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The Effects of Redenomination Risk on Sovereign Spreads During the Euro Crisis

A Review of Empirical Evidence

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Abstract

Redenomination risk has been the object of increasing research in the fields of macroeconomics. This master thesis serves several purposes. First, it gathers the disseminated state-of-the-art research on redenomination risk in a single, comprehensive and exhaustive document. Second, it discusses the different measures conceptually, identifying the underlying logic of each measure and highlighting their advantages and limitations. Third, it provides an in-depth analysis of the potential effects of a Euro breakup in the financial instruments that are used to measure redenomination risk. More specifically, it navigates the intricacies of the 2014 ISDA definitions. Eventually, the thesis provides guidance for future research as to improve our understanding of redenomination and its impact. Whereas there is enough evidence on the essential role that redenomination played driving the sovereign spreads of peripheral countries to record highs, we find that there is not a consensual view on how a euro break-up would affect certain core-countries, such as France. Since the source of break-up concerns has nowadays shifted from investors screens to voting polls, having a unified approach to redenomination cannot be more relevant.

JEL Classification Codes: E02, E44, E50, G12, G15
Key Words: Redenomination, Sovereign Debt Crisis, Literature Review

Table of Acronyms

CAC Collective Action Clauses
CDS Credit Default Swaps
EA Euro Area
ECB European Central Bank
EFSF European Financial Stability Facility
EFSM European Financial Stability Mechanism
EMU European Monetary Union
EONIA Euro Overnight Interbank Offered Rate
ESM European Stability Mechanism
EU European Union
FAVAR Factor Augmented Vector Autoregression
GARCH Generalized Autoregressive Conditional Heteroskedasticity
GIIPS Greece, Italy, Ireland, Portugal and Spain
ISDA International Swaps and Derivatives Association
LTRO Longer-Term Refinancing Operations
OMT Outright Monetary Transactions
OTC Over-the-counter
QE Quantitative Easing
SMP Securities Market Programme
UMP Unconventional Monetary Policy
VAR Vector Auto Regression

Contents

1. Introduction

Several years after the double-dip recession, Eurozone countries were still healing the remaining wounds caused by the Global financial crisis (2007-2008) and the sovereign debt crisis (2010-2014). As the French economist, Charles Wyplosz, putted it in 2015 referring to the European Commission forecasts: “Five years later, growth is miserable and is forecasted to remain miserable”. Besides the sluggish growth recovery, other persistent damages were, and are still today, dramatically high levels of unemployment, particularly amongst the youth of peripheral countries, and a drop in aggregate demand, let alone the contagion of Euroscepticism in the monetary union (Marelli, 2016). Recent literature has focused on the role that the fear of a union breakup, the so-called redenomination risk, had on the sovereign spreads, driving them to record highs and pushing the Eurozone closer to the brink of collapse. For the first time since the introduction of the euro, the market participants were questioning the irreversibility of what had become the biggest monetary union in the world. The same contracts denominated under the jurisdiction of Italy, Portugal and Spain, were traded at a premium in comparison with equivalents under foreign jurisdiction, and therefore, irrespective of the credit risk of the reference entity. Although there is a general agreement amongst academics and policymakers on the relevance of redenomination in the increase of spreads during the Euro crisis, there is no consensus on what is the most adequate measure to disentangle this risk from the other factors that influence the sovereign yields, and consequently, the extent to which they influenced the premiums. Roberto De Santis, principal economist at the ECB, attributes up to 30, 40 and 50% of the spreads to redenomination respectively for France, Spain and Italy (at their peak). In contrast, the Klose and Weigert estimate that bondholders of sovereigns of Italy, Spain, Ireland and Portugal would suffer from a depreciation reducing the value of their holdings by 10% at most. According to Kirshnamurhy redenomination did not play any role in Italian sovereign spreads.

Several questions naturally arise: How did a monetary union of well above 300 million individuals and gathering some of the most important economies (no less than 3 out of the 7 largest economies in the world) lost the confidence on the continuity of its commitment? To what extent redenomination risk affected the sovereign spreads of such countries? How can the divergence in current literature be reconciled? These are the questions discussed in the following sections.

The paper is organized as follows. The current section sets up the non-technical context of the Sovereign Crisis. The second section provides further analysis on how redenomination would have affected sovereign bonds and Credit Default Swaps contracts. Finally, the third section provides a systematic literature review of the existing measures of redenomination. We compare these measures conceptually. Eventually, we conclude providing guidance for future research in the field.

1.1. The Euro Crisis

In anticipation of the introduction of the euro, interest rates in the eurozone decreased and started stabilizing already back in 1995. The government bond spreads of Greece, Italy Ireland, Portugal and Spain (hereinafter, the GIIPS countries) relative to Germany decreased to remarkably low levels (see Figure 1). This decrease in risk premiums was, amongst other things, brought by the confidence on the Maastricht treaty and its convergence criteria; low inflation rates, budget deficits lower than 3% and a sovereign debt lower than 60% of national GDP. Suddenly, countries that had previously been

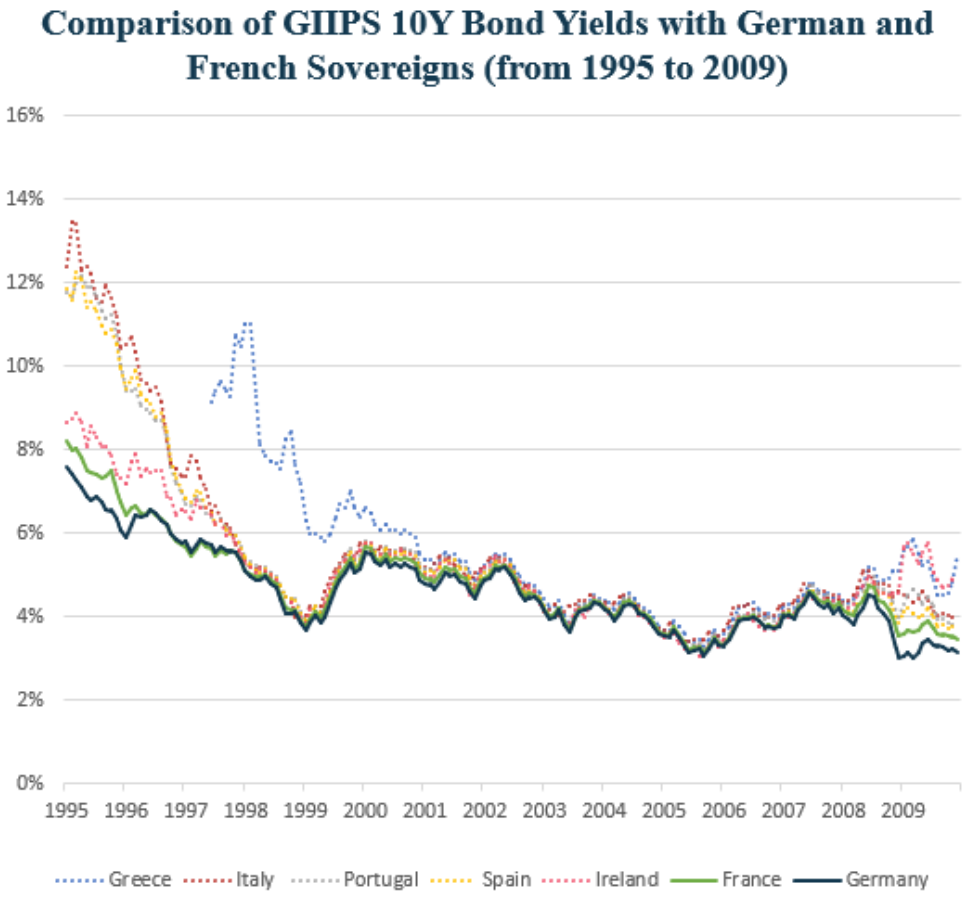

Figure 1.

Source: FED Data

paying over a 10% premium on their sovereign debt could borrow at much lower rates. These favorable credit conditions led to excessive debt borrowing in comparison with the productive effects they generated (CEPR, 2015). However, the excessive credit growth and fiscal indiscipline would later become a major cause of the sovereign debt crisis (Wyplosz, 2014).

The increasing budget deficits disconnected from macroeconomic fundamentals, such as the growth in sovereign revenue, led to a sharp increase in debt to GDP ratios (see Figure 2). In 2009, right before the sovereign crisis, the average government debt in a euro area country was 80% of GDP and the compounded debt of the 19 EU countries of the Euro Area summed up to 7.36 trillion euros (Eurostat, 2019). Importantly, the outstanding obligations were paid with additional debt. That worked while credit was cheap and available, the rest is history; the Global financial brought liquidity problems to surface as the EURIBOR-EONIA spread (a risk-free proxy for interbank lending) increased and the interbank market dried-up (Shambaugh, 2012; ECB, 2019).

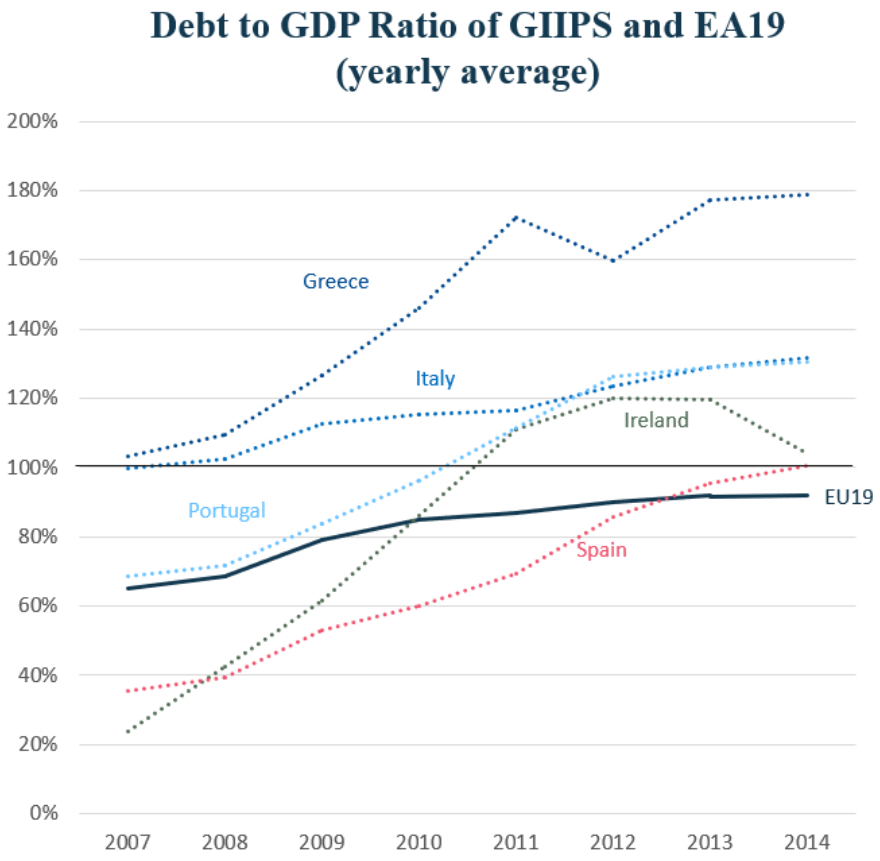

Figure 2.

Source: Eurostat Data

In October 2009 Greece's newly elected prime minister, Geroge Papandreu, revealed that the budget deficit would exceed by 12% of GDP, that is, twice as much as it had been forecasted (CFR, 2018). At that point, Greece had a debt of around 130% of GDP. Two years later the situation had worsened for the eurozone in general, but in particular for the peripheral countries. In 2012, the GIIPS countries leaded the ranking of indebtedness with all countries having credit obligations exceeding their entire economic output of one year except for Spain, and Belgium being the only non-peripheral exception above that threshold (see above or Figure 3 below). The Hellenic Republic was still head of list, with a sovereign debt rising to 160% of total GDP, followed by Portugal, Italy and Ireland (in that order).

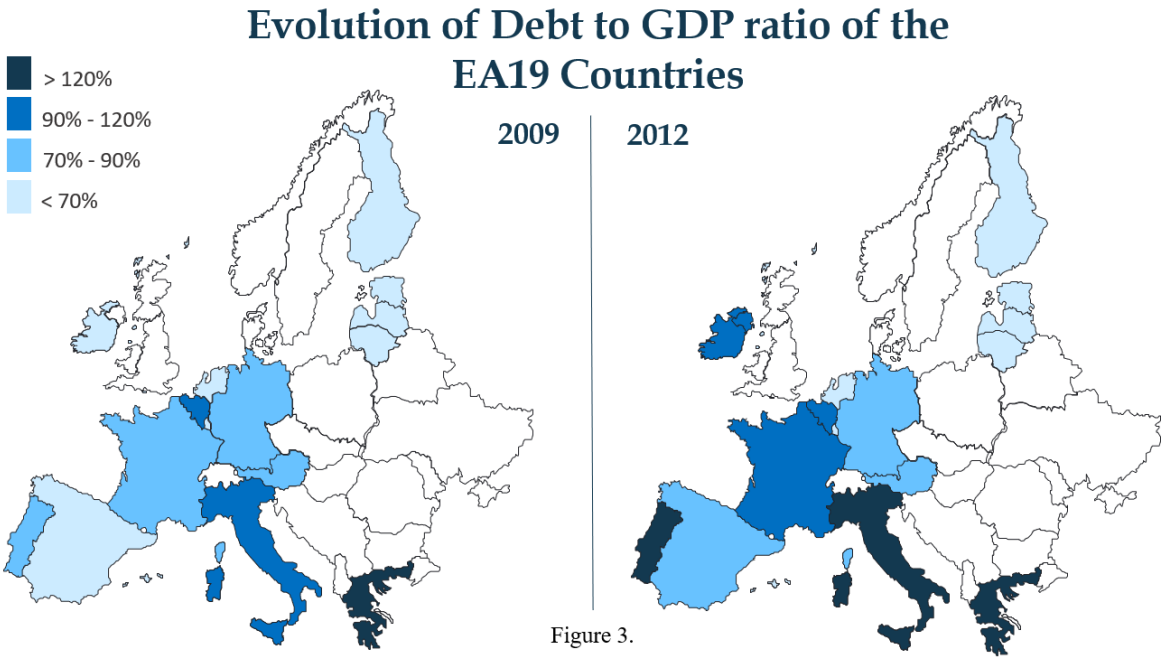

Figure 3.

Source: Eurostat Data

Importantly, the challenges faced by each eurozone member were country-specific. For instance, Spain and Ireland experienced a banking crisis and a real state bubble whereas Greece's problems related to fiscal policy (Shambaugh, 2012). For the sake of conciseness, those details are out of the scope of this paper. If you are interested in conducting further research on the topic, the Centre for Economic Policy Research (CEPR) provided a consensual and extensive analysis of the causes of the crisis which gathers the views of several renowned economists (see reference: CEPR, 2015).

In short, the eurozone countries entered three self-reinforcing crises (see Figure 4). First, governments had harder times financing themselves. This was the result of a slow economic growth and a higher unemployment which reduced tax revenue and increased

the government spent. Moreover, the dried-up credit liquidity which was reflected on increasing sovereign yields. Second, banks were undercapitalized and had tremendous exposure to local sovereign debt. For instance, the government debt holdings in Spain by Spanish banks was the equivalent to 20% of GDP. And third, economic growth slowed as investment from both banks and governments evaporated (Shambaugh, 2012).

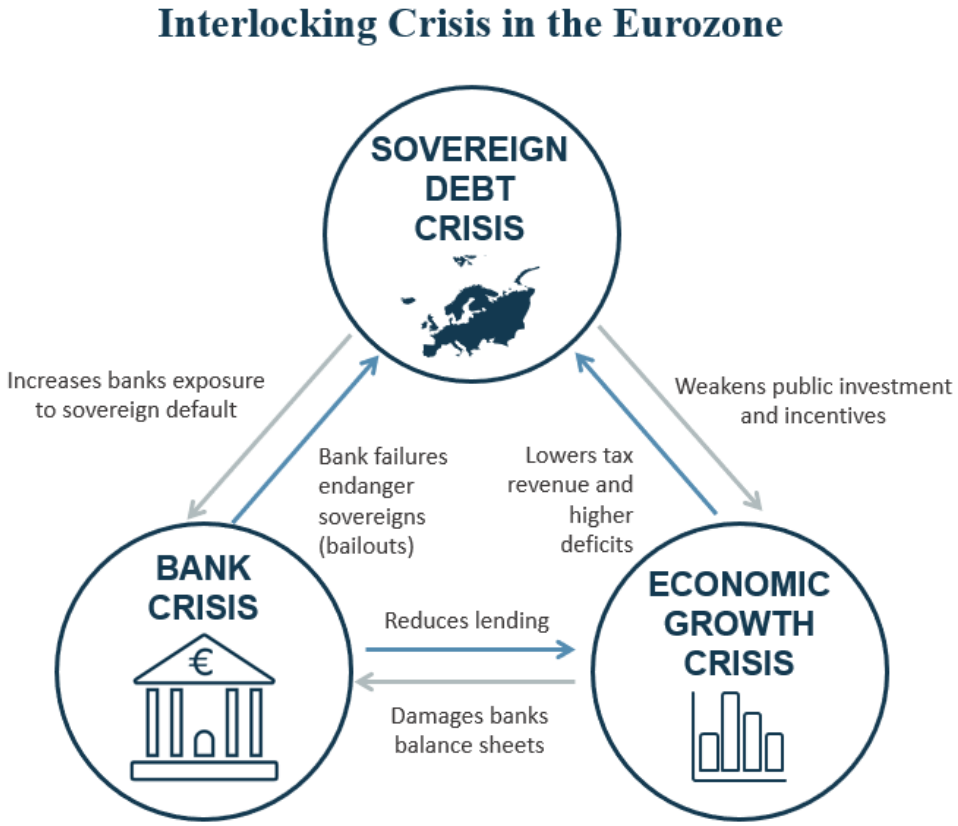

Figure 4.

Source: Adapted from Shambaugh, 2012

The 2011-2013 period was critical for some eurozone countries. As seen in Figure 5 and Figure 6, 10-year bond spreads of several peripheral countries over Germany raised dramatically, reaching the highest levels since the adoption of the euro (the Figures use monthly data provided by the Federal Reserve Economic Data). At their peak in the fall 2011 and the summer of 2012, Italian and Spanish yields were close to 7%. During that same period, the spread with the 10-year German Bunds continued widening, as the yield latest moved in the opposite direction during that period. Greece's 10-year yields peaked at almost 30% in the beginning of 2012. Right before the default, 2-year quotes were

above 200% (Krishnamurthy et al., 2018). Eventually, the yields of Portugal and Ireland were also remarkably high; both over 10% at their worst.

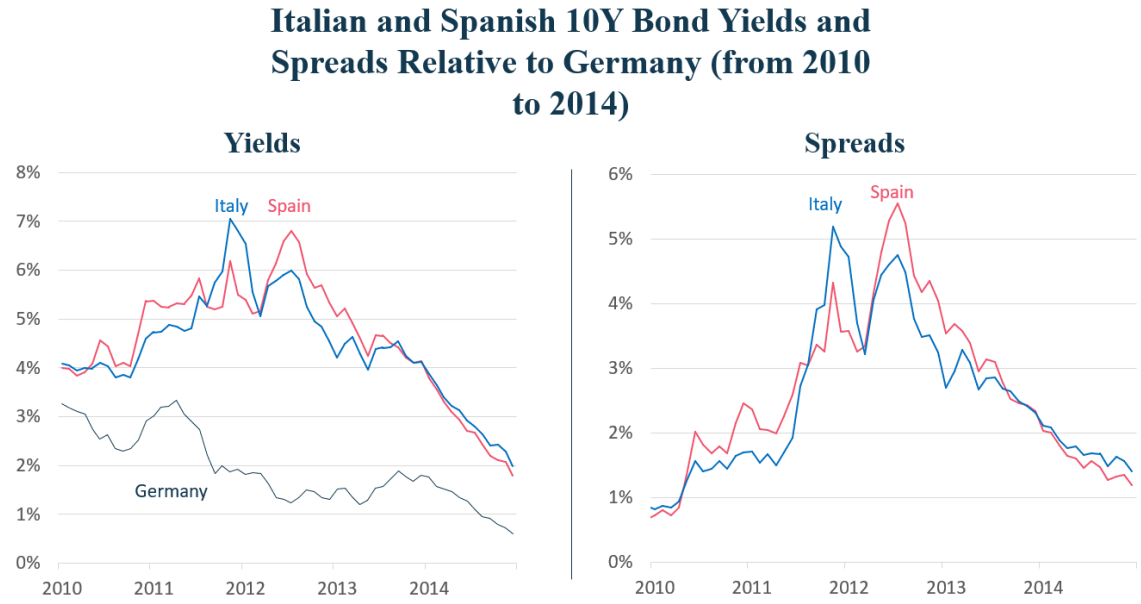

Figure 5.

Source: FRED Data

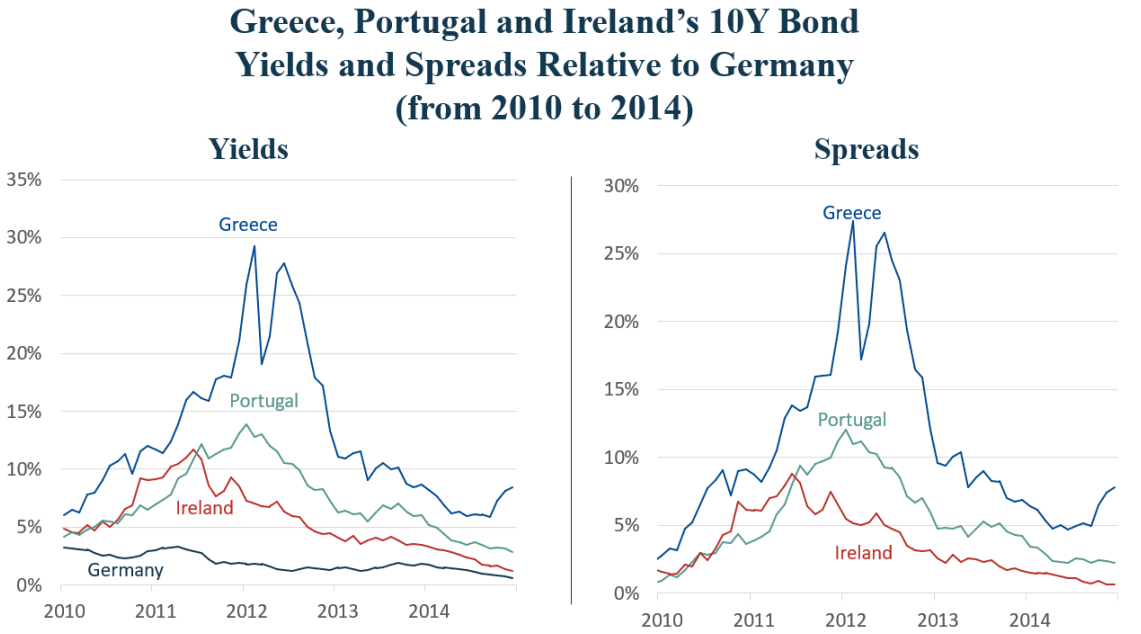

Figure 6.

Source: FRED Data

1.2. ECB Unconventional Monetary Policies

As a response to the economic worsening in the euro area the ECB launched a series of Unconventional Monetary Policies (hereinafter, UMP's). In normal times, the central bank's policy consists in fixing a target for the interbank overnight interest rates (EONIA) and modifying the money supply in the economy through Open Market Operations to maintain price stability (Bini Smaghi, 2009). However, in such exceptional

circumstances, the transmission mechanisms of conventional monetary policy are inhibited, and central banks must resort to UMP's. The ECB used three different unconventional policies (ECB, 2018).

1.2.1. Securities Market Programme

The first UMP of the European Central Bank was the Securities Market Programme (SMP), launched on May 2010. In words of the back then president of the ECB, Jean-Claude Trichet, "*the Securities Markets Programme is designed to ensure an effective functioning of the monetary policy transmission mechanism by helping to resolve a malfunctioning of some segments of the euro area debt securities markets"* (Trichet, 2010). In practice, the program essentially provided liquidity to those countries that were dysfunctional through the purchase government debt on the secondary market (ECB, 2010). The table below contains ECB's holdings as of December 31st, 2012.

ECB's Purchases under the Securities Market Programme as of 31-12-2012

Issuer Country	Nominal Amount (EUR Billion)	Average Remaining Maturity (years)
Ireland	14.2	4.6
Greece	33.9	3.6
Spain	44.3	4.1
Italy	102.8	4.5
Portugal	22.8	3.9

Table 1.

Source: ECB

That date, the total outstanding debt that had been purchased by the ECB as part of the SMP program was of 218 billion (ECB, 2013).

1.2.2. Longer-Term Refinancing Operations

On the 8 of December 2011, a month after the election of Mario Draghi as new president, the ECB announced a second measure to support credit liquidity and lending in the eurozone; two Longer-Term Refinancing Operations (LTRO). At their most essential level, they consisted in providing banks with extremely cheap money so they could in turn purchase government bonds and drive their yields down. The two new LTRO's extended a previous 12-month version from October 2011 and offered a longer maturity (3 years) with the option of early repayment and full allotment. As for the implementation,

the two LTRO's amounted to 1 trillion euros: 489 billion in December 2011 for 523 credit institutions and 530 billion in February 2012 for 800 institutions (ECB, 2012).

1.2.3. Outright Monetary Transactions

Notwithstanding ECB's efforts, the fear of a union breakup led the sovereign spreads of peripheral countries to a second peak in the summer of 2012 (see Figure 5 and 6 above). The critical situation pushed the newly elected president, Mario Draghi, to deliver his famous speech at the Global Investment Conference on the 26 of July, where he stated that the markets were pricing a convertibility risk and that "*the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough"* (Draghi, 2012). A few days later, to demonstrate the commitment of the central bank, he suggested that a new UMP would be introduced.

Eventually, on the 6 September 2012, a press release announced the official termination of the SMP's and the launch of the third Unconventional Monetary Policy; Outright Monetary Transactions (OMT). OMT's consisted in bond purchases in secondary markets too. However, this policy focused solely on the short-term part of the yields (maturities from 1 to 3 years) and included as a necessary condition the adherence to a stability program (European Financial Stability Facility/European Stability Mechanism). Moreover, the OMT's did not set any ex-ante quantitative limits on the transactions (ECB, 2012). In a press conference, Mario Draghi explicitly stated that the main aim of the OMT's was to remove redenomination risk, that was reflected in the short tail of the bond yields. According to him, the fear of a euro breakup was driving the differences in credit costs between eurozone regions to unacceptable levels, as they were well above the inherent risk of those countries (Draghi, 2012).

One year later Benoit Coeuré, member of the ECB's executive board, on the occasion of the anniversary of the OMT's commented the following: *"Overall, in the first half of 2012, the pricing of redenomination risk led to a significant and rapid increase in spreads between government bonds in euro area countries. These divergences could not be explained by changes in fiscal or macroeconomic fundamentals"* (Coeuré, 2013). Following OMT's the government yields and spreads considerably decreased, in Coeuré's words, because they served as an insurance against redenomination. Interestingly, even though they had an important role in re-establishing trust and driving the yields back to normal levels, no OMT has been activated to date (ECB, 2019).

1.3. From Contagion to Redenomination

Besides policymakers, the increase in sovereign premiums also draw the attention of academics, which provided extensive evidence that indeed the spreads were, to a large extent, unrelated to fundamental factors. Previous research had observed a statistically significant relation between sovereign spreads and fundamental factors like economic growth, budget deficits and debt to GDP ratios (discussed above). However, academia suggested that, since the beginning of the eurozone crisis these factors could not sufficiently explain the variations in sovereign spreads. De Grauwe and Ji find evidence that investors had been mispricing spreads for a long time. Before the crisis, Greek and German bonds had been trading at similar rates while having significantly different fundamentals. In contrast, the spreads of the GIIPS during the crisis were over priced in comparison with other countries outside monetary unions which had similar debt to GDP ratio (De Grauwe and Ji, 2012). De Santis finds that contagion from Greece severely affected countries with weaker fundamentals, in particular Ireland, Portugal, Italy, Spain, Belgium and France (De Santis, 2012). In turn, Italy was affected by contagion from Spain and Portugal (Metiu, 2012). According to Metiu, although unrelated to Italian fundamentals, over half of the unexpected increases of the Spanish spreads were transmitted to the Italian spread, Antonio di Cesare et alia estimated that, at the end of August 2012, the Italian 10-year spread over Germany based on fundamentals should have been around 200 basis points instead of 450bp. Moreover, they find evidence that German yields were decreasing due to safe-haven-flows while the fear of a euro break-up was driving the spreads of core and non-core countries in opposite directions (Di Cesare et al., 2012). According to Favero, the markets were reconsidering the viability of the monetary union and priced the possibility of an exit in some of the eurozone countries (Favero, 2013).

Consequently, several authors provided additional efforts to measure that "convertibility" risk, which is the aim of this paper. Before jumping into the measures that have been suggested by the literature (Section 3), the next section provides the foundations for the analysis. First, it defines redenomination and puts it into a historic perspective. Second, it analyses the specificities of the eurozone crisis and dissects the financial instruments used to measure redenomination. More specifically, it dissects the market functioning and the legal implications of a break-up on both sovereign bonds and Credit Default Swaps in that order.

2. Redenomination Foundations

2.1. Definition and History

Redenomination is defined as the process whereby a country recalibrates its currency, whether it is due to excessive inflation, to the formation of a currency union, or to the break-up of such a union (De Santis, 2015). Although the come-on stage of redenomination seemed unusual in the beginning of the euro crisis, redenomination is almost as old as monetary history. The Roman empire debased their coins by modifying their composition several times (Walker D. R., 1978). So did he English with its silver currency in 1696 in order to finance the nine years war in 1696 against the Netherlands, a decision which led to the creation of the British Gold Standard which later became the International Gold Standard (Larkin, 2006). In 2005, Turkey shifted to the New Lira at a conversion rate of one million to one. The same year Romania introduce its fourth version of the leu. There is also precedent for monetary union break-ups in modern history as it happened, for instance, in former Czechoslovakia. Layna Mosley recorded 60 redenomination's due to excessive inflation in the 1960-2003 period (Mosley, 2005). Andrew K. Rose examined the departures of monetary unions and counted more than 69 cases since World War II (administrative regions, colonies, overseas departments and territories included). The introduction of the euro itself implied the redenomination countries previous currencies (see Figure 7). However, currency breakups historically happened for political reasons (Rose, 2007).

Conversion Rates Between the Euro and the Currencies of the Member States adopting the euro

1 euro	=	40,3399	Belgian francs
	=	1,95583	German marks
	=	166,386	Spanish pesetas
	=	6,55957	French francs
	=	0,787564	Irish pounds
	=	1 936,27	Italian lire
	=	40,3399	Luxembourg francs
	=	2,20371	Dutch guilders
	=	13,7603	Austrian schillings
	=	200,482	Portuguese escudos
	=	5,94573	Finnish marks.

Figure 7.

Source: Council Regulation (EC) No 2866/98 of 31 December 1998

2.2. Redenomination Risk in the Eurozone

As opposed to the questioning of the monetary union fostered by the rise of Eurosceptic parties in the euro area, the fear of a union break-up during the crisis was market driven. Political or not, these concerns were very real. For instance, at the same time the spreads peaked for the first time, the Financial Times wrote "Draghi warns on eurozone break-up" (Financial Times, 2011). Half a year later, in the midst of the second peak of 2012's summer, the newspaper published an article titled "Central Bankers Brace for Euro Break-Up". It reported a survey made by UBS where 75% of the respondents (more than 80 central bank reserve managers and sovereign wealth funds holding over 8 trillion USD in assets) believed that one country would leave the euro area in the next five years. Moreover, a small portion stated, by the end of the year, the euro would have disappeared (Financial Times, 2012). Regardless of the accuracy and potential biases of the two articles, they evidence that there was a market perception of redenomination risk. For simplicity, we will refer to the "market perception of redenomination risk" as "redenomination risk". Thus, the redenomination risk of a given country is the premium priced by the market for the perceived risk of that country leaving the union, and not the real probability of that country leaving the union. Another important distinction is the one between redenomination and political risks. Political risks refer to the inability of the government to conduct the fiscal measures necessary for healthy public finances whereas redenomination refers to the risk that an asset is paid in a new devaluated currency. The first relates to underlying fundamentals, and the second relates to self-fulfilling speculation. Indeed, in the context of an election where a Eurosceptic party has high stakes of being elected both risks can increase simultaneously (De Santis, 2017).

Market fears gave rise to a set of essential questions: Can Eurozone countries leave the union? Will they continue to be part of the European Union? If yes, how would such a process take place? Will the economy benefit or shrink after such a shift? In fine, the key question raised by market participants was: will assets (loans, bonds, derivatives etc.) keep their value, or they will be deteriorated by a euro exit?

The question is particularly complex because an exit had never been conceived, and there is no explicit procedure to leave the solely the EMU. From a legal perspective a member of the eurozone could technically leave the European Union under article 50 of the Lisbon treaty (the one that was used by the UK for Brexit) and request to rejoin the EU but not the monetary union like Denmark and the UK (Dor, 2011). Another legal path would

consist in amending the treaties of the European Union. However, as highlighted in an ECB's publication, both options as well as the expulsion of a country from the EMU would need a *unanimous* agreement of the member states of the EU, and are, therefore, extremely unlikely (Athanassiou, 2009). In a study published by Nomura in November 2011, they identified 4 case scenarios to assess the likelihood of any asset or liability being redenominated (Nomura, 2011). These scenarios were the result of permutations of the following parameters (see Figure 8):

1. **The legal jurisdiction of the asset**: Obligations issued under *local law* were likely to be redenominated into the new currency. The *foreign law* contracts, however, depend on the type of exit.
2. **The method of the breakup**: There consequences of a legal and multilaterally agreed exit would be very different of those of an unlawful and unilateral withdrawal. In the first case, courts would enforce a new EU directive at an agreed exchange rate. If agreed between countries, one can assume that the conversion rate will not be detrimental to other sovereigns and investors. A unilateral departure of the monetary union was also conceivable. According to the *Lex Monetae*, which is internationally recognized, countries have the right to determine their legal tender.
3. **Continuity of the Euro**: If there is a full-blown break-up and the euro no longer exists, the obligations denominated in euros would, a fortiori, be converted into the new local currency.

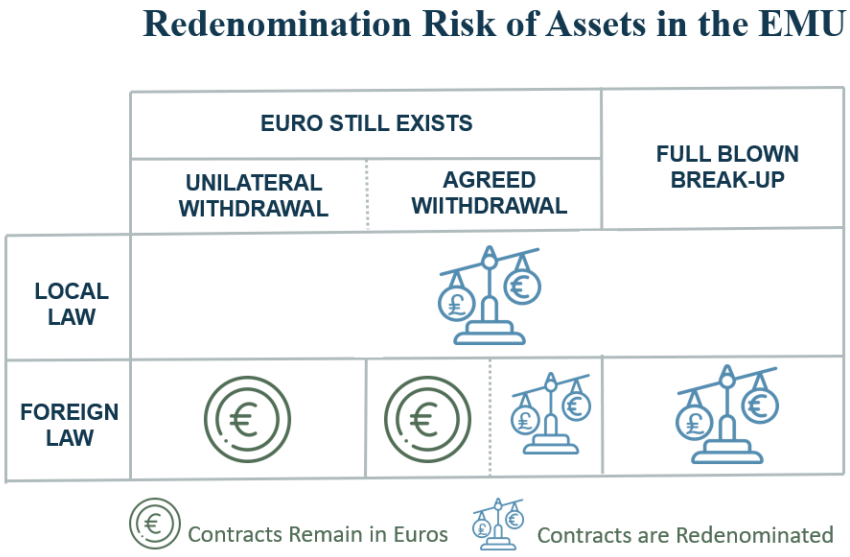

Figure 8.

Source: Adapted from Nomura, 2011

In summary, the assets that can be redenominated are the ones that are issued under local law. The foreign law obligations could be redenominated only if the euro no longer exists or in the unlikely case where there is an agreed exit. In 2011, over 90% of the outstanding sovereign debt of Greece and Portugal was issued under Greek and Portuguese law (Allen & Overy, 2011).

A final consideration is that International-Bonds might be mistakenly interpreted as foreign law bonds. For instance, in 2011 Greece had 120 billion euros of local sovereigns and 173 billion euros of International-Bonds, amongst which only 16 billion were under foreign law. That is 5% of total debt. Moreover, out of the 147 billion euros of Spanish International-Bonds, only around 8 billion were estimated to be issued under foreign law. As seen in Table 2, the three G7 members of the EMU, France Italy and Germany, also had a great proportion of their obligations denominated under local law.

Location of Issuance of Eurozone Assets (in bn EUR)

	Equities	Bonds						Loans		Total
		Sovereign		Financial		Non- Financial		Local Banks	Foreign Banks	
		Local	Intl	Local	Intl	Local	Intl			
Austria	74	106	88	140	152	34	34	371	77	1,074
Belgium	170	220	130	182	313	18	24	315	219	1,591
Finland	121	19	56	33	46	10	18	183	98	584
France	1,115	1,339	53	949	1,268	209	337	2,230	1,038	8,537
Germany	992	1,327	250	433	1,800	294	108	2,369	842	8,415
Greece	28	120	173	80	151	0	9	267	78	907
Ireland	87	48	48	202	329	2	10	349	400	1,475
Italy	371	1,529	198	556	816	278	81	1,990	428	6,245
Netherlands	185	304	19	370	1,006	91	62	1,043	574	3,654
Portugal	52	76	49	87	148	38	9	292	116	867
Spain	423	516	147	617	1,293	18	18	1,920	409	5,361
Total	**3,617**	**5,603**	**1,210**	**3,650**	**7,322**	**992**	**709**	**11,329**	**4,278**	**38,710**

Notes: International refers to the location of issuance and not the Governing law. The comma is a thousand delimiter.

Table 2.
Source: Nomura, 2011 (Bloomberg)

Nomura's study concludes that, in the case that the new currency will trade at a discount (likely for the GIIPS countries according to them), *" the immediate conclusion from an investor perspective should be that assets issued under local law should trade at a discount to foreign law obligations, given the greater redenomination risk for local law instruments*" (Nomura 2011).

In 2013, in accordance with the ESM treaty the bonds issued by governments of the monetary union and with maturity of over one year had to contain a Collective Action Clause (CAC). Essentially, a CAC allows a supermajority of sovereign debt holders to decide on a debt restructuring binding all the holders. These were included to "promote international efforts for orderly restructurings in the event of sovereign debt crises". As a matter of fact, CAC's had already been introduced in international issuances of debt in some eurozone countries before the adoption of 2013's treaty. However, CAC's do not *de iure* affect the ability of a state to local law can override these clauses (Allen & Overy, 2017). De Santis, compared the spread between Italian bonds with similar coupon and maturities and observed that the difference was marginal (around 10bps) and without any particular direction (De Santis, 2017)

2.3. Credit Default Swaps

Credit Default Swaps (CDS) are a key financial instrument when it comes to measuring redenomination. In short, CDS work like insurance contracts; in the same manner we protect our cars, one might want to shield a financial instrument from events that could deteriorate its underlying value. After describing how they work, the subsections below describe in detail the extent to which CDS protect their holders from redenomination.

2.3.1. How Do CDS Work?

CDS allow "swapping" the risk of a credit default between two counterparties; the buyer and the seller of the protection. Although CDS are not technically insurance contracts, they work in the same manner. If, let's say, I am a risk averse investor holding Greek sovereigns in the height of the crisis, I might want to hedge the underlying default risk in exchange of a periodic fee (see Figure 9). In the case Greece defaults on its obligations, the seller of the protection will compensate me with an amount such as I endure no economic loss. For instance, if there is a 50% haircut on the bonds, as it was the case of Greece in 2012, the seller of the protection will have to compensate me with half of the value of the notional amount (the total amount that is protected). From the seller perspective, if there is no credit event, I would benefit from the CDS premium until the term of the contract. This premium is expressed in basis points (1/100th of a percent) and paid yearly until maturity. Say that, because the Greek bonds were very risky, the premium of 5-year CDS on Greek sovereign bonds was of 1,000bp (10%). If there would

have been no debt restructuring, the seller of such a protection would have earned up to 50% of the notional amount at maturity.

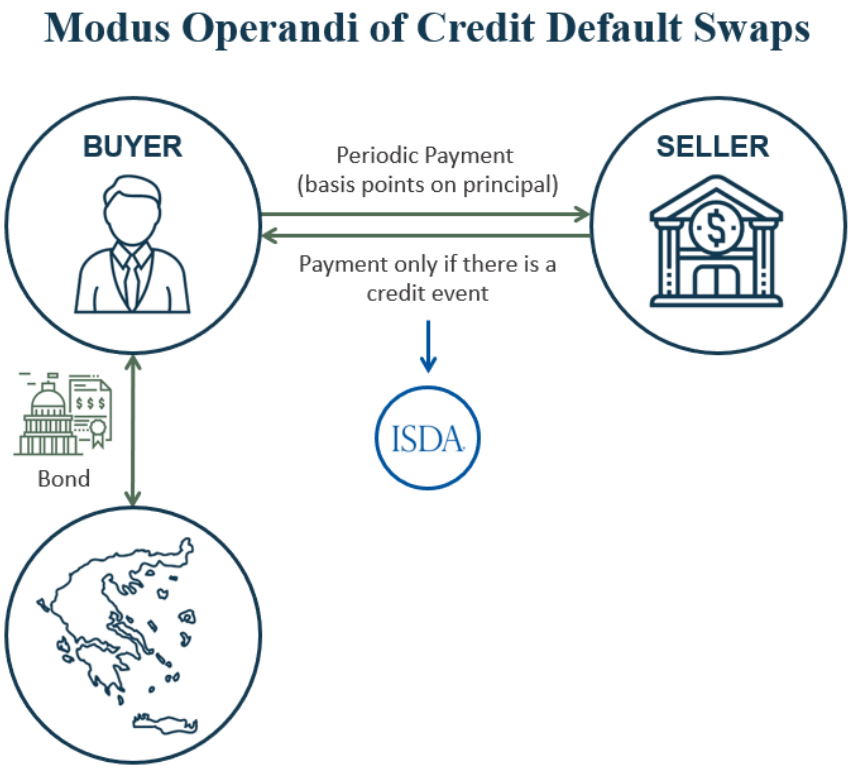

Figure 9.

2.3.2. The CDS Market

Credit Default Swaps are amongst the most widely used Over-the-counter (OTC) derivatives. In 2018, the total notional amount outstanding CDS was 8.1 trillion USD, a strong decline from almost 60 trillion USD in early 2008 (ISDA, 2019). What is more, the total notional amount outstanding of the Swaps market (including fixed income and other Swaps) was 480 trillion USD in 2017, about twice the wealth of the entire world. That number, however, reduces to "only" 15 trillion USD in terms of market value, which is a more meaningful measure (ISDA, 2017). Conceptually, there exist three different types of CDS based on the source of credit exposure: (1) single-name, (2) multi-name and (3) asset-backed CDS. Single-name CDS reference the creditworthiness of a single entity whereas multi-name CDS are based on the credit risk of a portfolio or and index and ABCDS relate to a specific underlying asset or security. Single-name CDS's (to which we will refer hereinafter as CDS's) are traditionally categorized into financial corporations, non-financial corporations or sovereign states, according entity they refer to. Amongst the three, the category of government bonds is the least traded, although it

has kept increasing since the crisis. Moreover, the maturities of CDS contracts can vary from very short-term (less than a year) to long-term (more than five years), although the most liquid ones are 5-year CDS (Culp. et al., 2018). In terms of volume, Berg and Streitz analysed the trading activity of CDS markets between 2010 and 2012 and found that Italy was the country with the largest market size (more than five time the US) followed by France. With respect to trading frequency, Italy and Spain were the countries with the highest weekly trades on average (Berg and Streitz, 2015).

2.3.3. The ISDA Master Agreement

CDS contracts are ruled under the ISDA master agreement, a form produced by the International Swaps and Derivatives Association. In short, the participants have to complete a "confirmation" which sets out the specific terms of the transaction. For instance, it contains the trade and term dates, the strike price and option premiums, the currency of payment and importantly, the date of the ISDA master agreement and the ISDA Credit Derivatives Definitions to which it refers. The last point is especially important because these definitions determine the conditions under which the buyer will be compensated. These situations are called credit events. If an event falls within the definition, the protection is triggered. By contrast, if it doesn't, there will be no compensation whatever the economic loss might be. Therefore, the definitions of what is and what is not a credit event is crucial to determine the value of a CDS, the rationale being that the more protection I would get, the more I will be willing to pay. The essential question is whereas redenomination would have triggered a credit event or not. The ISDA definitions in the 2010-2014 period (the ones from 2003) foresaw six credit events amongst which three were applicable to sovereign bonds:

(1) Repudiation or moratorium of debt

(2) Failure to pay the obligations

(3) Debt restructuring

(4) Bankruptcy

(5) Obligation acceleration

(6) Obligation default

The credit event that rules state insolvency and also redenomination is the debt restructuring credit event (Allen & Overy, 2011). The entire text is provided in Appendix 1 (Chapter 4.7 of the ISDA Credit Derivatives Definitions). This credit event covered five situations which would trigger the protection:

(i) A reduction of the interests to be paid

(ii) A reduction of the premium or the principal to be paid at maturity

(iii) A postponement or deferral of the dates of payments

(iv) A change in the priority ranking (subordination)

(v) A change in a currency which is not a permitted currency

A permitted currency was defined as the legal tender of a G7 country or any country having a AAA rating on its long-term debt as of the date of such change as determined by either S&P, Moody's or Fitch (see Appendix 1). Therefore, if Italy, France or Germany were to leave the EMU and go back to their older currencies, in theory, any resulting loss in value would not be protected under 2003 Definitions (Allen & Overy, 2017). Similarly, for the non-G7 countries of the EA, only those that did not have a triple AAA rating on long-term debt would have been protected against redenomination. Investors that had bought a protection of Greek, Irish, Portuguese, or Spanish debt would have been compensated by a change in the currency of payment of their debt because none of these countries had a triple A rating during the 2010- 2014 period (see Appendix 2 and 3). By contrast, in the unlikely case that triple AAA holders that were not part of the G-7, such as the Netherlands, Luxemburg and Finland, would have redenominated their currency, CDS protections would not have been triggered. Finally, with regards to the triple A downgrades that occurred during the crisis, the question is a bit more complicated. The definition states that, as long as a country has an equivalent of an S&P AAA by one of the three rating agencies, the currency is considered a permitted currency and therefore the CDS will not protect against redenomination. Three EA countries with a triple A rating were downgraded during the 2010-2014 period; France, Belgium and Austria. The case of France is not affected because the country belongs to the G-7. Belgium, however, lost its last triple AAA from S&P in November 2011. Hence, before that date 2003 CDS would not protect a holder of protection from a change of currency (*in abstracto* of the likelihood of going back to the Belgian Franc). Finally, Austria was also downgraded by S&P in January 2011. However, it only lost Moody's Aaa in June 2016 and, consequently, Austrian CDS would not have triggered a credit event at any time during the crisis in the case it had left the EMU. Figure 10 shows which of the EA countries would have been protected by a CDS before and after the credit downgrades. In summary, amongst the GIIPS, only Credit Default Swaps on Italian sovereigns would not have protected the holder against a Euro break-up. By contrast, Belgium was the only core country shielded against redenomination from November 2011 forward.

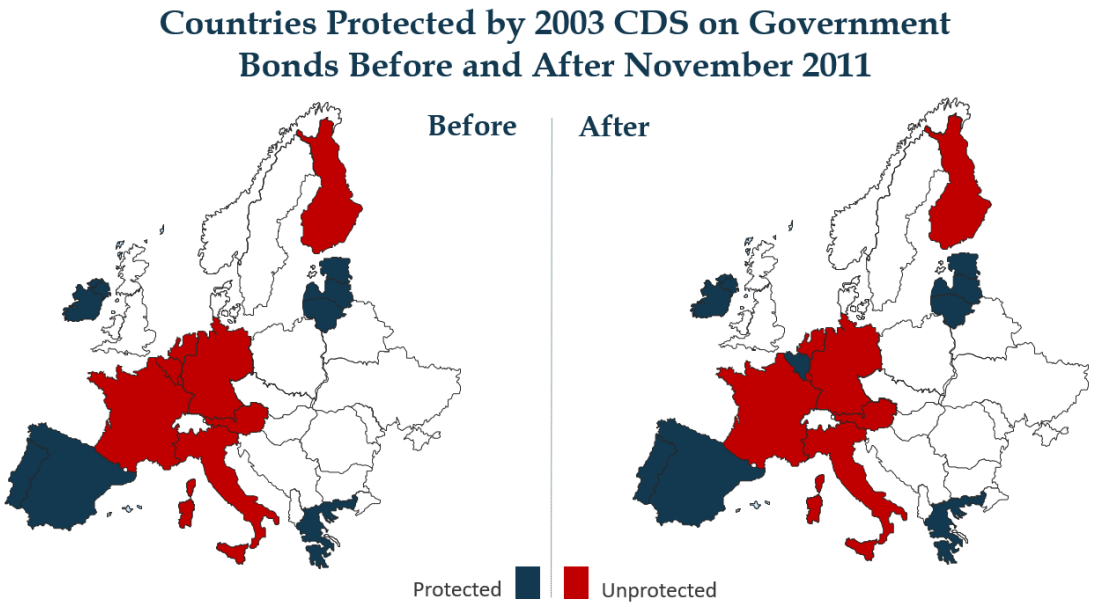

Figure 10.

2.3.3.1. Big-Bang Protocol

Another essential matter is whether a CDS contract itself could be redenominated. Until 2009, in the case of a dispute upon the occurrence of a credit event the two parties of the transaction would be subject to the decision of a court (Culp et al., 2018). This can be problematic, in particular if the enforcement courts are located in the country leaving the euro, because they will most likely recognize the new currency as legal tender and won't declare a credit event (Allen & Overy, 2017). However, since 2009, ISDA has standardized the determination credit events with a new protocol, called the "Big-Bang protocol". In a nutshell, they created Determinations Committees (CDs) for each major geographical region which decide whether a credit event has happened, its date of occurrence, and are in charge of the auction settlement. The decisions are binding on all CDS holders which have included the 2009 developments, which are a majority (Allen & Overy, 2011). For instance, the 9 of March 2012, the EMEA (Europe and Middle-Est) Determinations Committee unanimously decided that a restructuring credit event had occurred in Greece (ISDA, 2012).

2.3.3.2. New 2014 Definitions

The global financial crisis and the Greek debt restructuring, and other cases brought to the surface a number of flaws that would lead to outcomes that did not reflect the real economic value at stake. To address these issues the ISDA introduced the 2014 ISDA Credit Derivatives Definitions. These definitions introduced an extensive array of

changes and explicitly addressed the risk of a euro conversion. Consequently, they provided a much favorable shield. However, redenomination is not the only difference between the 2014 and 2003 definitions. Apart from tackling redenomination issues, the new standards also incorporate a novel "Government Intervention" credit event, a "Sovereign CDS asset package delivery", they upgrade the provisions dealing with the transfer of debt and adjust the settlement mechanism of debt restructurings etc. In sum, with the new definitions, single-name CDS holders referencing sovereigns have a better protection against redenomination, but also with regards to sovereign default (default risk). Figure 11 shows the changes relative to redenomination between the old and the new versions (in **bold**).

According to ISDA's news release in 2014, they "expected" market participants to begin confirming their transactions using the new definitions since the implementation date, which was September of that same year (ISDA, 2014). Therefore, the two populations of CDS currently coexist.

Changes in 2003 and 2014 Definitions Relative to Redenomination

2014 ISDA

Credit Derivatives

Definitions

4.7. "Restructuring" means that … the folloign events occur :

i. a reduction in the rate or amount of interest payable or the amount of scheduled interest accruals **(including by way of redenomination);**

ii. a reduction in the amount of principal or premium payable at ~~maturity or at scheduled~~ redemption ~~dates~~ **(including by way of redenomination);**

iii. a postponement or other deferral of a date or dates for the payment;

iv. A change in the ranking in priority of payment;

v. Any change in the currency or composition of any payment of interest or principal to any currency ~~which is not a Permitted Currency~~ **other that the lawful currency of Canada, Japan, Switzerland, the United Kingdom and the United States of America and the euro and any successor currency to any aforementioned currencies, which in the case in the euro, shall mean the currency which succeeds to and replaces the euro in whole)**

Figure 11.

Source: Adapted from ISDA and Mayer Brown

3. Review of Empirical Evidence

In synchrony with the rise of Sovereign Euro spreads, research on the determinants of sovereign yields increasingly pointed at redenomination as one of the main drivers in the dramatic changes of bond yields. This type of research is of special interest because the identification of the specific risks driving sovereign spreads supports a more targeted and accurate policy. In terms of impact, a few basis points make much of a difference in countries such as Italy and Spain, which have trillions of euros in outstanding debt. If those were to be redenominated, the entire eurozone would be endangered for systemic reasons. All the more reason to unify our understanding of redenomination and the measures that have been used so far. Rather than simply listing these measures by author or date one after another, we categorize them by the underlying rationale of the measure (see Figure 12.). To the best of our knowledge, there are three distinct measures of redenomination. Since it is a prolific field, it is likely that few published and in-progress publications have escaped our radar. However, we are confident that we have gathered the main state-of-the-art bibliography and that we provide an accurate high-level image of the work that has been done to date.

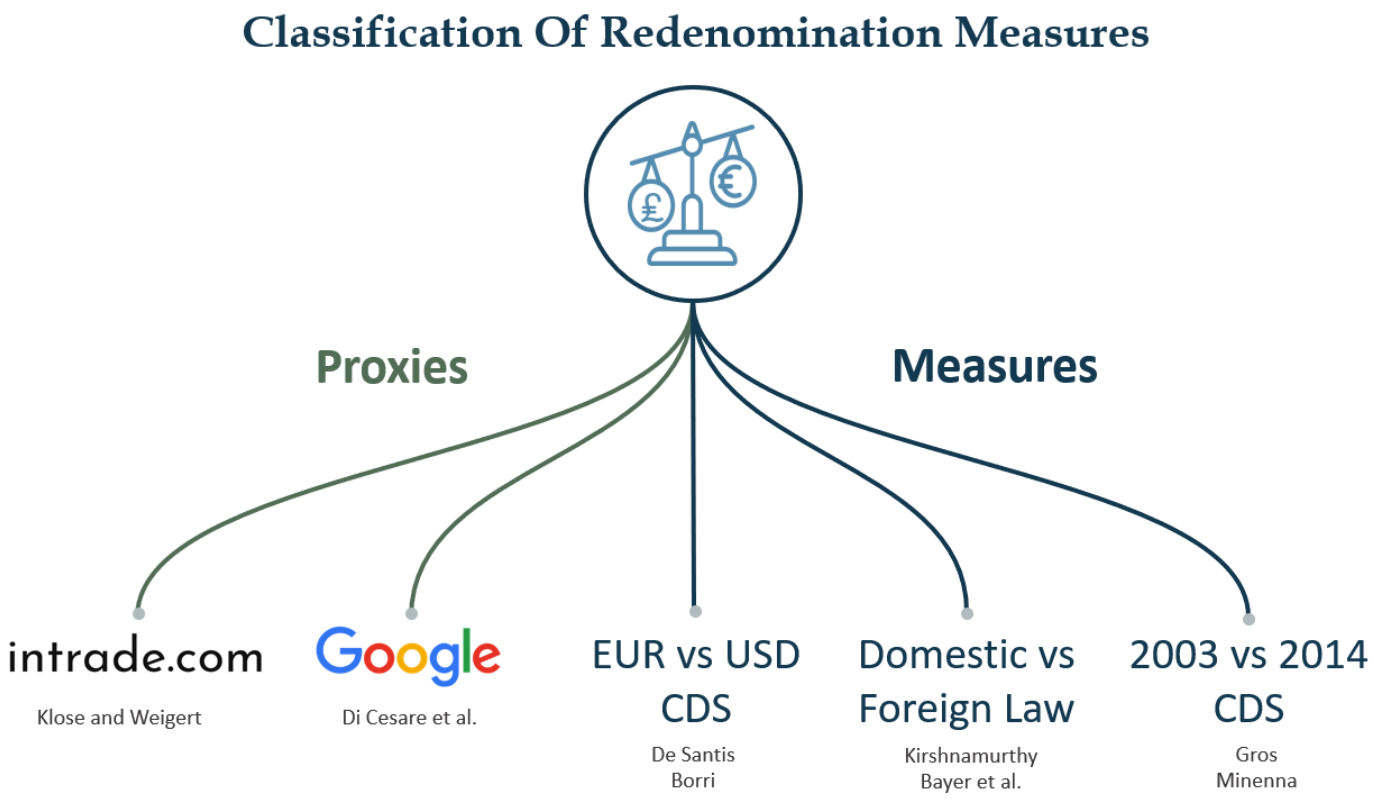

Figure 12.

Empirical measures are similar to building a house of cards; it does not matter how sophisticated the model is, if either the logic or the underlying data are incorrect, the conclusions will be wrong. Therefore, we sequentially analyze these measures with the "lenses" established earlier in this paper.

3.1. Proxies of Redenomination

Going back to the midst of the crisis, when academia demonstrated that the peaks in sovereign spreads were not driven by macroeconomic fundamentals, they highlighted the role of redenomination by using available indicators. Although they might not clearly disentangle redenomination, their importance in leading the literature towards redenomination is unquestionable. For this reason, we shortly summarize and comment them before jumping to redenomination measures.

3.1.1. Google Searches

Antonio Di Cesare et alia were the first authors (to our knowledge) to investigate the role of "convertibility risk" in the sovereign yield spreads. As stated previously, they find evidence that, to a large extent, bond yields were disconnected from their underlying fundamentals. In particular, they observe that the spreads between the 10-year bonds and the 10-year CDS of Italy and Spain increase more pronouncedly than the similar spread of core countries (Netherlands, Belgium, France and Germany). They deduce that the increasing gap is consistent with the assumption that the increasing interests across eurozone countries is due to redenomination. To support that hypothesis, they compare the residuals of the estimation of 10-year bond yields based on macroeconomic fundamentals with an indicator they created based on the searches of "euro break-up" (and similar words) in Google. These residuals measure the component of yields that is unexplained by fundamentals. From January 2010 to June 2012, they find a correlation of 0.77 between the unexplained part of the Italian yields and "break-up" searches on Google. Although lower, reversed German yields were also remarkably correlated to the indicator (0.56 for the same period). According to Di Cesare et al. this supports the expectations that, in the case of a euro break-up, the new German currency will be stronger whereas the one of "non-core" countries would depreciate.

3.1.2. Intrade Indicator

Following the questioning of the extent to which fundamental factors were driving the eurozone sovereign spreads, Jens Klose and Benjamin Weigert provided another proxy for redenomination. The authors used a market-based indicator retrieved from the investing platform Intrade (see Figure 13). This indicator provided an estimate of the probability of at least one country leaving the Euro before 2013. The estimate was derived from the implied probabilities of buy and sell orders relative to such an event. For instance, if the market price of any country leaving the EMU before 2013 was of 60$ out of 100$, it would mean that the underlying market perception of such an event was of 60% (Cassidy, 2013).

Intrade Indicator on "Any country currently using the Euro to announce intention to drop it before midnight Eastern Standard Time 31 Dec 2013"

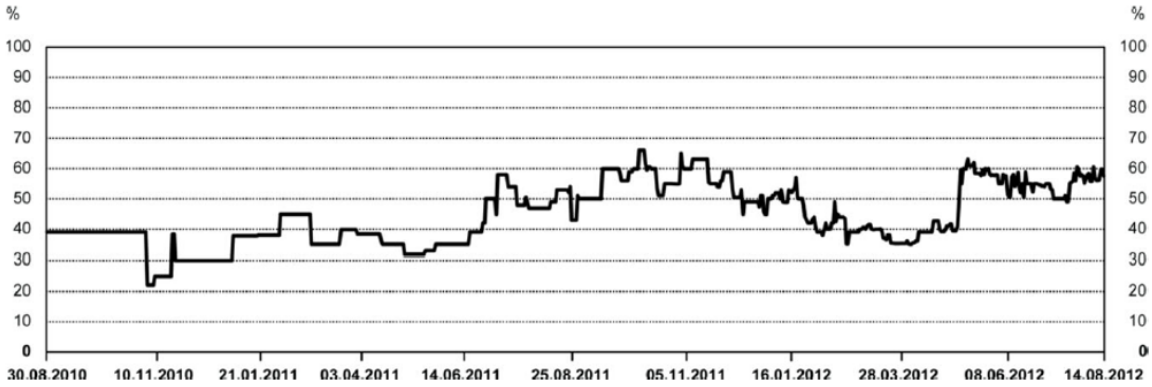

Figure 13.
Source: Adapted from Intrade by Klose and Weigert, 2012

Estimation

In order to model the sovereign yield spreads, the authors develop the following econometric framework:

$$R_T^C - R_T^{ECB} = \alpha_1^C (Bid - Ask)_{T-1}^C + \alpha_2^C CDS_{T-1}^C + \alpha_3^C Exit_{T-1} + \alpha_4^C USBonds_{T-1} + \alpha_5^C GARCH_T^C$$

The term on the left is the spread between the government bond yield and the risk-free rate of the ECB (EONIA). The first term of the right side of the equation is the liquidity premium which is measured by the bid-ask spread of the bonds. Second, the "fiscal and economic fundamentals" are proxied by CDS because, according to the authors, *"CDS premia incorporate all the available information concerning expected loses in the event*

of a default for each country, such as new information about rescue programmes, rising government deficits and revised growth estimates". Third, there is redenomination risk. As seen in the equation, the term *Exit* is not country specific because of the nature of Intrade's indicator (see Figure 13). Therefore, the coefficient α_3^C is to be understood as the product between the conditional probabilities of a country *C* leaving after "any country" leaves (presumably Greece according to the authors) and the rate of conversion of the newly introduced currency. The fourth term represents global risk aversion, estimated with the spread between American corporate BBB yields and US government bonds. Finally, the last term is the country specific volatility which is estimated with a GARCH.

Discussion of Results

The results estimated via Maximum Likelihood for Austria, Belgium, Germany, France Ireland, Italy, Netherlands, Portugal and Spain are displayed in Table 3 below. Interestingly, redenomination risk as modelled above is significant for all the eurozone countries analyzed except for Italy and Belgium which, as seen in a previous section, had an opposite behavior in CDS protection of a euro break-up in comparison with peripheral and core countries respectively. Apart from these two countries, the estimates corroborate the findings of Di Cesare et al.; the fear of a euro break-up was driving the sovereign yields of core and peripheral countries in opposite direction. They estimate that, if Greece were to leave the monetary union, the likely depreciation of would be relatively low: 0.68% for Italy (although not statistically significant), 3.04% for Spain, 5.09% for Ireland and 10.74% in the case of Portugal.

Klose and Weigert's Estimate of Redenomination Using Intrade's Market Based Indicator

	AT	BE	DE	FR	IE	IT	NL	PT	ES
Liquidity Premium	0.63***	0.92***	-2.28***	3.41***	-0.07**	8.81***	2.63***	0.70***	-0.11
	(0.03)	(0.26)	(0.23)	(0.07)	(0.03)	(1.80)	(0.25)	(0.26)	(0.16)
Credit (defaut) Risk	0.81***	1.25***	-0.49***	0.39***	1.06***	0.65***	-0.08	1.33***	1.56***
	(0.05)	(0.03)	(0.07)	(0.02)	(0.01)	(0.07)	(0.14)	(0.07)	(0.08)
Euro break-up	**-0.84*** **	**-0.01**	**-1.15*** **	**-2.45*** **	**5.09*** **	**0.68**	**-1.46*** **	**10.74*** **	**3.04*** **
	(0.12)	(0.22)	(0.10)	(0.00)	(0.29)	(0.49)	(0.09)	(2.48)	(0.50)
Global risk premium	0.67***	1.01***	0.57***	0.92***	1.99***	2.95***	0.46***	2.97**	1.05***
	(0.04)	(0.07)	(0.04)	(0.01)	(0.15)	(0.14)	(0.04)	(1.19)	(0.19)
Volatility	0.24***	0.58***	0.14***	0.14***	2.69***	1.35***	0.01	-0.73***	1.17***
	(0.02)	(0.05)	(0.02)	(0.00)	(0.03)	(0.10)	(0.01)	(0.24)	(0.09)

Notes: The data presente in this table was estimated by Klose and Weigert using Maximum Likelihood. The volatility term is also estimated via ML on a lagged GARCH. The authors deserve all the credits for this work.

Table 3.
Source: Klose and Weigert

Although the use of a market-based indicator has the advantage of reflecting investors' expectations, it has many limitations. On the one hand, since its bankruptcy in December 2012, Intrade data is no longer available. Thus, this model cannot be replicated to measure present or future redenomination. On the one hand, the estimate is not country specific, which adds a layer of complexity to the interpretation of results. Moreover, it could be questioned whether the estimate represents the entire market expectations or a biased subset of the demand and supply, since the trade volumes of the entire platform are insignificant in comparison with the trade volumes of sovereign bonds and CDS (Cassidy 2013). The model itself has some limitations too because the variables are not independent. For instance, CDS contained redenomination information. The result is that countries

3.2. Redenomination Measures

Other than the indicators just described, there exists three measures that intend to isolate redenomination from other non-fundamental factors influencing the yields of sovereign bonds of different eurozone countries. The first one compares CDS denominated in euros and US dollars. In turn, the second one compares different types of bonds under the assumption that the difference between local and foreign law bonds should capture redenomination. Finally, the last measure compares the delta between 2003 and 2014 CDS. The measures are described in further details below. The consistency in the weight given to redenomination in determining the sovereign spreads is also assessed and compared across paper.

3.2.1. EUR vs USD CDS

To date, with his capital work "A Measure of Redenomination Risk", Roberto De Santis has been the main contributor of this particular measure of redenomination, but also to the redenomination literature as a whole. De Santis measures redenomination using solely CDS contracts on sovereign bonds. The intuition is simple: in the presence of redenomination, the same contract denominated in different currencies must yield at different rates. For instance, let's think of two different CDS on Italian Government bonds, one paying off in dollars and the other in euros. From the perspective of the seller of such a protection, if the new currency weakens with respect to the dollar, it will cost

me relatively more to cover the loss. Form the point of view of the buyer, I would prefer to be paid-off in a stronger currency, which would likely be the case of the dollar against the new lira. Following this logic, euro denominated CDS should have traded at a discount in the countries suspected of introducing a new devaluated currency.

However, if the redenomination risk of a given country is measured solely with the quanto CDS (the difference between USD and EUR denominated CDS), the measure will take into account the expectations of an appreciation of the dollar against the euro or vice versa. For the measure to be country-specific, De Santis benchmarks the quanto CDS with the quanto of Germany to control for the FX expectations. The spread between the two quanto's should be close to zero if there are no intra-euro break-up risks. Redenomination is therefore expressed as:

$$REDENOMINATION_T^C = \underbrace{\left(USDCDS_T^C - EURCDS_T^C\right)}_{QUANTO_T^C} - \underbrace{\left(USDCDS_T^{DE} - EURCDS_T^{DE}\right)}_{QUANTO_T^{DE}}$$

Figure 14 and 15 plot redenomination (red line) for Italy and Spain. We used daily quotes from Datastream (the same data as De Santis) for 5-year CDS. At its peak, in the summer

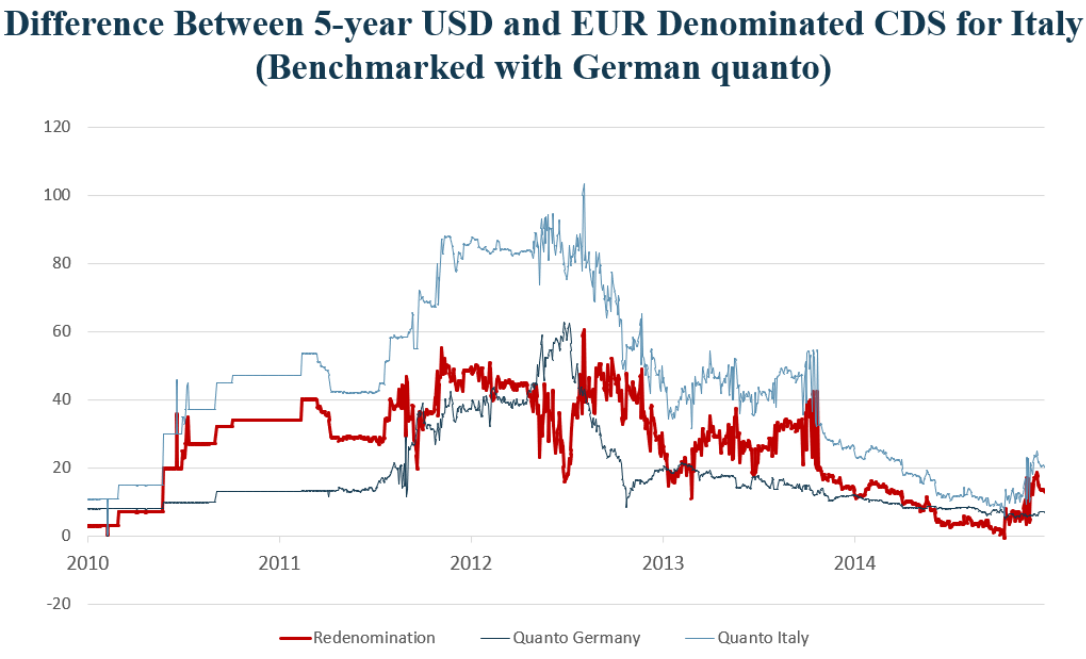

Figure 14.

2012, the difference between quanto-CDS was of 60bps for Italy and almost 100 bps for Spain.

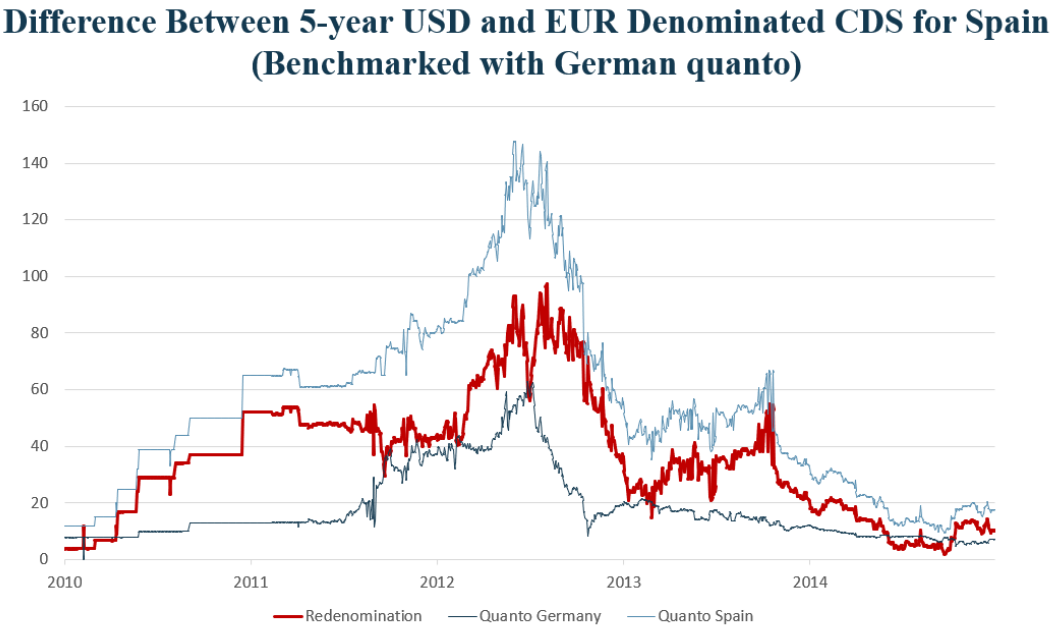

Figure 15.

Estimation

Based upon the previous measure, De Santis disentangles redenomination from all the other factors influencing sovereigns to quantify its impact on the spreads. He performs a Vector Auto Regression (VAR) on the 5-year sovereign yields of France, Spain and Italy where he defines redenomination shocks as independent from exchange rate fluctuations, global economy and regional indicators, liquidity, volatility and a wide variety of other factors. These global and regional variables are reported in Appendix 5. According to the VAR, in July 2012, redenomination risk shocks explained 165bps of the Italian spread (28%), 270bps of the Spanish spread (39%) and 13bps of the French spreads (28%). That amount decreased to 110bps in Italy and 160bps in Spain by the end of 2013, following the "whatever it takes" speech by Mario Draghi and the introduction of the OMT's by the ECB. Incidentally, De Santis also runs a Factor Augmented Vector Autoregression (FAVAR) which leads to similar results.

Discussion of Results

The role of redenomination driving sovereign spreads is considerably higher than the previous measure. Although not certain, the differences are likely explained by the noise introduced by correlated variables. With the VAR, Roberto de Santis forces redenomination shocks to be orthogonal to the foreign exchange and other market-wide factors. Moreover, the results of De Santis can be reconciled with the ones obtained by Di Cesare et al. through their Google indicator. According to the later, in the beginning of the month of August 2012, 250bps of the Italian 10-year sovereign spreads over Germany were unexplained by fundamentals and were very highly correlated (0.77) to break-up concerns. In comparison, De Santis finds that redenomination shocks on 5-year Italian bonds explained up to 165bps during the month before. Considering the term premium, the impact of liquidity and other factors other than liquidity on bond spreads, the magnitude of redenomination is similar for the two measures, or the least, could be reconciled. However, the same cannot be said by about the 0.68% impact of redenomination on Italian spreads from Klose's and Weigert's measure. Differently from the others, the measure De Santis does not allow for a potential appreciation for Germany vis à vis the peripheral countries because it is used as "safe" benchmark. Eventually, another divergence from previous findings is the negative impact of redenomination in France.

Extensions

Using the same measure Nicola Borri extended the analysis to a wider sample of countries (Apart from France, Italy and Spain, he also analyses Austria, Belgium, Finland, Germany, Ireland, Portugal, and Slovenia) and expanded period until October 2018. He finds that, before the Outright Monetary Transactions, redenomination-risk spillovers are insignificant for all the countries of the sample except Belgium, Ireland, Italy and Spain. After the UMP, he finds that the spill-overs are only significant for Italy and Spain. However, the author does not control for the FX expectations common to the Eurozone (USD/EUR appreciation or depreciation) and uses only the country-specific term of the equation above.

3.2.2. Domestic vs Foreign Law

The second measure of redenomination is based in the comparison of corporate and sovereign bonds denominated under local and foreign jurisdictions. The rationale is that,

in the event of a Euro-Breakup, all the securities issued under local law would be affected equally by the redenomination of the euro into a new local currency. For instance, if the Spanish Government decided to leave the euro and stablish a new *peseta*, both corporate and sovereign contracts would be equally affected by this change. Therefore, one could compare the yields of corporate and sovereign bonds to deduce the fear of a euro break-up. Krishnamurthy, Nagel and Vissing-Jorgensen are the main contributors to this measure. In their paper, they identify the following determinants of the Euro-denominated Government bonds yields:

$$R_T^C = Risk\ Free_T + Maturity_T + Default_T^C + Segmentation_T^c + Redenomination_T^c$$

First, there is a risk-free component accounting for the rates at which safe lending is taking place in the Euro Area. This risk-free rate is captured by the EONIA rate, which is the average rate of unsecured overnight lending of a panel of banks in the Euro Area. Second, there is a maturity risk which accounts for the risk of holding a security for a longer period in a context of uncertainty. The term premium and the EOINIA rate are the same for all the countries analyzed by the authors. Third, the credit default component refers to the inability of the bond issuer to meet his obligations. The default component is the major driver in bond yields modelling and depends on both the likelihood and the market value of the loss given default (Duffie and Singleton, 1999). Fourth, segmentation refers to all the frictions caused by market imperfections and liquidity issues. For example, if there are access barriers for investors in a given market, exchange prices will be determined by the equilibrium of a subset of demand. Consequently, the demand can be biased by the optimism of local investors or by budget constraints. In short, all the factors that deviate the exchange price from the one that would have been settled in an efficient market. Finally, there is redenomination, which "*... reflects the likelihood of redenomination (1), the depreciated value of the currency if redenominated (2) and the economic price-of-risk associated with redenomination (3).*" From equation 1, the redenomination measure can be expressed as:

$$Redenomination_T^c = R_T^C - (Risk\ Free_T + Maturity_T + Default_T^C + Segmentation_T^c)$$

The authors take into account the fact that Italian CDS would not trigger a credit event and develop the following measures for redenomination:

1. For Italy: Redenomination risk premium is identified from the difference between the swap-adjusted corporate EUR bond yield and the corporate CDS rate (using ENI as reference entity).
2. For Spain and Portugal: The redenomination risk premium component is identified from the difference between the corporate CDS rate and the corporate swap-adjusted USD yield (Using Telefonica for Spain and EDP for Portugal).

These measures are consistent with the implications of being part of the G7 in CDS and the fact that the jurisdiction is the main criterion of redenomination when it comes to bonds.

Estimation

To quantify the impact of the UMP's in sovereign spreads and the respective channel (one of the three country-specific terms in the equation; default, segmentation or redenomination), Kirsnamurthy et al. carry out an event study methodology using a Kalman filtering and a VAR. The results indicate that default and segmentation were the main impact channels of ECB's policies. The estimated redenomination contributed significantly for Spain (15%) and Portugal (24%) but not for Italy. The latest is inconsistent with previous literature. The difference might arise from the fact that corporate and sovereign bonds are hardly comparable.

Extensions

With a similar logic, Bayer et al. compare default-risk-free Italian sovereign bonds to safe international corporate Eurobonds. However, they use a different approach; they reconstruct the entire risk-free yield curves using over 353 international law corporate bonds and 39 to 64 sovereigns (depending on the country). They find that the yield of the former was higher for Italy, whereas French and German safe Eurobonds traded at a premium in comparison with their respective risk-free sovereign yields, highlighting an expected appreciation for core countries. Moreover, they find that the UMP's of the ECB (SMP, LTRO's and OMT) reduced the spread of the risk-free sovereigns over. Eventually, confirming Benoît Coeuré's speech, they find that redenomination is primarily reflected in the short end of the yield curves.

3.2.3. 2003 vs 2014 CDS Definitions

The third and last measure of redenomination compares the two existing populations of CDS contracts referring to 2003 and 2014 definition. Although technically out of the

scope of this paper (the 2014 definitions were published right after the crisis), we could not leave them unmentioned because of their intrinsic advantage; they explicitly incorporate redenomination as a credit event. In the context of the second round of the French elections between Macron and Le Pen and the disastrous results of the Eurobarometer in Italy, Marcello Minenna compared the ISDA basis (de difference between 2014 and 2013) and found that the gap between the two had doubled, from 20bps to 40bps. In France, the spread almost skyrocketed from 3 to 24 bps (Minenna, 2017). The gap also increased for Spain in lower proportions. He concludes that *"no one is completely immune from the possible consequences of a French secession. Even in Germany, the basis shows similar trends to those displayed in France and Italy,"*. Daniel Gross applies the ISDA basis to Italy in the first half of 2018 and finds that the increases in the risk spreads were caused to a similar extent by default risk and redenomination risk (around 80 bps).

We recall however that 2014 Definitions are by far more advantageous than the ones of 2003 in many other aspects than solely the protection of a euro break-up. Therefore, we must be careful when concluding that "*no one is completely immune from the French secession",* because there might be other factors influencing the yields. Again, 2014 definitions are so advantageous that they systematically trade at a premium. Finally, in terms of continuity, this measure is destined to disappear as 2003 CDS are renewed with new definitions.

3.3 Final Remarks

Figure 16 summarizes the results of the discussed measures and proxies in a visual manner. A red line means that that the market expects a depreciation or, equivalently, that redenomination risk increases the bond spreads. A green line means that the article concludes the opposite. The lines mean that redenomination is statistically insignificant according to the measure, while an empty box means that redenomination is not estimated. All the studies that have measured redenomination in Spain and Portugal have concluded that it paid a significant role in driving sovereign spreads upwards. As for Italy, there are two measures out of eight that conclude that redenomination did not play any statistically significant role in driving the sovereign spreads up. Given the lack of independence of variables in one of the measures and the construction complexity of the other, it is questionable whether these conclusions are accurate. By contrast, the other measures signal the considerable role of redenomination. Finally, the effect of

redenomination in core eurozone countries seems more contrasted. However, if we do not take into account the ISDA basis, which is systematically positive, we can observe that the markets expected an appreciation of the new German mark if the euro ceased to exist.

How Would Peripheral and Core Countries be Affected by Redenomination?

	PROXIS		QUANTO CDS		FOREIGN LOCAL		2003-2014 CDS	
COUNTRY	Di Cesare	Klose & Weigert	De Santis	N. Borri	Nagel et al.	Bayer et al.	Gros	Minenna
FRANCE		↗	↘	—		↗	↘	↘
GERMANY	↗	↗		—		↗	↘	↘
ITALY	↘	—	↘	↘	—	↘	↘	↘
SPAIN		↘	↘	↘	↘		↘	↘
PORTUGAL		↘		↘	↘		↘	↘

Unmeasured ↗ Appreciation ↘ Depreciation — No effect

Figure 16.

Nevertheless, we cannot conclude the same prognostic with the introduction of the new franc; Bayer et al. find that the market expected an appreciation, whereas according to the De Santis redenomination explained 30% of the French sovereign spreads at the height of the crisis.

4. Conclusion

To conclude, there has been a lot of progress in our understanding of the sovereign spread drivers and, in particular, the specific role of break-up concerns during the crisis. Although our current measures of redenomination diverge in some respects, they all agree in the essential: the fears of discontinuity of the eurozone had a substantial role driving the spreads of corporate bonds. However, there is still much progress to be done. Further understanding of its influence is needed for countries such as France, but also in other core countries such as Austria and Belgium. Moreover, much progress can be made by enlarging the scope to the effect of redenomination on corporate bonds and other different types of obligations. Finally, we remember that the purpose of developing knowledge is to drive action. In the specific case of redenomination, the objective is to support policy in its work towards maintaining the most ambitious monetary union that has ever existed. Again, since the source of break-up concerns has nowadays shifted from investors screens to voting polls, having a unified approach to redenomination cannot be more relevant.

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Appendices

Appendix 1: Restructuring credit event, Chapter 4.7. of the ISDA Credit Derivatives Definitions

Section 4.7. Restructuring.

(a) "Restructuring" means that, with respect to one or more Obligations and in relation to an aggregate amount of not less than the Default Requirement, any one or more of the following events occurs in a form that binds all holders of such Obligation, is agreed between the Reference Entity or a Governmental Authority and a sufficient number of holders of such Obligation to bind all holders of the Obligation or is announced (or otherwise decreed) by a Reference Entity or a Governmental Authority in a form that binds all holders of such Obligation, and such event is not expressly provided for under the terms of such Obligation in effect as of the later of (i) the Credit Event Backstop Date and (ii) the date as of which such Obligation is issued or incurred:

(i) a reduction in the rate or amount of interest payable or the amount of scheduled interest accruals;

(ii) (ii) a reduction in the amount of principal or premium payable at maturity or at scheduled redemption dates;

(iii) a postponement or other deferral of a date or dates for either (A) the payment or accrual of interest or (B) the payment of principal or premium;

(iv) a change in the ranking in priority of payment of any Obligation, causing the Subordination of such Obligation to any other Obligation; or

(v) any change in the currency or composition of any payment of interest or principal to any currency which is not a Permitted Currency.

a. "Permitted Currency" means (1) the legal tender of any Group of 7 country (or any country that becomes a member of the Group of 7 if such Group of 7 expands its membership) or (2) the legal tender of any country which, as of the date of such change, is a member of the Organization for Economic Cooperation and Development and has a local currency long-term debt rating of either AAA or higher assigned to it by Standard & Poor's, a division of The McGraw-Hill Companies, Inc. or any successor to the rating business thereof, Aaa or higher assigned to it by Moody's Investors Service, Inc. or any successor to the rating business thereof or AAA or higher assigned to it by Fitch Ratings or any successor to the rating business thereof.

(b) Notwithstanding the provisions of Section 4.7(a), none of the following shall constitute a Restructuring:

(i) the payment in euros of interest or principal in relation to an Obligation denominated in a currency of a Member State of the European Union that adopts or has adopted the single currency in accordance with the Treaty establishing the European Community, as amended by the Treaty on European Union;

(ii) the occurrence of, agreement to or announcement of any of the events described in Section 4.7(a)(i) to (v) due to an administrative adjustment, accounting adjustment or tax adjustment or other technical adjustment occurring in the ordinary course of business; and

(iii) the occurrence of, agreement to or announcement of any of the events described in Section 4.7(a)(i) to (v) in circumstances where such event does not directly or indirectly result from a deterioration in the creditworthiness or financial condition of the Reference Entity.

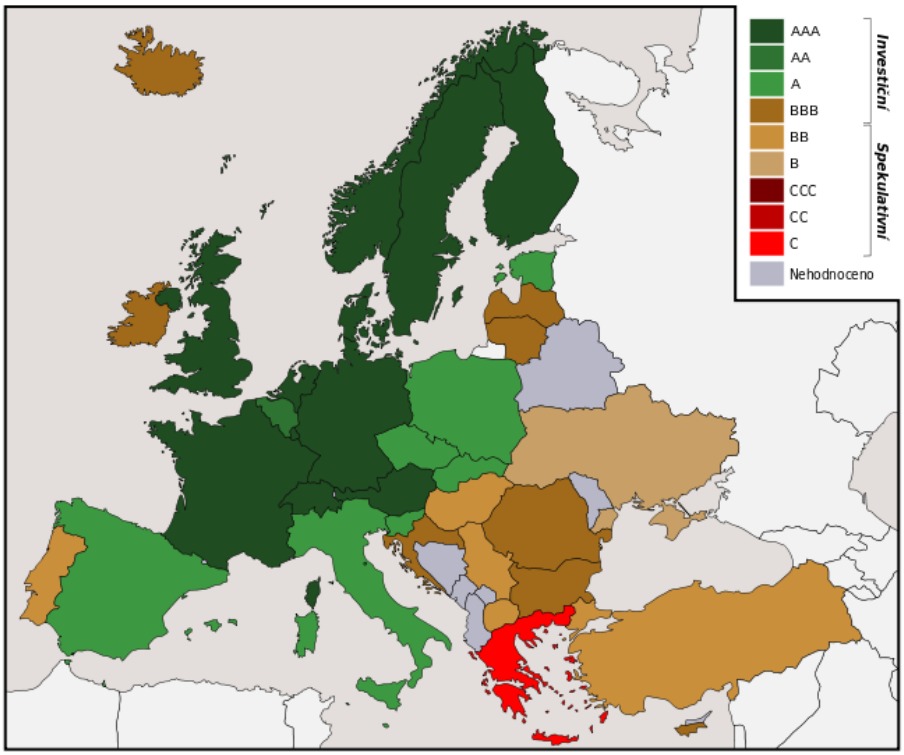
(c) For purposes of Sections 4.7(a), 4.7(b) and 4.9, the term Obligation shall be deemed to include Underlying Obligations for which the Reference Entity is acting as provider of a Qualifying Affiliate Guarantee or, if All Guarantees is specified as applicable in the related Confirmation, as provider of any Qualifying Guarantee. In the case of a Qualifying Guarantee and an Underlying Obligation, references to the Reference Entity in Section 4.7(a) shall be deemed to refer to the Underlying Obligor and the reference to the Reference Entity in Section 4.7(b) shall continue to refer to the Reference Entity.

Appendix 2: Legal Jurisdiction of Commonly Traded

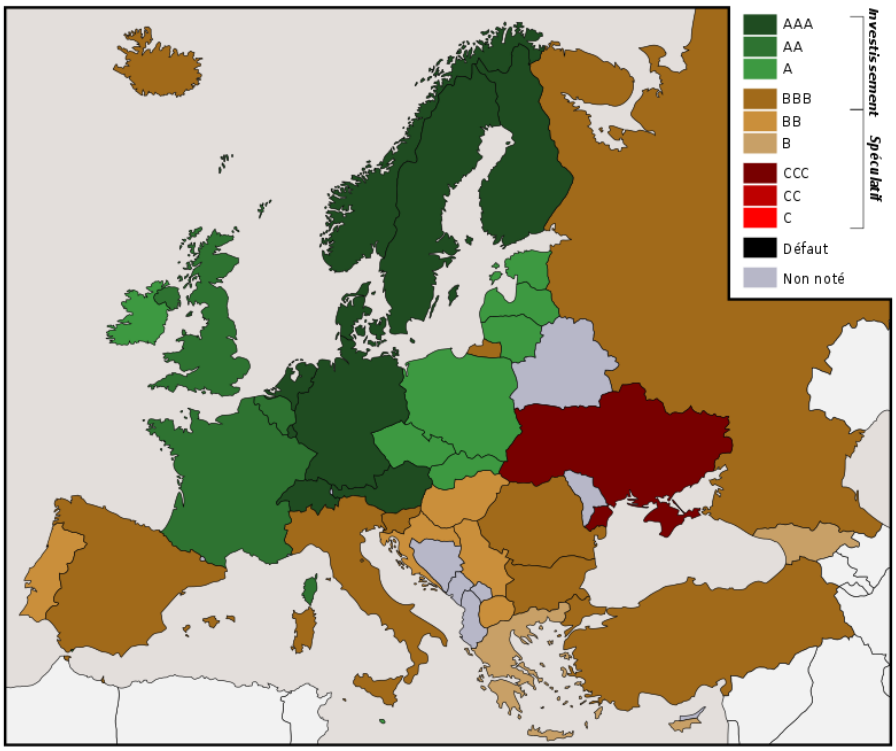
Governing Law	Security Type	Body of Law	Examples
Local Law	Sovereign Bonds, Bills	Local Statute/Contract	GGBs, Bunds, OATs
	International Bonds	Local Contract	Rep of Italy, Kingdom of Spain, etc
	Corporate Bonds	Contract	
	Covered Bonds (Pfandbriefe, OF, Cedulas, etc)	Covered Bond Law (Pfandbriefe)	Pfandbriefe, Obligacions Foncieres, Cedulas, Irish CBs
	Schuldscheine (marketable loans)	Contract	Banking schuldscheine
	Loans	Contract	
	Equities	Company	Any EU Equity
	Commercial Contracts	Contract	
	Deposits	Banking Law	CDs
English Law	Sovereign Bonds	Contract	Greek Euro-bonds, Rep Italy Eurobonds, Kingdom of Belgium USD-denominated bonds
	Corporate Bonds (Euro-bonds)	Contract	
	Loans (Euro-Loans)	Contract	Euro-Loans
	Commercial Contracts	Contract	
NY / Other Law	Sovereign Bonds	Contract	Yankees, Samurai, Kangaroos, Maple, Bulldogs, Dim Sum, Kauri, Sukuk, etc
	Corporate Bonds	Contract	
	Loans	Contract	
	Commercial Contracts	Contract	
Master Agreements	International Swap Dealers Association (ISDA)	English or NY Contract	IR Swap/Fwd, FX Swap/Fwd, CDS, Bond options
	Commodity Master Agreements	Various for each commodity	Gold Swaps/Forwards, Electricity Swaps/Fwds, etc
	Rahmenvertrag für Finanztermingeschäfte (DRV)	German Contract	Swaps and Repos with German counterparties
	Fédération Bancaire Française (AFB/FBF)	French Contract	Swaps with French counterparties and all local authorities
	Contrato Marco de Operaciones Financieras (CMOF)	Spanish Contract	Swaps with Spanish counterparties
	ICMA Global Master Repurchase Agrement (GMRA)	English Contract	Repo Agreements
	Master Repurchase Agreement (MRA)	NY Contract	Standard NY Law Repo Agreements
	European Master Agreement (EMA)	English Contract	Repo with Euro-systems NCB/ECB
	General Master Securities Loan Agreement (GMSLA)	English Contract	Sec lending
	Master Securities Loan Agreement (MSLA)	NY Contract	Sec lending

Source: Nomura ("Currency Risk in a Eurozone Break-up", 2011)

Appendix 3: Credit Ratings of the Long-Term Debt of European States on 22/02/2012 and 16/08/2014 according to Fitch Ratings



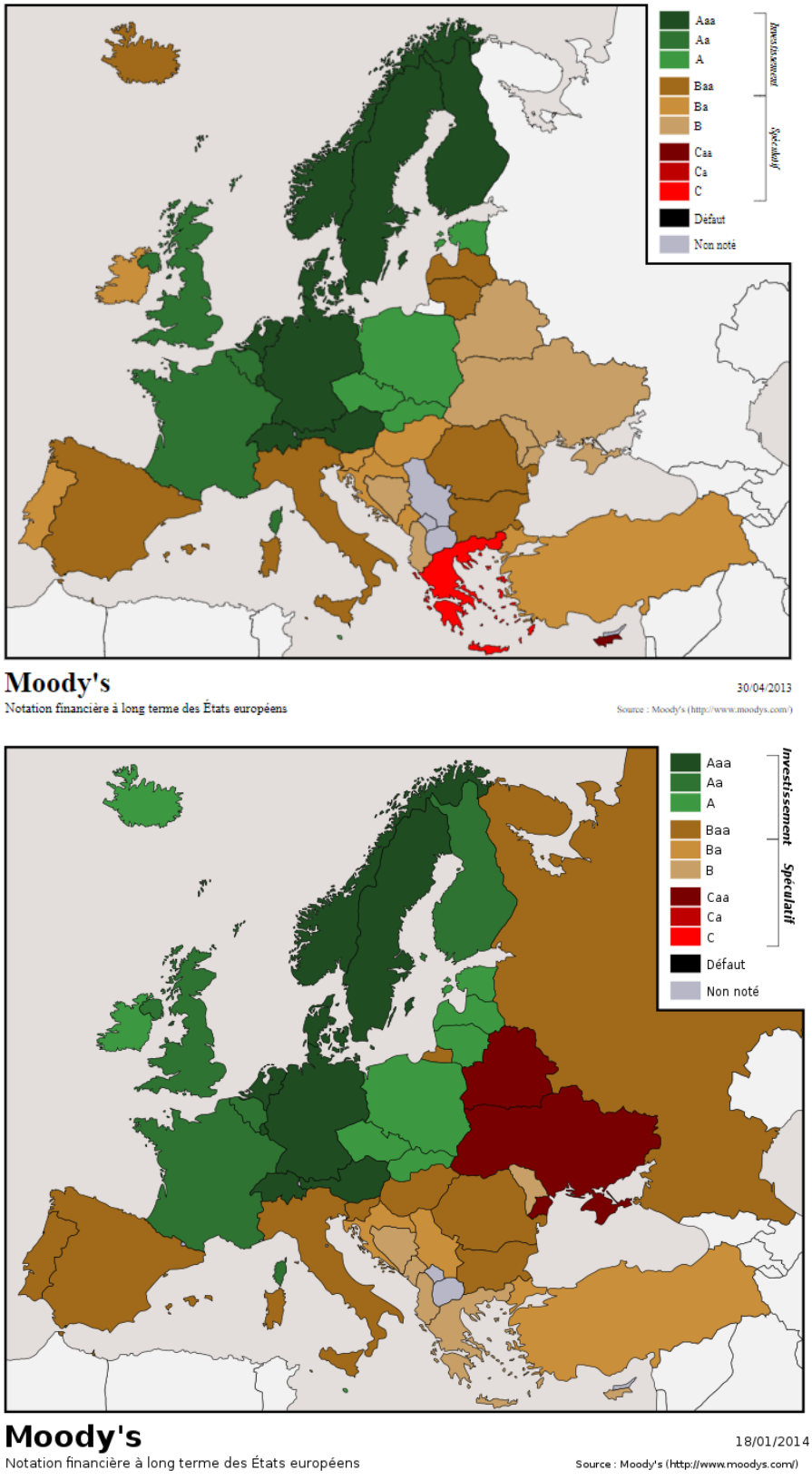
rating Fitch
dlouhodobý úvěrový rating evropských zemí
22/02/2012
zdroj : Fitch Ratings (http://www.fitchratings.com/index_fitchratings.cfm)



Fitch Ratings
Notation financière à long terme des États européens
16/08/2014
Source : Fitch Ratings (http://www.fitchratings.com/index_fitchratings.cfm)

Source: Fitch Ratings

Appendix 4: Credit Ratings of the Long-Term Debt of European States on 30/04/2013 and 18/01/2014 according to Moody's



Source: Moody's Corporation

Appendix 5: VAR Variables as Reported by Roberto de Santis

Variable	Data Source	Description
Stock Market Index	Reuters	The US stock market is the Thomson DataStream Global Equity Index for the United States provided by Thomson Reuters.
Volatility Premium	Reuters	The US volatility premium is calculated as the difference between the VIX index (obtained from Thomson Reuters) and a measure of realised volatility for the US stock market obtained as a GARCH(1,1) on the daily US stock market returns.
Investment Grade	Reuters	The US investment grade is the spread between the United States corporate BBB and AAA 7-10-year (USD) Merrill Lynch Bond Index provided by Thomson Reuters.
EUR depreciation versus USD 5-year forward	Bloomberg	The euro depreciation versus USD 5-year forward is computed using the covered interest rate parity condition as a difference between the euro area and the US OIS risk free rates at 5-year maturity
EUR depreciation versus USD.	ECB	The exchange rate is expressed as units of euro per US dollar
10-delta EUR/USD implied volatility	Bloomberg	The 10-delta dollar-euro option implied volatility is the difference in the US Dollar/Euro 1-month or 1-year Black-Scholes implied volatilities of an out-of-the-money 10-delta call option and an out-of-the-money 10- delta put option for OTC currency option markets provided by Bloomberg. A dollar-euro put (call) option is a European option of selling (buying) euro at the contractual option strike price in an exchange of US dollars at the option maturity.
Break-even inflation rate 5-yr forward.	ECB	The break-even inflation rate 5-yr forward is the five-year forward break-even inflation rate five years ahead provided by the ECB.
EA OIS	Bloomberg	The EA 5-yr OIS is the Euro OIS rate at 5-year maturity provided by Bloomberg
Euro area stock market volatility.	DataStream	The euro area stock market volatility is the realised volatility for the euro area stock market obtained as a GARCH(1,1) on the daily euro area stock market returns provided by Thomson DataStream.
Euro area Investment Grade	DataStream	The euro area investment grade is the spread between the European Monetary Union corporate BBB and AAA 7-10-year (Euro) Merrill Lynch Bond Index provided by Thomson DataStream

KfW-Bund spread	Bloomberg	The KfW-Bund spread is the difference between the 5-year KfW (`Kreditanstalt für Wiederaufbau') bond and the German sovereign bond (i.e. Bund). They are both guaranteed by the German government and, therefore, carry the same default risk. Any differences between agency and government bond yields should reflect international investors' preference for assets with the lowest liquidity risk.
Sovereign spread	Bloomberg	The Greek sovereign spread is the difference between the 10-year Greek sovereign bond and the 10-year Euro OIS provided by Bloomberg
Domestic stock market	Reuters	The domestic stock market is the Thomson DataStream Global Equity Index for the country provided by Thomson Reuters.
Sovereign yield bid-ask spread	Bloomberg	The sovereign bid-ask spread is the difference between the 5-year bid and ask EUR-denominated sovereign yield provided by Bloomberg.
Sovereign yield spreads	Bloomberg	Sovereign yield spreads. The sovereign yield spreads are the difference between the 5-year EUR-denominated sovereign bond of Italy, Spain and France and the 5-year Euro OIS rate provided by Bloomberg. They are midmarket prices for five-year sovereigns.

Source: ECB Working Papers: A Measure of Redenomination Risk, by Roberto de Santis

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