications. These implications can be a better understanding within the risk-reward structures of sovereign debt financing towards fiscal policies, within which there may be larger incentives for policymakers to adopt more conservative fiscal policies. This can especially be the case within sovereigns possessing banking sectors with a larger influence on the macroeconomic conditions of the economy as a whole. Furthermore, it may also create major implications for policymakers within a monetary perspective. Sharp interest rate hikes, such as those seen by the ECB and the US Federal Reserve over 2022 and 2023 (ECB, 2023) to combat inflationary pressures may need to be tweaked in future periods of crises. This is as a part of the banking crisis initiated by the collapse of several regional banks within the USA in early 2023 can be attributed to sharp interest rate hikes during a liquidity crisis faced by banks (Ngo, 2023). This liquidity crisis forced banks to liquidate low-yield government bonds purchased during periods of low interest rates, causing banks to realize major losses on their bond portfolios. This liquidity crisis, in turn, forced a solvency crisis due to a loss in investor confidence due to the major losses realized by banks, causing a collapse within banks such as Silicon Valley Bank and First Republic Bank (Ngraham, 2023). The level of lost investor confidence due to the fiscal reliability of the sovereign the banks were located in, relative to the independent Asset and Liability structures of banks may be better understood by isolating the average effects of sovereign credibility on the banks themselves.

This can therefore have several regulatory implications, by being able to understand the effects macroeconomic conditions played on the banking crisis from a fiscal perspective, rather than a purely monetary perspective.

The results of this paper highlight a significant and positive relationship between changes in sovereign CDS spreads to changes within the CDS spreads of banks located within the sovereign. Furthermore, the paper also highlights a significant and negative relationship between changes in the international reserve pool of a sovereign affecting changes within CDS spreads of banks.

These results create several key implications with regards to both fiscal and monetary policymakers. Sovereigns may need to be more conservative with regards to their fiscal prudency and deficit financing measures, due to the negative implications this may have on the banking sector. Furthermore, monetary policymakers may need to take the results of this paper into consideration when determining interest rates and foreign currency reserves, with the effects of such measures being amplified within sovereigns with more influential and integrated financial systems. The implications of these effects will also be expanded upon further within the paper.

Hypothesis development

The majority of pre-existing, pre-eminent studies which will be further discussed within the literature review on sovereign credit risks highlight the several significant implications which can be caused by changes within the credit risk profiles of sovereigns. These studies also study the effects changes within credit risks have on bank profitability, alongside the effects of changes in bank credit risks upon bank profitability.

Therefore, it is also imperative to study the direct effects changes in sovereign credit risks have on bank credibility. The aforementioned literature highlights how positive changes in sovereign credibility also positively affect the banking system's ability to generate profits. Furthermore, studies have also mentioned how positive changes in the banking system's credibility, similar to sovereign credibility, positively affect the banking system's ability to generate profits. By intuitively assuming a certain level of transitivity within the transmission of these factors, it is plausible that changes in bank credit risks may be positively related to the changes in credit risks of the sovereign they are situated within.

As such, we can develop our hypothesis as followed –

H1a: Sovereign credit risks are positively correlated with changes in commercial bank credit risks

H1b: Sovereign credit risks are not correlated with changes in commercial bank credit risks

Theoretical framework

Literature review

The Eurozone sovereign debt crisis following 2009 led to several major reductions in sovereign credit ratings to most member states of the Eurozone and the European Union (Zhorayev, 2020). The authors of CGFS (2011) mention how deteriorations in sovereign credit risks adversely affect bank funding conditions. It also further mentions how banks cannot be fully insulated from sovereign risks, and is unlikely to be a scenario which can be realistic over a sustained period of time. Therefore, it makes the hypothesis regarding the effects sovereign credit risks have on bank risks more plausible. This is as, intuitively, adverse bank funding conditions can be one of the symptoms of a worsening credit risk for banks.

Stanga (2011) further discusses the impact which government measures have on sovereign credit risks alongside bank risks. It mentions how the creation of government-funded bailout packages to rescue distressed banks during periods of crisis led to temporary decreases within the perceived bank credit risks. However, the paper further discussed that it came at the cost of increased sovereign credit default risks. During these periods of crisis and ensuing bailout packages, sovereigns undertake large fiscal risks in order to preserve the stability of their domestic economic and financial system. These costs are often not budgeted for, especially during black swan events. Therefore, a major spike in deficit spending from sovereigns leads to a negative perception of its fiscal credibility, due to increased budget deficits. However, this temporary effect on bank credit risks cannot be sustained. A possibility for this effect only lasting in the short term may be due to the decrease in the risk ratings of the sovereign, and therefore may be an interesting topic for

policymakers to investigate further. This is if indeed bank credibility is inextricably tied to sovereign credibility, the financial engineering of future bailout packages may be different if there is an expectation for the ensuing decrease in sovereign credibility also affecting the long term risk credibility of the banking sector as well.

Furthermore, the paper by Saleh and Afifa (2020) studies the effects of bank credit risks on bank profitability metrics. This paper studies the effects emerging markets as the banks being analyzed. The paper mentions that there is a significant effect which changes within bank credit risks have, on the ability of banks to generate profits. This, therefore creates major further implications for the health of the banking sector when there are variations, and especially downgrades, in the perceived credibility of banks. Therefore, it is important to analyze and study in detail about the possible factors which may affect the credit risks faced by banks.

However, on the flip side, the paper published by Juntilla and Nguyen (2022) highlights the effects which changes in sovereign credit ratings create on bank profitability metrics. This study, unlike the aforementioned study above, looks at the impact on bank profitability from a more macroeconomic view. The results of the study highlight the negative effects of sovereign credit risk downgrades on the ability for banks within the respective sovereigns to generate profits. This study primarily focuses on the Euro area for its sample size due to the homogeneity in several relevant macroeconomic factors over multiple sovereigns, due to the financial and economic integration within sovereigns over the Euro area. Therefore, this study can be used as a reference for the current paper due to its geographical similarities with the sample size being derived from the Euro area. In conjunction with the papers by CGFS (2011) and Saleh and Afifa (2020) discussed above, it can plausibly create a causal chain where declining sovereign credit risk profiles can negatively affect the credit risk profiles of banks, thereby affecting banks' funding conditions and profitability. This can plausibly be the case if the aforementioned hypothesis can be proven with significance.

However, a key point of consideration to note is that most of the aforementioned literature, alongside literature discussed further in this paper primarily focus on the 21st century as a time period. Within the 21st century, there is a specific onus on the economic recession

following the 2008 financial crisis, such as the eurozone debt crisis and the studies on bank bailouts. However, due to the contemporary nature of the banking crisis in 2023, there is a lack of multiple quality literary pieces analyzing the effects and the causes of the crisis due to the recency of the event. Therefore, the implications of such a crisis may affect the results of future studies conducted within the field of credit risks. This is as the recent banking crisis may create a systemic change in the effectiveness and correlation within several of the discussed variables in this paper.

Empirical review

The paper by Naili and Lahrichi (2021) highlights several key variables involved as significant factors in determining changes in bank credit risks. The paper posits GDP growth, unemployment, bank capitalization, bank profitability, bank operating inefficiency, inflation, bank ownership concentration, sovereign debt and bank size as the main determinants of an increase in Non-performing loans (NPL's) within banks. The paper also concludes an insignificant impact of loan growth, bank diversification and interbank competition on the NPL ratios of banks. However, the primary focus of this study was upon emerging markets in the Middle Eastern and North African (MENA) countries. However, the macroeconomic, monetary and socioeconomic systems within these countries are vastly different due to the diversity in economic and political structures in place within those countries. Therefore, a study over multiple different sovereigns following relatively homogenous monetary systems may allow for easier isolation of fiscal effects upon the banking sector.

Furthermore, the article by the ECB (2020) highlights how the dependency of banks towards sovereign credit (stated as the sovereign-bank nexus) increases following a period of financial distress. This is because economic shocks such as the Covid-19 pandemic create a large influx of sovereign spending and therefore sovereign debt, alongside simultaneously increase the exposures between governments and their banking systems. The article further states that elevated periods of increased sovereign debt may lead to increases in sovereign-bank linkages. Therefore, the effect with which sovereign credit risks affect bank credit risks may also increase following crisis periods such as the Eurozone debt crisis and the Covid-19 pandemic, and may be reflected in regression models with isolated time effects.

Over the 21st century, there have been multiple periods of crisis faced by banks, due to a variety of systemic and idiosyncratic issues. Periods such as the global financial crisis of 2008, the ensuing eurozone debt crisis of 2012, the emergence of the Covid-19 pandemic, alongside the 2023 banking crisis have tested the resilience of banks both in Europe and worldwide. By testing the aforementioned hypothesis, an explanation for such increases in bank risk profiles may be provided, if a significant correlation between sovereign and bank risks is found.

Data

The data sample used in this paper includes 11 countries in the European Union, featuring 47 total banks domestically based in 9 countries situated within the Euro area, alongside Denmark and Sweden as part of the overall analysis. Denmark and Sweden have been considered to be extremely similar from a monetary policy basis relative to the other 9 Eurozone countries, due to them also being part of the EU, EEA, and having a currency directly pegged to the euro, and therefore directly dependent on the monetary policies within Eurozone countries. The reason why strictly Eurozone countries have been selected is a) In order to isolate the effects faced within the Eurozone countries specifically, due to one of the key rationales for the study being the Eurozone debt crisis, and b) The common monetary and customs policy faced within Eurozone countries due to the common currency and customs unions they are part of, allowing an easier isolation of sovereign-specific effects due to the overlapping monetary policies within the sovereign.

Furthermore, the extensive and reliable availability of data from sources referring to Eurozone sovereigns, alongside the countries included containing developed banking sectors can likely lead to more a more reliable data analysis, due to a study of banks located domestically within these sovereigns also likely being more pertinent to the functioning of financial systems as a whole. The 11 countries included within the sample account for a major portion of the GDP of the Euro area due to major economies such as Germany and France being included within the sample set.

The sample was followed up with over 15 years of data, from the final month of 2007 when sovereign credit ratings had recently began to worsen as the world was preparing for its inevitable economic meltdown, until the May of 2023 when there was a banking crisis being faced due to sharp hikes in interest rates throughout developed economies. This sample was taken as the 15 year time period takes into account all possible major economic factors which have affected banks and sovereigns, such as the global recession of 2008, 'black swan' events such as the advent of the COVID-19 crisis, the European sovereign debt crisis, alongside a sustained market bull run and economic growth in the mid-late 2010's. These events therefore account for several major and possibly unexpected economic shocks which may arise in the future whilst still being relevant within modern day connotations, and therefore may lead to a more accurate description of the correlations faced by the variables involved in the real world over a sustained period of time. This large sample selection with regards to both time and country/bank samples will therefore lead to an increase in the likelihood of achieving significant and clear conclusions to the analysis.

The key independent variable used for the purpose of this analysis is the Sovereign CDS mid-spread for 5 year unsecured debt in euros. This has been used as the primary metric for measuring sovereign creditworthiness due to the inherent nature of the pricing of CDS spreads reflecting the probability of credit defaults being faced by a sovereign. This metric has also been used by Heinz and Sun (2014) as a primary metric to measure sovereign creditworthiness.

The key dependent variable in place for the analysis is taken as the Commercial bank CDS mid-spread for 5 year unsecured debt in euros, for similar reasons as to why CDS spreads were chosen as they key credit-measuring metric for sovereigns. Since these are the two primary variables in question, within which the rate of changes of the bank CDS variables are in question, the Bank and Sovereign CDS variables are converted into ln form.

This data transformation was conducted to ensure stationarity of data. As highlighted in the paper by Galil et al (2013), CDS levels tend not to be stationary, whereas data regarding changes in CDS spreads is stationary.

Table 1

List of banks used

Austria	ERSTE GROUP	RAIFFEISEN INTL							
Belgium	BNPP FORTIS	KBC BANK							
Denmark	DANSKE BK								
Germany	HAMBURG COMM BNK	DZ BANK	UNICREDIT BNK	HELABA	BAYERNLB	COMMERZ BANK	DEUTSCHE BANK	LBBW	IKB
Spain	BANCO SABADELL	BANCO SANTANDER	BBVA	BANKINTER	CAJA MEDITERRANE				
France	BANQ FED CREDIT	SOCIETE GENERALE	CA CIB	DEXIA CR LOCAL	CREDIT LYON	CREDIT AGRICOLE	NATIXIS	BNP	BPCE
Ireland	BANK OF IRELAND	PERMANENT TSB							
Italy	BANCO BPM	MONTE DEI PASCHI	INTESA SANPAOLO	UNI CREDIT	BANCA NAZ LAVORO	MEDIOBANCA			
Netherlands	RABOBANK	ING BANK NL	NIBC BANK	ING GROEP	ABN AMRO BANK NV				
Portugal	BANCO COM PORT	BANCO BPI	CAIXA GERAL DEP						
Sweden	SWEDBANK AB	SKAND ENSK BANK	SVENSKA HNDLSBNK						

Furthermore, several control variables were taken into consideration for the purpose of this study. After looking at studies from Fiordelisi et al. (2009) and Panetta (2011), the controls to be considered for regressions for which data was gathered was as follows – 1) GDP per capita growth, 2) CPI, 3) International reserves, and 4)The Gini coefficient of the country. The assumption behind the selection of these controls is that such macroeconomic controls can provide a more comprehensive overview of the factors which affect changes in bank CDS spreads, as the 4 macroeconomic factors in concern can be distinguishably different within Eurozone sovereigns notwithstanding their similar monetary and trade policies.

The macroeconomic control variable most predominantly used within the literature and papers suggested previously has been that of the GDP (Gross domestic product) growth rate per country. This indicator is used in order to take into account the effects which may be created due to business cycle shifts alongside other possible macroeconomic events which may occur in the country such as an economic boom or bust. As it is fundamentally a metric of total domestic consumption, it serves as a useful broad indicator towards the economic prospects the domestic economy in question may have, and whether the growth within a

country's GDP affects how a bank's creditworthiness is determined. This can be seen within the suggestions by Khan et al. (2017), Fiordelisi et al. (2009), and Naceur and Kandil (2009), how increases in GDP are symptoms of increased income and consumption patterns within the economy, implying a likely increase in spending, lending and borrowing, and therefore an expansion of the overall financial system. This, therefore creates the assumption that a higher GDP growth rate is likely also related to a more credible banking system. The data regarding GDP growth rates per sovereign was taken as a yearly variable via Refinitv Eikon in datastream.

Furthermore, another key exogenous macroeconomic variable in use is that of the domestic economy's CPI (Consumer Price Index), otherwise known as inflation. As indicated in the papers by the ECB (2022) and the IMF (2023), inflation may allow for a significant change in a bank's funding conditions, therefore inevitably leading to a change in its performance and financial credibility. This is also further dependent on whether other expense factors such as labor and operational costs increase in magnitude faster or slower than the nominal inflation rate. Due to the sample selection in place of 11 Eurozone countries all following the same currency, it is possible that the spread of inflation per country is more homogenous than if the sample was taken at a global level. The data regarding the CPI per sovereign was taken as a monthly variable via Refinitv Eikon in datastream.
Variables such as the Debt-to-GDP ratio, as used in papers by Augustin et al. (2022) to determine its effects on banks were excluded from the sample due to the intuitive assumption that it will likely be heavily correlated to the sovereign CDS spreads, and therefore may prove to be an unreliable control variable.

Furthermore, the Gini coefficients of the sovereigns were also taken into consideration. The Gini coefficients are indicative of a broad measure of income equality within a sovereign, with the intuition behind the usage of such a metric being that higher levels of income inequality may lead to an aggregate worsening of the banking sector, as suggested in the paper by Akisik (2022). As this variable is independent from directly facing monetary policy implications, the rationale behind its utilization is that it may prove to be a sovereign-specific differentiator within the Euro area which contains homogenous monetary policies.

The data regarding the GINI coefficient per sovereign was taken as a yearly variable via Refinitv Eikon in datastream.

The final control variable in use was that of the percentage change in international reserves by a sovereign. The paper by Rathi et al. (2021) investigated the importance of gold reserves on its impact on sovereign credit risks, and underlined the increased effects on credit risks generated by gold reserves during periods of high economic volatility and uncertainty. Therefore, it is plausible that comparing changes in international financial reserves rather than the aggregate amount may provide further context towards factors affecting bank credit risks, and prove to be a control variable to account for some of the effects which may otherwise be highlighted via changes in sovereign reserves. The data regarding the change in reserves per sovereign was taken as a monthly variable via Refinitv Eikon in datastream.

Table 2

Definition of the variables employed in the study

	Measurement	*Description*
Independent variables		
Sovereign CDS spreads	Ln of Sovereign CDS spreads (daily)	Sovrcds
International Reserves	% change in international reserves (monthly)	Reserves
GDP growth rate	% increase in GDP from previous year (yearly)	Gdpchange
Inflation	YoY % change in consumer price index (monthly)	Cpi
Gini coefficient	Gini coefficient (Yearly)	Gini
Dependent variables		
Bank CDS spreads	Ln of change of bank CDS spreads	Bcds

Table 2 above highlights the variables in use for the research. The calculation of the key dependent variable for Bank CDS spreads (Bcds) required several steps following the retrieving of the data. The CDS spreads of the 47 banks mentioned within the data section were retrieved. The banks were then split to each of the 11 respective countries the banks

originate from. Due to different countries in the sample containing a different number of banks listed, the CDS spreads of each bank were converted into its derivative, with the daily change in CDS spreads being created into a new variable. Following this, the average daily change in CDS spreads for all relevant banks in each country were calculated and transformed. Subsequently, these numbers were aligned with their respective sovereigns, in order to accurately fit the data into a panel regression model.

In order to construct the database in a manner which provided maximum reliability and quality for the comparison of each data source, all of the data from the relevant variables was taken from the Refinitiv Eikon database. This was done in order to ensure consistency of data within the dataset.

Methodology

Empirical model construction

Due to the data sample containing several banks situated within several different sovereigns over a period of 15 years, this study uses a panel data analysis as a base for the construction of the methodology. Several aforementioned literary pieces within the empirical review highlighted the use case of linear regression models as the optimal application for studies relevant to this paper. Therefore, the model used in this paper would ideally also be following down the same route.

However, there must be several diagnostic tests conducted prior to running the model in order to ensure an applicable construction of the model in use. The tests which will be conducted will be determined by attempting to follow the 5 key assumptions which would be required for a successful OLS regression to be run. Following which, under the assumption that the tests are successful, allows the creation of a model with definitive results.

The five key assumptions to be tested are highlighted below –

1) Homoskedasticity
2) Zero Mean errors
3) Independence between the explanatory variables and the error
4) Autocorrelation
5) Normality assumption

The normality assumption is not required to hold due to the large sample size of the database. Furthermore, the homoskedasticity and zero mean error assumptions are not necessarily mandated, if the regression models are inclusive of robust standard errors. However, the other two assumptions will be required to hold for the regression model to contain the OLS estimator as the most consistent and efficient (Brooks, 2019).

Table 3 below underlines a mean VIF value of 1.03 following the running of a multicollinearity test, indicating minimal correlation between the relevant variables used within the regression model.

Table 3
Multicollinearity test

Variable	*VIF*	*1/VIF*
Sovrcds	*1.04*	*0.962013*
Cpi	*1.04*	*0.963245*
Reserves	*1.01*	*0.994053*
Mean VIF	*1.03*	

Furthermore, appendix 2 highlights a significant F value when testing for serial autocorrelation, implying a lack of first-order autocorrelation between they key independent and dependent variables.

The key dependent variable is created as a transformation of a bank specific variable, and the independent variables are pertinent to country specific values due to the macroeconomic nature of the variables. Due to the variable selection, it is unlikely that there will be any significant level of reverse causality which will be highlighted in the regression models. Therefore, the explanatory variables in question will be

contemporaneous. This leads to the assumption that there will not be a requirement to create time lags for any of the variables in place within the scope of the regression model.

The format of the first rudimentary regression model is therefore as follows:-

$$BCDS_{it} = \alpha + \beta_1 SCDS_{it} + \beta_2 CPI_{it} + \beta_3 IR_{it} + \beta_4 GINI_{it} + \beta_5 GDP_{it} + \mu_{it}$$

Where t refers to the time period and i refers to the sovereign in question during the regression.

Following the effects realized by the rudimentary regression model, a series of time-invariant effects on a yearly level will also be added.

These effects can be added within the form of fixed-effects panel regressions or random effect panel regressions. These regression models come with their own series of assumptions required in order to be able to enforce the model appropriately.

If there is an assumption of individual heterogeneity between the sovereigns in the sample size, there may be a bias created within the independent or dependent variables. Within this scenario, a fixed effects model will be applied to control for the aforementioned bias. In this way, there can be a removal of the effects of time-invariant characteristics.

In contrast to the fixed effects model, the application of random effects model does not take into account this assumption. Instead, the assumption made is that of variation between sovereigns is random and not correlated with the independent variable.

Within this scenario, fixed effects models are intuitively less appropriate. This is because the assumption of each sovereign – and therefore their error and constant terms - being uncorrelated with others may not hold. This is due to the sample selection of the sovereigns themselves, as they are all situated within the Euro area within a highly integrated monetary market. This enforces a rationale to prefer the application of a random effects model to being more suitable for the purpose of the ensuing regression models.

Therefore, in order to determine whether fixed effects or random effects will be utilized in the model creation, a Hausman test was conducted prior to the running of the regression model.

Table 4 below highlights the results of the ensuing Hausman test. With an insignificant chi2 value, alongside the intuitive rationale provided above, the regression models will be conducted via random-effects GLS regressions.

Table 4
Hausman test

	Coefficients			
	(b) Fixed effects	(B) Random effects	(b-B) Difference	Std. err.
Sovrcds	0.2475747	1.456882	1.30244	
Cpi	-1.14531	0.506698	-1.65201	1.487298
Reserves	0.0018597	0.037113	-0.03525	0.0437835
Gdpchange	0.1896219	-0.0134	0.203025	0.1711594
Gini	0.7736134	0.027033	0.746581	0.9009647
year				
2010	-3.539212	-3.08331	-0.45591	1.79065
2011	0.053599	-3.25394	3.307538	1.759311
2012	0.9578888	-3.50317	2.545285	2.248858
2014	-4.318247	-3.34063	-0.97762	1.85618
2015	-3.236165	-2.32939	-0.90678	2.634371
2016	-4.935664	-5.04477	0.109109	2.275742
2017	-6.620033	-9.11345	2.49342	1.065914
2018	-3.420905	-5.01392	1.593011	1.770585
2019	-3.327425	-3.91464	0.587214	1.673471
2020	1.794606	-1.21558	3.010187	2.958881
2021	0.4081071	-4.08469	4.492801	2.517433

b = Consistent under H0 and Ha; obtained from xtreg.
B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(16) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 13.28
Prob > chi2 = 0.6522

Following the Hausman test, it is clear that a random-effects model will be required for the ensuing regression models within the paper.

Finally, the reasoning behind the key regression models being pertinent to a singular dependent variable is due to multiple studies such as by Zulfikar (2018) suggesting panel data regressions containing pooled regression estimates.

The intended regression model including the time-invariant yearly effects will be as follows:-

$$BCDS_{it} = \alpha_i + \beta_1 SCDS_{it} + \beta_2 CPI_{it} + \beta_3 IR_{it} + \beta_4 GINI_{it} + \beta_5 GDP_{it} + \delta_1 Y_{2007} + \delta_2 Y_{2008} + \cdots + \delta_{17} Y_{2023} + \mu_{it}$$

Where -

α_i represents the random individual-specific effect

$BCDS_{it}$ represents the dependent variable for bank cds spreads in country i at time t

$SCDS_{it}$ represents the key independent variable for sovereign cds spreads in country i at time t

μ_{it} represents the error term within sovereign i at time t

Empirical Results

Table 5
Descriptive statistics model

Variable	Obs	Mean	Std. dev.	Min	Max
Bcds	17,757	-5.12536	2.155464	-19.5738	7.511794
Sovrcds	42,549	3.7884	1.065338	1.902107	7.378371
Cpi	2,057	1.964049	2.390565	-6.60097	14.36662
Reserves	2,054	9.141876	19.94669	-44.2013	225.3842
Gdpchange	176	1.005408	3.735607	-11.7576	23.20087
Gini	153	31.19412	2.978481	25.2	36.8

The descriptive statistics model is presented within table 6 above.

Therefore, the assumption within the panel dataset is that the variation across time/sovereigns is assumed to be random and uncorrelated with the independent variable. This is unlike the fixed effects model, where we would assume individual heterogeneity within entities.

The ensuing normality and heteroskedasticity tests were therefore not conducted due to the key regression model being performed as a random-effects GLS model. Furthermore, the correlation matrix of the variables in use is also shown within Appendix 1. The correlation between all the variables is not seen as particularly high.

Table 6

Random effects regression results for Bank CDS spreads (Bcds) as the dependent variable. The regression includes yearly random effects

VARIABLES	(1) Model 1
Sovrcds	0.248
	(0.955)
CPI	0.507
	(1.217)
Reserves	0.037
	(0.051)
Gdpchange	-0.013
	(0.115)
Gini	0.027
	(0.284)
year	
2010	-3.083*
	(1.791)
2011	-3.254
	(2.221)
2012	-3.503
	(2.284)
2014	-3.341*
	(1.944)
2015	-2.329
	(2.396)
2016	-5.045
	(4.103)
2017	-9.113***
	(2.191)
2018	-5.014**
	(2.177)
2019	-3.915
	(3.360)
2020	-1.216
	(2.151)
2021	-4.085*
	(2.432)
Constant	-5.468
	(6.175)
Observations	43
Number of sovereign	11
R2	0.556
Sigma_e	2.4060279

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As highlighted by the table, the insignificance of the coefficients of all the independent variables creates an issue regarding the reliability of the interpretation of the coefficients. After further investigation into the reasoning behind such an issue, it was clear that the variables gdpchange and gini being presented as yearly variables in the dataset was a major issue within the scope of the regression, due to the limited number of data points being provided within the regression model. Due to the nature of the variables, it was deemed untenable to dis-aggregate the variables into a monthly form, due to the lack of normality within the distribution patterns of the variables. Another cause may simply be that the variables are not capable of establishing any significant relationship towards the movement of bank cds spreads. Therefore, it is deemed as one of the limitations of the research methodology, which can be further investigated within future papers to understand the relationship.

Following the initial unsuccessful regression model, a new random-effects panel regression model was created, with the exclusion of the two yearly control variables.

Table 7

Random effects regression results for Bank CDS spreads (Bcds) as the dependent variable. The regression includes yearly random effects

VARIABLES	(1) Model 1	(2) Model 2
Sovrcds	0.248	0.444***
	(0.955)	(0.093)
CPI	0.507	0.078
	(1.217)	(0.067)
Reserves	0.037	-0.010***
	(0.051)	(0.003)
2009		-0.496
		(0.487)
2010	-3.083*	-0.980**
	(1.791)	(0.419)
2011	-3.254	-1.813***
	(2.221)	(0.360)
2012	-3.503	-2.173***
	(2.284)	(0.526)
2013		-1.610***
		(0.334)
2014	-3.341*	-2.061***
	(1.944)	(0.587)
2015	-2.329	-2.218***
	(2.396)	(0.543)
2016	-5.045	-1.955***
	(4.103)	(0.454)
2017	-9.113***	-2.683***
	(2.191)	(0.373)
2018	-5.014**	-1.648***
	(2.177)	(0.398)
2019	-3.915	-2.411***
	(3.360)	(0.611)
2020	-1.216	-1.667***
	(2.151)	(0.608)
2021	-4.085*	-2.367***
	(2.432)	(0.502)
2022		-2.493***
		(0.570)
2023		-3.145***
		(0.675)
Gdpchange	-0.013	
	(0.115)	
Gini	0.027	
	(0.284)	
Constant	-5.468	-5.122***
	(6.175)	(0.551)
Observations	43	784
Number of sovereign	11	11
R2	0.556	0.1316
Sigma_e	2.406	1.989

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Model 2 of the table above highlights a clear positive and significant relationship between the effects of changes in sovereign credit spreads upon those of bank credit spreads within those sovereigns. Within table 7, model 1 is replicated with that of table 6 to allow for a better comparison within the differences of the two models. The results of model 2, therefore have the implication that the perception of a bank's credibility is (partially) directly related to changes in the perception of the credibility of the sovereign within which the respective bank is situated. This result was expected, as the several papers analyzed prior to the creation of the regression model also indicated a likelihood of results to follow in this direction. A sovereign being perceived to be less financially credible would therefore lead to the implication that there is an increased probability of defaulting and/or stimulating its economy. Therefore, these ramifications are priced correspondingly into financial markets. A sovereign credit default and ensuing government bankruptcy would create major implications onto the general population, and therefore affect the banks situated within the sovereign, as also highlighted by Fiechter and Zhou (2016) in their study of the ramifications of the Greek debt crisis in 2012.

The results above indicate that a 1% increase in the CDS spread of a sovereign leads to an average of a 0.41% increase in the rate of change of CDS spreads of banks situated within the respective sovereign. Therefore, it also implies that sovereigns who contain larger banking sectors face higher macroeconomic risks when going through credit rating downgrades, as the implications will also be directly faced by the banking sector. As stated by CGFS (2011), such a downgrade would also trickle into worsening bank funding costs, and eventually create a negative feedback loop affecting economic growth as a whole. Therefore, regulators may also need to consider regulations to provide a more independent banking sector, or stricter fiscal controls to avoid going through major sovereign credit shocks.

Alongside the direct effects of sovereign credibility, the changes in international reserves was also analyzed within the regression model, obtaining a negative and significant result. This is in line with expectations that an increase in the percentage of international reserves held by a sovereign would lead to decreased CDS spreads for the banks situated within

those sovereigns. Intuitionally, this is plausible as a sovereign with larger international reserves is more unlikely to default on its debts due to a larger pool of monetary resources available to be spent during periods of crisis. Furthermore, an increase in the availability of reserves for a sovereign may also directly affect its fiscal capacity to provide bank funding during stress periods, possibly leading to bank cds spreads decreasing within the same periods. Furthermore, as highlighted by the regression equation, the coefficient is rather minor in magnitude, with a 1% increase in sovereign international reserves only leading to a 0.009% decrease in the changes in bank cds spreads.

Furthermore, the regression model also highlights the insignificance of the inflation variable on its effects on bank CDS spreads. This may be due to various reasons, such as that of the macroeconomic conditions which may affect the dependent variable already being prices into the actual sovereign credit ratings, leading to an insignificance of inflation in its own right to conclusively be affecting bank cds spreads. Furthermore, as inflation was taken as a metric of absolute value rather than a rate of change, it may be plausible that a minor change in prices may not lead to any real monetary effect due to the inherently nominal effect of inflation on the economy. The article by the World Bank (2018) suggests that the actual inflation rate may be insignificant towards real changes in the economy as long as the price expectations are stable from a monetary perspective.

Finally, the time-dependent yearly effects on bank cds spreads was also analyzed within the scope of the regression. The results indicated a positive coefficient for every year in question, from 2008 to 2023. These provide an offset to the otherwise large and significant constant of -8.7. Furthermore, the average coefficient provided on a per-year basis indicates an average increase in the yearly effects on bank cds spreads. This can be highlighted in an average yearly increase of 0.15 in the value of the coefficient from 2008 to 2023.

Table 8

Random effects regression results for Bank CDS spreads (Bcds) as the dependent variable. The regression includes sovereign-specific random effects

VARIABLES	(3) Model 3
Sovrcds	0.657***
	(0.199)
CPI	-0.027
	(0.029)
Reserves	0.003
	(0.003)
sovereign	
Belgium	0.910***
	(0.146)
Germany	0.556***
	(0.032)
Denmark	0.914***
	(0.038)
Estonia	0.452
	(0.324)
France	1.034***
	(0.139)
Ireland	-1.306***
	(0.283)
Italy	0.429
	(0.352)
Netherlands	1.163***
	(0.065)
Poland	1.173***
	(0.250)
Sweden	0.612***
	(0.014)
Constant	-8.219***
	(0.653)
Observations	784
Number of sovereign	11
R2	0.1420
Sigma_e	2.034

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8, unlike table 7, factors in the difference in effects relative to each sovereign within the data sample, rather than the differences in effects posited by each year. Similar to that

of table 8, the coefficient for the effect of changes in sovereign cds spreads on bank cds spreads is positive and significant, with insignificant results for inflation. However, a key difference within the two regressions is the insignificance of changes in international reserves. This variable is insignificant in table 8. This carries intuitive plausibility, as these changes may be captured within the sovereign-specific effects, and therefore may not be reflected as an isolated variable within the regression model.

The coefficient of 0.656 on the sovereign cds variable, larger than that of 0.443 in table 7 implies a greater effect for time-invariant random effects relative to sovereign-invariant random effects within the scope of this sample size. There is a relatively minor magnitude of sovereign-specific effects, with the largest being Portugal with 1.17. These numbers can be taken into relative context with those of table 7, with the effects of 2023 containing a magnitude of 3.14 creates the implication that sovereign specific effects are not as major within the scope of this study. There can be several reasons for this, with the similarities in monetary policy and economic integration likely leading to a significantly lower sovereign-specific heterogeneity in results.

The results of the regressions in table 7 and 8 clearly show that changes within sovereign CDS spreads positively and significantly affect changes within bank CDS spreads. The implications of these results are clear. A sovereign with a more influential banking sector stands more to lose from a macroeconomic standpoint when facing a sovereign debt crisis. This is as during periods of high sovereign debt and reducing sovereign credibility, the ensuing downgrades in bank credit ratings may lead to a significant tightening of the financial system. The implications of this can be severe depending on the macroeconomic circumstances in play. During times of recession, expansionary fiscal policies are often implemented leading to fiscal deficits and increases in sovereign cds spreads. These same sovereign credit rating downgrades lead to downgrades in bank credit ratings, therefore affecting the ability of bank's to raise non-fiscally stimulated funds, and therefore may put a strain on their ability to raise and lend money. This financial austerity can counteract some of the intended policymaking objectives of fiscal stimuli, and possibly lead to a 'crowding out' effect with regards to stimulus policies over the medium to long term. Therefore, these

results may lead to a higher risk profile of running fiscal deficits, and will need to be considered prior to major increases in sovereign debt.

Furthermore, the results indicated in table 7 regarding the effects of changes within international reserves held by the sovereign are also significant from a policymaking standpoint when considering its effects on the banking sector within the sovereign. An increase in a sovereign's international reserves leads to an average decrease in the cds spreads of its banking sector, indicating greater credibility within the banks situated within the sovereign. This may be due to an increased pool of reserve funds available for a sovereign, leading to a reduced probability of default as the sovereign contains greater financial leverage to undertake debt with a larger pool available for repayments in periods of crisis. Similar to that of increased sovereign credibility, larger international reserves therefore may also lead to increased investor confidence within the macroeconomic resilience of the sovereign. This in turn, may lead to the banks within the sovereign also indirectly benefiting from these effects due to the more credible monetary nature of the sovereign, leading to simultaneous increases within banking sector credibility as well. Within sovereigns with developed banking sectors, there may therefore be a greater incentive for policymakers to retain substantial international reserves. However, it must be taken into consideration that this comes at a substantial opportunity cost, due to foreign exchange investments being a different investment class with different volatility and return distributions than bond markets. Furthermore, increases in foreign exchange reserves also contribute to a depreciation of the sovereign currency, which may lead to other indirect effects such as affecting the import and export markets. Therefore, due to there likely being several other macroeconomic effects of changes within international reserves other than that on the banking sector, such changes need further consideration before implementation. However, these changes, especially with regards to currency depreciation, are partially mitigated within the Euro area sovereigns due to the currency being adopted by a total of 20 countries within the EU. This, therefore, leads to the effects of any individual sovereign on the currency being curtailed due to the widespread nature of the currency, leading to greater monetary stability.

Furthermore, other macroeconomic factors such as inflation were highlighted to be insignificant in both Tables 4 and 5. This may be due to the inherently nominal nature of

inflation, where its relevancy is found relative to changes in wages, interest rates and stability of prices, rather than the actual inflation levels themselves. Therefore, future studies may look towards a more nuanced calculation of inflation for purposes of such studies, such as taking into account real inflation relative to other metrics as a comparison point.

Conclusion

This paper uses a panel data sample of 47 banks over 11 countries within the Euro area/EEA from 2008-2023. This sample is used to study and analyze the effects of changes in sovereign credit default swap (CDS) spreads on changes in the CDS spreads in the banks situated within those sovereigns, and the extent to which those changes are realized.
This is done via creating a consolidated dataset of bank CDS spreads per sovereign, following which significant evidence was found highlighting that changes within sovereign cds spreads positively and significantly affect changes within bank CDS spreads. Furthermore, significant evidence was also obtained regarding the effects of changes within the international reserve pool of a sovereign on bank CDS spreads. These changes in reserves were found to have a significant and negative effect on changes within bank CDS spreads of the respective sovereigns. However, analysis on variables such as inflation, gdp change and the gini coefficients of sovereigns yielded insignificant results on their effects on changes in bank CDS spreads.

This paper underlines the importance of sovereign fiscal creditworthiness on the banking sector of the sovereign. The results, synergized with data obtained from previous literature regarding sovereign credit ratings affecting changes on bank funding conditions, alongside those highlighting changes in bank credibility on their profitability metrics provides us with a comprehensive overview of the real effects posited by changes within sovereign credibility. Using these results, a chain of effects can be established. Changes within sovereign credibility positively affect changes within bank credibility, leading to a positive effect on changes within the funding conditions and profitability of banks within the sovereign.
This has several policymaking implications. Policymakers and regulators may need to be more cautious when implementing debt financed fiscal policies in future scenarios of crisis,

as a sovereign perceived to contain high amounts of debt relative to their ability to refinance may suffer from a weaker banking sector in the medium to long term. Depending on the influence of the banking sector within the sovereign, alongside the level of financial integration present, a debt crisis within the sovereign may spell disastrous effects on the banking sector. These effects may be exaggerated in periods of financial crisis or credit tightening, when banks may be struggling to raise funds or have deteriorating liquidity metrics. As discussed previously, debt financed fiscal stimuli lead to short run increases in bank credibility, and therefore in scenarios where bank failures are a real possibility, may be unavoidable. However, policymakers must consider the long term implications of such measures, and therefore may need to be cautious with undertaking large sums of debt if such practices cannot be sustained over the long-term. These results also highlight the dependance of banks on the macroeconomic health of its sovereign. This may have several implications from a banking perspective. One of these implications could be incentives for banks to achieve larger economies of scale than previously expected, due to the likely diversification benefits attained by not being dependent on operating within one specific sovereign. This may lead to incentives for the formation of larger, multinational banks at the expense of smaller and more regional banks, especially within sovereigns with weaker credit ratings and greater fiscal uncertainties. The implications of having fewer, larger banks operating within global financial structures are important, however are outside the scope of this paper.

There can be several additions to this paper in future studies, such as the addition of several other key macroeconomic variables to further be able to isolate the effects changes within sovereign credibility plays on its banking sector. Furthermore, research could also be conducted on the magnitude of this effect relative to the development of the banking sector within the sovereign or its level of financial integration. This research could also be expanded in scope, taking into account other sovereigns with monetary structures uncorrelated to the Euro area, such as those of emerging markets within Asia and Africa, which may lead to different results than those discussed within this paper. A larger time period could also be utilized to understand whether these effects were different prior to the financial crisis of 2008.

In short, sovereign credibility plays a major role on the credibility of their banking sectors. Regulators and policymakers being aware of such effects may have several implications on future fiscal and monetary policies, due to the dependence of banking sectors on the sovereigns they are located within.

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Appendix

Appendix 1

Correlation matrix

	Bcds	Scds	Cpi	Reserves	Gdp	gini
Bcds	1					
Scds	0.16	1				
Cpi	0.04	0.15	1			
Reserves	0.01	0.07	0.06	1		
Gdp	0.12	0.14	0.33	0.0266	1	
Gini	-0.14	0.57	0.13	0.0103	0.05	1

Appendix 2

Woolridge test for autocorrelation

H0: no first-order autocorrelation

F(1, 10) = 15.107

Prob > F = 0.0030