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“SOVEREIGN CREDIT RISK IN EMERGING MARKETS:
AN EMPIRICAL VALUATION MODEL”

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Abstract

The sovereign debt of emerging market economies as an asset class offers attractive opportunities to international investors seeking portfolio diversification. However, investors need to assess the level of default risk embedded in sovereign debt and the adequate price for such risk.

For these purposes, this thesis develops an empirical framework composed of two models. In the first model, I assess the effect of several macroeconomic factors on the sovereign CDS spreads of a monthly panel of 19 emerging countries from January 2007 to July 2019. I estimate the model by a dynamic fixed effects regression. Sovereign CDS are credit derivative contracts based on the solvency of sovereign issuers, wherein the seller promises to make a contingent payment to the buyer if the sovereign reference entity fails to meet its obligations. They are often adopted as a proxy of the pricing of sovereign credit risk, as the spreads on these securities tend to comove strongly with the spreads on the underlying bonds.

In the second model, I investigate the leading indicators of sovereign defaults on an annual panel of 43 emerging countries from 1996 to 2014. I estimate the model by a binary logistic regression. Finally, I implement a classification method based on this model, which predicts the probability of each country to default in the following year and classifies it accordingly.

I find that global factors (such as the U.S. yield curve and the U.S. equity market) and country-specific factors (such as inflation, the depreciation rate of the local currency and the credit rating assigned to the issuer) are the main drivers of sovereign CDS spreads. The effect of all these variables, though, varies both across regions and over time. On the other hand, country-specific fundamentals (especially the soundness of public finances, the development of the banking sector and the recent history of past defaults, as well as the quality of the ESG factors) are strong signals of sovereign default risk. The classification method achieves overall good performances, correctly calling 96% of upcoming defaults while not leaving any sound investment opportunity behind.

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List of Abbreviations

2SLS	Two-stage least squares
CBOE	Chicago Board Options Exchange
CDS	Credit default swap
CPI	Consumer Price Index
CTOT	Commodity Terms-of-Trade database (International Monetary Fund)
EMU	European Monetary Union
EPI	Environmental Performance Index (Yale University and Columbia University)
FE	Fixed effects
FRED	Federal Reserve Bank of Saint Louis
FX	Foreign exchange
GDP	Gross Domestic Product
GEM	Global Economic Monitor (World Bank)
GIIPS	Greece, Ireland, Italy, Portugal and Spain
HDI	Human Development Index
IDS	International Debt Statistics (World Bank)
IFS	International Financial Statistics (International Monetary Fund)
IMF	International Monetary Fund
IV	Instrumental variables
OLS	Ordinary least squares
PCA	Principal component analysis
RE	Random effects
S&P500	Standard and Poor's 500 stock index
T-o-T	Terms-of-trade
WDI	World Development Indicators (World Bank)
WEO	World Economic Outlook (International Monetary Fund)
WGI	World Governance Indicators (World Bank)

Introduction

In the post-crisis environment of negative interest rates and growth stagnation, the attractiveness of emerging sovereign debt to global investors has steadily increased over the last decade. Conversely to the fragility of the public finances of several emerging market economies in the late 1990s and the early 2000s (notably, the distress following the 1997 Asian financial crashes, the 1998 Russian default and the 2001 Argentine default), in recent years sovereign issuers of emerging countries as a whole have shown greater resilience to episodes of financial turmoil. Such a statement holds, especially, when compared to the financial meltdown in the United States in the wake of the 2007-2008 global financial crisis and the sovereign debt distress in Europe in the period 2010-2012.

Moving from the enhanced confidence in investors' risk attitudes towards emerging market economies, some researchers investigated the nature of this paradigm shift by studying the drivers of the two components of spreads. The first component relates to the risk premia attached by investors to sovereign bonds, whereas the second component refers to the pure default risk embedded into government securities. The former can be defined as the remuneration for the default risk to which investors are exposed; in this sense, it proxies the market perception of sovereign risk. It matters to investors as they wish to profit from potential mispricings in the market, especially to investors whose trading activity originates from a speculative motive. Some part of the academic literature on the topic attributes changes in sovereign risk premia to shifts in global factors (McGuire & Schrijvers, 2003; Pan et al., 2008; Longstaff et al. 2011), while another strand emphasises the role of country-specific differentials (Hilscher & Nosbusch, 2010; Afonso et al., 2014; Aizenman et al., 2016). Other papers analyse the interlinkages across spreads over time, pointing out the spillovers and contagion effects arising in periods of financial distress (Beirne & Fratzscher, 2013; Caporin et al.; 2018). The latter component of spreads concerns the assessment of the default risk of a sovereign issuer. This measure is also of primary importance to investors, particularly to those participating in the market for a hedging motive. Most of the studies in this field identify weaknesses in the banking sector (Acharya et al. 2014; Gennaioli et al., 2014) or in the external position of a country (Eichengreen & Hausmann, 1999; Hofmann et al., 2019), respectively, as the main causes of sovereign defaults. Some authors (such as Manasse et al., 2003; Hilscher & Nosbuch, 2010; Jeanneret & Souissi, 2016) look at the recurrent patterns leading to defaults and build early-warning indicators based on such information.

In this work, I adopt the perspective of an international investor wishing to assess the credit risk of sovereign issuers in emerging market economies. For this purpose, I explore both the components of spreads by applying two distinct econometric models. In the first model, I assess the causal effect of several global and country-specific factors on sovereign CDS spreads in emerging market economies.[1] I estimate the model by fixed effects OLS panel regression. The model aims to calibrate the pricing of sovereign risk based on empirical evidence rather than on a structural approach. As this question is of major interest to speculative investors whose trading activity focuses on a short-run horizon, I employ data with monthly frequency. This choice constitutes a reasonable compromise between daily frequency on the one side, which provides the highest degree of granularity over time, and quarterly or annual frequency on the other, which has the advantage of larger data availability. I complement the first part with a principal component analysis (PCA), which quantifies the degree of cointegration between the individual series of spreads. In the second model, I inspect the role of a different set of global and country-specific factors on the probability of default of sovereign issuers in emerging countries. I estimate the model by a binary logistic regression. After the estimation, I adopt a classification method to predict the occurrence of a default in a given country in the following year. In this model, I employ annual data, as considerations about the sustainability of sovereign debt typically concern long-run investors driven by a hedging motive.

This thesis contributes to the existing literature by building on the methodologies applied by previous research and expanding on them in a few directions. With respect to the model on the pricing of sovereign risk, it comprehends an extensive set of explanatory factors; it proposes a treatment for endogeneity, and it accounts for possible changes over time and across regions. For what concerns the model on sovereign defaults, it also considers a wide set of predictors. Specifically, it includes both the groups of variables accounting for weaknesses of the banking sector and external fragility. Furthermore, it adds extra-financial information to the usual set of predictors, embedding the ESG valuation of a country into the assessment of its sovereign default risk. Finally, it provides a quite accurate classification tool to discriminate sovereign issuers between more and less prone to default.

Overall, the results of this study indicate that sovereign CDS spreads tend to move primarily according to changes in international risk factors (notably, the U.S. equity market and

[1] I adopt sovereign CDS spreads (rather than sovereign bond spreads) as a proxy for the pricing of sovereign credit risk. I will justify this choice in the literature review in Section 1.

the U.S. yield curve). Some country-specific factors also play a relevant role: namely, the variables related to the monetary policy of a country, both on the internal and the external side (inflation and the depreciation rate of the local currency, respectively), and its sovereign creditworthiness. However, the influence of some of these variables varies over time and across regions. On the other side, the deterioration of country-specific fundamentals especially seems to lead to sovereign defaults. Domestic financial fundamentals (such as the levels of general government debt, domestic bank credit to the private sector and the soundness of the banking sector), as well as extra-financial performances (in terms of the ESG scores), are the main determinants of sovereign debt sustainability. Furthermore, current defaults to domestic creditors and past defaults to international creditors help predict upcoming external defaults. The external position of a country appear as less relevant as a whole, the only significant predictor being the depreciation rate of the local currency. Finally, although there is no clear evidence that international factors systematically affect the probability of default, the global financial crisis caused an upwards shift in sovereign default risk.

The thesis is organised as follows. In Section 1, I review the literature in the specific field, distinguishing between the strand related to the drivers of sovereign spreads and the other strand concerning the determinants of sovereign defaults. In Section 2, I explain the methodology adopted in the two models. In Section 3, I introduce the datasets and some descriptive statistics. In Section 4, I report the results of the estimation of the models and the classification. Finally, in the last Section I draw some conclusions.

1 Literature review

Before proceeding to analyse the different positions proposed in the literature, I will underline a few methodological notes relating to my own research and justifying the scope of the following literature review. First, when generically referring to sovereign spreads, I mean government bond yields or sovereign CDS returns interchangeably. There exists some empirical evidence that the two measures of sovereign risk are indeed substitutes, both in emerging markets (Ammer & Cai, 2010) and in the EMU (Arghyrou & Kontonikas, 2012). Second, this literature review focuses on foreign currency sovereign debt. Despite the remarkable growth in local currency sovereign bond markets after the 2000s[2], I decided to limit my attention to the specific features of foreign currency sovereign risk as foreign currency debt still constitutes the largest fraction of general government debt in emerging countries and the related literature is substantially larger.[3] Third, although the scope of my model is limited to emerging market economies, this literature review includes analyses of advanced countries. Indeed, previous research on the sovereign debt crisis in the EMU provides meaningful insights for this study too, especially considering the increasing degree of integration of current financial markets (Amstad et al., 2016). Fourth, I focus on the empirical literature on the determinants of the pricing of sovereign credit risk, thus neglecting most of the contribution of theoretical pricing models. Finally, there exist multiple strands of literature about sovereign credit risk, but I will only explore those strands that more directly relate to the purposes of the thesis. Specifically, I will examine previous academic contribution on the following two research questions: the first question assesses the determinants of the pricing of sovereign credit risk (Section 1.1), while the second one analyses the drivers of sovereign defaults (Section 1.2).

[2] For an overview of the historical trends and the currency composition of the market, see Burger et al. (2012) and Ottonello and Perez (2019).

[3] The only exception consists in those studies based on a sample of countries from the EMU, wherein the sovereign bonds under consideration are denominated in local currency. However, differently from other local currencies, international markets consider the euro as a hard currency (such as the Swiss franc or the Japanese yen). Thus, the currency risk associated with euro-denominated instruments is comparable to that of their dollar-denominated counterparts.

1.1 Determinants of sovereign spreads[4]

1.1.1 Historical context

The academic debate on the pricing of the risk embedded in sovereign bonds can be traced back to the Merton (1974) credit risk model. However, its structural framework, originally conceived for corporate debt, is not fully applicable to its sovereign counterpart (Augustin et al., 2012, p. 120). Indeed, while the contingent-claim analysis provides a theoretical pricing model for economic defaults (i.e. due to an objective inability of the firm to pay back its obligations), the analysis of sovereign debt introduces a subjective element, as the government can strategically default at its own discretion (thus configuring an unwillingness of the issuer to pay).[5]

Although sovereign debt in emerging countries experienced unprecedented growth rates between the 1970s and the 1980s, the formal discussion on the pricing of sovereign bonds at the time was still narrow. Indeed, the increasing interest in emerging debt was largely due to the boom in the market for syndicated bank loans to developing countries, notably to Latin American countries.[6] In principle, pricing a loan is different from pricing a bond though, as the risk structure of the former is not fully comparable to the one of the latter (Eichengreen and Mody, 1998, p. 1). Banks can perform more efficient monitoring of the debtor's ability to pay back its obligations than other investors can. Moreover, bonds typically benefit from a higher level of seniority than other debt securities, while the legal status of bank loans tends to be more variable.[7]

The process of recognition of the peculiar features of sovereign bonds developed along with the inception of the market for Brady bonds and the introduction of indices of secondary market bond spreads in the early 1990s.[8] As the integration process of domestic markets into a

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[4] This section extends the literature review by Augustin (2012) in the directions undertaken by more recent studies.
[5] For a more recent implementation of a contingent claim analysis on sovereign risk, see Gray et al. (2007).
[6] A notable exception, tracing a comparison between bank loans and bonds, is represented by Edwards (1986), which still gives more attention to bank lending though. In fact, the paper reports that the amount of new bank loans granted to 50 developing countries between 1978 and 1984 accounts for ten times the newly issued bonds, thus justifying the larger interest in the former than in the latter.
[7] Although there is no theoretical reason to assume that bonds and loans are priced in the same way, Kamin and Von Kleist (1999) argue that, while empirically bonds have larger spreads than comparable loans in levels, their responses to changes of several explanatory variables do not differ materially.
[8] Brady bonds were dollar-denominated sovereign bonds issued by the governments of some developing countries following the 1989 Brady plan (named after the U.S.Treasury Secretary Nicholas Brady). This agreement allowed debt restructuring in those countries whose sovereign debt had suffered from severe impairment losses. The outcome of the restructuring was the securitisation of non-performing bank loans into Brady bonds. For more information on the specific instrument and the position of each developing country adhering to the plan, see Federal Reserve (2011, Section 4255.1).

global financial market was still developing and the information on emerging economies was limited, it seemed natural to identify rating agencies as the main sources of information on sovereign creditworthiness. Indeed, Cantor and Packer (1996) document a close relationship between credit ratings, macroeconomic variables and sovereign bond spreads, thus claiming that ratings reflect all the publicly available information on countries' fundamentals. At the same time, though, they show that credit ratings carry additional private information, as they also have an independent effect on sovereign spreads.

Nevertheless, the rapid expansion of the market for Brady bonds, along with the burst of the 1994 financial crisis in Mexico, raised questions among the analysts about the true information content of credit ratings: "Serious financial institutions are buying billions of dollars of long-term bonds from countries that five years ago were regarded as economic disaster areas. Moreover, they have been buying them at razor-thin margins over U.S. Treasury bond yields" (The Financial Times, 1997, reported in Kamin and Von Kleist, 1999). Indeed, while acknowledging the relevant effect of credit ratings on sovereign spreads, Kamin and Von Kleist (1999) provide evidence of a general declining trend of the spreads of various sovereign bonds throughout the 1990s for both the ends of the credit quality spectrum. Furthermore, the authors find the spreads compressed during that period "by more than can be explained by improvements in risk factors – credit ratings and maturity – alone" (p. 42). In the context of this general descending path, they also document a temporary divergence between speculative-grade and investment-grade bonds after the Mexican crisis. While the former experienced an upward shift in the risk premium attached by the market, the spreads of the latter steadily decreased without interruptions throughout the period, as by comparison they were perceived as safer. The evidence of a differential impact of the Mexican crisis on the spreads, conditional on the prior characteristics of the countries, is confirmed by the study based on the secondary market for Brady bonds reported by Barbone and Forni (1999). Moreover, their findings include tentative evidence of contagion, i.e. an increase in the correlations between the spreads of different countries in periods of financial distress.

These three unexplained elements – namely: the common influence on sovereign spreads over and beyond what explained by credit ratings; the cross-country evidence of differential factors other than just ratings; and the evidence of contagion – stimulated three directions in the literature, respectively. The first element motivates the interest in global factors as drivers of sovereign bond spreads. I will discuss it in Section 1.1.2. The second element points to the contribution of country-specific factors, which I will present in Section 1.1.3. Finally, the third element originated the research on potential changes in the cointegration properties between the spreads of different countries in times of financial distress. I will comment on this field of research in Section 1.1.4.

1.1.2 Global factors

While recognising a relevant role of country-specific fundamentals, some researchers question their exhaustiveness as drivers of sovereign spreads. These authors tend to emphasise a significant impact of systemic risk factors instead. Eichengreen and Mody (1998) apply a sample selection model à la Heckman (1979) to a sample of emerging countries in order to study both the probability of issuance and the spread at launch. The authors highlight that changes in market sentiment unrelated to fundamentals tend to move primary spreads (i.e. spreads at the time of issuance, as opposed to spreads on the bonds traded in the secondary market) by large amounts in the short run. The principal component analysis by McGuire and Schrijvers (2003) corroborates this finding: a single common factor accounts for one third of the total variance in daily spread changes in the secondary market. They observe the presence of this factor for both speculative-grade and investment-grade bonds, indicating that it may be attributable to the international investors' tolerance for risk.

Other authors identify global factors as predominant drivers of sovereign spreads, especially in the short run. Pan and Singleton (2008) build a structural model extracting information about the risk of default and the recovery process from the term structure of sovereign CDS spreads in emerging countries. This approach allows them to distinguish between one component of the spread linked to pure default risk and the other related to the risk premium attached by the market. Their principal component analysis documents that a single factor explains 96% of the daily variation in the spreads. Therefore, they claim that sovereign spreads in emerging countries tend to comove strongly according to changes in the international investors' risk appetite. In particular, when turning to an econometric analysis they find that risk premia are affected by market volatility (as proxied by the VIX index[9]) and high-yield bond spreads. By applying the same methodology to a larger sample of advanced and emerging countries reporting monthly frequency data, Longstaff et al. (2011) witness a proportion of variance due to the first component of 64%. They also argue that global factors (notably, the U.S. equity market, the high-yield bond market and the level of volatility implied by the VIX index) not only drive the risk-premium component of the spread but also – and even

[9] The VIX index, provided by the Chicago Board Options Exchange (CBOE), measures market expectation of near term volatility conveyed by stock index option prices.

more strongly – the default-risk component. However, the authors suggest caution in generalising their results, as they mainly refer to the pre-crisis period of global abundant liquidity and reaching for yield; country-specific factors may turn out to be more important in other periods. Fender et al. (2012) apply a model accounting for volatility clustering to the daily time series of sovereign CDS spreads and perform separate analyses for the pre-crisis period and the crisis period. They confirm the overall dominance of global factors over local factors, notably the U.S. bond market, equity market and high-yield market, as well as the bond market in other emerging economies. However, differently from Longstaff et al. (2011), they find that country-specific factors had a significant role only before the global financial crisis, but they ceased to exert any effect during the crisis and its aftermath. Amstad et al. (2016) provide additional evidence in favour of a leading role of a time-varying common factor, identified in their study with the risk appetites of global investors. Moreover, by extending the analysis to the period of relative calm in the financial markets following the crisis, they document the presence of a "new norm" wherein sovereign bond spreads in emerging economies are even more cointegrated than they were before the crisis. They suggest this shift in the cointegration regime to be due to the prevalent role of index-tracking funds in current investment practices. For a summary table of the main studies focusing on global factors, see Table 1.1 in the Appendix.

1.1.3 Country-specific factors

A larger strand of literature supports the tight linkages between country fundamentals and sovereign spreads. Remolona et al. (2008) provide a transitional study between these two views, i.e. the one leaning towards a global determination of sovereign spreads and the other supporting a local explanation. They split the spread between a default risk component and a risk premium component based on the expected losses implied by sovereign credit ratings. They find that country-specific fundamentals (and inflation especially) drive the probability of default, whereas global factors (such as market volatility and investors' risk appetite) affect the risk premium component of the spread. A different in-between position is the one reached by Comelli (2012), who finds that country fundamentals tend to be systematically significant, while the relevance of global factors varies across time and regions. The author also states that the effect of fundamentals is larger in relatively tranquil periods, whereas in periods of distress it is still present but smaller.

1.1 Determinants of sovereign spreads

As emerging market economies as a whole have shown greater resilience after the global financial crisis (Aizenman et al., 2016), the sovereign debt crisis in Europe started in 2010 has diverted the attention of many researchers from the former group of countries to the latter. Specifically, that some countries (notably the so-called GIIPS countries) experience a persistent and larger spread vis-à-vis other countries within the same currency area (notably Germany) has raised interest in the idiosyncratic factors behind the differential dynamics of the spreads. Among the studies based on a sample of countries from the EMU, several papers point out the responsibility of the fiscal authority in determining spreads. Hallerberg and Wolff (2008) emphasise the importance of the quality of fiscal institutions in compressing sovereign bond yields. Aizenman et al. (2013) outline the role of fiscal space as a primary driver of sovereign CDS spreads, along with other macroeconomic factors (namely inflation). Afonso et al. (2014) confirm the significant effect of fiscal fundamentals on sovereign bond spreads. However, they report that after the crisis the market started pricing a basket of risks not previously compensated by the spreads, notably the risk of the crisis' transmission, international risk and liquidity risk.

Similar analyses based on emerging countries highlight that the most relevant fundamentals in these economies are a mix of external and internal variables. As outlined by Hilscher and Nosbusch (2010), in principle it makes sense that external factors are more important in emerging countries than in advanced countries, because their domestic markets are smaller and their economies typically rely on commodity exports. Consequently, these authors stress the effect of terms-of-trade and its volatility as major drivers of sovereign bond yields. Ho (2016) finds that external factors (namely the level of international reserves, external debt and the current account balance) are significant long-term determinants of sovereign CDS spreads. Presbitero et al. (2015) adopt a sample selection model and find that both external fundamentals (namely the level of international reserves and the current account) and the fiscal space matter for the pricing of sovereign risk. Aizenman et al. (2016) build on this view and identify distinct patterns of sovereign CDS spreads over time and across geographic areas. They claim that external factors (and trade openness especially) were more important drivers before the global financial crisis, as in general a higher degree of interdependence with the rest of the world amplifies the impact of external shocks on the domestic economy. In the aftermath of the global financial crisis, instead, the markets assigned larger weights in their valuation models to the diverse mixes of fiscal and monetary policies adopted by the governments to counter the consequences of the crisis. Turning to the size of regional sovereign spreads, they report that Latin American countries tend to borrow at a systematically higher cost than Asian countries (as also suggested by Longstaff et al., 2011), and this gap widened as a consequence of the crisis.

Finally, a recent strand of literature focuses on the effect of ESG factors on sovereign spreads. Indeed, there exists some evidence that standard credit rating methodologies do not fully incorporate extra-financial information (Allianz Global Investors, 2017). Capelle-Blancard et al. (2019) carry out a study on a sample of OECD countries and find that overall ESG scores are significant determinants of sovereign risk and, consequently, of sovereign spreads. By splitting the overall ESG score into its three components, they pinpoint that the governance score exerts the largest effect; the social score has a smaller effect; whereas the environmental score does not affect spreads at all. Margaretic and Pouget (2018) perform a similar analysis on a sample of emerging market economies and report analogous evidence, i.e. sovereign spreads embed information on the ESG scores as a whole, but not on the environmental component alone. Furthermore, the dynamic approach of the study reveals some complex causal effects: while positive changes in the governance factor contemporaneously affect the spreads as new information is released, improvements in the social factor initially rise the spreads and lower them after some time. The authors claim the reason for the contemporaneous effect of the governance factor to be its widespread use in the current valuation models of international investors. On the other hand, they motivate the lagged influence of the social factor by suggesting that the market overstates the financial costs of social improvements in the short run, eventually recognising their benefits to the public finances in the long run. For a summary table of the literature on the country-specific determinants of sovereign credit risk, see Table 1.2 in the Appendix.

1.1.4 Spillovers and contagion

Some of the recent literature analyses the spillover effects and contagion between the sovereign spreads of different countries. Several papers (Longstaff et al., 2011; Fender et al., 2012; Amstad et al. 2016) suggest the existence of time-varying correlations across the spreads throughout periods of financial turmoil. When analysing the specific field of research though, it is worth pointing out that the results are largely dependent on the different methodologies employed by the authors (Augustin, 2012, p. 16).

Among those studies based on broad samples of advanced and emerging market economies, the research by Beirne and Fratzscher (2013) provides an analytical distinction between three different types of contagion. The first type is fundamentals contagion, arising from an intensification of the sensitivity of the markets to macroeconomic fundamentals. The second type is regional contagion, characterised by an increase in risk spillovers across countries within the same region. The third type is herding contagion or pure contagion, defined as a temporary cross-country dependence in the unexplained variance (i.e. the residuals from the regression of sovereign risk). The results of the country fixed effects estimation include systematic evidence of fundamentals contagion after the global financial crisis, especially for what concerns the GIIPS countries. Conversely, regional spillovers decreased in the aftermath of the crisis, particularly in the euro area. Overall, these results indicate a shift in the drivers of cointegration from geographical proximity and economic relationships to a discriminatory role of country fundamentals. There is some spot evidence of herding contagion, but this is more concentrated in time and geographically. Wu et al. (2016) focus on the distinction between regional contagion and global risk spillovers by the means of a multifactor asset pricing model based on the results from a generalised principal component analysis. They document the occurrence of immediate regional contagion following an extreme spike in the sovereign CDS spread of a country. The consequences of credit events reach the global level too, but at a slower pace. The regional effects appear to be mainly driven by country-specific fundamentals, whereas the global effects are explained by investors' attitudes towards risk and debt levels.

The European sovereign debt crisis prompted a large number of enquiries specifically addressing the linkages within the EMU. By implementing standard panel estimation techniques, Arghyrou and Kontonikas (2012) show evidence of contagion corresponding to the sovereign debt crisis in the EMU. They also document a shift corresponding to the global financial crisis: from a cointegration regime due to a "convergence hypothesis" between the centre and the periphery of the euro area to a more differentiated regime based on macroeconomic fundamentals and international risk (in line with Beirne & Fratzscher, 2013). Caporin et al. (2018) argue that the previous evidence in favour of contagion may be due to the implicit assumptions of linear regression techniques. Indeed, by adopting a quantile regression approach, they do not find any evidence of shift-contagion following the European debt crisis. Instead, they do find some signs of contagion in the EMU after the collapse of Lehman Brothers in the fall of 2008, but, surprisingly, in a negative sense (i.e. the synchronisation of the spreads of the euro area decreased rather than increasing in the wake of the crisis). Their interpretation is that the markets anticipated the upcoming fiscal distress in the euro area immediately after the outbreak of the financial crisis in the United States. For a summary table on the previous research on spillovers and contagion effects across sovereign spreads, see Table 1.3 in the Appendix.

1.2 Determinants of sovereign defaults

We can distinguish two conceptually different strands in the literature on the determinants of sovereign defaults. One strand is more concerned with the causes of sovereign defaults from an ex-post perspective. In other words, it inspects the pre-existing factors that determine the occurrence of a default. Its main objective is to explain the underlying reasons for which debt crises occur. Therefore, it usually adopts a causal, theoretical, thematic and backwards-looking approach. These studies usually build theoretical models based on some a priori knowledge, which they subsequently test by linear regression techniques in order to check their consistency with real-life data. I will analyse this field of literature in Section 1.2.1.

Another strand focuses on the information content of some variables from an ex-ante perspective. The purpose, in this case, is to identify some recurring patterns in related variables shortly before past crises in order to predict the occurrence and the timing of future crises. Compared to the other strand of literature, this kind of research adopts more of a descriptive, empirical, methodological and forward-looking approach. This field of research usually employs early-warning signals based on methodologies such as generalised linear models, event study analyses or machine learning algorithms. I will discuss these studies in Section 1.2.2.

1.2.1 Causes of sovereign defaults

Some authors underline the fragilities arising from unbalanced currency and maturity composition of a country's public debt. The seminal paper by Eichengreen and Hausmann (1999) introduces the concept of "original sin" with respect to the sovereign debt crises occurred throughout the 1990s (notably, in Mexico in 1994; in South-East Asia in late 1997; and in Russia in 1998). The authors define the original sin as "a situation in which the domestic currency cannot be used to borrow abroad or to borrow long term, even domestically" (p. 3). The root cause of this situation lies in the large unwillingness of international investors to hold local currency bonds issued in emerging and developing countries, as they fear that opportunistic devaluations may erode the real value of their bonds. Domestic issuers, then, are left with two alternatives. The first choice is borrowing in foreign currency; however, this choice exposes them to currency risk in the case of a depreciation of the local currency, as their assets are denominated in local currency while their liabilities in foreign currency. The second choice consists in borrowing short term, but this exposes them to refinancing risk in the case of a rise in the domestic interest rates, as their assets have longer maturities. Thus, in the presence of the original sin hypothesis, the balance sheets of domestic issuers (including sovereign issuers) are unavoidably unbalanced in the sense of either a currency mismatch (i.e. assets denominated in local currency and liabilities denominated in foreign currency) or a maturity mismatch (i.e. long-term assets and short-term liabilities). Both the mismatches eventually lead to a deterioration in the country's resilience to external shocks, as a currency crisis can easily trigger a debt crisis.

The recent empirical evidence on the original sin hypothesis emphasises that it may have disappeared over the last two decades as emerging countries have managed to rebalance the currency and maturity composition of their public debt. Ottonello and Perez (2019) report that local currency sovereign bond markets have steadily grown over the past decade, although foreign currency sovereign debt still represents the majority of the current outstanding amount. They attribute the gradual disappearance of the original sin to the progressive stabilisation of growth and inflation in these economies. Jeanneret and Souissi (2016) perform separate analyses for local currency and foreign currency debt, respectively. They observe a substantial similarity in the default rates of the two categories of debt. Moreover, they do not find any significant relationship between the fraction of foreign currency debt and the probability of default. Nevertheless, they find that maturity mismatches (as proxied by the fraction of short-term external debt) still impinge on the probability of default.

Moving from the evidence that local currency borrowing in emerging market economies has steadily climbed in recent years, Carstens and Shin (2019) propose a new version of the original sin hypothesis called "original sin redux". This alternative formulation of the hypothesis states that, because of the rebalancing in the currency composition of debt in these countries, their balance sheets do not bear the risks arising from currency mismatches anymore. Nevertheless, these risks have not disappeared, but they have shifted to the international investors' balance sheets instead. Indeed, as international investors typically have liabilities denominated in their home currency, a depreciation of the assets denominated in the local currency of an emerging country results in net portfolio losses to these investors. Since they typically face risk constraints in their portfolio allocation, when the depreciation rates exceed a certain level the constraints become binding. Consequently, they will rebalance their portfolio away from those countries wherein the local currency is subject to large depreciations. This means that even if emerging countries do not bear the risks from currency mismatches anymore, they can still suffer from the financial instability arising from the capital outflows following a depreciation of the local currency.

Other researchers focus on the vulnerabilities due to the linkages between the domestic financial sector and sovereign debt (i.e. the sovereign-bank nexus). Acharya et al. (2014) model an "Irish style" type of debt crisis, wherein the risk transmission channel runs from the banks to the sovereign. They recognise bank bailouts as a source of sovereign risk, as the government finances the bailouts by issuing new debt. Furthermore, an increase in sovereign risk, in turn, inflates bank credit risk, both directly via the government bonds held by banks, and indirectly via the explicit or implicit government guarantees on banks. Thus, they claim the existence of a "diabolic loop" between the public sector and the private sector, i.e. an intervention of the government in order to ensure the solvency of banks in the short run ends up increasing the credit risk of both public and private debt in the long run. While in their framework it is the financial weakness of the private sector impinging on the public sector, in Gennaioli et al. (2014) the reference is rather to a "Greek-style" type of debt crisis, wherein the risk transmission channel runs from the sovereign to the banking system. In their model, the incentive for a government to default is lower as creditor rights are stronger, banks hold more government bonds, and private capital inflows are larger, as the costs of default to the private sector increase with these factors.

The evidence provided by Reinhart and Rogoff (2011), based on the historical database from the same authors covering over two centuries of data, partially reconciles the strand of literature concerned with external fragilities with the other strand exploring the sovereign-bank nexus. The authors run some causality tests and establish that external debt crises tend to anticipate banking crises, which in turn help to predict sovereign defaults. As a concluding remark, notwithstanding the difficulties in disentangling the exact causal linkages between these types of crises (currency crises, banking crises and sovereign defaults), it is important to note that they often occur together. For a summary table on the causes of sovereign defaults identified in the literature, see Table 1.4 in the Appendix.

1.2.2 Early-warning signals of sovereign defaults

Another strand of literature examines the predictors signalling the occurrence of a debt crisis. Manasse et al. (2003) employ two alternative models in order to predict debt crises one year before they occur, i.e. a pooled logit model and a classification tree. From the logit model, they infer a close correspondence between the economic intuition and the empirical evidence. Both solvency (namely the level of external debt over GDP) and liquidity measures (namely the level of short-term debt over GDP and external debt-service payments) matter for the prediction of upcoming sovereign defaults. Other relevant early-warning variables are various country-specific imbalances, both external (such as a low current account balance) and internal (such as low output growth, a high level of inflation and high inflation volatility); from a global perspective, investors' confidence matter too. Finally, political uncertainty also affects the probability of default. Among those studies employing a pooled logit model, Hilscher and Nosbusch (2010) confirm the significance of both solvency and liquidity measures, adding to the former the distance in time since the last default. Compared to Manasse et al. (2003), their analysis emphasises the role of external imbalances: the authors claim that these variables have a substantial impact, particularly on open emerging market economies, as they are more dependent upon international markets than advanced economies. Accordingly, they stress the importance of the volatility of the terms-of-trade and the level of official reserves as proxies of resilience to external trade shocks and international capital flows, respectively. Jeanneret and Souissi (2016) corroborate previous findings for what concerns output growth, the level of sovereign indebtedness and the maturity of the external debt. In addition, they include among the significant predictors the level of domestic investment. Differently from previous studies though, they do not observe any significant effect of governance factors (namely political instability and government effectiveness) on the probability of default. Thus, they conclude that sovereign defaults on foreign currency debt seem to be driven by an inability-to-pay motive rather than by an unwillingness-to-pay motive. Pescatori and Sy (2007) apply a panel logit model, instead, but confirm most of the results of comparable studies.

Other researchers focus their attention on the methodological issues related to the construction of early-warning models. Moving from the observation that empirical results tend to vary considerably among different papers, Chakrabarti and Zeaiter (2014) propose an extreme bound analysis in order to test the robustness of previous results to alterations in the conditioning information set. Indeed, they highlight that the effect of some variables (namely creditworthiness, output growth, leverage on export earnings, debt service, and inflation) is robust to different specifications. On the other hand, the estimates on other variables (such as trade openness, central bank liabilities, interest payments, cost of borrowing, imports, exports, per capita GNP, and government stability) appear to be highly sensitive to small alterations in the conditioning information set. Dawood et al. (2017) compare the forecasting performances of various econometric techniques (namely the binary logit model, the multinomial logit model, and the dynamic signal extraction approach) by separately applying each of them to different world regions. They show that the binary logit model outperforms the alternative models both for in-sample and for out-of-sample forecasting. From an empirical point of view, they emphasise the importance of including the spillover effects from the banking sector and the foreign exchange market among the predictors. Finally, Holopainen and Sarlin (2017) also perform a horse race among several alternative early-warning models for financial crises, but in this case, the competition is between conventional statistical and econometric techniques on one side and machine learning algorithms on the other. The former type of classification methods includes, for instance, the logit model, which – as I have documented above – is often employed in the literature, while the latter type gathers advanced techniques, such as *k*-nearest neighbours, neural networks and ensemble methods. They document that the latter type of classification methods tends to outperform the former type, thus invoking future economic research to make more extensive use of machine learning for early-warning purposes. For a summary table of the literature on the early-warning indicators of default, see Table 1.5 in the Appendix.

2 Methodology

2.1 Determinants of sovereign spreads

In the first model, I assess the causal effect of different factors on the monthly sovereign CDS spreads of 19 emerging market economies from January 2007 to July 2019. I consider a wide set of explanatory variables, either globally or locally determined. For each independent variable, I will now provide a brief discussion of the rationale, references in the literature and the expected sign of the respective coefficient.

2.1.1 Global determinants

- VIX index (absolute change). An increase in the VIX index (which is a proxy of the volatility in international financial markets) may cause an upward shift in the portfolio risk of global investors. Therefore, they may pull out of riskier investment and direct their funds to "safe havens", which in turn would cause an increase in the borrowing costs of emerging countries. Thus, I expect it to carry a positive coefficient (within the vector of coefficients $\boldsymbol{\beta_1}$ related to the global factors in Equation 2.2).
- U.S. effective federal funds rate (basis points, absolute change). [10] The effective federal funds rate is a proxy for the whole yield curve. A reduction in the U.S. interest rates may signal a contractionary phase in the global economy, thus starting capital flights away from riskier emerging countries. At the same time, however, lower interest rates in the U.S. may divert investments from the mainland to more attractive opportunities in emerging countries. Because of the debate in the literature about its sign[11], I decide not to make any conjecture on the expected sign.
- S&P500 stock index (percentage change). The major stock index provides a proxy of the market expectations about the future growth of the U.S. economy. Positive stocks

[10] The federal funds rate is the interest rate at which depository institutions trade federal funds (balances held at the Federal Reserve) with each other overnight. The effective federal funds rate is the weighted average rate for all of these types of negotiations.
[11] See McGuire and Schrijvers (2003, p. 76) for a review of the empirical findings on the sign of the U.S. interest rates.

performances may increase investors' confidence in debt sustainability in emerging economies, thus lowering their borrowing costs. Therefore, I expect an associated negative coefficient.

2.1.2 Country-specific determinants

- Industrial production index (seasonally adjusted, percentage change). This index provides the highest-frequency measure of the state of the real economy of a country (Remolona et al., 2008). Steady growth may contribute to the sustainability of sovereign debt. Therefore, I expect it to show a negative relationship with the CDS spreads (within the vector of coefficients $\boldsymbol{\beta_2}$ related to the country-specific factors in Equation 2.2).
- Consumer Price Index (CPI, percentage change). The inflation rate carries information about the monetary policy and, to some extent, about the fiscal responsibility of the government and financial stability of a country (Remolona et al., 2008). Even if the real value of foreign currency debt is not subject to monetisation, the creditworthiness of a sovereign issuer may still suffer from prolonged and sustained levels of inflation. Hence, I expect it to have a positive causal effect on CDS returns.
- Commodity terms-of-trade index (percentage change). The weighted ratio of net export prices over import prices indicates the ability of a country to generate dollar revenues and to pay back its external debt (Hilscher and Nosbusch, 2010). Therefore, I expect it to exert a negative impact on CDS returns.
- Nominal exchange rate (units of local currency per U.S. dollar, percentage change). As pointed out by the recent study of Hofmann et al. (2019), an appreciation of the bilateral nominal exchange rate vis-à-vis the U.S. dollar loosens financial conditions in the emerging economy and compresses sovereign credit risk spreads, both in local currency and foreign currency. Therefore, I expect a positive coefficient to be associated with an increase in the exchange rate (depreciation of the local currency).
- Currency volatility (percentage change). I also add to the variation in the exchange rate the per cent change in the 30-days local currency volatility. My hypothesis is that the markets may require an additional premium to cover potential risks arising from fluctuations in the value of the local currency. The impact of volatility is also emphasised by Hilscher and Nosbusch (2010) with respect to commodity prices. Hence, I expect the coefficient to have a positive sign.
- Foreign official reserves (absolute change). Official reserves measure the liquidity of the government: they determine its ability to shield its currency against excessive fluctuations

and to repay its short-term foreign currency debt (Remolona et al., 2008). Hence, I expect to see a negative relationship with sovereign CDS returns.

- Domestic stock index (percentage change). Local stock market returns may provide insight into the future growth of a country and attract investments from abroad (Longstaff et al. 2011). I expect positive returns to affect CDS spreads negatively.
- Credit rating (consensus, absolute change). I introduce a credit rating measure in the spirit of Remolona et al. (2008). It comprehends not only ratings per se but also credit reviews, which include outlooks and watches. The purpose of considering reviews is to capture changes in the creditworthiness of a sovereign issuer at a higher frequency than those implied by rating changes, so that the current valuation already discounts expected future changes. Furthermore, this timely measure combines ratings from S&P's, Moody's and Fitch to create a consensus among the major agencies. In order to build this measure, I perform a linear transformation of the credit ratings assigned by each agency to a numeric scoring system from 1 to 20, where 1 represents the lowest rating and 20 the highest (similarly to Afonso et al., 2012; see Table 2.1 in the Appendix for a conversion table among the original rating scales). Then, for each agency I compute a weighted average analogous to the one proposed by Remolona et al. (2008), according to the formula:

$$rating_{it} = \begin{cases} 0.7 \times rating_{0it} + 0.3 \times rating_{1it}, & if\ outlooks \\ 0.4 \times rating_{0it} + 0.6 \times rating_{1it}, & if\ watches \end{cases} \tag{2.1}$$

where $rating_{it}$ is the comprehensive measure for country *i* in month *t*, $rating_{0it}$ is the current rating assigned to the country and $rating_{1it}$ is the current rating adjusted by one notch depending on the direction of any pending outlook or watch. The probability weights are those indicated by the authors after discussions with credit analysts. Accordingly, a future change in the rating is considered more likely in the case of a watch than an outlook. Finally, I take the average between the three ratings to obtain the final consensus rating.

2.1.3 Specification

In the baseline specification, I construct a dynamic fixed effects regression as the following:

$$cds_{it} = \beta_0\, cds_{it-1} + \boldsymbol{\beta_1}'\boldsymbol{\Delta G_{it}} + \boldsymbol{\beta_2}'\boldsymbol{\Delta F_{it}} + u_i + \varepsilon_{it}, \tag{2.2}$$

where the dependent variable cds_{it} is the logarithm of the dollar-denominated 5-year sovereign CDS returns of country i in month *t*; $\boldsymbol{\Delta G_{it}}$ is the vector of global shocks; $\boldsymbol{\Delta F_{it}}$ is the vector of country-specific shocks; and ε_{it} is the idiosyncratic error term. I choose a dynamic fixed effects specification as it encompasses many of the subject-specific features outlined in the literature review. Indeed, as sovereign CDS returns exhibit strong persistence over time (Afonso et al., 2014), I include the first lag of the dependent variable among the predictors.[12] Moving from the findings of Longstaff et al. (2011), I conjecture that global factors play a major role. Hence, I account for global shocks by adding a vector of predictors $\boldsymbol{\Delta G_{it}}$ (reported in Section 2.1.1). I also take into account a set of shocks in country-specific fundamentals $\boldsymbol{\Delta F_{it}}$ (reported in Section 2.1.2) in order to model dynamic heterogeneity across countries. Finally, I consider country-specific individual effects u_i to capture time-invariant heterogeneity across countries (as in Comelli, 2012).

I estimate the model by several panel estimation techniques, taking care of different issues possibly affecting the dataset (namely serial correlation, heteroscedasticity and cross-sectional dependence). While treating the global variables as exogenously determined, I take into consideration the possibility that country-specific shocks may be driven by sovereign CDS spreads (i.e. reverse causality). Hence, I provide an alternative instrumental variable (IV) approach in order to deal with potential endogeneity issues.

2.2 Determinants of sovereign defaults

In the second model, I predict the probability of an external sovereign default in the following year based on a wide set of countries' characteristics and global financial conditions in the current year. I employ yearly frequency data in order to identify the structural features that may trigger a default and signal its arrival. In a sense, while the model on the determinants of sovereign spreads aims to predict the short-run changes in the market pricing of sovereign risk as a whole (as composed by default risk and the risk premium attached by investors), the purpose of this model is to isolate the long-run default risk component. In addition to some of the previous country-specific predictors, I include among the explanatory variables several other socio-demographic and economic factors, which I will now briefly present.

[12] Nickell (1981) shows that including the lagged dependent variable among the predictors introduces a bias in the fixed effects panel estimation. However, as Afonso et al. (2014) point out, the size of the bias declines as the time dimension T of the panel increases, to the extent that it is already quite small when T=20 (Hallerberg and Wolff, 2008). Since in my dataset the average T=144, I decide to ignore the bias (as Afonso et al., 2014, do with the same time dimension). See Bruno (2005) for a quantitative assessment of the size of the bias in unbalanced datasets.

2.2.1 Country-specific determinants

- Population (logarithm). Larger countries may show greater resilience to any shortcoming in the repayment of their debt and some may even benefit from a "too-big-to-fail" logic. Therefore, I expect to see a negative coefficient (within the vector of coefficients $\boldsymbol{\beta_2}$ related to the country-specific factors in Equation 2.4).
- GDP (percentage change). GDP growth is one of the direct drivers of the public debt-to-GDP ratio as, ceteris paribus, it automatically decreases the level of the ratio, thus improving sovereign debt sustainability. Hence, I expect it to carry a negative coefficient.
- Domestic credit to the private sector from banks (as a percentage of GDP). The size of the banking sector is a proxy for the level of financial development (De Gregorio and Guidotti, 1995). Intuitively, financially developed economies are more likely to have greater access to international capital flows. Furthermore, Gennaioli et al. (2014) show that sovereign defaults are costlier in those markets where the financial system is more developed, as banks' holdings of sovereign bonds are typically larger and the level of creditor protection is higher. Thus, the incentive for a sovereign issuer to default is lower in those countries. Therefore, I expect the size of the banking sector to have a negative effect on the probability of default of the sovereign.
- General government debt (as a percentage of GDP). The stock of public debt may be deemed unsustainable if the market expects it to take an explosive path in the long run. Therefore, I expect it to enter the specification with a positive coefficient.
- Overall budget balance (as a percentage of GDP). The overall budget balance (i.e. comprehensive of interest payments) determines the pace of convergence (or divergence) of the debt-to-GDP ratio over time. Following the logic of the general government debt, it should affect the probability of default in a negative sense.
- Resource-rich country (dummy). I adopt the binary indicator introduced in an IMF (2012) paper. A country with abundant natural resources is more likely to ensure debt sustainability through international trade and privatisations. Therefore, I expect to see a negative relationship.
- Banking crisis (dummy). Some papers (Acharya et al., 2014) identify the implicit guarantee by governments on bank losses (the so-called sovereign-bank nexus) as a significant and self-reinforcing determinant of increasing sovereign debt burdens. Therefore, when a banking crisis is ongoing in the country, it should increase the probability of sovereign default.
- Domestic default (dummy). An ongoing domestic default (i.e. a default of the sovereign issuer to domestic residents) may trigger upcoming shortfalls on external debt repayments too. Thus, I expect its coefficient to have a positive sign.

- ESG rating. In order to capture extra-financial information about countries, I include among the predictors an overall ESG rating obtained as a weighted average of three distinct governance, social and environmental scores, each of them ranging between 1 and 100. The weights assigned to these factors are 50%, 25% and 25%, respectively. I expect this overall score to have a negative relationship with the probability of default.
- Current account balance (as a percentage of GDP). As it mirrors the capital and financial account balance in the balance of payments of a country, the current account balance provides information on the direction of international capital flows. Capital inflows relax the government financing needs, whereas capital outflows deteriorate its external position. Hence, I expect the current account balance to carry a negative coefficient.
- Volatility of the commodity terms-of-trade index (percentage). In addition to the per cent change in the net export price index already introduced in the first model, here I also consider the 12-month level of volatility of the same index. Hilscher and Nosbusch (2010) find that higher uncertainty in international commodity prices tends to inflate refinancing risk in exporting countries. Thus, I expect this volatility measure to drive the probability of default positively.
- Currency crisis (dummy). A large short-term depreciation of the local currency may trigger defaults on foreign currency denominated debt and deteriorate the creditworthiness of a government. Hence, I expect it to exert a positive effect.
- Indicator of distance in time since the last default. I build an indicator similar to the one used by Jeanneret and Souissi (2016) to account for the history of external defaults of a country. It ranges from 1 to 100, wherein 1 means the last default in the country is more distant in time, while 100 means the country is currently in default. It is based on the formula:

$$last\ default_{it} = \frac{100}{(1 + years\ last\ default_{it})} \tag{2.3}$$

where $last\ default_{it}$ is the indicator for country i in year t and $years\ last\ default_{it}$ is the number of years since the last default (capped at 99 if larger). As in Jeanneret and Souissi (2016), it decays rapidly and approaches 1 after a few years, meaning that I assume the memory of the market of past defaults is not persistent. I expect it to have a positive coefficient.

- Number of regional defaults in the last five years. I include this variable to capture regional clustering effects in sovereign defaults. I expect the related coefficient to carry a positive sign.

2.2.2 Specification

I estimate the model by a binary logistic regression (following Jeanneret and Souissi, 2016). In the baseline specification, the marginal probability of default is given by:

$$P_t(default_{it+1} = 1) = \frac{1}{1 + \exp[-(\beta_0 + \boldsymbol{\beta_1}'\boldsymbol{G_{it}} + \boldsymbol{\beta_2}'\boldsymbol{F_{it}} + \varepsilon_{it})]} \tag{2.4}$$

where $default_{it+1}$ is a binary indicator equal to 1 if a default occurs in country *i* in year *t+1*; as in the model on sovereign spreads, $\boldsymbol{G_{it}}$ and $\boldsymbol{F_{it}}$ represent vectors of global and country-specific factors, respectively, and ε_{it} is the idiosyncratic error term. The vector of global variables contains many of the factors already included in the first model (defined in Section 2.1.1). The only differences are that the VIX index and the effective federal funds rate now enter in levels (as opposed to changes) and I drop the S&P500 returns due to multicollinearity issues. The vector of country-specific fundamentals adds the explanatory variables reported in Section 2.1.2 to some of the factors already included in the model for sovereign spreads; I refer the reader to the estimation of the model in Section 4.2 for the full list of country-specific factors.

After the estimation, I evaluate the prediction power of the model as a binary classifier by training it on a subsample period (training set) and assessing its performances on the remaining sample (test set). I derive the classification method from the review of early-warning signals by Holopainen and Sarlin (2017).

3 Data

3.1 Determinants of sovereign spreads

3.1.1 Data selection

I employ two unbalanced panel datasets, one for each model. The first dataset includes monthly data from January 2007 to July 2019 and covers all the 19 countries in the Bloomberg Barclays Emerging Markets Local Currency Liquid Government Index (see Table 3.1 in the Appendix for a full list of countries). I collected data on end-of-period dollar-denominated 5-year sovereign CDS returns from Bloomberg. The choice of studying sovereign CDS spreads rather than government bond yields is supported by the literature. While reporting mixed evidence from previous studies, in the literature review by Augustin (2014) the author stands in favour of larger informational efficiency in the credit derivative market, as bid-ask spreads tend to be smaller than in the underlying bond market and price discovery is faster in markets showing higher levels of liquidity. Moreover, I focus on sovereign CDS contracts with a 5-year maturity, an asset class usually regarded as the most liquid across the whole term structure. For a full definition and references to the sources of the data included in the set of independent variables, please see Table 3.2.

Table 3.2: Sources and definitions of the data employed in the model of sovereign CDS spreads.

Variable	Definition	Source
CDS	Dollar-denominated 5-year sovereign CDS spread (in basis points).	Bloomberg
VIX	Average VIX index.	FRED
Fed funds	Average U.S. effective federal funds rate (in basis points).	FRED
S&P500	S&P500 index closing price.	Yahoo! Finance
Industrial	Industrial production index (seasonally adjusted).	GEM
Prices	Consumer Price Index.	IFS
Terms-of-trade	Net export price index.	CTOT
Exchange rate	Nominal bilateral exchange rate vis-à-vis the U.S. dollar (units of local currency per U.S. dollar).	IFS
Currency volatility	30-day volatility of the exchange rate (% of the value of the currency).	Bloomberg
Reserves	International reserves (in months of imports).	GEM
Stocks	Domestic stock index closing price.	GEM, Bloomberg
Rating	Comprehensive measure of credit rating (see Section 2.1.2).	Bloomberg

Note. All the data have monthly frequency.

3.1.2 Descriptive statistics

In Table 3.3 I display some descriptive statistics from the full sample for the first model. Focusing on sovereign CDS spreads, we can observe that the respective variable stands, on average, at 135 basis points. It also shows considerable variance, as the standard deviation is equivalent to more than half the mean (77 basis points).

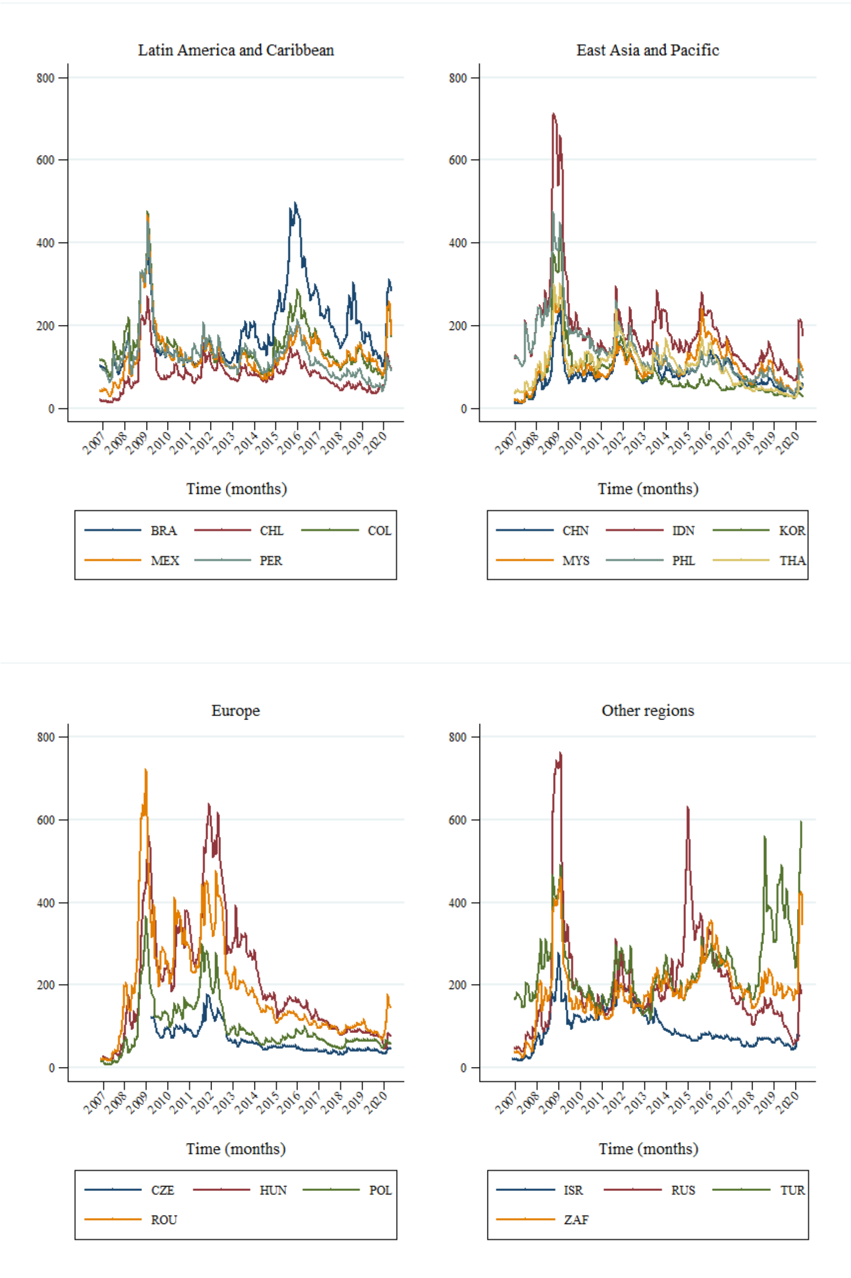
Table 3.3: Summary statistics of the full sample.

	Obs.	Mean	St. dev.	Min.	25%	Median	75%	Max.
CDS	3019	134.94	77.07	38.47	76.80	117.37	173.30	324.82
VIX	3163	18.86	8.65	10.13	13.49	16.24	21.24	62.64
Fed funds	3163	124.61	165.03	7.00	12.00	22.00	195.00	526.00
Δ log S&P500	2888	0.54	3.76	-7.78	-1.76	1.08	3.17	6.67
Δ log Industrial	2846	0.23	1.88	-3.65	-0.88	0.32	1.34	3.98
Δ log Prices (inflation)	2888	0.30	0.37	-0.33	0.02	0.27	0.53	1.10
Δ log Terms-of-trade	2888	0.01	0.35	-0.66	-0.19	-0.02	0.18	0.79
Δ log Exchange rate (depreciation)	2888	0.16	2.71	-4.73	-1.54	-0.08	1.70	6.05
Δ log Currency volatility	2904	-0.52	27.61	-50.08	-19.59	-1.28	18.03	55.22
Reserves	2864	10.30	6.51	1.06	5.70	8.16	13.70	35.87
Δ log Stocks	2888	0.17	5.67	-11.61	-3.47	0.57	4.10	10.16
Rating	3059	12.81	2.51	7.33	11.00	12.67	15.00	17.67

Note. In column: number of observations, mean, standard deviation, minimum value, 25th percentile, median, 75th percentile and maximum value of each variable (in row). The sovereign CDS spreads and the effective federal funds rate are expressed in basis points. The VIX index, the level of reserves and the credit rating are in absolute terms (see Table 2.1 in the Appendix for a conversion table among the original credit rating scales). All the logarithmic differences (measuring growth rates) are in percentage. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail) to control for the presence of outliers.

In order to disentangle the portion of variance related to the time dimension and the other due to the cross-sectional dimension, in Figure 3.1 I plot the original (not winsorised) series of the sovereign CDS returns from January 2007 to March 2020 gathered in different graphs by region. From a visual inspection, the most noticeable feature of the series concerns their volatility over the sample period (time dimension). Indeed, we can clearly spot some historical events that had a major resonance on all the spreads contemporaneously. We can observe the largest spikes in almost all the series from the end of 2008 to the beginning of 2009, as a consequence of the peak of the global financial crisis. We can also appreciate the sizeable degree of cointegration of the series during the crisis. After the crisis, sovereign CDS returns tended to diverge more because of the greater relevance assigned by investors to local factors in tranquil times (Amstad et al., 2016). Some notable exceptions to this otherwise diverging process are the widespread increase during the 2010-2012 European sovereign debt crisis; the minor jump following the taper tantrum crisis in mid-2013; and the sharp rise in the first quarter of 2020 due to the COVID-19 pandemic. All these periods of increased cointegration between the spreads are associated with episodes of turbulence in the financial markets, again in line with the evidence from Amstad et al. (2016). Some upwards shifts in the individual time series are attributable to idiosyncratic rather than systemic factors. I will just point out a few examples. CDS spreads in Hungary and Romania were more affected by the European sovereign debt crisis than other countries. Several Latin-American governments bore substantially higher funding costs during the recession in Brazil of 2014-2016. The spread on Russian sovereign CDS shows a spike corresponding to the 2014 political crisis in Ukraine. Finally, Turkey experienced hiking levels of sovereign spreads following the political tensions of recent years.

Figure 3.1: Monthly sovereign CDS spreads by region and reference entity, in basis points.



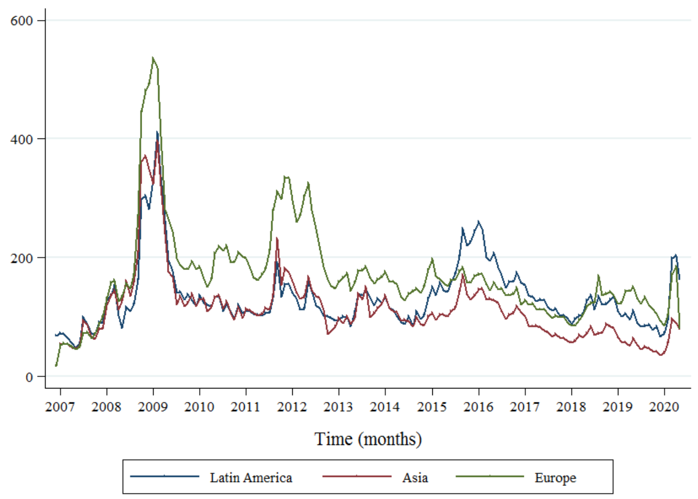
3.1 Determinants of sovereign spreads

The remarkable cointegration properties between the series derive from their strong dependence on common factors. Indeed, in Figures 3.2, 3.3, and 3.4 in the Appendix, I document that the series of the average sovereign CDS returns exhibits high correlations with some global variables widely adopted in the literature. Specifically, these are the VIX index (Figure 3.2 in the Appendix), the U.S. effective federal funds rate (Figure 3.3 in the Appendix), and the S&P500 index (Figure 3.4 in the Appendix). In the case of the VIX index, the correlation coefficient is positive (0.81), as an increase in market volatility inflates sovereign credit risk as well. On the opposite, the correlation coefficients with the U.S. effective federal funds rate and the S&P500 index are negative (-0.49 and -0.50, respectively). While the interpretation of the correlation coefficient corresponding to stock market returns is straightforward (the borrowing costs of emerging market economies benefit from improving world growth prospects), the explanation behind the correlation coefficient accounting for the U.S. yield curve is multifaceted. I will discuss it further in Section 4, when evaluating the results from the model.

While changes in the spreads closely relate to shocks in global financial variables, the overall divergence process in the levels of the spreads reflects the heterogeneity of the countries in the sample (cross-sectional dimension). In order to visualise it, in Figure 3.5 I plot the cross-sectional averages of some sovereign CDS spreads by region over time. Specifically, I only show three regions: East Asia and Pacific (shortened to "Asia" for simplicity); Latin America and the Caribbean ("Latin America"); and Europe and Central Asia ("Europe").[13] We can see that during the 2007-2008 global financial crisis the regional average series move close one to each other. In the peak of the crisis (from the end of 2008 to the beginning of 2009), though, the series for Europe stood at a substantially higher level, possibly reflecting the market expectations of upcoming fiscal distress in the area (Caporin et al., 2018). During the European sovereign debt crisis, both the series for Asia and Latin America remained at a comparable level. However, from 2014 onwards the two series have diverged considerably, reshaping a traditional regional spread (Aizenman et al., 2016). Strikingly, even after the end of the sovereign debt crisis in Europe, the CDS based on the sovereign debt of European countries continued offering, on average, larger risk premia than those related to the sovereign debt of Asian countries, perhaps indicating permanent effects of the crisis on their borrowing costs.

[13] The average series for Sub-Saharan Africa and the Middle East and North Africa are excluded because they are less representative, as both are computed on one individual series only (South Africa and Israel, respectively).

Figure 3.5: Average sovereign CDS spreads by region over time, in basis points.



Note. The three regions under consideration are: East Asia and Pacific ("Asia"), Latin America and Caribbean ("Latin America"), and Europe and Central Asia ("Europe"; see Table 3.1 in the Appendix for the regional classification of the countries).

Indeed, Table 3.4 confirms that Asian sovereign CDS constitute a benchmark for comparisons between regions: Asian sovereign CDS offer, on average, smaller risk premia with respect to both Latin American spreads (larger by 18.28 basis points) and, even more largely, to European spreads (larger by 46.48 basis points). I will now explore more in detail the nature of the regional differences between Europe and Asia, and Latin America and Asia, respectively. Over the period, industrial production in Latin America grew substantially less than in Asia (-0.32%); the European differential, instead, is not significant. Prices in Asia were more stable than in the other two regions: on an average annual basis, they increased by 3% over the whole period, while the same indicator recorded a 4% annual growth both in Europe and in Latin America. From an external perspective, the commodity terms-of-trade index slightly deteriorated in Asia, while the same figure showed minor improvements in Europe and Latin America. This suggests that the role of terms-of-trade in determining spreads may be limited. Other indicators related to the external position, such as the depreciation and the volatility of the local currency, do not significantly differ. The differences in international reserves (in months of imports) are significant in both cases, but show opposite signs. On average, the European monetary authorities had smaller reserves than their Asian counterparts did; in turn, Asian authorities held smaller reserves than their Latin American counterparts did, revealing some ambiguity of the relationship between reserves and sovereign spreads[14]. Finally, the credit

[14] See Bianchi et al. (2018) for a quantitative model on the optimal level of international reserves in the presence of sovereign default risk.

rating of Asian sovereign issuers was, on average, higher by almost one notch than European and Latin American countries. These figures altogether indicate that Asian countries have managed to address some of the imbalances leading to the local financial crashes of the late 1990s. On the opposite, while the regional spread to Latin American countries is widely documented in the literature, the one concerning European countries may be of more recent establishment, perhaps reflecting some persistent effect of the European sovereign debt crisis (Wu et al., 2016).

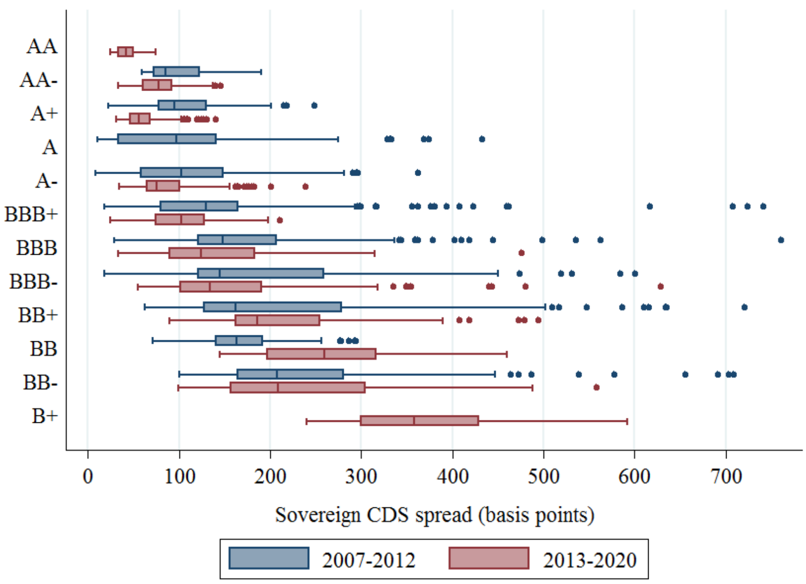
Table 3.4: Summary statistics by region.

	Europe		Latin America		Asia		Europe – Asia		Lat. Am. – Asia	
	Mean	S. d.	Mean	S. d.	Mean	S. d.	Diff.	*P*-val.	Diff.	*P*-val.
CDS	161.13	92.15	132.94	64.20	114.66	62.92	46.48	0.000	18.28	0.000
Δ log Industrial	0.27	1.72	0.06	1.87	0.38	1.99	-0.11	0.192	-0.32	0.000
Δ log Prices (Infl.)	0.33	0.42	0.33	0.32	0.24	0.36	0.09	0.000	0.09	0.000
Δ log T-o-T	0.02	0.32	0.03	0.36	-0.01	0.37	0.03	0.016	0.04	0.030
Δ log FX rate (Depr.)	0.22	3.04	0.21	2.93	0.07	1.95	0.15	0.219	0.14	0.269
Δ log Curr. vol.	-0.11	24.38	-0.06	29.23	-1.03	30.11	0.93	0.474	0.97	0.509
Reserves	7.42	6.69	12.96	6.69	11.09	5.44	-3.67	0.000	1.87	0.000
Δ log Stocks	-0.03	6.19	0.11	5.92	0.36	5.14	-0.39	0.145	-0.25	0.367
Rating	12.22	2.41	12.49	2.21	13.30	2.74	-1.08	0.000	-0.81	0.000

Note. The three regions under consideration are East Asia and Pacific ("Asia"), Latin America and the Caribbean ("Latin America") and Europe and Central Asia ("Europe"; see Table 3.1 in the Appendix for the regional classification of the countries). For each regional group, I report the mean and the standard deviation. Furthermore, I report the statistical difference between the mean of Europe and Asia, and the mean of Latin America and Asia, respectively, along with the *p*-value from a *t*-test computed on each of these differences. The sovereign CDS spreads are expressed in basis points. The level of reserves and the credit rating are in absolute terms (see Table 2.1 in the Appendix for a conversion table among the original credit rating scales). All the logarithmic differences (measuring growth rates) are in percentage. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail).

Another interesting feature of sovereign CDS spreads concerns their relationship with sovereign credit ratings. It is worth noting from Table 3.3 that 75% of the observations in the sample refer to sovereign issuers exhibiting an investment-grade status (see Table 2.1 in the Appendix for a conversion of the ratings). In Figure 3.6 I show the box plots of sovereign CDS spreads by the median of the ratings ("consensus rating") assigned to the issuer by Standard and Poor's, Moody's and Fitch, respectively, and the period under consideration. Specifically, I distinguish between the distress period covering the global financial crisis and the sovereign debt crisis in Europe (2007-2012) and the more tranquil period thereafter (2013-2020). This distinction allows spotting at least two patterns in the data, one related to the differences across ratings and the other to the changes in their distribution over time. Looking at the differences across ratings, the whole distribution of CDS spreads shifts towards lower levels as the rating climbs from speculative to investment grade. All the within-class distributions show a positive skew. However, both during and after the distress period, the variability within each rating class is generally lower for the investment-grade end of the rating spectrum and higher for the speculative-grade end. This indicates that the prices of sovereign CDS referring to high-rated countries reflect their own credit rating more accurately than the prices of the same asset class referring to low-rated countries do. We can also appreciate some general changes over time in the relationship between ratings and spreads. After the distress period, the distribution of the spreads within most of the rating classes (the top quartiles, especially) tends to shift towards lower levels than during the crises. Moreover, the variance within each rating class diminished after the crises. Both of these general trends are attributable to the time-varying risk attitudes of investors. However, there seems to be an exception: while for all the investment-grade and some speculative-grade sovereign CDS (equal to and above BB+) both the median and the variance of the spreads have decreased after the crises, the respective distributional measures of the very low end of the speculative-grade spectrum (below BB+) seem to have increased instead. I interpret this descriptive evidence in the light of potential changes in the production and interpretation of credit ratings. Indeed, the distress period caused a sudden and widespread downgrading of sovereign credit ratings (Financial Crisis Enquiry Commission, 2011). This process may have restored investors' confidence in the investment-grade end of the sovereign credit quality spectrum, as it cleaned these classes up of the weakest assets. At the same time, though, it may have not eliminated the inherent adverse selection issue, shifting the related uncertainty to the speculative-grade end of the spectrum instead.

Figure 3.6: Sovereign CDS spreads by credit rating class and period, in basis points.



Note. Along the horizontal axis, I display the box plots representing the distribution of sovereign CDS spreads, gathering observations by the median credit rating class assigned by Standard and Poor's, Moody's and Fitch (on the vertical axis) and the period under consideration (in legend). The box in the middle of each thin line includes the central 50% of the distribution (included between the 25th and the 75th percentile, named Q1 and Q3, respectively), while the vertical line in the middle of the box indicates the 50th percentile (median, Q2). The left end of the thin line indicates the minimum value larger than Q1-1.5×(Q3-Q1), while the right end indicates the maximum value smaller than Q3+1.5×(Q3-Q1). The dots not lying on the thin line represent extreme values, i.e. outside the range included between Q1-1.5×(Q3-Q1) and Q3+1.5×(Q3-Q1).

3.2 Determinants of sovereign defaults

3.2.1 Data selection

The second dataset records annual data from 1996 to 2014 on 43 emerging countries (of which 14 are also included in the first dataset; see Table 3.5 in the Appendix for a full list of the countries in the second dataset). I retrieved data on external sovereign defaults from the historical database on financial crises constructed by Reinhart and Rogoff (2009). In particular, I adopt the strictest definition of default among those provided by the authors, which only accounts for defaults to private creditors, thus excluding defaults to official creditors (see Table 3.6 in the Appendix for a list of defaults). The definitions and the sources of the data for the independent variables included in the second model (in addition to the ones already defined in Table 3.2) can be found in Table 3.7.

Table 3.7: Sources and definitions of the data employed in the model of sovereign external defaults.

Variable	Definition	Source
Default	Dummy equal to 1 if the sovereign issuer is in default to external private creditors in the current year.	Reinhart and Rogoff (2009)
Financial crisis	Dummy equal to 1 if the year is 2007 or 2008.	-
Population	Population (in millions).	WEO
GDP	Gross Domestic Product (in millions of U.S. dollars).	WEO
Credit	Domestic credit to the private sector from banks (% GDP).	WDI
Public debt	General government debt (% GDP).	WEO
Budget balance	Overall budget balance (% GDP).	WEO
Resource rich	Dummy equal to 1 if the country is rich in natural resources.	IMF (2012)
Banking crisis	Dummy equal to 1 if the government bails out one or more banks in the current year.	Reinhart and Rogoff (2009)
Domestic default	Dummy equal to 1 if the sovereign issuer is in default to domestic private creditors in the current year.	Reinhart and Rogoff (2009)
ESG	Overall ESG score (50% governance, 25% social, 25% environmental).	WGI, HDI, EPI
Current account	Current account balance (% GDP).	WEO
Terms-of-trade volatility	12-month volatility of the net export price index.	CTOT
Currency crisis	Dummy equal to 1 if the annual depreciation rate vis-à-vis the U.S. dollar is larger than 15% in the current year.	Reinhart and Rogoff (2009)

Variable	Definition	Source
Last default	Indicator accounting for the number of years since last default (see Section 2.2)	Reinhart and Rogoff (2009)
Regional defaults	Number of sovereign issuers in external default in the region in the previous five years.	Reinhart and Rogoff (2009)
Reserves	International reserves (in months of imports).	WDI
Foreign currency debt	Foreign currency debt (% total public debt).	IDS
Short-term debt	Short-term external debt (% total external debt, both public and private).	IDS

Note. All the data have annual frequency.

3.2.2 Descriptive statistics

In Table 3.8 I display some descriptive statistics from the full sample for the second model. We can observe that, on average, the number of defaults in the sample is quite modest, amounting to only 13% of the sample in the period 1996-2014. In Figure 3.7 in the Appendix, I plot the same ratio by year over the extended period 1975-2016, so as to provide some perspective over time. The fraction of countries in default is in line with the relative frequency of currency crises (13%) and banking crises (11%), feeding into the hypothesis that there might be some linkages among these types of financial distress (Reinhart & Rogoff, 2011). In order to visualise the extent to which these three types of crises are interrelated over time, in Figure 3.8 in the Appendix I display the fraction of defaults contemporaneously accompanied by both a currency crisis and a banking crisis; a banking crisis only; a currency crisis only; or no other crisis at all (i.e. pure sovereign defaults), respectively. As in Figure 3.7, I consider a longer time interval (1975-2014) in order to appreciate the dynamics in the data.

Table 3.8: Summary statistics on the full sample.

	Obs.	Mean	St. dev.	Min.	25%	50%	75%	Max.
Default	712	0.13	0.34	0.00	0.00	0.00	0.00	1.00
VIX	712	21.12	6.09	12.81	15.48	22.36	25.60	32.69
Fed funds	712	2.40	2.20	0.09	0.16	1.67	4.96	6.24
Financial crisis	712	0.12	0.32	0.00	0.00	0.00	0.00	1.00
Population	712	101.73	265.20	1.19	9.79	26.46	61.24	1,367.82
Δ log GDP (GDP growth)	712	4.55	3.23	-5.16	2.91	4.56	6.48	10.79
Δ log Prices (Inflation)	712	7.75	8.21	-0.25	3.21	5.52	9.36	51.46
Credit	712	37.73	27.67	4.42	18.10	29.12	49.76	111.59
Public debt	712	47.20	24.91	8.43	29.78	42.63	61.09	137.39
Budget balance	712	-2.20	3.27	-10.70	-4.20	-2.21	-0.30	6.66
Resource rich	712	0.36	0.48	0.00	0.00	0.00	1.00	1.00
Banking crisis	712	0.11	0.32	0.00	0.00	0.00	0.00	1.00
Domestic default	712	0.04	0.19	0.00	0.00	0.00	0.00	1.00
ESG	712	50.67	8.72	29.18	46.15	50.38	55.46	71.81
Current account	712	-1.13	5.77	-18.31	-4.39	-1.79	1.79	14.83

	Obs.	Mean	St. dev.	Min.	25%	50%	75%	Max.
Δ log Terms-of-trade	712	0.27	4.62	-38.01	-1.00	-0.07	0.99	49.71
Terms-of-trade volatility	712	1.01	1.84	0.03	0.28	0.49	1.02	30.83
Currency crisis	712	0.13	0.34	0.00	0.00	0.00	0.00	1.00
Last default	712	39.14	38.03	1.00	8.33	20.00	100.00	100.00
Regional defaults	712	3.74	3.01	0.00	1.00	3.00	7.00	12.00
Δ log Exchange rate (Depr.)	701	4.19	10.66	-9.73	-1.55	1.64	7.03	48.14
Reserves	666	5.66	4.80	0.42	3.05	4.46	6.60	36.78
Foreign currency debt	633	93.61	9.43	30.13	91.79	97.55	99.50	99.83
Short-term debt	633	14.99	8.82	0.00	8.71	13.30	19.67	34.44

Note. In column: number of observations, mean, standard deviation, minimum value, 25^{th} percentile, median, 75^{th} percentile and maximum value of each variable (in row). The indicators for external default, financial crisis, richness in natural resources, banking crisis, domestic default and currency crisis are dummy variables. The VIX index, population (in millions), the ESG score, the volatility of the terms-of-trade, the indicator for the distance since last default (see construction in Section 2.2), the number of defaults in the region in the previous five years and the level of reserves are in absolute terms. The effective federal funds rate is in percentage. All the logarithmic differences (growth rates) are in percentage. Domestic credit from banks, public debt, overall budget balance, current account and foreign currency public debt are in percentage of GDP. Short-term debt is in percentage of total external debt. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail) to control for outliers.

From a closer examination of the economic fundamentals reported in Table 3.8, we can recognise a few peculiar traits of emerging market economies, in most of the cases corresponding to common sense. By looking at the internal macroeconomic variables, I document remarkable output growth rates, and even larger inflation rates, on average. In the top 75% of the sample, the annual real GDP growth rate exceeds 3%; in the top half of the distribution, it is even larger than 4.5%. Nevertheless, extreme negative shocks in output are also considerably large (-5%), indicating substantial market risk. Along with the noticeable output growth rates, another typical feature of emerging market economies relates to the persistent and sustained levels of inflation. Indeed, while the risk of deflation seems to be almost null (the minimum observed value is close to 0), the top half of the sample records inflation rates above 5.5%, and the top 25% experiences double-digit rates. Despite the winsorisation, some extreme spikes are still present (more than 50%).

When considering the external position of these countries, I witness, on average, a decline in the value of their own currencies over the period, matched by current account deficits in their international balance sheets. This deterioration is partially compensated, on average, by adequate levels of international liquidity (as measured by the level of foreign exchange reserves, expressed in months of imports) and by favourable dynamics in the international commodity prices. In line with the large observed inflation rates, the distribution of the nominal depreciation rate tends towards positive values and shows a positive skew, indicating widespread – and, in some cases, extreme – declines in the value of the local currencies of emerging market economies vis-à-vis hard currencies. In the bottom 25% of the sample, though, we can observe the tendency of some local currencies to appreciate rather than depreciate, probably associated to the positive and often large current account balances achieved by 25% of the sample. On average, countries in the sample exhibit both a budget balance deficit (-2.2% as a ratio over GDP) and a current account deficit (-1.1% as a ratio over GDP), in line with the "twin deficits" hypothesis of a positive correlation between the two. Nonetheless, the average amount of reserves almost reaches a level equivalent to six months of imports, which is double the minimum level of three months suggested as a rule of thumb by the IMF (2011)[15]; only 25% of the sample falls below this threshold. Furthermore, emerging countries generally benefitted from a relative increase in their export prices compared to their import prices over the period, as indicated by the positive average change in the commodity terms-of-trade index. This possibly relate to the fact that more than one third of the countries in the sample is rich in natural resources. Another distinctive feature consists in the fraction of foreign-currency debt over total debt, which is well above 90% in 75% of the sample, thus confirming its overall preponderance in the currency composition of the sovereign debt in emerging market economies (Ottonello and Perez, 2019).

By inspecting the distribution of the variables, we can detect some elements of heterogeneity within the classification as emerging market economies. We can spot large differences especially among the fixed characteristics of the countries in the sample, i.e. those varying the least over time. For instance, some notable differentials are in socio-economic variables such as population, domestic credit to the private sector from banks, general government debt and the ESG factors. I will now analyse more in detail the heterogeneity in the sample by separately reporting the characteristics of two distinct groups (Table 3.9). The first group is composed by the observations related to the countries not being in default in the following year (either not starting a default or exiting a current default status). The second group includes the observations from those countries being in default in the following year (either staying in the default classification if they are currently defaulting, or entering a default if they are not).

[15] While suggesting complementing this simple rule with more comprehensive approaches, the paper does not dismiss it, as there exists some empirical evidence in favour of its adoption.

Table 3.9: Summary statistics by defaulting countries and non-defaulting countries in the following year, respectively.

	Not defaulting in the next year			Defaulting in the next year				
	Obs.	Mean	St. dev.	Obs.	Mean	St. dev.	Diff.	*P*-val.
VIX	618	21.02	6.12	94	21.75	5.86	-0.74	0.261
Fed funds	618	2.38	2.21	94	2.57	2.12	-0.19	0.425
Financial crisis	618	0.12	0.32	94	0.11	0.31	0.01	0.770
Population	618	113.66	282.54	94	23.34	30.29	90.31	0.002
Δ log GDP (GDP growth)	618	4.65	3.01	94	3.88	4.35	0.77	0.102
Δ log Prices (Inflation)	618	7.35	7.27	94	10.38	12.52	-3.03	0.024
Credit	618	41.25	27.87	94	14.61	8.76	26.64	0.000
Public debt	618	43.62	21.43	94	70.77	32.39	-27.15	0.000
Budget balance	618	-2.36	3.35	94	-1.15	2.47	-1.22	0.000
Resource rich	618	0.35	0.48	94	0.45	0.50	-0.10	0.085
Banking crisis	618	0.10	0.30	94	0.21	0.41	-0.11	0.011
Domestic default	618	0.02	0.13	94	0.18	0.39	-0.17	0.001
ESG	618	52.39	7.49	94	39.36	7.77	13.03	0.000
Current account	618	-0.88	5.47	94	-2.81	7.24	1.93	0.015
Δ log Terms-of-trade	618	0.29	4.68	94	0.08	4.21	0.22	0.647
Terms-of-trade volatility	618	1.01	1.91	94	1.04	1.36	-0.03	0.842
Currency crisis	618	0.12	0.33	94	0.17	0.38	-0.05	0.270
Last default	618	30.75	32.80	94	94.34	19.30	-63.59	0.000
Regional defaults	618	3.58	3.08	94	4.78	2.27	-1.19	0.000
Δ log Exchange rate (Depr.)	618	3.74	9.72	83	7.57	15.71	-3.83	0.033
Reserves	605	5.82	4.92	61	3.99	2.95	1.84	0.000
Foreign currency debt	539	93.74	9.65	94	92.84	8.00	0.91	0.329
Short-term debt	539	15.45	9.05	94	12.38	6.79	3.07	0.801

Note. In column: number of observations, mean, standard deviation, minimum value, 25th percentile, median, 75th percentile and maximum value of each variable (in row). The indicators for external default, financial crisis, richness in natural resources, banking crisis, domestic default and currency crisis are dummy variables. The VIX index, population (in millions), the ESG score, the volatility of the terms-of-trade, the indicator for the distance since last default (see construction in Section 2.2), the number of defaults in the region in the previous five years and the level of reserves are in absolute terms. The effective federal funds rate is in percentage. All the logarithmic differences (growth rates) are in percentage. Domestic credit from banks, public debt, overall budget balance, current account and foreign currency public debt are in percentage of GDP. Short-term debt is in percentage of total external debt.All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail).

We can see that the split analysis between defaulting and non-defaulting countries reflects many of the large variations already observed in the full sample analysis. Some of these differences, which I will now mention, appear to be highly significant. On average, countries exiting the default classification (or keeping out of such classification, if not currently in default) are larger in terms of population than defaulting countries. This may indicate that the sovereign debt of larger countries is more sustainable than the sovereign debt of smaller countries simply because of stronger economic forces or perhaps because they benefit from a "too-big-to-fail" logic.

Furthermore, it appears that the economic fundamentals of non-defaulting countries are in relatively better health conditions, both internally and externally. On the internal side, on average, the inflation rate is substantially lower (approximately by 3%). Private indebtedness to domestic banks on GDP is larger by 26% roughly, whereas the ratio of public debt over GDP is smaller in absolute value by more than 27%. This evidence supports the arguments of Gennaioli et al. (2014), who claim that the level of financial development of the private sector feeds into the sustainability of public debt. In turn, the reduced relative stock of public debt may be one of the reasons for more expansionary fiscal policies, as witnessed by the larger budget deficits on GDP, whose mean exceeds the same statistic computed on the defaulting group by 1.2% in absolute value. Finally, the overall ESG score is higher, on average, by 13 points.

On the external side, in line with the split evidence from inflation, the average depreciation rate of the local currencies of non-defaulting countries is lower by almost 4% in absolute terms, confirming the relatively more stable value of their currencies. Accordingly, on average, non-defaulting countries exhibit smaller current account deficits than defaulting countries by an absolute factor of almost 2%, while their level of foreign exchange reserves allows for two additional months of imports compared to the same measure from the other group. Surprisingly, the abundance of natural resources seems to be more common among defaulting (45%) than non-defaulting countries (35%), although the difference between the two groups is barely significant. The statistical insignificance of the differences in the variables associated with the original sin hypothesis (namely, the fraction of foreign currency debt over total debt and the fraction of short-term external debt over total external debt) is particularly striking, if considering the importance that some authors (Eichengreen and Hausmann, 1999; Hofmann et al., 2019) attribute to these factors. I will further inspect their role when interpreting the results of the estimation of the model.

Local and regional episodes of financial distress are also associated with an upcoming default or the perpetuation of the current default status. Notably, external sovereign defaults seem to be clustered both in time and within regions. Indeed, the probability of observing a default in a country in the following year decreases in the distance in time since the last year in which the country was in default. Furthermore, the probability increases in the number of countries in default in the previous five years within the same region. Moreover, there is a correlation between domestic defaults and external defaults, as countries not defaulting on their external debt are 17% less likely to be in default to domestic creditors. I also report some interesting information about the association between different types of crises. Specifically, banking crises are associated with external sovereign debt crises in the following year. On the other hand, there seems to be no correlation between the occurrence of a currency crisis in a year and the triggering of a sovereign default in the following year.

Finally, it is worth pointing out that sovereign defaults do not exhibit any correlation with the VIX index, the U.S. yield curve, and the global financial crisis, respectively. In fact, I do not find any systematic difference in the global variables accounting for the financial cycle between the two groups. This suggests that, while international investors price global risk drivers into sovereign CDS spreads, these factors do not seem to impinge on the sustainability of sovereign debt.

4 Model

4.1 Determinants of sovereign spreads

4.1.1 Principal component analysis

Before proceeding with the estimation of the model, I run a principal component analysis (PCA) on the time series of percentage changes in sovereign CDS returns over a subsample of 18 countries (the Czech Republic was excluded due to limited data availability in the earliest years).[16]

In Panel A of Table 4.1, I report the results of the PCA of the percentage changes in sovereign CDS spreads over the full sample period. Following Afonso et al. (2014), I will only explore those components whose associated eigenvalues are larger than or equal to 0.7 approximately. Therefore, I will focus on the first three components. Overall, the evidence indicates that a large fraction of variance in the changes of sovereign CDS returns can be explained by a single common factor. In the full sample period, this fraction amounts to 65% of the total variance. The second component contributes to explain 14% of the total variance. Adding the third component yields a cumulative explained variance of 82%. In Panel B of the same table, I report the results of a PCA on percentage returns of the domestic stock indices of the countries in the sample, so as to provide some terms of comparison (as in Longstaff et al., 2011). We can observe that the proportion of variance explained by each component is larger for changes in spreads than for stock returns. Furthermore, by following the eigenvalue rule, three components seem to be enough for spreads, whereas four components are required to explain stock returns. Therefore, I claim that sovereign CDS spreads in emerging countries appear to be more cointegrated than stock indices, at least at a monthly frequency (in line with Longstaff et al., 2011, and Fender et al., 2012).

[16] Principal component analysis (PCA) is a statistical technique for data reduction. It consists of an optimisation problem that successively generates linear combinations of the data (principal components) with maximum variance, subject to a condition of orthogonality between different components. One of its main advantages with respect to traditional regression techniques are parsimony, as it allows fully explaining the dataset by the use of a smaller number of factors, and adaptiveness, meaning it does not require any a priori specification of the model as it autonomously extracts as much information as possible from the data. See Jolliffe and Cadima (2016) for a technical discussion.

Table 4.1: Results from PCA on the full sample period based on sovereign CDS spreads and domestic stock indices, respectively.

Panel A: Percentage changes in sovereign CDS spreads.

	(1) Eigenvalue	(2) Difference	(3) Proportion	(4) Cumulative
First	11.697	9.262	0.650	0.650
Second	2.435	1.738	0.135	0.785
Third	0.698	0.193	0.039	0.824
Fourth	0.505	0.074	0.028	0.852
Fifth	0.431	0.089	0.024	0.876

Panel B: Percentage returns of domestic stock indices.

	(1) Eigenvalue	(2) Difference	(3) Proportion	(4) Cumulative
First	12.190	10.986	0.642	0.642
Second	1.204	0.348	0.063	0.705
Third	0.856	0.129	0.045	0.750
Fourth	0.727	0.132	0.038	0.788
Fifth	0.595	0.090	0.031	0.820

Note. The PCA is based on the monthly series of the changes in sovereign CDS returns for N = 18 countries between January 2007 and July 2019 (T = 150). The first five principal components are reported in row. In Column 1 I report the eigenvalue corresponding to the *nth* component. The eigenvalue indicates the proportion of variance explained by the *nth* component, whereby the total variance is normalised to N. In Column 2 I show the difference between the eigenvalue of the *nth* component and the eigenvalue of the *(n+1)th* component. In Column 3 I obtain the proportion of variance explained by the *nth* component alone (equal to the eigenvalue of the *nth* component divided by N). Finally, in Column 4 I report the cumulative variance explained by the first *n* components.

In Table 4.2 I split the full sample period into three distinct periods. Then, I report the proportion of variance explained by each component and the cumulative variance up to the third component in each period. This exercise aims at spotting potential changes over time in the transmission mechanisms to sovereign CDS returns. Column 1 refers to the results for the full sample period, as reported in Table 4.1. Column 2 covers the global financial crisis and the subsequent recession (2007-2009). Column 3 relates to the sovereign debt crisis in Europe (2010-2012). Finally, Column 4 identifies the relatively tranquil period in financial markets following the European sovereign debt distress (ranging between 2013 and 2019). I detect some evidence of contagion in periods of financial turmoil. The importance of the first common factor peaked in the years of the global financial crisis, with the fraction of variance explained by the first component reaching more than 71%. This level remained substantially unaltered throughout the European sovereign debt crisis. It finally descended at a proportion close to 58% in the more stable years following the sovereign debt crisis. Because the impact of common factors seems to heighten during systemic crises, this evidence suggests the adoption of herding behaviours by investors. Conversely, in tranquil times investors differentiate more across countries and country-specific factors play a greater role (Amstad et al., 2016).

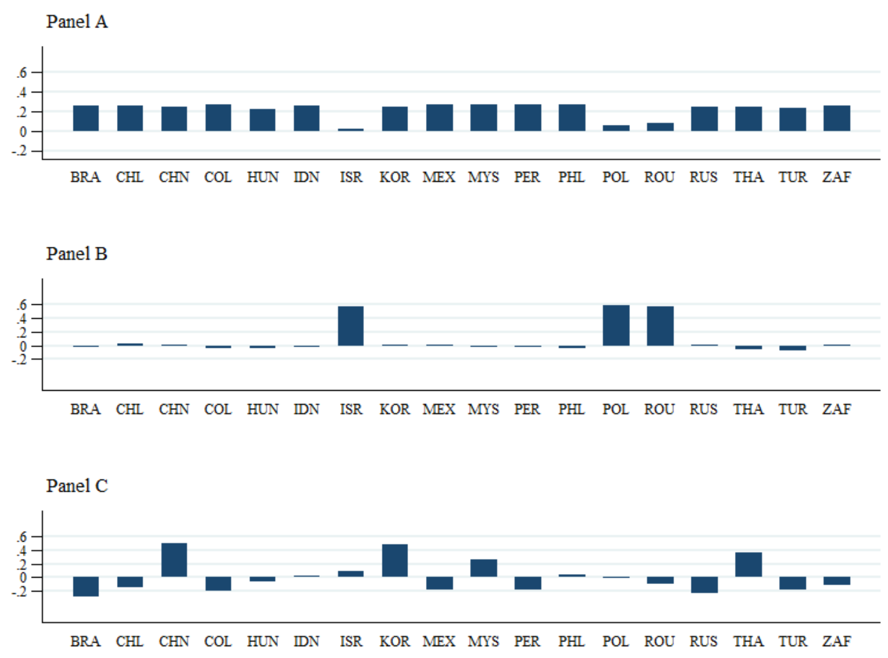
Table 4.2: Results from a PCA on alternative subsample periods.

	(1) 2007-2019		(2) 2007-2009		(3) 2010-2012		(4) 2013-2019	
	Prop.	Cum.	Prop.	Cum.	Prop.	Cum.	Prop.	Cum.
First	0.650	0.650	0.717	0.717	0.712	0.712	0.578	0.578
Second	0.135	0.785	0.143	0.860	0.135	0.847	0.110	0.688
Third	0.039	0.824	0.029	0.890	0.038	0.884	0.072	0.760

Note. The PCA is based on the monthly series of the changes in sovereign CDS returns for N = 18 countries between January 2007 and July 2019 (T = 150). The first three principal components are reported in row. Each column reports the proportion of variance explained by the *nth* component and the cumulative proportion of variance explained by the first *n* components for each period. Column 1 refers to the full sample period (2007 – 2019); Column 2 to the global financial crisis (January 2007 – December 2009); Column 3 to the sovereign debt crisis in Europe (January 2010 – December 2012); and Column 4 to the following period of enhanced stability in global financial markets (January 2013 – July 2019).

Another matter of interest is to assess any differential impact of common factors on different countries. Figure 1 shows the loadings (also called weighting vectors) of the first three principal components on each country. We can see that the first component loads similarly on almost all the countries. A few exceptions are some European countries (Poland and Romania) or not European but strongly connected to Western advanced economies (Israel), whereby the loading factor is much smaller. The second component captures the source of commonality among these three countries, while it almost amounts to zero for all the others. Following the approach of Longstaff et al. (2011), we can roughly interpret this as a regional spread between Europe and the other regions. To inspect the possibility that this regional spread is due to the European sovereign debt crisis started in 2010, I compute the loadings for the first component over different periods (Table 4.3). Indeed, I find that, while in general all the sovereign CDS returns moved in the same direction with the first component over the full sample period, in the period from 2010 to 2013 the time series for Israel, Poland and Romania tended to move in the opposite direction compared to those of all the other countries. The interpretation for the third principal component is somehow less intuitive. The only clear pattern can be found in the several positive weights on Asian sovereign CDS returns as opposed to the negative weights on their Latin-American counterparts, which again may be interpreted as evidence of a regional spread.

Figure 4.1: Loadings of the first three principal components on each country.



Note. The PCA is based on the monthly series of the changes in sovereign CDS returns for N = 18 countries between January 2007 and July 2019 (T = 150). Panels A, B and C above show the loadings of the first three principal components, respectively (on the vertical axis), on each country series in the sample (on the horizontal axis), wherein each loading can be interpreted as a sort of correlation coefficient between the *nth* component and the series for the respective country.

Table 4.3: Loadings of the first component on each country in different subsample periods.

	(1) 2007-2019	(2) 2007-2009	(3) 2010-2012	(4) 2013-2019
Brazil	0.264	0.261	0.270	0.268
Chile	0.257	0.241	0.253	0.272
China	0.244	0.250	0.263	0.206
Colombia	0.272	0.260	0.269	0.291
Hungary	0.227	0.253	0.198	0.185
Indonesia	0.263	0.252	0.262	0.277
Israel	0.015	0.051	-0.118	0.012
South Korea	0.246	0.265	0.252	0.188
Mexico	0.274	0.265	0.269	0.282
Malaysia	0.268	0.256	0.266	0.277
Peru	0.267	0.262	0.238	0.287
Philippines	0.269	0.263	0.264	0.284
Poland	0.052	0.085	-0.050	0.045
Romania	0.077	0.086	-0.026	0.141
Russia	0.252	0.251	0.268	0.242
Thailand	0.248	0.248	0.246	0.241
Turkey	0.236	0.255	0.253	0.224
South Africa	0.263	0.255	0.260	0.271

Note. The PCA is based on the monthly series of the changes in sovereign CDS returns for N = 18 countries between January 2007 and July 2019 (T = 150). The table reports the loadings of the first component on each individual series (in row) over different periods (in column), wherein each loading can be interpreted as a sort of correlation coefficient between the first component and the series for the respective country. Column 1 refers to the full sample period (2007 –2019); Column 2 to the global financial crisis (January 2007 – December 2009); Column 3 to the sovereign debt crisis in Europe (January 2010 – December 2012); and Column 4 to the following period of enhanced stability in global financial markets (January 2013 – July 2019).

As a last step of the PCA, I quantify the levels of correlation between the first three components and some global financial variables in the attempt to identify any of these as the sources of common variation (Table 4.4). To facilitate the interpretation, I gather the variables into four groups. The first group refers to the stock market performances. It comprehends percentage returns on the S&P500 index for companies based in advanced countries, as well as percentage returns on the MSCIEM index for companies based in emerging countries. The second group only includes financial markets volatility, as measured by the VIX index. The third group accounts for the U.S. yield curve. Changes in the effective federal funds rate, the 3-month Treasury bill rate and the spread between the 10-year government bond and the 3-month Treasury bill (accounting for the slope of the yield curve) all belong to this category. Finally, the last group reflects information on high-yield bond spreads and includes changes in the Moody’s spread between BAA- and AAA-rated companies, changes in the North-American high-yield spread, and changes in the spread between BAA-rated companies and the 10-year U.S. government bond. We can observe a strong negative correlation between the first component and stock returns (both the S&P500 and the MSCIEM series). On the other hand, changes in the VIX index and the high-yield bond spreads also show a strong but positive correlation with the first component. The second component seems to correlate more with changes in the U.S. yield curve (negatively with the effective federal funds rate and the 3-month rate, positively with the term premium of the 10-year versus the 3-month Treasury rates). Again, it is also positively associated with changes in the high-yield bond spreads. The correlations of the third component mimic some pattern of both the first and the second components, but they are smaller in magnitude. Thus, they do not allow drawing any additional conclusion.

All in all, these results point toward a dominant role of global conditions in the pricing of sovereign risk. The state of the financial cycle in the U.S. market, as captured by stock returns, the yield curve and high-yield bond spreads, drives the largest part of the covariation in emerging sovereign spreads.[17] Finally, this common variation seems to amplify over periods of financial distress.

Table 4.4: Pairwise correlations between the first three principal components and some global factors.

	(1) First	(2) Second	(3) Third
Stock returns			
Δ log S&P500	-0.749	-0.012	-0.101
Δ log MSCIEM	-0.795	0.015	-0.000
Volatility			
Δ VIX	0.552	0.028	0.078
Yield curve			
Δ Overnight	-0.237	-0.134	-0.031
Δ 3-month	-0.269	-0.048	-0.112
Δ 10-year minus 3-month	-0.020	0.103	-0.036
Credit spreads			
Δ BAA minus AAA	0.512	0.081	0.038
Δ North American high-yield	0.705	0.016	0.061
Δ BAA minus 10-year Treasury	0.603	0.088	0.072

Note. The PCA is based on the monthly series of the changes in sovereign CDS returns for N = 18 countries between January 2007 and July 2019 (T = 150). The table displays the pairwise correlations between the first three principal components (in column) and some widely adopted global financial variables (in row; see, for instance, Longstaff et al., 2011).

4.1.2 Estimation

Before proceeding to the estimation of the model, I make sure that the logarithmic series of sovereign CDS spreads are stationary (similarly to Comelli, 2012; Poghosyan, 2014; Ho, 2016). Stationarity is an important condition in dynamic panel data models, especially if the time dimension of the sample T is larger than the cross-sectional dimension N. If this condition is not met, the OLS estimation may lead to spurious regressions (Baltagi, 2013, p. 251). Therefore, I check for unit roots in the panels by implementing two alternative tests: the Im-Pesaran-Shin test (2003) and a Fisher-type test based on the Augmented Dickey-Fuller test (Choi, 2001)[18]. I

[17] Although high-yield spreads tend to comove with sovereign CDS spreads, I decided not to include these variables in the specification of the first model, as they display multicollinearity with stock returns especially.

[18] Im, Pesaran and Shin (2003) test the null hypothesis that all the panels contain unit roots, against the alternative hypothesis that some panels are stationary. Under the null, the test statistics is asymptotically distributed as a N(0,1) for the cross-sectional dimension $N \to \infty$ such that $N/T = 0$ (i.e. N is small enough compared to T). The Fisher-type test by Choi (2001) adopts the same null and alternative hypotheses of the Im-Pesaran-Shin test. Under the null, it is asymptotically distributed as a χ^2 with 2N degrees of freedom as $T \to \infty$ for finite N. Both the tests allow for heterogeneous coefficients of the autoregressive terms under the alternative hypothesis, as both the test statistics combine information from separate Augmented Dickey-Fuller tests on the individual series. However, the Fisher-type test has the advantage that it can deal with unbalanced panel datasets with gaps in the individual time series.

demean the series to mitigate the effect of cross-sectional dependence; I also allow for a multiple lag structure, and a trend term or a drift term, alternatively. Both tests reject the null hypothesis that all the panels contain unit roots at a 1% significance level. Hence, I assume that the series of sovereign CDS spreads are stationary and suitable for a dynamic fixed effects panel estimation.

I report the estimates from different specifications in Table 4.5. As I detect the presence of serial correlation, heteroscedasticity and cross-sectional dependence in the dataset, I will correct each of these issues one at a time to show how the estimates are affected. Finally, I will provide an approach to deal with potential endogeneity issues.

As a starter, in Column 1 I run a fixed effects panel estimation with the first lag of the dependent variable as the only predictor and an AR(1) disturbance in the error term. Modelling the error structure in order to account for first-order serial correlation is a recommended feature when the time dimension T is larger than the cross-sectional dimension N (Cameron and Trivedi, 2009, Chapter 8.10). The coefficient of the first lag is significant and large. This evidence is consistent across different specifications, thus confirming that the data generating process of sovereign CDS returns shows a strong persistence over time (Afonso et al., 2014). Moreover, the first lag alone explains a substantial fraction of the total variance in the data (as measured by the adjusted R^2).

In Column 2 I introduce the set of global variables. All the coefficients for which I previously formulated a hypothesis are statistically significant and with the expected sign. The coefficient of the variable accounting for the change in the effective federal funds rate is also statistically significant and turns out to have a negative sign. I interpret this finding in the sense that the U.S. yield curve signals the state of the U.S. economy and, consequently, of the world economy. As the Federal Reserve cuts the policy rate, the expectations on future macroeconomic prospects deteriorate, thus the sovereign CDS spreads of emerging countries rise. On the opposite, when the U.S. interest rates are climbing, they signal increasing confidence in future growth, thus the sovereign CDS spreads of emerging countries fall.

In Column 3 I report the estimates on the full specification, i.e. resulting from adding the set of country-specific fundamentals to the specification in Column 2. Among the global factors, the change in the VIX index loses significance, but the other drivers remain strongly significant. Some country-specific variables are also significant and with the expected sign, namely industrial production, inflation, depreciation of the local currency, volatility of the local currency, domestic stocks returns and credit rating. However, the fraction of variance explained by the model slightly decreases with respect to the specification in Column 2, suggesting that country-specific shocks as a whole may have a minor effect on the pricing of sovereign risk.

Table 4.5: Regression of the determinants of sovereign CDS spreads.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	FE	FGLS	FE	LSDV	2SLS FE
Δ log CDS	0.927***	0.930***	0.922***	0.967***	0.937***	0.926***	0.936***
	(0.006)	(0.006)	(0.006)	(0.003)	(0.010)	(0.012)	(0.007)
ΔVIX		0.002***	0.001	0.002***	0.001		0.001
		(0.001)	(0.001)	(0.001)	(0.001)		(0.001)
Δ Fed funds		-0.001***	-0.001***	-0.001***	-0.001**		-0.001***
		(0.000)	(0.000)	(0.000)	(0.000)		(0.000)
Δ log S&P500		-0.019***	-0.015***	-0.015***	-0.015***		-0.014***
		(0.001)	(0.001)	(0.001)	(0.002)		(0.002)
Δ log Industrial			-0.002*	-0.001	-0.002	-0.002**	-0.006
			(0.001)	(0.001)	(0.001)	(0.001)	(0.004)
Δ log Prices			0.017**	0.021***	0.016**	0.013**	0.054**
			(0.007)	(0.006)	(0.008)	(0.007)	(0.021)
Δ log T-o-T			-0.011	-0.013**	-0.011*	-0.016**	0.031
			(0.007)	(0.006)	(0.006)	(0.006)	(0.028)
Δ log FX rate			0.011***	0.012***	0.011***	0.005***	0.015*
			(0.001)	(0.001)	(0.002)	(0.002)	(0.008)
Δ log Curr. vol.			0.000***	0.000***	0.000***	0.000	0.000
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ Reserves			-0.003	-0.005*	-0.004	-0.000	-0.001
			(0.002)	(0.002)	(0.004)	(0.003)	(0.005)
Δ log Stocks			-0.001*	-0.002***	-0.002	-0.003***	-0.002
			(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Δ Rating			-0.067***	-0.055**	-0.062**	-0.084***	0.091
			(0.026)	(0.022)	(0.031)	(0.024)	(0.184)
Constant	0.350***	0.276***	0.277***	0.161***	0.303***	0.290***	0.000
	(0.030)	(0.026)	(0.026)	(0.017)	(0.048)	(0.058)	(0.000)
Obs.	2969	2814	2724	2743	2743	2743	2642
R^2	0.873	0.897	0.894	.	0.927	0.950	0.918
Adjusted R^2	0.873	0.896	0.892	.	.	.	0.917
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Country	yes	yes	yes	no	yes	yes	yes
Time	no	no	no	no	no	yes	no

Note. Results from the regressions on a monthly panel dataset of N = 19 emerging countries between January 2007 and July 2019 (average T per country = 144, minimum T = 122, maximum T = 150). The dependent variable is the logarithm of sovereign CDS spreads. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail). Columns 1-3 report the estimates from a fixed effects panel regression with an AR(1) disturbance in the error term. The independent variables in Column 1 only include the first lag of the dependent variable; in Column 2 a set of global factors is added to the predictors specified in Column 1, while in Column 3 I also add a set of country-specific shocks to the predictors in Column 2. In Column 4 I run a feasible generalised least squares (FGLS) estimation with a heteroscedastic AR(1) error structure. In Columns 5 and 6 I report the results from a fixed effects panel regression with Driscoll-Kraay standard errors, accounting for heteroscedasticity, serial correlation of various forms and cross-sectional dependence. In Column 5 (baseline) I consider the same full specification of Column 3 and 4, while in Column 6 I replace the set of global shocks by a set of time dummies accounting for the month. In order to deal with potential endogeneity issues, in Column 7 I show the results from a 2SLS fixed effects panel estimation with cross-section weights accounting for cross-section heteroscedasticity. The endogenous regressors are all the variables in the set of country-specific fundamentals and the instruments are their first to third lag (see Table 4.6 for additional test statistics on the estimation of which in Column 7). The *p*-value in the bottom of the table is the result of a test of joint significance of the coefficients. I indicate whether the specification includes country and/or time fixed effects in the bottom of the table. Standard errors are in parentheses. ***, **, * indicate that the coefficients are significant at a 1%, 5% and 10% confidence level, respectively.

In Column 4 I provide the estimates from a feasible GLS (FGLS) panel estimation. Compared to the fixed effects models of Columns 1-3, the FGLS estimator has the additional advantage of correcting heteroscedasticity across panels, but it does not allow for individual time-invariant effects[19]. All the significant variables in Column 3 are so also in Column 4. In addition, many other variables now gain statistical significance, both among the global factors (namely, the VIX index) and the country-specific factors (commodity terms-of-trade and official reserves). Furthermore, they have the expected sign. While accounting for heteroscedasticity did not deteriorate the significance of the estimates with respect to the previous estimation (as one would have expected), omitting individual time-invariant effects seems to cause more explanatory variables to capture heterogeneity across countries.

Therefore, in Column 5 I return to a fixed effects model with Driscoll-Kraay standard errors (Driscoll and Kraay, 1998), which constitutes my baseline specification. In addition to allowing for individual heterogeneity, this technique provides consistent estimates as it accounts at the same time for several forms of serial correlation, heteroscedasticity and cross-sectional dependence (Hoechle, 2008). As expected, reintroducing individual fixed effects cause some variables to lose statistical significance. The global factors maintaining significance are the effective federal funds rate and the S&P500 returns (in line with the results from the PCA), while the country-specific factors are inflation, the commodity terms-of-trade, the depreciation of the local currency, the volatility of the local currency and the credit rating.

As a robustness check, in Column 6 I report an alternative specification, wherein I replace global factors by dummy variables accounting for the month. Again, as in Column 6 I run a fixed effects model with Driscoll-Kraay standard errors. The test of joint significance of the time dummies (not reported) rejects the null hypothesis, thus validating the importance of the time dimension as previously captured by the global drivers. We can also observe some country-specific factors lose statistical significance, whereas other factors gain it. Nevertheless,

[19] While the result of the Hausman test supports the adoption of a fixed effects model (*p*-value = 0.004), the estimates do not change much when a random effects model is implemented; furthermore, the use of a FGLS estimator is justified by the literature (Afonso et al., 2014, although they do not show the outcome). Thus, it makes sense to apply it in this study as well.

I am more interested in those variables maintaining significance across all the alternative full specifications from Column 3 to 6, because the corresponding estimates remain consistent regardless of the respective estimation technique. These are inflation, the depreciation of the local currency and the credit rating.

Finally, I wish to explore more in detail the causal effect of country-specific fundamentals. Indeed, while it seems plausible that country-specific fundamentals drive the market pricing of sovereign risk, there exists a substantial possibility that sovereign CDS spreads affect the contemporaneous country-specific fundamentals too. As an example, let us consider a potential causal effect running from sovereign CDS spreads to the exchange rate. Hiking sovereign CDS returns may tilt the market expectations toward a default equilibrium; this would trigger capital outflows, which in turn would lead to a depreciation of the currency eventually. This feedback loop, called reverse causality, is likely to cause endogeneity of the predictors. In the presence of endogeneity, the standard OLS estimates can suffer from a severe bias. Therefore, in order to deal with potential endogeneity issues, I perform a 2SLS fixed effects estimation as in Afonso et al. (2014), wherein I use the first to the third lag of country-specific drivers as instruments for the endogenous regressors. I also employ cross-section weights accounting for cross-sectional heteroscedasticity. Before analysing the results for the single estimates, let us have a look at some test statistics assessing the overall adequacy of the IV approach (Table 4.6). The underidentification test rejects the null hypothesis that the instruments have insufficient explanatory power to predict the endogenous variables. Moreover, the Sargan test fails to reject the null hypothesis of the validity of the over-identifying restrictions. Thus, the instruments appear to be relevant and valid, respectively.[20] The Durbin-Wu-Hausman endogeneity test fails to reject the null hypothesis of exogenous regressors in the structural equation. Therefore, while still showing the results from the IV approach as a robustness check, I find no empirical evidence that the OLS estimates suffer from endogeneity.

Table 4.6: Test statistics on the IV estimation.

Name of the test	H_0	Statistic	*P*-value
Anderson canonical correlations test	The instruments are not relevant	$\chi^2(17) = 42.38$	0.001
Sargan test	The overidentifying restrictions are valid	$\chi^2(16) = 22.35$	0.132
Durbin-Wu-Hausman test	The regressors suspected of endogeneity are actually exogenous	$\chi^2(8) = 6.64$	0.576

[20] A severe bias may arise from the use of weak instruments in the first stage regression (Stock and Yogo, 2002). Thus, I perform several tests (not reported) and find some evidence that my instruments are not weak.

Note. This table shows the results from the Anderson canonical correlation test (or underidentification test), the Sargan test (or overidentification test) and the Durbin-Wu-Hausman test (or augmented regression test for endogeneity) on the IV model reported in Column 7 of Table 4.5.

Indeed, the results of the 2SLS fixed effects estimation, reported in Column 7 of Table 4.5, indicate that most of the previous conclusions still hold when accounting for endogeneity. Specifically, they confirm the persistence of sovereign CDS returns over time, as well as the importance of the U.S. yield curve and the U.S. stock market. The bulk of the country-specific factors is also confirmed, in the sense that both inflation and the depreciation of the local currency are still significant – albeit the latter not as strongly as in the previous specifications. All the signs are unchanged and the magnitude of most of the significant coefficients remain in line with the previous results (except inflation, which becomes four times larger). A striking difference is in the estimates of the credit rating, which in this case does not appear to be significant. Oddly, it seems that rating changes do not have any exogenous impact on sovereign CDS spreads but rather they are endogenously determined. These findings are somehow consistent with Afonso et al. (2012), which document a two-way causality between the two variables in the short run (based on a panel dataset of 24 European countries in the period 1995-2010). In addition to the traditional causal effect running from the ratings to the sovereign CDS spreads, they show that price movements tend to anticipate rating adjustments in the same direction by 1-2 weeks (i.e. inverse causal effect). My results indicate that the causal relationship between ratings and sovereign CDS spreads is likely to be more complex than in the usual sense. While keeping this caveat in mind, I will not explore this issue further, as disentangling the direction of causality between the two is beyond the purpose of this thesis. Furthermore, as I have shown above, endogeneity does not seem to constitute a major issue in my model.

Summing up, I conclude that sovereign CDS returns exhibit a strong persistence over time. They are also significantly and negatively affected by global shocks (notably, the U.S. stock returns and the effective federal funds rate). Within the group of country-specific changes, inflation and the depreciation rate of the local currency are the most significant and positive predictors. The comprehensive measure of credit rating is significant as well and affects sovereign CDS returns in a negative sense. However, the causal linkage between these two variables seems to be more difficult to establish.

4.1.3 Sensitivity analysis

As in the descriptive analysis I documented sizeable time and regional differences in sovereign CDS spreads, in this subsection I assess the extent to which the estimates change when allowing for structural breaks over time and across regions, respectively. Specifically, in the analysis over time (Table 4.7), I consider the possibility of differential effects of each variable during the global financial crisis and the European sovereign debt crisis. In the regional analysis (Table 4.8), I estimate the baseline model on three regions separately (Europe and Central Asia, Latin America and the Caribbean, and East Asia and Pacific, respectively).

The sensitivity analysis over time follows the econometric approach of Afonso et al., 2014, which accounts for different periods by the use of interaction variables (although the research question in their study focuses on the effect of fiscal fundamentals on European spreads). In Column 1 of Table 4.7 I report the results from the estimation on the baseline specification (the same as in Column 5 of Table 4.5), whereas in Column 2 I show the results from a modified version of the baseline regression, which includes a dummy variable accounting for the global financial crisis. I assign a value equal to 1 if the observation belongs to the period from August 2007 (when financial tensions in the markets began to rise) to March 2009 (also adopted as ending date of the financial crisis by Afonso et al., 2014), and 0 otherwise. This dummy enters the specification both alone and in a set of interaction terms with all the other variables. I observe notable differentials in the impact of some global factors. Specifically, while in general changes in the VIX index do not appear to affect sovereign CDS spreads, during the global financial crisis the influence of market volatility is significant and positive. This means that the volatility in the stock market matters less to investors in tranquil times, but becomes more important in period of financial turmoil. Furthermore, while the U.S. yield curve exerts a negative effect on CDS spreads in general, during the crisis its effect is countered by one of the same magnitude, but opposite direction. This indicates that, in line with my previous interpretation from the estimation of the baseline model, U.S. interest rates are more informative in tranquil times, as they are free to fluctuate towards the market equilibrium. In periods of systemic distress, though, the information content of the yield curve is substantially reduced, as interest rates are artificially managed and restrained at low levels in order to stimulate credit, investment, and production. This evidence corroborates the findings by Comelli (2012), who reports a significant negative effect of short-term U.S. interest rates only before the global financial crisis.

Table 4.7. Sensitivity analysis of the regression of sovereign CDS spreads over time.

	(1) FE	(2) FE	(3) FE
Δ log CDS	0.937***	0.928***	0.916***
	(0.010)	(0.013)	(0.013)
Δ log CDS × Financial crisis		0.009	0.011
		(0.007)	(0.008)
Δ log CDS × Sovereign debt crisis			0.005*
			(0.003)
Δ VIX	0.001	-0.001	-0.002
	(0.001)	(0.002)	(0.002)
Δ VIX × Financial crisis		0.006**	0.007***
		(0.002)	(0.002)
Δ VIX × Sovereign debt crisis			0.007**
			(0.003)
Δ Fed funds	-0.001**	-0.003***	-0.002**
	(0.000)	(0.001)	(0.001)
Δ Fed funds × Financial crisis		0.003***	0.002**
		(0.001)	(0.001)
Δ Fed funds × Sovereign debt crisis			0.002
			(0.003)
Δ log S&P500	-0.015***	-0.015***	-0.017***
	(0.002)	(0.002)	(0.003)
Δ log S&P500 × Financial crisis		-0.006	-0.004
		(0.007)	(0.007)
Δ log S&P500 × Sovereign debt crisis			0.013***
			(0.004)
Δ log Industrial	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Δ log Industrial × Financial crisis		-0.003	-0.003
		(0.004)	(0.004)
Δ log Industrial × Sovereign debt crisis			0.001
			(0.003)
Δ log Prices	0.016**	0.021***	0.019**
	(0.008)	(0.008)	(0.008)
Δ log Prices × Financial crisis		-0.024	-0.025
		(0.030)	(0.030)
Δ log Prices × Sovereign debt crisis			-0.020
			(0.016)
Δ log Terms-of-trade	-0.011*	-0.017***	-0.013*
	(0.006)	(0.006)	(0.007)
Δ log Terms-of-trade × Financial crisis		0.019	0.016
		(0.016)	(0.017)
Δ log Terms-of-trade × Sovereign debt crisis			-0.016
			(0.033)
Δ log Exchange rate	0.011***	0.012***	0.014***
	(0.002)	(0.002)	(0.002)
Δ log Exchange rate × Financial crisis		-0.011*	-0.012**
		(0.006)	(0.006)

	(1)	(2)	(3)
	FE	FE	FE
Δ log Exchange rate × Sovereign debt crisis			-0.004
			(0.004)
Δ log Currency volatility	0.000***	0.000*	0.000**
	(0.000)	(0.000)	(0.000)
Δ log Currency volatility × Financial crisis		0.001***	0.001***
		(0.000)	(0.000)
Δ log Currency volatility × Sovereign debt crisis			-0.000
			(0.000)
Δ Reserves	-0.004	-0.004	-0.005
	(0.004)	(0.004)	(0.003)
Δ Reserves × Financial crisis		0.007	0.008
		(0.013)	(0.013)
Δ Reserves × Sovereign debt crisis			0.019
			(0.011)
Δ log Stocks	-0.002	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)
Δ log Stocks × Financial crisis		0.001	0.001
		(0.002)	(0.002)
Δ log Stocks × Sovereign debt crisis			0.001
			(0.002)
Δ Rating	-0.062**	-0.053**	-0.047*
	(0.031)	(0.024)	(0.028)
Δ Rating × Financial crisis		-0.051	-0.068
		(0.118)	(0.120)
Δ Rating × Sovereign debt crisis			-0.062
			(0.051)
Financial crisis		-0.033	-0.033
		(0.046)	(0.049)
Sovereign debt crisis			0.015
			(0.012)
Constant	0.303***	0.349***	0.400***
	(0.048)	(0.062)	(0.064)
Observations	2743	2743	2743
Pseudo R^2	0.927	0.930	0.932
Adjusted R^2	.	.	.
P-value	0.000	0.000	0.000
Country	yes	yes	yes
Time	no	no	no

Note. Results from the regressions on a monthly panel dataset of N = 19 emerging countries from January 2007 to July 2019 (average T per country = 144, minimum T = 122, maximum T = 150). The dependent variable is the logarithm of sovereign CDS spreads. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail). In Column 1 I report the results from the estimation of a fixed effects model on the full sample period. In Column 2 I add to the specification in Column 1 the interaction terms of each variable with a dummy equal to 1 if the observation belongs to the global financial crisis period from August 2007 to March 2009, and 0 otherwise. In Column 3 I add to the specification in Column 2 the interaction terms of each variable with a dummy equal to 1 if the observation refers to a country belonging to the regions of Europe and Central Asia or Middle East and North Africa in the period from April 2009 to July 2012, and 0 otherwise. The *p*-value in the bottom of the table is the result of a test of joint significance of the coefficients. I indicate whether the specification includes country and/or time fixed effects in the bottom of the table. Driscoll-Kraay standard errors robust to heteroscedasticity, serial correlation and cross-sectional dependence are in parentheses. ***, **, * indicate that the coefficients are significant at a 1%, 5% and 10% confidence level, respectively.

Within the set of country-specific fundamentals, all the significant variables in the baseline specification (namely inflation, changes in the terms-of-trade, currency depreciation, changes in the currency volatility and changes in the credit rating) remain significant when considering the interactions with the crisis dummy; in addition, the variable accounting for domestic stocks returns becomes significant. I witness some crisis-specific effects of the variables related to the local currency only. The effect of the depreciation of the local currency is nullified, in the crisis period, by an opposite effect of approximately equal size; the influence of the volatility of the currency, instead, increases during the crisis. I interpret the former in the light of the diminished importance of external factors as determinants of sovereign spreads in the aftermath of the crisis (in favour of fiscal factors instead, according to Aizenman et al., 2016). On the other hand, the latter is in line with an enhanced role of market volatility in periods of financial distress (analogous to the evidence on the VIX index).

In Column 3 I add to the specification reported in Column 2 the interaction of each explanatory variable with a dummy equal to 1 if the variable is observed in one of the two regions of Europe and Central Asia, or the Middle East and North Africa, respectively, at the time of the European sovereign debt crisis, and 0 otherwise. The choice of the two regions comes from the outcome of the principal component analysis in Section 4.1.1, indicating a high degree of commonality between the European spreads (e.g. Poland, Romania) and the Israeli spread (the only country within the Middle East and North Africa group in the first model), especially in the sovereign debt crisis period. The time interval under consideration starts in April 2009 (implying that the global financial crisis immediately turns into the sovereign debt crisis in Europe, as in Afonso et al., 2014) and ends in July 2012, when the "whatever it takes" speech by the ECB President took place[21]. The persistency of the spreads slightly increases in the selected regions in the wake of the sovereign debt crisis, but the coefficient is barely significant. The most noticeable differences concern the set of global factors. The effect of the VIX index is significant and positive in these regions in the sovereign debt distress period, just like in the global financial crisis period. In fact, the magnitude of the coefficients related to its

[21] "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough" (ECB, 2012). With these words, on 26 July 2012 the then President of the ECB, Mario Draghi, announced the full commitment of the ECB to alleviate tensions in the sovereign bond markets by extending and enlarging the newly introduced quantitative easing program, if necessary. Later, many analysts have considered this choice of words as a turning point towards the resolution of the sovereign debt crisis in Europe (Brunnermeier, 2018).

interactions with the two dummies (the one accounting for the global financial crisis and the other for the European debt crisis) is the same. The evidence on the enhanced role of the VIX index in turbulent times (in line with the findings of Afonso et al., 2014) hints at some signs of continuity in the investors' risk attitudes in Europe between the global financial crisis and the subsequent sovereign debt distress period. However, there are also tentative signs of discontinuity when compared to the global financial crisis. On the one hand, the negative risk transmission channel with the U.S. interest rates was re-established as in tranquil times, thus restoring the signalling effect of the yield curve. On the other hand, the negative effect of the S&P500 returns on European spreads diminished considerably with respect to both the global financial crisis and more tranquil times, as the interaction term generates an opposite positive effect, almost equal in size. One should bear in mind that the U.S. stock market experienced a remarkable jump after the end of the financial crisis (Figure 3.4). This means that the borrowing costs of European sovereign issuers did not benefit from international spillovers from the global equity market as much as they would have done in normal times. When analysing the set of country-specific fundamentals, I do not witness any significant differential impact on sovereign CDS spreads compared to tranquil times.

In Table 4.8 I display the results from running the baseline regression on each region separately. The approach adopted in this regional analysis is in the spirit of the studies by Comelli (2012) and Aizenman et al. (2016) on monthly and quarterly data, respectively, but includes a partially different set of explanatory variables. I only consider three regions out of the five listed in Table 3.1: Europe and Central Asia ("Europe"), Latin America and the Caribbean ("Latin America") and East Asia and Pacific ("Asia"). In Column 1 I estimate the model on the full sample (as in Column 5 of Table 4.5), while in Columns 2, 3 and 4 on European, Latin American and Asian countries only, respectively. I confirm that, in general, sovereign CDS spreads in Europe tend to be more persistent than in the other two regions. Among the global variables, both the negative sign and the magnitude of the coefficient for the U.S. interest rates stay constant across regions, but its statistical significance varies, being very significant for Europe, barely significant for Asia, and not significant for Latin America, respectively. The S&P500 returns, instead, are significant for all the regions, but the size of the negative coefficient varies across regions, being more than double for Latin America and Asia than for Europe. This indicates that the pricing of the sovereign risk of European issuers depends more on the U.S. yield curve, while the sovereign risk premia of Latin American and Asian issuers are more affected by the U.S. stock market (in line with the previous evidence suggested by the PCA, Section 4.1.1). I interpret these differences in the sense that the synchronisation between European sovereign spreads and the world economy mainly occurs through the financial cycle (as captured by changes in the U.S. yield curve), whereas in the case of Latin American and Asian spreads it prevalently works through the business cycle (as proxied by the S&P500 returns). These results differ from those reported by Comelli (2012), who finds the VIX index positively affects spreads in all the regions, while the short-term U.S. interest rates do not have any influence. However, in their analysis, these variables enter the regression in a logarithmic form and their sample considers a different period, so their results are not fully comparable.

Within the set of country-specific fundamentals, the most relevant variables are those referring to the stability of the value of the local currency. Specifically, a depreciation of the local currency has a larger (positive) effect for Latin America and Asia than for Europe, possibly because of the history of exchange rate crises in the first two regions. The volatility of the local currency is also significant in each of the three regions, although its magnitude is negligible. On the other hand, changes in the commodity terms-of-trade and domestic stocks returns are significant in Europe only. The constant terms for Latin American and Asian spreads indicate that sovereign issuers in these regions pay a fixed (i.e. time-invariant) premium, which is larger than the one paid by European issuers (consistent with Comelli, 2012).

Summing up, the analysis allowing for time-varying coefficients reveals that the effect of some factors on sovereign CDS spreads changes in periods of distress. Specifically, during the global financial crisis, the negative transmission mechanism with the U.S. yield curve was interrupted, whereas market volatility (as measured by the VIX index) started playing a greater role. The heightened role of uncertainty concerned the volatility of the local currency too, which became significant in the crisis period, while its depreciation rate became less important. In the European sovereign debt crisis, the negative link with the U.S. interest rates was restored. In addition, the influence of U.S. stock returns on European spreads was weaker than in tranquil times, but the volatility of the U.S. stock market continued to exert a positive effect on European spreads as during the global financial crisis. On the other hand, the regional analysis highlights that European spreads are more affected by the U.S. interest rates, whereas Latin American and Asian spreads depend more heavily on U.S. equity returns. The variables accounting for the stability of the local currency are relevant for all the regions, whereby other macroeconomic fundamentals (such as the change in the commodity terms-of-trade and domestic stock returns) are significant for Europe only. Finally, spreads in Europe tend to be more persistent over time, while in Latin America and Asia the borrowing costs are shifted upwards by a larger time-invariant risk premium.

Table 4.8: Sensitivity analysis of the regression of sovereign CDS spreads across regions.

	(1)	(2)	(3)	(4)
	All	Europe	Latin America	Asia
Δ log CDS	0.937***	0.948***	0.932***	0.932***
	(0.010)	(0.011)	(0.015)	(0.012)
ΔVIX	0.001	-0.000	0.003	0.001
	(0.001)	(0.001)	(0.003)	(0.002)
Δ Fed funds	-0.001**	-0.001***	-0.001	-0.001*
	(0.000)	(0.000)	(0.001)	(0.000)
Δ log S&P500	-0.015***	-0.008***	-0.020***	-0.021***
	(0.002)	(0.002)	(0.003)	(0.003)
Δ log Industrial	-0.002	-0.001	0.000	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Δ log Prices	0.016**	0.006	0.012	0.016
	(0.008)	(0.011)	(0.011)	(0.013)
Δ log Terms-of-trade	-0.011*	-0.021*	0.015	-0.006
	(0.006)	(0.011)	(0.014)	(0.014)
Δ log Exchange rate	0.011***	0.008***	0.012***	0.016***
	(0.002)	(0.002)	(0.003)	(0.005)
Δ log Currency volatility	0.000***	0.000*	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Δ Reserves	-0.004	-0.006	-0.003	-0.004
	(0.004)	(0.008)	(0.005)	(0.005)
Δ log Stocks	-0.002	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.002)	(0.001)
Δ Rating	-0.062**	-0.029	-0.051	-0.076
	(0.031)	(0.039)	(0.042)	(0.065)
Constant	0.303***	0.256***	0.328***	0.321***
	(0.048)	(0.053)	(0.073)	(0.057)
Observations	2743	869	728	855
Pseudo R^2	0.927	0.945	0.920	0.928
Adjusted R^2	.	.	.	.
P-value	0.000	0.000	0.000	0.000
Country	yes	yes	yes	yes
Time	no	no	no	no

Note. Results from the regressions on a monthly panel dataset of N = 19 emerging countries from January 2007 to July 2019 (average T per country = 144, minimum T = 122, maximum T = 150). The dependent variable is the logarithm of sovereign CDS spreads. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail). In Column 1 I report the results from the estimation of a fixed effects model on the full sample of countries. In Column 2, 3 and 4, I apply the same model to separate regressions on three regional groups of countries, namely Europe, Latin America and Asia, respectively. The *p*-value at the bottom of the table is the result of a test of joint significance of the coefficients. I indicate whether the specification includes country and/or time fixed effects in the bottom of the table. Driscoll-Kraay standard errors robust to heteroscedasticity, serial correlation and cross-sectional dependence are in parentheses. ***, **, * indicate that the coefficients are significant at a 1%, 5% and 10% confidence level, respectively.

4.2 Determinants of sovereign defaults

4.2.1 Estimation

In Table 4.9 I report the results of the estimation of the second model by a binary logistic regression. The standard errors are clustered at a country level to correct for heteroscedasticity and serial correlation (Petersen, 2009). I add each group of predictors one at a time in order to compare the estimates from alternative specifications.

In Column 1 I regress the dependent variable on global factors only. The VIX index only is significant and carries the expected sign. However, the coefficients are not jointly significant at a 5% level and the R^2 is very low. Hence, I derive global factors do not seem to have any substantial effect on the default probability of the sovereign (see also Jeanneret and Souissi, 2016). Along with the evidence from the first model, these results suggest that global variables affect the risk premium component of sovereign spreads, but not the default risk of a country (Remolona et al. 2008).

In Column 2 I add to the previous specification a set of country-specific domestic variables. Interestingly, almost all of them are significant and most of them have the expected sign. A notable exception, not even reaching a statistical significance of 10%, is inflation. Given that it is one of the few significant country-specific predictors of sovereign CDS returns in the first model, its irrelevance here may seem at odds with the previous results. However, its lack of significance matches the results provided by Jeanneret and Souissi (2016), who show inflation only impinges on the probability of default on local currency debt, as debt monetisation does not apply to foreign currency debt. Therefore, inflation seems to affect the risk premium component (as international investors attach a value to the financial stability and government credibility signals inferable from the level of inflation), but not the foreign currency default risk.

I also include some country-specific external factors in Column 3 but, strikingly, none of them appears to be significant. I will come back to some of these partial results in the light of the full specification.

Table 4.9: Determinants of the probability of a sovereign issuer being in external default.

	(1) Global	(2) Domestic	(3) FX	(4) Default history	(5) RE	(6) Original sin
VIX	0.024**	-0.055	-0.041	-0.041	-0.024	-0.085*
	(0.012)	(0.039)	(0.043)	(0.056)	(0.064)	(0.045)
Fed funds	0.048	-0.328***	-0.359***	-0.299	-0.177	-0.328**
	(0.056)	(0.119)	(0.131)	(0.183)	(0.187)	(0.130)
Financial crisis	-0.264	2.017*	2.265**	2.603**	2.769*	3.427***
	(0.340)	(1.030)	(0.980)	(1.216)	(1.433)	(1.249)
Population		-0.812**	-0.820*	-0.649*	-1.062	-0.572
		(0.362)	(0.426)	(0.341)	(0.669)	(0.461)
Δ log GDP		-0.214**	-0.189	-0.182	-0.180	-0.099
		(0.102)	(0.121)	(0.128)	(0.131)	(0.147)
Δ log Prices		-0.033	-0.008	-0.002	-0.006	-0.080
		(0.033)	(0.036)	(0.035)	(0.034)	(0.055)
Credit		-0.079***	-0.075**	-0.070***	-0.139***	-0.092***
		(0.030)	(0.030)	(0.020)	(0.050)	(0.017)
Public debt		0.044***	0.044***	0.036**	0.040*	0.026**
		(0.014)	(0.015)	(0.015)	(0.024)	(0.013)
Budget balance		0.182**	0.218**	0.168	0.068	0.174
		(0.081)	(0.098)	(0.109)	(0.117)	(0.122)
Resource rich		-2.223***	-1.979**	-1.442*	-2.542	-1.470*
		(0.860)	(0.842)	(0.828)	(1.665)	(0.788)
Banking crisis		1.730**	1.576**	1.718***	1.662***	1.919***
		(0.704)	(0.673)	(0.536)	(0.575)	(0.559)
Domestic default		2.918***	3.241***	2.468***	2.692***	3.296***
		(0.800)	(0.866)	(0.662)	(0.915)	(0.689)
ESG		-0.279***	-0.296***	-0.271***	-0.357**	-0.274***
		(0.067)	(0.078)	(0.053)	(0.140)	(0.086)
Current account			0.020	0.055	0.116	0.013
			(0.067)	(0.063)	(0.104)	(0.066)
Δ log Terms-of-trade			-0.070	-0.079*	-0.069*	-0.097
			(0.043)	(0.047)	(0.041)	(0.066)
Terms-of-trade volatility			-0.240	-0.291	-0.320	-0.357
			(0.177)	(0.219)	(0.225)	(0.225)
Currency crisis			-0.243	0.123	0.054	
			(0.679)	(0.666)	(0.889)	
Last default				0.039***	0.028***	0.038***
				(0.006)	(0.009)	(0.008)
Regional defaults				0.095	0.021	0.032
				(0.125)	(0.161)	(0.155)
Δ log Exchange rate						0.098**
						(0.041)
Reserves						0.112
						(0.102)
Foreign currency debt						0.019
						(0.105)
Short-term debt						-0.019
						(0.034)

	(1) Global	(2) Domestic	(3) FX	(4) Default history	(5) RE	(6) Original sin
Constant	-2.493***	16.502***	16.976***	12.018***	18.846**	11.696
	(0.531)	(3.570)	(3.737)	(2.569)	(7.451)	(8.698)
No. observations	712	712	712	712	712	576
No. countries	43	43	43	43	43	35
No. defaults	94	94	94	94	94	50
Pseudo R^2	0.004	0.676	0.684	0.748	.	0.677
P-value	0.051	0.000	0.000	0.000	0.000	0.000
Log-likelihood	-276.620	-90.087	-87.900	-70.062	-67.038	-54.928

Note. Results from the regressions on a yearly panel dataset of N = 43 emerging countries between 1996 and 2014 (average T per country = 16, minimum T = 3, maximum T = 19). The dependent variable is a dummy variable equal to 1 if the country is in external sovereign default to private creditors in the following year. Columns 1-4 report the estimates from a binary logistic regression. In Column 1 I include only the set of global variables. In Column 2 I add some domestic country-specific fundamentals. In Column 3 I add some foreign country-specific fundamentals. In Column 4 (baseline) I add to the predictors the history of external sovereign defaults of the country. In Column 5 I run a random effects logistic regression on the full specification of Column 4. Finally, in Column 6 I add some variables accounting for the original sin hypothesis and replace the dummy for currency crises by another variable measuring the depreciation rate of the local currency. All the country-specific continuous variables have been winsorised at a 5% level (2.5% on each tail). Robust standard errors clustered at a country level are in parentheses. The *p*-value is the result of a test of joint significance of the coefficients. ***, **, * indicate that the coefficients are significant at a 1%, 5% and 10% confidence level, respectively.

In Column 4 (baseline) I add to the previous specification two variables related to past external defaults of the sovereign issuer and other sovereign issuers from the same region, respectively. I find the history of defaults does matter, as countries who were in default in the past are more likely to be in default also in the future. However, a similar statement does not hold for what concerns regional sovereign defaults, as they do not seem to push other countries in the same region to default.

As I am now discussing the baseline case, we can spot the most relevant predictors by comparing the estimates across the different specifications analysed so far (Columns 1-4). Among the global variables, only the dummy for the 2007-2008 financial crisis reaches some statistical significance, thus confirming my previous interpretation of the overall scarce significance of global factors as structural drivers of defaults. Among the country-specific factors, the domestic factors especially seem to contribute in predicting sovereign defaults: almost all of them (except inflation and the overall budget balance, which loses significance in our baseline specification) are significant and with the expected sign. Within the group of external country-specific factors, from the baseline specification, only the change in the commodity terms-of-trade seems to exert some negative effect on the probability of default (in line with the findings in Hilscher and Nosbusch, 2010). Surprisingly, the occurrence of a currency crisis does not seem to affect the probability of external default of the sovereign issuer. I will address this issue in detail when discussing the results from Column 6.

In Column 5 I adopt the same set of explanatory variables as in Column 4, but I run a panel logistic regression with random effects.[22] The only difference in the estimates is the complete loss of statistical significance of the dummy accounting for natural resource-rich countries, but the signs of all the significant predictors do not change. The adjusted Wald test of joint significance of the coefficients (reported at the bottom of Column 5) rejects the null hypothesis of nil panel-level variance, suggesting the presence of unobserved heterogeneity. Nevertheless, there is a caveat. The random effects logit model relies on the assumption that the underlying shocks have no serial correlation, which is a very strong assumption. On the other hand, the model has no known robustness properties to serial correlation; therefore, in general, the resulting estimates are likely to be inconsistent (Wooldridge, 2010, Section 15.8.3). Hence, while providing the results from this specification as a robustness check, I decide to disregard the time dimension of the data and proceed with a pooled logit estimation with clustered standard errors throughout the remaining analysis.

In Column 6 I provide the results from a different specification that includes a few more variables accounting for the original sin hypothesis (see Section 1.2.1). Specifically, the variables directly linked to this hypothesis are the fraction of foreign currency debt over total external public debt (accounting for currency mismatches) and the fraction of short-term debt over total external debt (accounting for maturity mismatches). I also consider the level of international reserves, as Hofmann et al. (2019) claim an adequate level of reserves to be one of the main policy tools against the amplification of external shocks arising from mismatches in the debt composition. Finally, in order to capture the magnitude of external shocks, I drop the dummy for currency crises (which did not seem to have any significance in all the previous specifications) and replace it with the change in the nominal bilateral exchange rate (wherein a positive change indicates a depreciation of the local currency).

Although the qualitative indicator for currency crises did not exert any material effect, the quantitative variable for the change in the nominal exchange rate now gains statistical significance: the amount of depreciation has a positive impact on the probability of default. Therefore, I claim that, while in general a depreciation of the local currency does increase the

[22] As from the Stata manual, "the random-effects model is calculated using quadrature, which is an approximation whose accuracy depends partially on the number of integration points used" (StataCorp, 2015). When the estimates are largely affected by the choice on the number of integration points, they cannot be interpreted reliably. This is not the case in the current study, so I can safely make statistical inference.

probability of default, the occurrence of an extreme currency event does not seem to exert additional upward pressure per se. Moreover, I do not find any evidence that the debt structure, both in terms of currency and maturity composition, has any effect whatsoever on the probability of default. Similarly to the first model, the level of reserves does not seem to have any significant impact as well (analogous results are found by Jeanneret and Souissi, 2016). This lack of evidence suggests that while the Eichengreen and Mody (1998) original sin hypothesis may have vanished because of the improved balancing in the currency and maturity composition of sovereign debt (Burger et al., 2012), the consequential original sin redux hypothesis proposed by Carstens and Shin (2019) may be yet to come, at least in this 1996-2014 dataset.

Overall, by focusing on those variables that retain statistical significance in each of the full specifications (Columns 4-6), I conclude that country-specific factors play an important role in predicting external sovereign defaults in emerging countries. Domestic fundamentals especially tend to exert a significant impact. Financial soundness of both public and private balance sheets (as captured by the levels of general government debt, domestic bank credit to the private sector and the nexus between domestic sovereign defaults and banking crises) is of primary relevance, but also extra-financial performances (as measured by our composite ESG indicator) matter for debt sustainability purposes. On the internal side, domestic defaults tend to anticipate external defaults. On the external side, the history of past defaults to international investors help predict future defaults; its effect is larger as the last default is closer in time, but it rapidly decays after a few years. Other external factors, such as the depreciation rate of the currency or changes in the commodity terms-of-trade (and especially those factors accounting for the original sin hypothesis), appear as somehow less relevant. Finally, global factors seem to have a minor effect. Nevertheless, I detect an upwards shift in sovereign risk in the period of the global financial crisis.

4.2.2 Classification

After estimating the logistic regression model, I evaluate its properties as a binary classifier.[23] Indeed, the occurrence of a sovereign external default in country *i* in year *t+1* can be interpreted

[23] Classification is a supervised learning technique used for predicting a dependent categorical variable based on a set of independent variables. It starts by splitting a dataset in two parts, one called training set and the other test set. On the training set, the analyst builds a model that identifies the effect of each predictor on the outcome variable. The model is then applied to the test set in order to predict the outcomes of this new sample. Finally, the

as an early warning signal issued in year *t*. Therefore, it is natural to think of the model as a valuable tool for investors to distinguish between "safer" and "riskier" sovereign bonds. In order to do so, I split the full sample into two subsamples, one for training the model (training set) and the other for testing it on the remaining data (test set). As a robustness check, I propose three alternative separations into training and test set according to different time breaks. For training purposes, I adopt the baseline specification in Column 4 of Table 4.9.[24]

In Table 4.10. I report the contingency matrices from the classification on alternative sample periods. In Panel A I train the model on the period 1996-2008, in Panel B on the period 1996-2010 and in Panel C on the period 1996-2012. I always assume a probability cutoff of 0.50, so that the classification is based on the mathematical expectation of default.[25]

Table 4.10: Contingency matrices from different classifications based on alternative training sets.

Panel A: Training 1996-2008, testing 2009-2014.

	No crisis	Crisis	Total
No signal	230	1	231
Signal	0	23	23
Total	230	24	254

Panel B: Training 1996-2010, testing 2011-2014.

	No crisis	Crisis	Total
No signal	155	1	156
Signal	0	13	13
Total	155	14	169

Panel C: Training 1996-2012, testing 2013-2014

	No crisis	Crisis	Total
No signal	77	1	78
Signal	0	6	6
Total	77	7	84

predicted outcomes are compared with the actual outcomes to assess the performances of the classifier. See Holopainen and Sarlin (2017) for a review of various classification methods as early-warning models.

[24] For classification purposes, the specification in Column 4 was preferred to the one in Column 6 because of the number of defaults in the respective datasets, almost double in the former than in the latter. The classification properties of the estimator considerably improve by providing more information on historical defaults.

[25] Global investors may prefer giving up on potentially attractive investment opportunities in order to prevent any default to harm their portfolios (i.e. in statistical terms, increasing sensitivity at the expense of specificity). It is certainly possible to tweak the probability cutoff to a lower value (e.g. 0.01): the sensitivity of the classifier then reaches 100% (i.e. all the upcoming defaults are correctly predicted), but its specificity falls to around 86%. To a large extent, the choice on the parameters is subjective and depends on the loss function of the individual investor.

I will now assess the performances of the model in terms of three popular measures: accuracy (i.e. the fraction of correctly predicted outcomes over total predicted outcomes); specificity (i.e. the fraction of correctly predicted negative outcomes over total predicted negative outcomes); and sensitivity (i.e. the fraction of correctly predicted positive outcome over total predicted positive outcomes). In all the subsample periods, the overall accuracy is very high (approximately around 99%). In terms of specificity, the model achieves excellent performances, in the sense that no sound investment opportunity is forgone (100%). In terms of sensitivity, the classifier correctly predicts almost all the sovereign defaults occurring in the next year (96%, 93% and 86% in Panels A, B and C, respectively). However, considering that all the panels report one false negative (i.e. a crisis occurred but no signal was issued), it is worth spending some words on this seemingly systematic error. This missed call always refers to the same observation, namely the 2014 Argentine default. While this default has its roots in the long history of financial crises in Argentina, it has some peculiar features that make it rather different, for instance, to the 2001 Argentine crisis. In the 2001 context, the Argentine economy was collapsing at a rapid pace and default was widely expected by the market because of the government inability-to-pay. Conversely, while in 2014 the health conditions of the economic system had substantially improved compared to the 2001 crisis, the default arose from a political decision of the Argentine government not to negotiate with a minority of creditors, thus showing a clear unwillingness-to-pay. However, as international markets believed the economic costs of a default would have been higher than the political cost of negotiation, many market analysts did not expect the default to occur and, in the prior years, the economic fundamentals of Argentina did not suffer from any deterioration of the sovereign's credit quality (Vuletin, 2014).[26] Although the classifier probably needs to capture political risk factors more effectively, a decision to default not previously discounted by the markets can be considered to a large extent as exogenous to the model. Therefore, I decided to treat this case as an outlier and neglect the related systematic classification bias.

[26] The "selective" default sprang from a 2014 U.S. court ruling in favour of some holdout investors who had been claiming for full repayment of their credit. The holdout investors were a minority of Argentine bondholders (2% of the investor base, owning around 7% of the sovereign debt of the country), mostly composed by hedge funds and vulture funds. They had been refusing to accept the haircuts proposed by the Argentine government and accepted by the vast majority of its creditors (98%). While the full repayment of the holdout creditors alone was likely to be sustainable from a public finance perspective, it would have triggered a "rights upon future offers" (RUFO) clause that obliged the government to pay in full also those creditors who had previously accepted the haircuts. Since the RUFO clause was expiring at the end of the year, many analysts expected the government to negotiate with the holdout creditors for a one-year stay. Indeed, international markets considered this as a "win-win" outcome: the government would have offered adequate guarantees to the holdout creditors while preventing the triggering of the RUFO clause. However, the government deemed this political compromise too high a price to pay and decided to default on the holdout creditors.

Conclusion

The sovereign debt of emerging countries has attracted growing interest among international investors over the last decade as these economies progressively managed to shield against adverse macroeconomic shocks. This major improvement raised questions among academics about the causes of this paradigm shift and the true nature of sovereign credit risk in emerging countries. Specifically, some authors in the literature investigated the drivers of the default risk embedded in sovereign debt, while other authors focused on the determinants of the pricing of that specific risk. This thesis addresses both the issues from the perspective of an international investor and by the adoption of an empirical approach, which includes two distinct models. In the first model, I regress sovereign CDS spreads on their first lag, some global factors and some country-specific fundamentals; I estimate the equation by fixed effects panel OLS. I also run a PCA in order to quantify the commonalities across spreads over time. In the second model, I estimate the probability of default of each country in the following year by a binary logistic regression based on an extensive set of global and country-specific leading indicators. Then, I train the model on a subsample and test its classification properties on the remaining sample.

In the first model, I show that sovereign CDS spreads are largely persistent over time (as in Afonso et al., 2014). Global risk factors, especially the U.S. stock market and the U.S. yield curve, are robust and negative determinants of sovereign borrowing costs. Indeed, the results of the PCA point out that spreads exhibit a high degree of cointegration. Nevertheless, some country-specific fundamentals, namely inflation and the depreciation rate of the local currency, are also relevant and have a positive effect. These results closely relate to the evidence provided by Longstaff et al. (2011). Credit ratings appear to have a significant negative effect (consistent with the seminal paper by Cantor and Packer, 1996). However, I suspect potential simultaneity with spreads, in line with more recent analyses investigating the Granger causality between spreads and ratings (Afonso et al., 2012). The influence of all these variables, though, depends on both the period and the region under consideration. Concerning shifts over time, the U.S. interest rates ceased to exert any effect in the wake of the global financial crisis, while the positive role of market volatility significantly increased in the same period. Among country-specific fundamentals, the volatility in the value of the local currency became more important, whereas its depreciation rate lost relevance. In European emerging countries during the regional sovereign debt crisis, the negative role of the U.S. yield curve was restored. However, the borrowing costs of European sovereigns decoupled from the U.S. stock market, while still being affected by international markets volatility. The evidence on volatility especially is in line with Afonso et al. (2014). With respect to differences across regions, I report evidence of two clusters, one represented by Europe and Central Asia, and the other including Latin America and the Caribbean and East Asia and Pacific. The spreads in the former are more persistent over time. Furthermore, they are affected by the U.S. yield curve, as well as by the U.S. stock market returns. On the other hand, the spreads in the latter are less persistent but bear a larger time-invariant premium. Moreover, they do not depend on the U.S. interest rates, but they are more affected than the former by the U.S. equity market.

In the second model, I document that country-specific fundamentals in general are the most relevant leading indicators of sovereign defaults (as argued by Remolona et al., 2008). Notably, the sustainability of public finances and the financial development of the domestic banking sector are important factors. Particularly, the health of the banking sector is crucial, as banking fragilities impinge on government debt sustainability (Acharya et al., 2014). However, financial figures are not the only relevant indicators, as extra-financial performances (in terms of ESG indicators) also contribute to signal the occurrence of a default (Margaretic & Pouget, 2018). Current domestic defaults tend to anticipate upcoming external defaults, while a history of past defaults makes sovereign debt distress more likely to recur (but its effect is negligible when the last default is distant in time, as in Jeanneret and Souissi, 2016). The depreciation rate of the local currency is the only relevant predictor among the external variables. International risk factors do not seem to affect systematically the probability of default. Nonetheless, the global financial crisis shifted upwards the probability of default of all the countries in the sample. Finally, it is worth noting that the robustness of the estimates is corroborated to a certain extent by the accuracy of the classification method, which correctly predicts most of the out-of-sample observations.

An interesting remark pertains to the limited relevance of external factors as drivers of default risk. Specifically, differently from the predictions of the original sin hypothesis proposed by Eichengreen and Hausmann (1999), neither currency mismatches nor maturity mismatches in the composition of sovereign debt seem to affect default risk. The irrelevance of currency mismatches is in line with Jeanneret and Souissi (2016); however, in their study maturity mismatches are a significant predictor of default. The depreciation rate of the local currency is relevant, but the mere occurrence of an extreme currency shock does not seem to push the probability of default up. Furthermore, inflation – which reflects internally the stability of the currency – does not appear to be a significant predictor of default as well (consistent with

Jeanneret and Souissi, 2016). When compared to the robust role of the depreciation rate and inflation in the model related to sovereign risk premia, it highlights that international investors still price these factors into spreads, despite their limited effects on the actual default risk. I interpret this evidence as a heritage from the decades prior to the early 2000s, when hiking inflation rates and external fragilities severely undermined the creditworthiness of sovereign issuers of emerging market economies.

This thesis builds on the existing empirical literature on sovereign default risk and its pricing by the means of a comprehensive approach, which takes care of several potential issues related to the data and the methodology adopted to address the research question. However, I acknowledge that there is room for improvement. Regarding the data, the whole analysis would benefit from the use of information released at a higher frequency, e.g. daily or weekly data for sovereign spreads on the one side, and monthly or quarterly data on sovereign defaults on the other. It would be also interesting to analyse more in detail the impact of some specific factors, e.g. ESG performances, or the interaction of banking and currency crises with sovereign defaults; but clearly, both these extensions of the model are conditional on larger data availability (especially if analysing emerging market economies). For what concerns the methodology, and specifically the model on sovereign spreads, one possible amendment would be to allow for heterogeneous slopes by the adoption of a pooled mean group estimator or a mean group estimator (Pesaran et al., 1999), which relax the assumption of homogenous coefficients of the dynamic fixed effects panel regression. Another extension of interest would consist in disentangling the direction of causality between spreads and credit ratings, for instance by the use of a VAR framework. With respect to the model on sovereign defaults, the performances of the classifier may improve by moving from conventional econometric techniques to more sophisticated machine learning algorithms, e.g. random forest or neural network (Holopainen & Sarlin, 2017). However, compared to the binary logistic regression, these classification methods usually require a full parametrisation by the researcher, which would probably suit applied research better than a master thesis.

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APPENDIX A

Table 1.1: Summary table of the literature review on the global determinants of sovereign spreads.

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
Eichengreen and Mody (1998)	37 EC	1991.01 1996.12	Irrelevant[1]	Estimating the determinants of the issuance of sovereign bonds and of primary spreads	Heckman sample selection model	Both demand and supply factors are important. Short-run movements are due to changes in market sentiment
McGuire and Schrijvers (2003)	15 EC	1997.03 2003.06	Daily	Measuring the common factors behind sovereign spread movements in the secondary bond market	Principal component analysis	Changes in a single common factor drive one third of the variation. This factor is identified with investors' risk attitudes
Pan and Singleton (2008)	3 EC	2001.03 2006.08	Daily	Disentangling the parameters of the risk-neutral default and recovery processes from the term structure of sovereign CDS spreads	Principal component analysis. Maximum likelihood estimation	Changes in a single common factor capture almost all the variation (96%) in the term structure of spreads
Longstaff et al. (2011)	26 AC and EC	2000.10 2010.01	Monthly	Disentangling the default risk component and the risk premium component of the sovereign CDS spread and estimating their determinants	Principal component analysis. Maximum likelihood estimation	Changes in a single common factor account for most of the variation (64%) in the spreads. Global variables (U.S. equity, volatility and bond spreads) determine both the default risk and the risk premium component
Fender et al. (2012)	80 EC	2002.04 2011.12	Daily	Estimating the determinants of sovereign CDS spreads before and after the global financial crisis	Principal component analysis. GARCH model	Spreads are driven by global and regional risk premia (namely U.S. bond, equity and high-yield returns) rather than by country-specific fundamentals, especially in the aftermath of the global financial crisis
Amstad et al. (2016)	28 EC and AC	2004.01 2014.12	Monthly	Estimating the effect of economic fundamentals on sovereign CDS spreads	Principal component analysis and subsequent regression of component loadings	Before the global financial crisis a single common factor drives half of the variation in the spreads; after the crisis its influence is even more dominant than before. Its effect does not depend on country fundamentals

Note. [1] The variables are measured at the time of issuance.

Table 1.2: Summary table of the literature review on the country-specific determinants of sovereign spreads.

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
Hallerberg and Wolff (2008)	11 EMU countries	1993.03 2005.03	Quarterly	Estimating the effect of fiscal institutions on sovereign bond spreads	Fixed effects dynamic panel OLS regression	The quality of the fiscal institutions is an important determinant of sovereign spreads
Remolona et al. (2008)	24 EC	2002.01 2006.05	Monthly	Disentangling the default risk component and the risk premium component of sovereign CDS spreads and estimating their determinants	Fixed effects dynamic panel OLS regression	The default-risk component is mainly driven by country-specific fundamentals, while the risk-premium component depends on the investors' global risk aversion
Hilscher and Nosbusch (2010)	32 EC	1994 2007	Yearly	Estimating the effect of the terms-of-trade and other macroeconomic	Fixed effects panel OLS regression	The volatility of terms-of-trade is a significant driver of sovereign bond spreads

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
				fundamentals on sovereign credit risk		
Comelli (2012)	28 EC	1998.01 2011.12	Monthly	Estimating the determinants of sovereign bond spreads and backtesting the model	Fixed effects panel OLS regression	Country-specific factors are systematically important, while the effect of global factors varies across time and regions. Good country fundamentals are less relevant in periods of distress
Afonso et al. (2014)	10 EMU countries	1999.01 2010.12	Monthly	Estimating the determinants of long-term sovereign bond spreads	Principal component analysis. Dynamic fixed effects panel 2SLS regression	Fiscal fundamentals are the main determinants of sovereign risk, but several risk factors become relevant after the global financial crisis
Presbitero et al (2015)	104 EC and DC	1995 2013	Yearly	Estimating the determinants of the issuance of sovereign bonds and primary bond spreads	Heckman sample selection model	Both fiscal (budget balance) and external fundamentals (current account balance and international reserves) affect spreads, as well as global market volatility
Ho (2016)	8 EC	2008.03 2013.06	Quarterly	Estimating the heterogeneous effect of the macroeconomic fundamentals related to a country's external position on sovereign CDS spreads	Pooled mean group estimator	External country-specific factors (current account, external debt and international reserves) have a significant long-run effect on sovereign spreads
Aizenman et al. (2016)	20 EC	2004.06 2012.09	Quarterly	Estimating the effect of country fundamentals on sovereign CDS spreads before and after the global financial crisis	GMM dynamic panel regression	External fundamentals are more important drivers of spreads before the crisis, while after the crisis fiscal fundamentals become more relevant
Margaretic and Pouget (2018)	33 EC	2001 2010	Yearly	Estimating the effect of ESG factors on sovereign bond spreads	GMM dynamic panel regression	The governance factor has a negative and immediate impact on spreads. The social factor has an initially positive and then negative effect. The environmental factor does not affect spreads
Capelle-Blancard et al. (2019)	20 OECD countries	1996 2012	Yearly	Estimating the effect of ESG factors on sovereign bond spreads	Dynamic fixed effects panel OLS regression	Both the governance factor and the social factor have a negative effect on spreads, while the environmental factor does not affect them. They become more important after the global financial crisis

Table 1.3: Summary table of the literature review on the spillovers and contagion between sovereign spreads.

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
Arghyrou and Kontonikas (2012)	10 EMU countries	1991.01 2011.08	Monthly	Examining the determinants of sovereign risk after the European sovereign debt crisis	Principal component analysis. Time series and fixed effects panel estimation techniques	Sovereign bond spreads in the EMU tend to converge before the sovereign debt crisis. After the crisis they decouple because of the greater role of macroeconomic fundamentals and international risk
Beirne and Fratzscher (2013)	31 EC and AC	1999 2011	Monthly	Estimate the drivers of sovereign risk during the European sovereign debt crisis	Fixed effects panel OLS regression	The authors find evidence of fundamentals contagion on sovereign risk. Regional contagion, instead, decreases after the crisis. Herding contagion is clustered in time and geographically
Wu et al. (2016)	67 EC and AC	2002 2013	Daily	Identifying regional contagion effects and their interaction with macroeconomic	Event study analysis. Generalised principal	The authors document evidence of immediate regional contagion on sovereign credit risk, while global contagion occurs at a slower pace

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
				fundamentals and global risk factors	component analysis; multifactor asset pricing model. Time series regression	
Caporin et al. (2018)	7 EMU countries	2003.01 2013.04	Daily	Measuring shift-contagion effects during the global financial crisis and the sovereign debt crisis in Europe	Quantile regression	The degree of cointegration among EMU countries decreases after the U.S. financial crisis; the divergence process is due to differentials in the expectations of fiscal distress. The transmission mechanism remains unaltered before and after the European sovereign debt crisis

Table 1.4: Summary table of the literature review on the causes of sovereign defaults.

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
Eichengreen and Hausmann (1999)	3 EC and AC	Irrelevant[1]	Irrelevant[1]	Understanding the causes of financial fragility and providing optimal exchange rate policies	Case studies analysis	The authors underline the materiality of the original sin hypothesis (i.e. a situation in which the local currency cannot be used to borrow abroad, nor long term) in some financial distress episodes
Reinhart and Rogoff (2011)	70 EC and AC	1800 2014	Yearly	Assessing the interrelationships between sovereign defaults and other types of crises (currency crises, banking crises)	Multinomial logit regression	External debt surges (caused by currency crises) tend to originate banking crises, which in turn tend to trigger sovereign debt crises
Acharya et al. (2014)	24 EU member States (of which 19 EMU countries)	2007.01 2011.04	Daily	Assessing the interlinkages between bank bailouts and sovereign credit risk	Fixed effects panel OLS regression	Bank bailouts increase sovereign credit risk, which in turn raises bank credit risk as banks hold government bonds and explicit and/or implicit government guarantees
Gennaioli et al. (2014)	46 EC and AC	1980 2005	Yearly	Estimating the effect of stronger private financial institutions on sovereign risk	Fixed effects panel OLS regression. Probit model	Sovereign defaults are costlier and, thus, less likely in those countries wherein the financial sector is more developed, banks holds more government bonds and private capital inflows are larger
Jeanneret and Souissi (2016)	100 EC and AC	1996 2012	Yearly	Estimating the determinants of sovereign defaults by currency denomination	Binary logit model	Currency mismatches in the sovereign debt composition do not affect the probability of default, whereas maturity mismatches do affect it
Ottonello and Perez (2019)	18 EC	2004 2014	Yearly	Study the determinants of the currency composition of sovereign debt	General equilibrium model	The disappearance of the original sin hypothesis over time is due to the gradual stabilisation of growth and inflation

Note. [1] Their analysis focuses on three specific case studies.

Table 1.5: Summary table of the literature review on the early-warnings of sovereign defaults.

Authors (date)	Sample	Period	Frequency	Research question	Methodology	Results
Manasse et al. (2003)	47 EC	1970 2002	Annual	Identifying patterns in the data leading to a sovereign debt crisis	Event study analysis. Binary logit model	The most efficient leading indicators of default are solvency measures, liquidity measures, internal and external macroeconomic imbalances and investors' risk attitude
Pescatory and Sy (2007)	31 EC	1975 2002	Annual	Assessing the adequacy of standard sovereign default definitions for early-warning purposes	GEE logit population-averaged model	Solvency measures, liquidity measures and other internal and external macroeconomic variables are significant predictors of default. Liquidity is even more important when defining debt distress as turbulence in the sovereign bond market, whereas inflation loses significance
Hilscher and Nosbusch (2010)	32 EC	1994 2007	Annual	Estimating the effect of the terms-of-trade and other macroeconomic fundamentals on sovereign credit risk	Reduced form logit model	The volatility of terms-of-trade (along with measures of solvency, liquidity and creditworthiness) is a significant predictor of sovereign defaults
Chakrabarti and Zeaiter (2014)	190 EC and AC	1970 2010	Annual	Checking the robustness of some of the most common predictors of default in the literature to alternative specifications	Extreme bound analysis	The effect of some factors on the probability of default is robust to differences in the conditioning set, while the effect of other factors varies considerably depending on the specification adopted by the researcher
Jeanneret and Souissi (2016)	100 EC and AC	1996 2012	Annual	Estimating the determinants of sovereign defaults by currency denomination	Binary logit model	Sovereign defaults on foreign currency debt are mainly due to the government's inability-to-pay
Dawood et al. (2017)	38 EC and AC	1980 2012	Annual	Comparing the performances of alternative econometric models for the early-warning prediction of sovereign defaults	Binary logit model. Multinomial logit model. Dynamic signal extraction approach	The binary logit model accounting for regional heterogeneity of the signalling indicator has the best performances as an early-warning model in terms of predictive power. It is also important to allow for spillovers from the banking sector and foreign exchange market
Holopainen and Sarlin (2017)	15 EU member States	1976.03 2014.09	Quarterly	Comparing the performances of different classification methods for the early-warning prediction of financial crises	Various statistical, econometric and machine learning techniques	Machine learning algorithms tend to outperform traditional early-warning models based on statistical rules or econometric techniques

APPENDIX A

Table 2.1: Conversion table of the rating scales from Moody's, S&P and Fitch into the numeric rating scale used in the first model.

		Moody's	S&P	Fitch	Numeric scale
Investment grade	Highest quality	Aaa	AAA	AAA	20
	High quality	Aa1	AA+	AA+	19
		Aa2	AA	AA	18
		Aa3	AA-	AA-	17
	Strong payment capacity	A1	A+	A+	16
		A2	A	A	15
		A3	A-	A-	14
	Adequate payment capacity	Baa1	BBB+	BBB+	13
		Baa2	BBB	BBB	12
		Baa3	BBB-	BBB-	11
Speculative grade	Likely to fulfil obligations, ongoing uncertainty	Ba1	BB+	BB+	10
		Ba2	BB	BB	9
		Ba3	BB-	BB-	8
	High credit risk	B1	B+	B+	7
		B2	B	B	6
		B3	B-	B-	5
	Very high credit risk	Caa1	CCC+	CCC+	4
		Caa2	CCC	CCC	3
		Caa3	CCC-	CCC-	2
	Near default with possibility of recovery	Ca	CC	CC	1
				C	
	Default	C	SD	DDD	
			D	DD	
				D	

Note. Source: Afonso et al. (2012).

Table 3.1: Countries included in the first dataset by region.

Latin America and Caribbean	Sub-Saharan Africa	East Asia and Pacific	Middle East and North Africa	Europe and Central Asia	South Asia
1. Brazil	6. South Africa	7. China	13. Israel	14. Czech Republic	
2. Chile		8. Indonesia		15. Hungary	
3. Colombia		9. South Korea		16. Poland	
4. Mexico		10. Malaysia		17. Romania	
5. Peru		11. Philippines		18. Russia	
		12. Thailand		19. Turkey	

Note. The six world regions, as recognised by the IMF, are in column. The 19 countries in the dataset belong to the Bloomberg Barclays Emerging Markets Local Currency Liquid Government Index. I have 153 monthly observations for each country (144 non-missing observations on average, min. 122, max. 150).

Table 3.5: Countries included in the second dataset by region.

Latin America and Caribbean	Sub-Saharan Africa	East Asia and Pacific	Middle East and North Africa	Europe and Central Asia	South Asia
1. Argentina	19. Angola	**29. China**	35. Algeria	**39. Poland**	42. India
2. Bolivia	20. Central African Republic	**30. Indonesia**	36. Egypt	**40. Russia**	43. Sri Lanka
3. Brazil	21. Côte d'Ivoire	**31. Malaysia**	37. Morocco	**41. Turkey**	
4. Chile	22. Ghana	32. Myanmar	38. Tunisia		
5. Colombia	23. Kenya	**33. Philippines**			
6. Costa Rica	24. Mauritius	**34. Thailand**			
7. Dominican Republic	25. Nigeria				
8. Ecuador	**26. South Africa**				
9. El Salvador	27. Zambia				
10. Guatemala	28. Zimbabwe				
11. Honduras					
12. Mexico					
13. Nicaragua					
14. Panama					
15. Paraguay					
16. Peru					
17. Uruguay					
18. Venezuela					

Note. The six world regions, as recognised by the IMF, are in column. Countries also included in the first dataset are in bold.

APPENDIX A

Table 3.6. External sovereign defaults by region, country and year.

Panel A: Latin America and Caribbean.

	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Argentina						X	X	X	X	X									X
Dominican Republic										X									
Ecuador													X	X					
Honduras	X	X	X	X	X	X	X	X	X	X									
Nicaragua					X	X	X	X	X	X	X	X	X	X	X				
Panama	X																		
Paraguay								X	X										
Venezuela									X	X									

Panel B: Sub-Saharan Africa.

	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Angola					X	X	X	X											
Central African Republic		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Côte d'Ivoire		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		
Kenya			X		X														
Nigeria									X	X									
Zimbabwe										X				X	X	X	X	X	X

Panel C: East-Asia and Pacific.

	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Indonesia					X		X												
Myanmar				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Panel D: Middle East and North Africa.

	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Algeria	X																		

Note. Panels A, B, C and D report the list of external sovereign defaults for the four regions of Latin America and the Caribbean, Sub-Saharan Africa, East Asia and Pacific and Middle East and North Africa, respectively. I report the year of the observation (1996-2014) in column, while the respective country is in row. An issuer is considered in default if not meeting its external obligations in the corresponding year, regardless of whether the default started in a previous year. Sovereign defaults on official external creditors are excluded. Please note that some default events have been omitted from the list due to limited data availability.

APPENDIX B

Figure 3.2: Average VIX index (in absolute points) and average sovereign CDS spread (in basis points) over time.

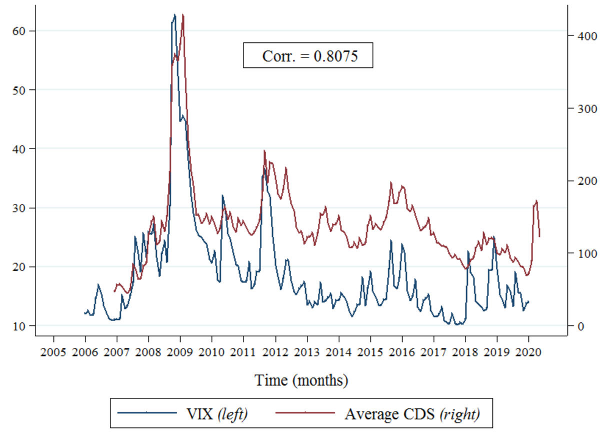


Figure 3.3: Average U.S. effective federal funds rate (in basis points) and average sovereign CDS spread (in basis points) over time.

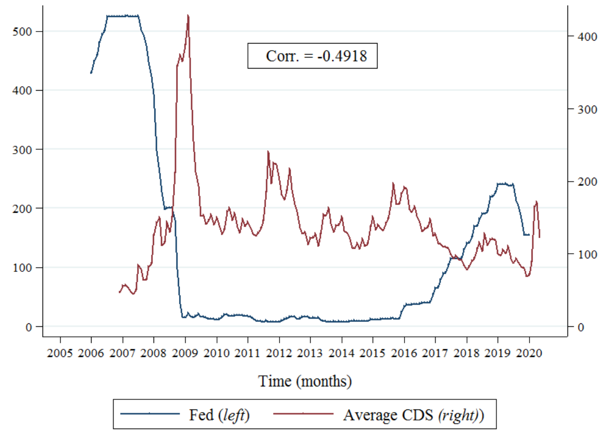
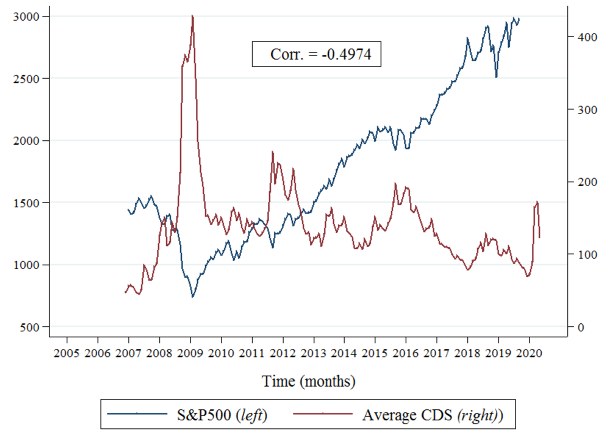


Figure 3.4: S&P500 index monthly close (in absolute terms) and average sovereign CDS spread (in basis points) over time.



APPENDIX B

Figure 3.7: Fraction of countries being in default and entering a default, respectively, by year, in percentage.

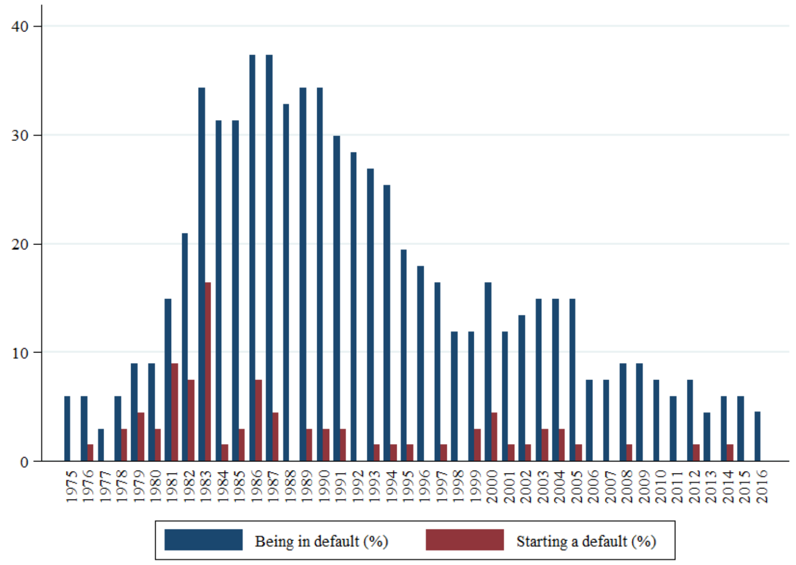


Figure 3.8: Fraction of countries in default contemporaneously experiencing a currency crisis and/or a banking crisis by year, in percentage.