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CONTAGION AND CREDIT DEFAULTS IN SOVEREIGN DEBT MARKETS FOLLOWING COVID

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Abstract

Sovereign debt is a special asset class that supposedly inherits peculiar market dynamics. Political considerations during default events add complexity for market participants and contagion effects are suspected by scientific literature and financial professionals. Predominantly cost of debt (yields), but also financial distress, can supposedly be driven by contagion effects. Following the Covid disruption, we examine 33 sovereigns from emerging and developing countries and derive that mere contagion effects exist but were less pronounced during the crisis. Conversely, yields seemed to be more sensitive in relation to the sovereigns' individual fiscal fragility during the shock, compared to pre- and post-Covid.

Keywords: Credit Default Swaps, Credit Spread, Yield Contagion, Sovereign Debt, Debt Capital Markets, Sovereign Asset Liability Management, Sovereign Default

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1. Introduction

1.1 Context and Problem Statement

In its annual sovereign default study the rating agency S&P Global announced that six nations defaulted in 2023 on either foreign and/or local currency debt, increasing from five in 2022 (S&P Global 2024). Another prominent rating agency Fitch, stated in 2023 that sovereign defaults had reached soaring heights with 14 separate default events since 2020 (Fitch 2023). A credit default in the context of government debt describes the situation in which a sovereign debtor is financially not able or simply is deciding willingly to not serve a maturing debt principal or interest payment.

Nowadays post-Covid, the pandemic might seem far away and vastly forgotten, but it definitely had an impact on economies and financial markets globally. Real GDP deteriorated globally by -2.7% YoY in 2020 when Covid broke out. In comparison, growth figures were much more resilient following the financial crisis in 2008 with a slight real GDP reduction of -0.1% YoY globally that year (IMF 2024a). Furthermore, major stock index levels dropped severely in a fire sale from mid of February to mid of March in 2020: the S&P 500 dropped by -31.8%, the Nikkei 225 by -30.1%, and the Euronext 100 by -32.5% (Bloomberg 2024). Finally, as stated, sovereigns struggled much more following Covid in comparison to 2008, when reported sovereign default events amounted to only five during the years 2008-2011 (S&P Global 2024). Linking the economic crash during Covid with the reported default events, the question occurs how sovereign debt markets evolved in the post-Covid time, following a period of severe economic disruptions and external shocks.

In this context, this paper uses a twofold approach to dissect sovereign debt dynamics. The main focus will be on the empirical analysis of government credit spreads, which is conducted to understand yield driving factors, obtain insights about the importance of contagion effects in public debt markets and how those effects worked out during Covid, when compared with other periods before and after. Additionally, selected sovereign defaults – considerably different from corporate defaults – are examined based on Sovereign Asset Liability Management (SALM) attributes in a post-Covid setting and evaluated qualitatively in context of scientific literature.

1.2 Literature Review

Based on the academic status quo we will define own hypotheses, which we will conceptualise and test for validity. The focus on yield dynamics and sovereign defaults, especially in context of each other, allow us to make a more sophisticated and collated contribution to the overall field of sovereign debt market research. Thus, a relevant cognition for our research are narratives portrayed by Moreira Rato (2020) in context of the Portuguese debt restructurings, regarding the importance of credibility and trust over time from investors towards sovereign debtors, as well as the role of rating agencies. Sovereign debtors essentially rely on their own credibility and the trust of investors in the long run to obtain (continuous) financing support from creditors. For that, investors use rating agency reports, among other inputs to evaluate a government's creditworthiness. Besides such ratings, insights derived from debt profiles could be relevant to consider. Hence, findings of Wessel (2015) should be taken into account for the cause of this paper. The author created a government debt framework, which finds remedy for real-world frictions of the Ricardian equivalence, formalised by Barro (1974, 1976). The equivalence states that under certain assumptions household consumption and well-being is not affected by how a government finances its expenditures[1]. For that, Wessel describes a trade-off model between the issuance of "cheap" short-run debt and fiscal risk. While debt instruments

[1] The Ricardian equivalence is basically the public finance counterpart to Modigliani-Miller's (1958) corporate finance theorem, which states that the overall value of a company is independent of its capital structure

with short durations capitalise on low term premia, the issuer of such debt is exposed to market volatility when it comes to refinancing its debt. Therefore, the debt duration profile of a sovereign should be a fundamental factor when evaluating its creditworthiness.

Continuing this train of thought, the debt currency structure should be of relevance as well. Exactly at this angle takes on research of Eichengreen, Hausmann and Panizza (2002), defining the "original sin". As many countries cannot borrow abroad in their domestic currency, they have to take on foreign currency debt with all its implications. Such countries take on a currency mismatch on their balance sheets and with that, additional currency risks. Especially for countries with high inflation and currency depreciation dynamics, debt denominated in foreign currencies can be challenging to repay. These factors were also described by Tomz and Wright (2013) who analysed external sovereign borrowing and country defaults. This research underpins the relevance of the debt structure for our research approach.

Besides those intrinsic factors that arise from the SALM of a respective country, it is important to recognise the debt dynamics of governments, which fund their activities through taxes, debt and in certain cases seigniorage (Government Budget Constraint in Appendix A1). Countries do not default in the same way as a company might do, as countries usually do not go out of business and cease to exist. A determined sovereign debtor generally can pay back its debt with enough effort. Countries default as a result of complex cost-benefit considerations, involving not only fiscal and economic aspects, but even more so political factors (Moreira Rato 2024). From this perspective it is worth mentioning that sovereigns usually tend to default only selectively. According to the Bank of England (2024), just 6% of sovereigns defaulted on 50-100% of their totally outstanding government debt between 1960 and 2023. However, in cases of a sudden stop, which is an abrupt cease of net capital inflows into an economy, a government can only fund itself internally through taxes, domestic debt, and seigniorage (in countries which do not conduct independent monetary policy through a central bank). Unfortunately for such countries, raising taxes, issuing domestic debt or providing new money supply takes time or might not be feasible at all (i.e. insufficiently established local debt markets). Lacks of funding occur and could cause a government to default on its debt, only because of its incapability to source cash in time (illiquidity) and independent of the sovereign's fiscal situation. These sudden stops caused by contagious investor sentiment, are analysed by research of Calvo, Izquierdo and Mejía (2004), which postulates that sudden stops are basically an emerging market phenomenon and often come in bunches for countries with different economic fundamentals.

In this context it is interesting to acknowledge the perspectives of investors and existing creditors. The idea of sovereign credit risk (captured by yield levels / credit spreads) priced and expressed based on external factors rather than country-specific fundamentals should require an underlying cause, i.e. investors, who favour or reject sovereign debt assets depending on external factors. This assumption is additionally supported by findings of von Luckner, et al. (2023) stating that large heterogeneity exists in size of creditor losses ("haircuts") following sovereign debt restructurings. Haircuts are especially high in cases of geopolitical disasters (wars, revolutions) and interim restructurings have smaller haircuts than final restructurings. Hence, it is conceivable that investors rely also on the credibility of a state and the overall sentiment towards government debt assets when lending money, since haircuts can occur unexpectedly in size and timing – vastly independent on a state's fiscal situation.

These combined findings feed into our first hypothesis that sovereign debt markets are more driven by external factors and investor sentiment (contagion) than by intrinsic fundamentals, which ultimately influences credit spreads. Spillover effects could lead in the worst-case scenario to defaulting sovereigns which did not even encounter specific financial shocks, due to market illiquidity since new debt issuances could become too expensive or unavailable due to overly cautious lenders. Thus, our empirical analysis focuses on contagion effects and yield factors. This approach contributes to the academic findings, particularly by segregating the sample into intervals of pre-, during, and post-Covid timeframes. Primarily, our methodology builds upon the approach of Longstaff, et al. (2011), who argue based on a sample period from 2000-2010 that sovereign credit yield is majorly linked to global factors, such as the US stock and high-yield markets, rather than it is linked to local economic measures. The authors analysed 26 developed and less-developed countries. Having a sovereign-individual approach, the authors observed contagion effects from -4.5 bp to 11.9 bp on sovereign spreads per bp increase of another group’s average of CDS spreads.

Further, as markets tend to have higher correlation during financial market crises (Sandoval Junior and Italo De Paula 2012) it would be of great relevance to understand communality of sovereign yields during Covid, which caused market disruptions without being a financial crisis per se. Hence, such insights complement additionally the works of the ECB (2011), De Bruyckere, et al. (2013), Beirne and Fratzscher (2013), Silvapulle, et al. (2016), and Mitchener and Trebesch (2021), which all investigated contagions between bank and/or sovereign default risk in selected European countries during the European debt crisis. In a step further, Hardy and Zhu (2023) analysed the intertwined relations of central banks and the bank-sovereign nexus during Covid. The authors argue that banks are key investors in sovereign debt markets and can be stabilising in early stages of a crisis. As bank and sovereign credit spreads tend to be more closely linked when banks own more government debt assets (e.g. in form of public sovereign bonds), policy makers (i.e. central banks) should pay attention on potential spillover effects between banks and sovereigns, monitor the sovereign-bank nexus and if necessary adjust it by asset-purchase programmes. Furthermore, the empirical analysis of our paper contributes to research of Candelon and Moura (2023) that studied the determinants of yield curves in four emerging economies during the pandemic, arguing that coronavirus transmission rates increased sovereign borrowing cost and public policy interventions impacted bond risk premia.

Therefore, our empirical approach consists of testing the hypothesis that yield contagion exist, and in combination with external effects, influences individual sovereign CDS spreads more than intrinsic factors, and of attempting to understand how these dynamics changed during Covid.

2. Methodology & Analysis

2.1 Data Comprehension

To analyse contagion effects on credit yields our approach builds on Longstaff, et al. (2011), but differs from their research, as a broader sample size of 33 emerging and developing countries (according to IMF (2023)) with a more versatile fundamental background is examined (full list Appendix A2). Over and above that, we include a more sophisticated country-specific angle by including SALM control variables, such as the capital and debt structure of the respective government. We chose the examination period 2018 (Q4) to 2024 (Q1) to capture contagion dynamics before, during, and after Covid. By starting in 2018, we analyse the conditions just prior to the pandemic, without extending too far back, as academic research is quite conclusive about contagion effects in prior years. This allows us to focus on the transition through the pandemic and thereafter, offering a comprehensive understanding of how sovereign debt dynamics have been working out precisely over time.

To capture credit yields and potential contagion effects in sovereign debt markets, we make use of financial debt instruments, publicly trading in secondary markets. Since secondary bond markets can be rigid due to low secondary liquidity, we will refer to highly liquid CDS data, enabling more accurate findings. Otherwise it becomes difficult to distinguish whether illiquidity aspects or actual credit risk / contagion effects are the dominating force in driving bond spreads and with that credit yields (Bao, Pan and Jiang 2010). A CDS is in simple terms an insurance against a specified credit event of an underlying security/issuer. For this insurance the CDS buyer pays a scheduled premium (spread) to the protection seller, as long as the credit event does not occur during the contract period. The CDS spread is therefore a proxy for the risk premium of a sovereign debt issuer. With triangular arbitrage arguments it is also possible to approximate exact bond credit spreads with CDS spreads. (Pereira 2024). The bond credit spread is the sovereign specific credit spread, corresponding to the credit risk level on top of the risk-free term structure. Hence, those spreads are an indication of the sovereign specific funding costs and will be the predicted variable of our model. The 33 countries are grouped into four regions (Africa: 6, Asia: 8, Europe: 7, LATAM: 12). This grouping allows us to distinguish between regional and global contagion effects. For example, we juxtapose the median CDS spread of the remaining 5 African countries to the CDS spread of Kenya for any point in time as the regional CDS contagion variable. The medians of the remaining regions' sovereign spreads are collated in the global CDS variable. This means for the Kenia example, the global CDS regressor is the median of the 27 sovereigns from Asia, Europe, and LATAM. We have decided to proceed with the median instead of the average (as done by Longstaff, et al. (2011)) to cater for the right-skewed distribution of the CDS spreads (visualised in Appendix A3).

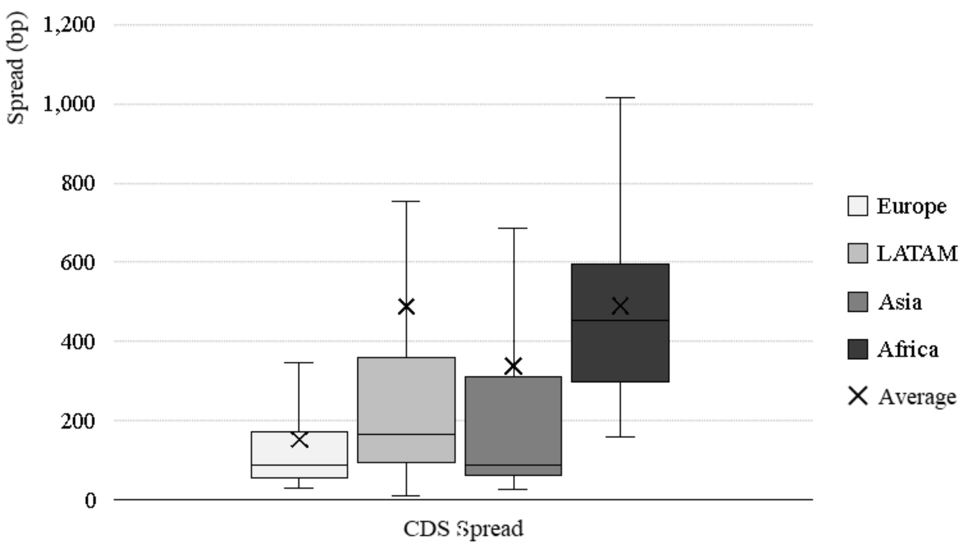
Further control-regressors are chosen to capture conceivable drivers of these CDS spreads. Thus, we employed a carefully selected set of variables that integrates macroeconomic indicators, global financial markets data, as well as individual SALM fundamentals of the respective sovereigns, controlling for unique aspects of country-specific credit risk. In combination, these factors should provide a robust foundation for determining the influences on CDS spreads. Starting with fundamental SALM variables, we make use of the debt structure of the analysed countries. With that we intend also to clarify on the sudden stop phenomenon that postulates that country-specific SALM indicators were of secondary importance when defaults occur (Calvo, Izquierdo and Mejía 2004). Implicitly, if this hypothesis held true, CDS spreads should also not be too much affected by SALM indicators. As indicated before, a focus on the sovereign debt maturity profile can capture dynamics that result from the ratio of publicly traded short-term to total debt (duration ratio). For short-term maturities we are concordant with the common understanding and categorise as such, debt within a one year maturity. Furthermore, considering the relevance of the original sin, we put a focus on the publicly traded external debt (denominated in foreign currencies). The ratio of foreign debt to total debt (external debt ratio) will act as a proxy, validifying the original sin theorem. Ultimately, we put the public sector debt in relation to a country's economic power; the debt to GDP ratio helps to explain the mere effect of leverage on a sovereign's credit risk.

Further local control-variables, which are not directly indicated on the balance sheet of a sovereign in a "classical accounting sense", comprise financial market dynamics, which are still country specific. For this reason, we include the monthly volatility of the FX exchange ratio between the local currency and the USD, as well as the S&P credit rating for foreign currency debt. S&P Global scores sovereigns in 23 different rating classes from AAA to D, with a rating history reaching back to 1941 for selected countries (S&P Global 2023). Transforming the qualitative ratings into numerical values (AAA = 0, … , D = 22) is necessary to feed the regression model in a later step. The final group of quantitative control-regressors consists of external global market indicators that capture key financial market dynamics. These include the weekly VIX index level, which reflects market volatility and investor sentiment while serving as a benchmark for global equity market performance; and the weekly yield change of 5-year U.S. Treasury bonds, indicating shifts in interest rates and debt market trends. Together, these variables should offer a comprehensive view of versatile influences on sovereign debt markets.

Eventually, we have added another technical dummy variable group for various reasons. Since we already have separated the observed countries into four regions for the regional/global CDS computation, it is easy to use this grouping as a further dummy variable. Thus, we set European countries as the base case, indicated as 0 for all regional dummy variables to avoid perfect multicollinearity. Plus, we utilise dummy variables for both the post- and during Covid period, which we will incorporate (in)directly in our regression models. Given the varying timelines of the pandemic across different regions and the lack of an universally agreed-upon global timeframe, we have opted to define the period from 2020 (Q2) to 2022 (Q1) as the reference interval for our analysis. Moreover, due to the nature of CDS contracts we have encountered periods for some countries, for which markets did not quote a CDS spread. No spread quotation happened mostly around a selective default event of the underlying sovereign. For such cases we added a dummy variable. Additional to this dummy variable, the corresponding time stamp (week in which no spread was quoted) must have a quantitative value (which is a technical requirement in our used Statistics Programme “R”). Thus, we substituted the missing CDS spread with a fictive value. Intuitively, a spread of 10,000 bp (or 100% of notional) would come to mind. However, as CDS spreads are indicated on an annual basis, a spread can even exceed this value, which implies an expected imminent default. For this reason, we took the observed maximum spread (Ecuador 17,848.25 bp on 27/03/2020) plus 1 bp and applied it (17,849.25 bp) for missing CDS values. Finally, it needs to be accentuated that while an additional default dummy variable would seem sensible, isolating influences on spreads from default events, incorporating such a dummy would bias the results and had no meaningful implications. As CDS spreads cease to be quoted during sovereign defaults, the model would only rely on the spread, which we artificially allocated to time stamps with missing CDS spreads.

The detailed summary statistics of the total sample data (full observation period) is presented in the Appendix (A4). With 33 countries over a time period of 287 weeks the sample size totals in N = 9,471 observations. It becomes apparent again when analysing all individual CDS spreads, that high outliers pull the mean to a level of 380 bp, whereas the median is much lower at 158 bp. This delta highlights the suspected positive skewedness of such data and corroborates our approach of using the median rather than the average when computing the contagion proxies: regional and global CDS spreads. In this context it is interesting to acknowledge that the compounded global CDS spreads (avg. 162 bp / med. 161 bp) tend to be more balanced than the regional spreads (avg. 191 bp / med. 143).

Graph 1) **CDS Spread Boxplot by geographic Region**



This fact is expected, since the regionally calculated spreads incur a geographical bias (compare with Appendix A5). The bias is visualised in Graph 1, which demonstrates the different quartiles of the spread levels across the four regions (statistical outliers neglected). We can conclude that the CDS of sovereigns, from the African region, tend to quote higher (1^{st} / 3^{rd} Quartile between 298 bp and 594 bp) than those of all other observed sovereigns. Second highest quotes are from LATAM (1^{st} / 3^{rd} Quartile between 94 bp and 358 bp), then Asia (1^{st} / 3^{rd} Quartile between 63 bp and 309 bp), and lastly Europa with the lowest spreads (1^{st} / 3^{rd} Quartile between 56 bp and 172 bp). Acknowledging this difference in spread levels underpins additionally the necessity of geographic dummy variables, isolating geographic biases.

Next, taking a look at the fundamental SALM indicators, the versatility of the chosen data set becomes clearer. While most sovereign debtors maintain a short-term debt ratio of 7% - 17%, the external debt ratio reaches from 0% to 100% with most indications around 11% - 59%. This versatility is also reflected in the wide range of Debt/GDP ratios between 18% - 155%, for which African countries have the highest medians of 68%. A further look onto the local country specific factors reveals that domestic credit ratings tend to be slightly better than the foreign ratings, which is fairly intuitive, since domestic debt is free of currency risk. Notwithstanding, the gap between domestic and foreign credit ratings is neither universal nor uniform in whether it is negative or positive (Packer 2003). However, as the median indicates, the observed sovereign ratings are between low investment grade and high sub-investment grade (or high yield): BB+ (foreign) and BBB- (domestic). The highest foreign rating of A+ has been held by China, Slovakia, and Chile. It is important to mention that although we have analysed the local credit ratings to obtain a better picture of credit default events, only the foreign rating is used as an explaining variable, to avoid multicollinearity. Eventually, we deem that the chosen global control variables are behaving in expected manners. While the VIX has massive outliers up to a level of 66$ right at the beginning of Covid in March 2020, the median quotes around 19$, which is considered “normal”, predicting no subsequent unusually low or high volatility (S&P Dow Jones Indices 2017). The 5Y US Treasury yield increased by 0.14% on average, during the observation period. Ultimately, we obtained a balanced sample by using only sovereigns, which had data availability for all the preselected variables across the entire observation period. Just for the CDS spreads we had to apply a less stringent filter, since defaulted sovereigns are of high interest for our research question but as a result of the default event, have no quoted CDS prices. (Short explanations and sources of selected variables are shown in Appendix A6).

2.2 Empirical Concept

Overall, we suspect that funding frictions, such as elevated cost of debt, financial distress, or defaults, of governments occur from market illiquidity (sentiment: investors’ (un)willingness to finance more sovereign debt assets) or fragility (individual balance sheet and credibility issues). Eventually, those frictions are priced and captured by the CDS spread. As we also focus on the diverging debt and spread dynamics in context of Covid, we conduct our panel regressions on the same data set across four different observation periods. The first observation period comprises the full sample size from 2018 (Q4) to 2024 (Q1), including (post) Covid dummy variables. The three remaining samples are divided between the pre-Covid, Covid, and post-Covid time (congruent to the (excluded) Covid dummies). Based on the aforementioned variables, which are grouped into five sections (SALM, local, global, contagion, dummy) we have conceptualised a panel regression model (Regression Equation Appendix A7).

For the dependent variable, we opted to use the natural logarithm (ln) of the CDS spreads to account for the highly skewed distribution of the spreads. By applying the log transformation, we stabilise the variance, reduce the impact of extreme outliers, and ensure that the model's assumptions of normality and homoscedasticity are better satisfied. This results from the fact that strictly positive values tend to have conditional distribution that is heteroskedastic and skewed. The logarithm can mitigate such effects, if not completely eliminate them (Wooldridge 2013). Additionally, the log transformation allows for a more intuitive interpretation of the results, as the coefficients can be expressed in terms of percentage changes in CDS spreads. This interpretation is even more relevant for our research, as relative terms are better explaining changes of contagion and yield dynamics, rather than absolute spread levels.

Before running the actual regression it can already be insightful to consider the simple correlation matrix of the quantitative variables (Correlation Matrix Appendix A8). Going forward, we will focus on the statistically significant correlations. Unsurprisingly, the correlation between the criterion and the credit rating (AAA = 0,…,D = 22) is highly positive (Foreign Rating: 0.406). While the total Debt/GDP ratio exhibits a rather high positive correlation (0.251), the External Debt Ratio (EDR) seems to be negatively correlated (-0.023) with the CDS spreads. This EDR finding is rather unexpected and warrants further investigation when conducting the empirical regression. Another positive correlation to the dependent variable occurs with the VIX (0.072), which indicates that volatile markets could affect sovereign yields. Ultimately, the CDS response variable is also positively correlated with the pooled regional sovereign spreads, which could be a first indication of contagion effects in sovereign debt markets. Having another look at the correlation of the independent SALM variables among each other, reveals additionally some interesting interrelations. The concomitant correlations between the debt profile and the debt/GDP point into different directions. While the Duration Ratio (DR) is positively correlated (0.130), the EDR exhibits a strongly negative correlation (-0.318) with the debt/GDP ratio. Those correlations insinuate that higher indebted sovereigns also take on more short-term debt, while lower leveraged sovereign borrowers seem to have better access to foreign debt markets. Nonetheless, for a more sophisticated analysis in context of the Covid pandemic we make use of the beforehand mentioned econometric instrument, the panel regression. In the following section we will approach the longitudinal data with three different estimation techniques and conduct each model in total four times. As indicated before, we will obtain the particularities during the pre, during, and post-Covid period, as well as for the total sample period.

2.3 Ordinary Least Square-, Fixed Effects-, and Random Effects-Model

Conventionally, a panel analysis begins with the Ordinary Least Squares (OLS) method, which assumes homogeneity across entities, making it simple to implement but potentially biased if unobserved heterogeneity exists (Wooldridge 2010). The Fixed Effects (FE) model addresses this limitation by controlling for time-invariant unobserved factors unique to each entity, thus improving causal inference. However, this approach neglects fixed variables that do not vary over time. In contrast, the Random Effects (RE) model assumes that unobserved entity-specific effects are uncorrelated with explanatory variables, allowing for more efficient estimations. However, when this non-correlation assumption is violated, RE estimates become inconsistent (Wooldridge 2013). Hence, after reiterating through all three models across the entire sample period, we conduct statistical tests to validate their consistency and suitability for our underlying data and regression method. Therefore, we make use of a simple F test, which determines the better fit between the pooled OLS and the FE approach (Croissant and Millo 2008), as well as the Hausman test to assess the RE against the FE model (Hausman 1978). Finally, when we have found the most appropriate method we will apply it for the three separated sample periods pre-, during, and post-Covid. Once these results are obtained, we will examine and compare only the output of the bespoke regression model.

We conducted the first method, an OLS that pools the data across groups and time. Concretely, this approach ignores, as mentioned, the panel structure and treats the information as one cross-sectional dataset. For the full sample period we obtained an adjusted R^2 value of 0.87, which was the highest value of all three models (OLS, FE, and RE) for the entire observation period. The F-statistic was statistically significant ($p < 0.001$) with a value of 4,215. Out of the nine quantitative explaining coefficients only β_7 (5Y US-Treasury yield change) was not statistically significant, in contrast to the rest which were all statistically significant at $p < 0.001$. The intercept and four dummy variables were also indicated statistically significant at the same level ($p < 0.001$) with the exception of δ_2 (Asia), which was statistically significant at $p < 0.01$ and δ_4 (Covid), which was statistically significant at $p < 0.1$ (detailed summary Appendix A9).

In a consecutive step, we address potential serial correlation over time, which cannot be captured by our pooled OLS approach. By removing the time-invariant factors, the FE model assumes the remaining variables to be unbiased predictors (Wooldridge 2013). With a still solid, but lowest of all three models, adjusted R^2, the FE model achieved a value of 0.532 and a statistically significant F-statistic of 901. By omitting the time-consistent dummy variables, all quantitative coefficients obtained a statistically significant output, except for the global explaining variable β_7 (5Y US-Treasury yield change) that was not significant at any commonly used significance level. Again, δ_4 (Covid) was not at all statistically significant.

Finally, the RE model needed to be computed, as we aim to retrieve a profound insight into our underlying data and a robust interpretation, which we can only obtain by considering all perspectives. With the RE model, time-consistent explanatory variables are taken into account again and variations between entities (sovereigns) are assumed to be random (Wooldridge 2013). Whereas almost all quantitative explanatory variables have had a statistically significant ($p < 0.001$) effect on the normal logarithm of CDS spreads (except β_7 (5Y US-Treasury yield change), which remained statistically insignificant), the dummy variables δ_1 (Africa), δ_2 (Asia), and δ_4 (Covid) did not satisfy any conventional significance level either. Notwithstanding, the model achieved an exceptionally high Chi^2 statistic of 11,250 and a moderate adjusted R^2 of 0.543 (detailed summary Appendix A10).

The highly significant statistics for a vast majority of the considered coefficients insinuates that our chosen empirical approach could yield in meaningful insights. Thus, following common practice, we test the three models for empirically validity but also for logical plausibility. As indicated before, a simple F test helps to determine whether the pooled OLS or the FE model is more statistically appropriate (Croissant and Millo 2008). Our F test attains a p-value below 0.001 ($F = 189.5$, $df1 = 29$, $df2 = 9{,}426$). Thus, the null hypothesis, implying no significant individual specific effects, must be rejected. Unobserved heterogeneity seems to be present in our data that has statistically significant effects on the output variable. The FE model provides a better fit for the sample, which is highly conceivable, as sovereign specific effects are to be expected. As we can now repudiate the pooled OLS approach, we still need to conduct the Hausman test to understand which of the remaining models fits best. At $p < 0.001$ ($Chi^2 = 59.4$, $df = 12$), we can reject the null hypothesis with the greatest conventional significance level.

This outcome suggests that random effects are correlated with the explanatory variable and entity specifics (heterogeneity) would bias the RE estimates (Hausman 1978). Under these circumstances the FE model provides most consistent and reliable estimates. This result is also consistent with standard empirical practice. When taking sovereigns as a sample unit, it is rather unreasonable to assume a random sample (Wooldridge 2013). Therefore, it is not plausible that the unobserved fixed term α_i was uncorrelated with any of the explanatory variables. Accordingly, we will use the FE model going forward. For concluding certainty, we have computed both the F test and the Hausman test with the other three sample intervals. The results of those tests were all conclusive and proposing the FE model to be most fitting.

Appendix A11 showcases the estimates for the entire observation period, as well as the separated time intervals. Remarkable is that all quantitative explanatory variables, which are statistically significant, head into the same direction across all four compared observation periods. The only exception in this context is the DR, which indicates a negative coefficient of -0.0045 for the entire sample period, in contrast to the positive estimates of 0.0077 and 0.0055 for the Covid and post-Covid period, respectively. In conjunction with the other two SALM variables, a certain pattern can be recognised, although with the caveat of lacking statistical significance for the DR pre-Covid and the debt/GDP post-Covid. Ignoring the data with no empirical significance, it could be derived that the influences on CDS spreads intensified during Covid, which calmed down thereafter while staying still elevated in comparison to before the pandemic. I.e. an increase of 1 pp. of a sovereign's EDR would have led to an increase of the CDS spread by 0.19% before Covid, 0.72% during Covid, and 0.43% post-Covid c.p. (note, the initially observed negative correlation from the correlation matrix did not hold true in our model) A similar pattern can be observed for the DR's effect, which decreased after Covid from a coefficient of 0.0077 during Covid, to 0.0055, which means that an increase by 1pp of the DR led to an increase of CDS spreads by 0.55% c.p. If compared to the total period, the DR indicated even a negative effect on CDS spreads of -0.45%, which is actually counterintuitive. Identically to the identified trend, behaved the debt/GDP Ratio's effect, which increased to 0.61% during Covid from 0.14% before, for an increase by 1pp of debt/GDP c.p.

This pattern held also true for the other local and global control variables. Commencing with the local variables, the biggest effect (in general of all quantitative variables) bared the sovereign's credit rating. A rating which was worse by a single rating step (e.g. BB to BB-) resulted c.p. in an increase in CDS spreads by 12.33% before, 12.36% during, and 16.8% after Covid. Also the currency volatility in relation to the USD adhered to the mentioned pattern of an amplified effect during Covid, with slightly more moderate but still elevated indications after Covid, in comparison to pre-Covid. However, the coefficient before Covid does not reach any conventional empirical significance level. Nonetheless, the currency volatility increased the output variable considerably severely c.p. by 1.91% for each pp. during Covid. Eventually, the only global variable which is statistically significant (at $p < 0.001$) is the VIX index, which demonstrated the same behaviour as the other aforehand described independent variables. An increase by 1$ in the VIX level affected the CDS spreads most heavily during Covid by growing c.p. by 1.46%, which increased from 0.2% before Covid and stayed at 0.44% after the crisis.

Our main focus, the contagion variables, differed from this trend of acceleration during and following Covid. While both the regional and global CDS proxies are statistically significant for all timeframes at $p < 0.001$ the trajectory of both coefficients reached its turning (low) point during Covid. Interestingly, the global contagion effects tended to be higher than the regional contagion effects. But whereas the contagion effects decreased drastically during Covid (regionally: 0.22% to 0.03% and globally: 0.24% to 0.03% per bp increase) the regional CDS spreads' influence grew post-Covid less meaningfully (to 0.12% per bp more), while global contagion effects (of 0.21% per bp more) tended to rise again towards pre-Covid levels (all c.p.). This development reveals potential dynamics that during a crisis period, such as the Covid pandemic, the mere contagion effects are actually less economically significant than in other periods. Therefore, it is conceivable that the contagion effect, might be weaker during the pandemic, as the influence of other intrinsic variables was significantly amplified. Considering, that the Covid crisis was no financial-crisis in a classical sense, but much more an external shock, which affected economies through a pandemic fatigue, sovereigns had different capacities to react to Covid depending on their economic situation. The individual fragility played apparently a much greater role during the pandemic, when every government had to react to the Covid shock by itself. The magnitude and severity of the crisis depended crucially on the sovereign specific economic capacity to react to the shock. Therefore, sovereigns might have been analysed by market participants more individually and independently of each other. Hard credit factors, such as SALM, local and global financial market dynamics were more focused on, while simultaneously blatant sentiment driven spreads were less likely. Generally, the contagion coefficients tend to be in absolute values, smaller for the full observation period (0.0012 and 0.0014) than any other statistically significant quantitative control variable. Nonetheless, the suspected contagion effects seem to be prevalent and real. Moreover, these effects change in the course of time, with weaker contagion effects during Covid, remaining lower post-Covid than before the pandemic, insinuating that investors potentially have a greater focus on the individual credit story of sovereigns than before.

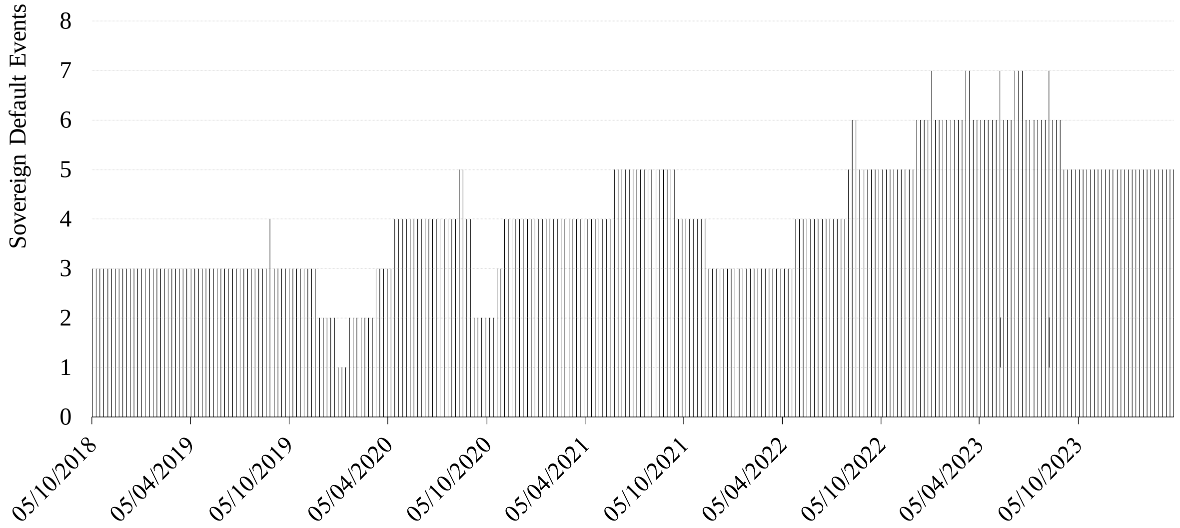
Overall, in contrast to the post-Covid dummy, the Covid dummy for the total sample time does not attain statistical significance. Whatsoever, the post-Covid coefficient of 0.1916 supports the observed dynamics of intensified explanatory effects on the individual CDS spread. Concretely, the positive value indicates that c.p. the CDS spreads were 19.16% higher after Covid than before. Due to missing statistical significance, it is hardly possible to suggest meaningful implications during Covid for the full sample period, solely based on the Covid dummy.

While understanding the altering yield dynamics over time, we can obtain a clear picture of which coefficient group had how much impact on the sovereign credit spreads. For the full observation period, SALM sums up to 0.0107 in absolute terms, while global coefficients (0.0085) in combination with the contagion effects (0.0026) add up to 0.0111. When neglecting the local coefficients, namely the credit rating and currency volatility, the external factors are marginally higher than the SALM specific coefficients. However, considering the local variables, the dominant factors in CDS spreads are sovereign specific. This became even clearer during Covid, when contagion effects decreased and have been staying below pre-Covid levels, while in contrast, CDS spreads remained generally higher post-Covid. Acknowledging these facts, we can reject our hypothesis that external (global) factors and mere contagion influence sovereign credit yields more than intrinsic factors.

2.4 Sovereign Default Events

After establishing that yield contagion effects indeed exist in sovereign debt markets and have been changing in the course of the pandemic, we can now shift our attention towards the sovereign default events. Maintaining a consistent research framework, we hold onto the chosen sample period and we analyse sovereign default events in depth by example of the four defaulted states, included in the 33 sovereigns analysed before. However, for reference we examined additionally 116 countries, rated by S&P. Of these 116 countries, we found 11 other defaulted sovereigns that we use for further guidance (full sample in Appendix A12; Russia excluded, since the S&P rating ceased before its default). Those 15 sovereigns were in selective default for a combined duration of 1,169 weeks (counting overlaps). Graph 2 emphasises on the fact that during the entire observation period, at least one sovereign was rated as selectively defaulted. Even more interesting is the development over time of the default events. In fact, it seems like there are certain patterns of default waves in the most recent history, which would be in line with the hypothesis of sentiment driven market illiquidity. Concisely, it becomes apparent that sovereign defaults tend to be followed by other defaulting sovereigns.

Graph 2) **Selectively Defaulted (SD) rated Sovereigns by S&P**



Source: visualised by the author based on S&P Global (2023) and Bloomberg (2024)

For example, while Venezuela was in the beginning of 2020 the sole defaulted sovereign, Argentina selectively defaulted on 21/01/2020, which was followed by the Lebanon on 11/03/2020 and finally Ecuador on 13/04/2020. Similar "default waves" were observable by the example of Zambia and Suriname in October and November of 2020, or Belarus (*apparently, Belarus was excluded in S&P's annual default study, mentioned on p.1*) and Ukraine in August 2022.

However, Graph 2 also shows that sovereigns defaulted close to the global Covid outbreak in the beginning of 2020. Commencing with Argentina, which has an infamously long history of credit defaults, the country defaulted first on its domestic debt end of January 2024 and ten weeks later in April on its external debt. With a debt/GDP ratio of 103.8% in 2020, the sovereign was actually highly levered in comparison to the 33 analysed sovereigns of the sample, which were on average indebted by 63.0% of their corresponding GDP during that year. Nonetheless, Ecuador, which defaulted shortly after Argentina's external default on its own debt on 13/04/2020, while only having a debt/GDP ratio of 63.6%, was vaguely in line with the average of the sample. Also quite different in magnitude are the DRs of both sovereign borrowers. With 14.7% short-term debt/total debt Argentina had a slightly higher ratio than the average of 14.4%. Ecuador had a marginal short debt share of 1%, which is only a fraction of the average. Those observations are in line with the discussed underlying assumptions of the sudden stop theorem, discussing versatile fundamentals of defaulting sovereierngs (Calvo, Izquierdo and Mejía 2004). In contrast to the CDS spreads, which are driven predominantly by intrinsic fundamentals, sovereigns default not necessarily because of surpassing certain financial ratios or economic conditions (intrinsic fundamentals), but seemingly rather because of financial market dynamics or a contagious investor sentiment, which is also more in line with the proposal of Longstaff, et al. (2011). Notable is whatsoever, the sharp increase of Argentina's EDR from 34.8% in Q1 2020 to 44.5% in Q2 2020, which would support the presumption of the original sin (Eichengreen, Hausmann and Panizza 2002) stating that countries overload themselves with a debt-currency-mismatch, resulting in (selective) defaults.

Although, El Salvador and Cameroon defaulted only once during the observation period in May and August 2023, respectively, the economic conditions were again ambiguous. El Salvador quoted in 2023 a debt/GDP ratio of 84.7% (sample avg. 60.1%), a DR of infinitesimally small 0.1% (sample avg. 13.2%) and an EDR of 0% (sample avg. 36.8%), whereas Cameroon was indicated at a debt/GDP ratio of 43.2%, DR of 10.3% and EDR of 67.6%. Eventually, it is interesting to acknowledge that Argentina was the only sovereign that defaulted more often/for a longer duration on its domestic debt than external debt. Precisely, Argentina was rated as SD for 39 and 25 weeks on its domestic and foreign currency debt, respectively, while the other 14 countries were rated as SD for on average 13.6 and 80.4 weeks on their domestic and foreign debt, respectively. This observation also supports the theory of contemporary literature, such as from Erce, Mallucci and Picarelli (2024), which states that external defaults are larger in magnitude and take longer to resolve in comparison to domestic debt defaults.

2.5 Discussion and Limitations of Results

Putting our findings together, we can postulate that contagion effects indeed exist in sovereign debt markets. During the Covid shock, these effects counteracted to other underlying credit factors. While intrinsic SALM and financial market factors amplified their impact on credit spreads, contagion effects were less pronounced during the pandemic. Conversely, contagion effects rose again afterwards, as the other credit metrics' effects calmed down. Nonetheless, we can reject the hypothesis that credit yields are dominated by external markets factors and contagion. The highest impact on credit spreads, according to our model, has the country specific credit rating. Other SALM, local and global financial market indicators are rather balanced in regards to their spread implications. As discussed, when analysing sovereign defaults, we fail to reject the hypothesis that sovereign debt markets are more driven by external factors and contagion for the sample intervals around Covid. In contrast to CDS spreads developments, which are essentially driven by intrinsic fundamentals, defaults happened to sovereigns vastly independently of SALM and local financial factors.

Following the examination and acknowledgement of results it is essential to undergo scientifically critical deliberations. For this reason it should be imperative to address the imputed substitution bias from the missing CDS spreads around default events. By artificially setting the quoted CDS spread to an extreme level the meaningfulness of the missing CDS coefficient is impaired. Having a statistically significant dummy variable only implicates that the substitution affected the regression results materially, however, economic interpretation attempts should be cautious. While the substitution is considerably reasonable, the magnitude of the displayed effect is rather technical than meaningful. To a certain extent, this circumstance translates into the survivorship bias as well. According to Brown, et al. (1992), the survival bias is a form of selection bias, ignoring those entities which are not selected. This bias is on the one hand valid for the non-quoted CDS spreads of actually defaulted sovereign entities, which we have included, but even more so for sovereign debtors that were not selected for various reasons. The most obvious reason in this context is that missing CDS contracts, or sufficient spread quotation during the sample period, made an inclusion into the analysis obsolete. Particularly the perspective on recent defaults, such as Sri Lanka, Mozambique, Russia or Ukraine (S&P Global 2024), could give profound insights into relevant contagion dynamics.

Generally, the underlying sample data is to some degree rigid and stiff. Especially the debt/GDP indication of the IMF, which is only available on an annual granularity, could shed light on SALM related debt dynamics, if reported more regularly (i.e. quarterly). Then again, as these ratios should not be too extremely volatile, this could also rather have a cosmetic effect. In this context, it could be interesting to investigate the debt factors even further. Since, the underlying data focus solely on the publicly traded debt instruments (i.e. bonds), it could be interesting to gain insights related to the overall public sector debt of a sovereign (i.e. loans). The World Bank provides public debt figures for selected countries (The World Bank Group 2024), which as of now, does not fully comprise this paper's scope, which is why we have decided to proceed with the publicly traded debt instead. Should the data basis of the mentioned source be enlarged, the inclusion of such data could complement sovereign debt markets research.

3. Conclusion

In conclusion, the study on the contagion of sovereign credit yields and defaults unbosoms dynamics influenced by both systemic and idiosyncratic factors. Ironically, as the Covid disease contagion peaked, sovereign yield contagion effects diminished drastically during the pandemic. While a persistent phenomenon, contagion effects amplified again following Covid, but remained below pre-pandemic levels. Interestingly, during the pandemic, sovereign credit spreads displayed heightened sensitivity, driven primarily by intrinsic credit factors, offsetting the lower contagion trends. This circumstance suggests that the individual capacity of a government to react to the Covid shock, played a crucial role during the pandemic. Sovereign specific fragility determined the credit spread and ultimately the cost of public debt. On the other hand, sovereign defaults did not exhibit a clear pattern when analysed by the underlying financial ratios and SALM indicators, suggesting that these events were less uniform and more reflective of contagion waves, which is in line with scientific literature. Therefore, it is interesting to acknowledge, that on the one hand, spreads are driven rather by intrinsic credit metrics, but on the other hand, definite credit defaults are seemingly less determined by individual fragility. Further going research, dissecting sovereign defaults could help to understand why credit spreads are vastly driven by intrinsic factors, while in contrast default events are seemingly more caused by market and external factors and less by fiscal fragility.

For future research, we would suggest to intensify the analysis of sovereign defaults events by increasing the time frame and/or the analysed fundamental factors. While the selected SALM ratios constitute sufficient control variables for the empirical yield analysis, those ratios can easily be complemented by measures of economic power or other fundamentals, i.e. government deficit/surplus, taxable entities and citizen, demographic variables, et cetera. Such efforts would contribute even further to our empirical results regarding yield contagion dynamics and the contextualisation of related default events in the recent past.

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Appendix

A1) Equation 1: **Government Budget Constraint extended by Seigniorage** (Silva 2023)

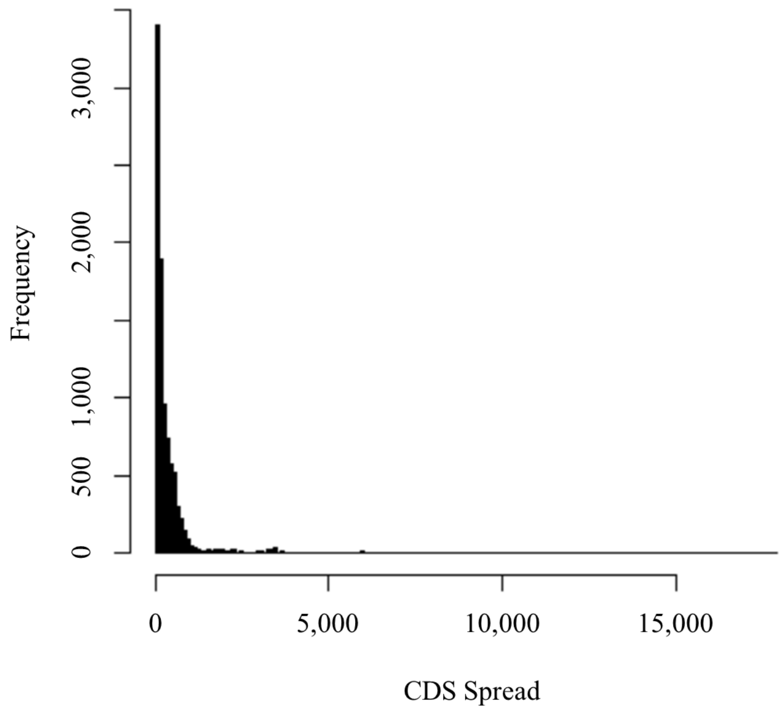
$$G_t + B_{t-1} + rB_{t-1} = T_t + B_t + \frac{M_t - M_{t-1}}{P_t}$$

G_t: government expenditures, T_t: taxes, B_t: outstanding bonds at end of period t (public debt), r: interest rate, M_t: money supply, P_t: prices, *for time t=1,…,T*

A2) Table 1: **Country Sample**

Country Sample						
Angola	Argentina	Brazil	Bulgaria	Cameroon	Chile	China
Colombia	Costa Rica	Ecuador	El Salvador	Guatemala	Hungary	India
Indonesia	Iraq	Kazakhstan	Kenya	Malaysia	Mexico	Pakistan
Panama	Peru	Philippines	Poland	Romania	Rwanda	Senegal
Serbia	Slovakia	South Africa	Turkey	Uruguay		

A3) Graph 1A: **Histogram CDS Spread Distribution (positively skewed)**



A4) Table 2: **Summary Statistics of the Sample Data for the total Observation Period**

		Min. :	1st Qu. :	Median :	Mean :	3rd Qu. :	Max. :	N :
	CDS Spread (bp)	10	78	158	380	405	17,848	9,387
SALM	SD/TD (%)	0.03	7.27	11.41	12.98	16.98	73.36	9,471
	FD/TD (%)	0	10.69	34.27	36.72	59.42	100	9,471
	Debt/GDP (%)	18.3	43.2	57.2	58.00	70.8	155.4	9,471
Local	Rating Foreign	4 (A+)	8 (BBB)	10 (BB+)	10 (BB+)	14 (B)	21 (SD)	9,471
	Rating Local	3 (AA-)	7 (BBB+)	9 (BBB-)	10 (BB+)	14 (B)	21 (SD)	9,471
	Currency/USD Volatility	0	0.24	0.58	0.84	1.1	47.74	9,471
Global	VIX ($)	12.01	15.32	18.71	20.68	24.34	66.04	9,471
	5Y US Treasury change (%)	-36.04	-3.69	0.14	0.51	4.05	52.5	9,471
Conta-gion	Regional CDS (bp)	44	86	143	191	216	932	9,471
	Global CDS (bp)	64	105	161	162	201	368	9,471
	Default *(during week)*	0					1	64
	Missing CDS	0					1	84

A5) Table 3: **Summary Statistics collated by geographic Region**

	CDS Spread (bp)	SD/TD (%)	FD/TD (%)	Debt/GDP (%)	Rating Foreign	Rating Local	Currency/USD Volatility (%)	Default Dummy
Africa								
Min. :	158	0.07	10.32	38.30	11 (BB)	10 (BB+)	0.00	0
1st Qu. :	298	7.78	37.18	56.10	13 (B+)	13 (B+)	0.28	
Median :	454	12.38	65.55	67.80	13 (B+)	13 (B+)	0.68	
Mean :	490	12.19	55.35	65.93	14 (B)	13 (B+)	0.88	
3rd Qu. :	594	14.99	72.35	73.30	15 (B-)	15 (B-)	1.27	
Max. :	3,024	63.31	92.62	119.10	16 (CCC+)	16 (CCC+)	5.08	1
Asia								
Min. :	28	0.03	1.23	19.90	4 (A+)	4 (A+)	0.00	0
1st Qu. :	63	10.89	3.73	40.10	7 (BBB+)	7 (BBB+)	0.24	
Median :	86	13.49	25.23	57.60	9 (BBB-)	9 (BBB-)	0.45	
Mean :	338	17.97	26.63	57.64	9 (BBB-)	9 (BBB-)	0.62	
3rd Qu. :	309	20.87	28.86	76.20	10 (BB+)	10 (BB+)	0.72	
Max. :	9,253	73.36	100.00	90.10	16 (CCC+)	16 (CCC+)	9.70	0
Europe								
Min. :	29	2.16	0.28	18.30	4 (A+)	4 (A+)	0.03	0
1st Qu. :	56	7.71	24.31	36.60	6 (A-)	5 (A)	0.57	
Median :	88	9.64	51.27	51.30	8 (BBB)	8 (BBB)	0.81	
Mean :	152	10.29	43.24	48.22	8 (BBB)	8 (BBB)	1.06	
3rd Qu. :	172	12.76	63.08	57.20	10 (BB+)	10 (BB+)	1.19	
Max. :	877	24.19	81.26	79.30	14 (B)	14 (B)	21.16	0

LATAM								
Min. :	10	0.04	0.00	25.80	4 (A+)	3 (AA-)	0.00	0
1st Qu. :	94	3.15	4.13	40.08	8 (BBB)	7 (BBB+)	0.00	
Median :	165	10.74	34.54	58.50	11 (BB)	10 (BB+)	0.45	
Mean :	488	11.60	30.33	60.00	11 (BB)	10 (BB+)	0.85	
3rd Qu. :	358	19.36	46.41	70.33	14 (B)	14 (B)	1.24	
Max. :	17,848	35.45	87.86	155.40	21 (SD)	21 (SD)	47.74	1

A6) **Further Details regarding the chosen Data**

Dependent variable – CDS spreads: The weekly CDS spreads of 5-year CDS contracts are obtained via the Bloomberg Terminal student access (Bloomberg 2024).

SALM Variables: We obtain the debt structure variables (external debt ratio and duration ratio) on an annual granularity from Bloomberg (2024) and the yearly public debt to GDP ratios from the IMF (2024b).

Local Variables: The FX exchange ratios between the local currencies and the USD were obtained from Bloomberg (2024). The S&P foreign credit ratings could be derived from S&P Global (2023) and complement by indications from Bloomberg (2024).

Global Variables: The VIX index and 5-year U.S. Treasury bond yields are obtained from the BBG student terminal (Bloomberg 2024).

A7) Equation 2: **Sovereign CDS Spread Panel Model**

$$\ln (s_{it}) = \beta_0 + \beta_1 DR_{it} + \beta_2 EDR_{it} + \beta_3 PD_{it} + \beta_4 FR_{it} + \beta_5 CV_{it} + \beta_6 V_t + \beta_7 UST_t$$
$$+\beta_8 sr_{it} + \beta_9 sg_{it} + \delta_1 A_i + \delta_2 As_i + \delta_3 L_i + \delta_4 C_t + \delta_5 PC_t + \delta_6 N_{it} + \alpha_i + u_{it}$$

tor time t = 1,…,T; country i = 1,…,N; α: unobserved fixed effects; u: idiosyncratic error – s: CDS spread – ***SALM****: DR: duration ratio(%); EDR: external debt ratio(%); PD: debt/GDP ratio (%) –* ***Local****: FR: foreign rating; CV: currency/USD volatility (%) –* ***Global****: V: VIX price level; UST: 5Y Treasury yield change (%) –* ***Contagion****: sr: regional CDS spread (bp); sg: global CDS spread (bp) –* ***Dummy****: A: Africa, As: Asia; L: LATAM; C: Covid; PC: post-Covid; N: CDS spread not available;*

A8) Table 4: **Correlation Matrix quantitative (non-dummy) Variables**

	CDS Spread	Rating Foreign	Debt/GDP	SD/TD	FD/TD	Currency/USD Volatility	VIX	5Y Treasury develop.	Reg. CDS	Glo. CDS
CDS Spread	1									
Rating Foreign	*<0.0001*	1								
	0.4057									
Debt/GDP	*<0.0001*	*<0.0001*	1							
	0.2506	0.3429								
SD/TD	*0.089*	*0.0215*	*<0.0001*	1						
	0.0175	0.0236	0.1296							
FD/TD	*0.0248*	*<0.0001*	*<0.0001*	*<0.0001*	1					
	-0.0231	0.3469	-0.3184	-0.0573						
Currency/USD Volatility	*0.5847*	*0.0289*	*<0.0001*	*<0.0001*	*0.7433*	1				
	0.0056	-0.0225	0.0963	0.1128	0.0034					
VIX	*<0.0001*	*0.7151*	*<0.0001*	*0.0001*	*0.8353*	*<0.0001*	1			
	0.0722	0.0038	0.0616	0.0399	-0.0021	0.1214				
5Y Treasury develop.	*0.0513*	*0.7992*	*0.9545*	*0.467*	*0.7141*	*0.0039*	*<0.0001*	1		
	-0.02	0.0026	-0.0006	-0.0075	0.0038	-0.0297	-0.159			
Reg. CDS	*0.0156*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*0.0005*	*<0.0001*	*0.1586*	1	
	0.0248	0.3412	0.1731	-0.0641	0.2387	0.0355	0.1306	-0.0145		
Glo. CDS	*0.078*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*0.024*	*<0.0001*	1
	-0.0181	-0.197	-0.0842	0.0518	-0.0657	0.071	0.3224	-0.0232	-0.0985	

with p-Values indicated above correlation

SD/TD – short-term debt to total debt (Duration Ratio)

FD/TD – foreign debt to total debt (External Debt Ratio)

A9) Table 5: **Pooled OLS Output across the entire Sample Period 4Q18 – 1Q24**

Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**	
(Intercept)	1.8186	0.0257	70.7158	< 2.2e-16	***
Duration Ratio	0.0023	0.0005	4.8957	0.0000	***
External Debt Ratio	-0.0024	0.0002	-11.8007	< 2.2e-16	***
Debt/GDP	0.0014	0.0003	5.4583	0.0000	***
Foreign Credit Rating	0.2639	0.0016	167.0432	< 2.2e-16	***
Currency/USD Volatility	0.0143	0.0030	4.7644	0.0000	***
VIX	0.0077	0.0007	10.4728	< 2.2e-16	***
5Y US Treasury yield change	0.0005	0.0005	0.9993	0.3177	
Regional CDS	0.0011	0.0001	15.9245	< 2.2e-16	***
Global CDS	0.0015	0.0001	11.5931	< 2.2e-16	***
Africa	-0.2459	0.0325	-7.5612	0.0000	***
LATAM	0.0839	0.0152	5.5193	0.0000	***
Asia	-0.0439	0.0138	-3.1877	0.0014	**
Covid	-0.0196	0.0117	-1.6757	0.0938	^
Post-Covid	0.1747	0.0165	10.5965	< 2.2e-16	***
Missing CDS	2.2407	0.0477	46.9746	< 2.2e-16	***

Total Sum of Squares: 12,499; Residual Sum of Squares: 1,626.1; R^2: 0.87; Adj. R^2: 0.87

F-statistic: 4,214.59 on 15 and 9,455 DF, p-value: < 0.001 ^p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001

A10) Table 6: **RE Output across the entire Sample Period 4Q18 – 1Q24**

Coefficients:	**Estimate**	**Std. Error**	**z-value**	**Pr(>|z|)**	
(Intercept)	2.2624	0.1108	20.4181	< 2.2e-16	***
Duration Ratio	-0.0044	0.0006	-7.3011	0.0000	***
External Debt Ratio	0.0035	0.0006	5.8726	0.0000	***
Debt/GDP	0.0022	0.0005	4.6013	0.0000	***
Foreign Credit Rating	0.1838	0.0066	27.9541	< 2.2e-16	***
Currency/USD Volatility	0.0154	0.0025	6.0356	0.0000	***
VIX	0.0081	0.0006	13.6410	< 2.2e-16	***
5Y US Treasury yield change	0.0004	0.0004	1.0001	0.3173	
Regional CDS	0.0012	0.0001	21.7590	< 2.2e-16	***
Global CDS	0.0014	0.0001	13.4613	< 2.2e-16	***
Africa	0.0455	0.1435	0.3169	0.7513	
LATAM	0.3415	0.1193	2.8636	0.0042	**
Asia	0.1618	0.1288	1.2566	0.2089	
Covid	-0.0101	0.0098	-1.0231	0.3063	
Post-Covid	0.1868	0.0135	13.8146	< 2.2e-16	***
Missing CDS	2.0172	0.0462	43.7052	< 2.2e-16	***

Total Sum of Squares: 2,269; Residual Sum of Squares: 1,036.1; R^2: 0.543; Adj. R^2: 0.543

Chisq: 11,249.9 on 15 DF, p-value: < 0.001 *p < 0.05; **p < 0.01; ***p < 0.001

A11) Table 7: **Fixed Effects (FE) Output for all Observation Periods** *(Std. Errors below)*

y = ln(CDS Spread (bp))	Total Sample	Pre-Covid	During Covid	Post-Covid
Coefficients:	Estimate	Estimate	Estimate	Estimate
Duration Ratio (%)	**(0.0045)***** *0.0006*	**0.0009** *0.0007*	**0.0077***** *0.001*	**0.0055***** *0.0014*
External Debt Ratio (%)	**0.0041***** *0.0006*	**0.0019*** *0.0009*	**0.0072***** *0.0014*	**0.0043**** *0.0016*
Debt/GDP (%)	**0.0021***** *0.0005*	**0.0014^** *0.0008*	**0.0061***** *0.0008*	**(0.0004)** *0.0008*
Foreign Credit Rating	**0.1637***** *0.0074*	**0.1233***** *0.0104*	**0.1236***** *0.0125*	**0.168***** *0.0156*
Currency/USD Volatility	**0.0156***** *0.0025*	**(0.0029)** *0.005*	**0.0191***** *0.0045*	**0.0047^** *0.0025*
VIX ($)	**0.0081***** *0.0006*	**0.002***** *0.0006*	**0.0146***** *0.001*	**0.0044***** *0.0012*
5Y US Treasury yield change (%)	**0.0004** *0.0004*	**0.0003** *0.0004*	**(0.0004)** *0.0004*	**(0.0002)** *0.001*
Regional CDS (bp)	**0.0012***** *0.0001*	**0.0022***** *0.0001*	**0.0003***** *< 0.0001*	**0.0012***** *0.0001*
Global CDS (bp)	**0.0014***** *0.0001*	**0.0024***** *0.0001*	**0.0003***** *< 0.0001*	**0.0021***** *0.0002*
Covid Dummy	**(0.0063)** *0.0098*			
Post-Covid Dummy	**0.1916***** *0.0135*			
Missing CDS	**2.0794***** *0.0473*	**2.7045***** *0.054*	**2.0319***** *0.0701*	
Observations N	9,471	2,574	3,432	3,465
R^2	0.534	0.802	0.654	0.263
Adjusted R^2	0.532	0.799	0.65	0.255
F-statistic	900.501*** (df=12; 9,426)	1,024.63*** (df=10; 2,531)	641.277*** (df=10; 3,389)	135.954*** (df=9; 3,423)
Significance Levels			^p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001	

A12) Table 8: **Sovereigns that defaulted (SD rated by S&P) during the Sample Period**

		Country Sample		
Argentina	Barbados	Belarus	Belize	Cameroon
Ecuador	El Salvador	Ghana	Lebanon	Mozambique
Sri Lanka	Suriname	Ukraine	Venezuela	Zambia