ECONOMIC ANNALS, Volume LV, No. 187 / October - December 2010
UDC: 3.33 ISSN: 0013-3264

SCIENTIFIC PAPERS

DOI:10.2298/EKA1087031D

Mikica Drenovak and Branko Urošević***

EXCHANGE-TRADED FUNDS OF THE EUROZONE SOVEREIGN DEBT

ABSTRACT: *Periods of high uncertainty bring liquidity concerns to the forefront for sovereign bond investors. Arguably the most liquid and cost-effective way for retail and small institutional investors to gain diversified sovereign bond exposure is through an exchange traded fund (ETF). In this paper we study the performance, country exposure, and replicating characteristics of a sample of 31 European index ETFs with exposure to eurozone sovereign debt. The obtained results are presented in the context of underlying index selection rules, types of replication, and movements in sovereign debt interest rates and sovereign CDS spreads. It is demonstrated that the ETFs focused on accurately track corresponding bond indices. This is consistent with earlier findings for equity index ETFs. Our results may be of interest for institutional investors, regulators, and everyone interested in sovereign debt investments.*

KEY WORDS: *exchange-traded funds, fixed-income, sovereign debt*

JEL CLASSIFICATION: D81, E43, G15, G24

* Faculty of Economics, University of Kragujevac, Serbia
** Faculty of Economics, University of Belgrade and the National Bank of Serbia, International Fellow of Laboratory for Financial Economics, ICEF, Moscow, Russia. The oppinions expressed in this paper are authors' alone and do not necessarily represent views of their respective institutions. The authors are indebted to Carsten Sprenger from ICEF, Moscow, and Drago Indjic at Sunningdale Capital, for many useful suggestions on an early draft of the paper. The authors gratefully acknowledge the support of the Serbian Ministry of Science and Technology, Grant OH 179005. E-mail: *branko.urosevic@cif.co.rs*

1. INTRODUCTION

Exchange traded funds (ETFs) gained prominence in the past decade. During the present time of global financial crisis, when the liquidity of most other financial instruments has plummeted, ETFs are trading stronger than ever. In this paper we study ETFs of eurozone sovereign bonds. In the past few years they have become increasingly popular among institutional investors, private wealth managers, and even small individual investors. We study the performance, country exposure, and replicating characteristics of a sample of 31 European index ETFs with exposure to eurozone sovereign debt. To the best of our knowledge this is the first systematic study of this class of ETFs.

ETFs were first introduced in North America in 1993. In Europe they first appeared on the market in 2000. Generally speaking, a standard ETF has the structure of an open-end mutual fund. Like a closed-end fund, however, investment units of ETFs are created by investment banks or asset managers and listed and traded on organized exchanges. Standard ETFs are, typically, index funds, i.e. portfolios replicating various investment indices.[1] They provide investors a chance to hold a diversified portfolio of their choice that is traded on a liquid, cost-effective, and relatively transparent market. There are ETFs offering exposure to various stock and bond indices. Furthermore, as exchange traded notes (or products) they track even non-exchange traded currencies, commodities, real estate, and hedge funds indices. An ETF can follow an actual index performance or provide a synthetic exposure to its various derivatives (short or inverse exposure, leveraged performance etc).[2]

Net asset value (NAV) and the portfolio structure of ETFs are published at the end of each trading day. In addition the exchanges on which they are traded are required to publish indicative NAV values (iNAVs) throughout the trading day (usually every 15 seconds). iNAVs are calculated based on the last realized prices for fund constituents. These values provide investors with a price benchmark throughout the trading day. According to Barclays Global Investors' research,[3] by the end of July 2009 there were 753 registered ETFs in Europe with assets under management (AUM) of over 183 billion US dollars. At the same time, in 706 listed ETFs in North America AUM were three times larger (approximately 581 US dollars).

1 Lately there have also been rule-based managed funds on the market (so-called intelligent ETFs).

2 Short or inverse ETF provides an exposure equivalent to holding a short position in an index

3 Barclays, *ETF Landscape Industry Review*, August 2009

In order to understand ETFs it is important to know the ways in which fund units (called creation units) are created and redeemed. The process consists of an exchange in kind between the fund and authorized participants. In the process of unit creation, the fund issues creation units to authorized participants in exchange for a basket of securities. Reversely, in the process of unit redemption, the fund takes the basket of securities from the authorized participants in exchange for previously issued creation units. Authorized participants are providing liquidity and transparency to trading units of ETFs. Performing arbitrage pricing, they hold prices of fund units close to fund iNAV values. Perhaps the most important feature of the in-kind creation and redemption process is that fund managers always distribute securities on the smallest-cost basis. In this way capital gains tax obligations are transferred from fund investors to authorized participants. The fund's unrealized capital gains are thus significantly reduced and sometimes completely eliminated resulting in very significant tax savings for investors with respect to regular mutual funds. This makes ETFs very tax-efficient. Importantly, ETFs are required to report Total Expense Ratio (TER), measured as a ratio of total expenses with respect to NAV.

A significant fraction of the academic research on ETFs focuses on North America. The reason for this is that the American ETF market is the oldest and most developed. Several authors have studied price characteristics and relative performance of the two competing products types - index mutual funds and index ETFs. Dellva (2001) shows that the relative advantage of investing in ETFs, from the cost point of view, depends on the investment horizon and the invested amount. The author finds that the process of in-kind creation and redemption provides considerable tax advantages, while transaction costs limit ETF attractiveness for small investors and those investors that trade frequently. Poterba and Shoven (2002) find that the comparison depends on whether closing prices or NAV is used for comparison purposes. Kostovetsky (2003) compares the two both quantitatively and qualitatively. He finds that the qualitative advantages of ETFs, namely that they are traded on the liquid market like a stock, is augmented by the cost efficiency of the product. Gastineau (2004) compares pre-tax performance of conventional index funds and index ETFs. This author attributes different operating efficiency of the two products to difference in timing of announcements of portfolio changes by fund managers.

Engle and Sarkar (2006) study intraday co-movement of iNAV values and market values of domestic and international ETFs. They conclude that for domestic ETFs, i.e. funds that follow an index consisting of domestic assets, average standard deviation from the iNAV values is around 15 basis points (bps).[4] On average deviations last less than 10 minutes. Therefore for domestic funds the arbitrage mechanism is quite efficient. In the case of international funds, on the other hand, average standard deviation is several times larger – 77 bps – while the price adjustment process lasts for around 3 hours (and sometimes can last more than a day). The reasons for this include higher transaction costs for overseas transactions, more complicated arbitrage mechanisms, and smaller liquidity of international ETFs. As a result pricing of international ETFs is less efficient than pricing of domestic funds. Alexander and Barbosa (2007) present an empirical comparison of different hedging strategies for reducing the uncertainty of ETF market makers' exposures arising from order imbalances. Rompotis (2009) report on the performance of ETFs and index funds belonging to the same investing family.

Despite the importance of ETFs in European markets there are relatively few research papers studying them. Amenc and Goltz (2009) study the role of European ETFs in providing investor exposure to various asset classes. The authors study roles and motivations of various market participants, how ETFs are used, which replication mechanisms are used most frequently, on which platforms transactions are performed, how to measure accuracy of index replication, as well as which investment alternatives to such products exist in Europe. The investigation is based on a large survey by the Edhec Institute (2009). [5] Out of 360 participants that took part in the survey (mostly asset and private wealth managers), most of them state liquidity as the key advantage of ETFs. Rompotis (2008) studies performance and trading characteristics of German equity ETFs. The author shows that they slightly underperform underlying indices. The tracking error is directly related to risk, bid-ask spreads, and management fees. Finally Blitz, Huij and Swinkels (2010) provide detailed analysis of Europe-listed index mutual funds and index ETFs that offer exposure to global equity markets. The authors conclude that European ETFs underperform (on average, by 50 to 150 bps per annum) their benchmarks[6].

These investigations primarily studied equity-market ETFs. On the other hand, one of the markets where creation of ETFs caused a significant increase in market liquidity and expansion of the investor base is the market of sovereign debt and, in particular, the market of eurozone sovereign debt. The sovereign debt market of

4 One basis point is one hundredth of a per cent.

5 The EDHEC European ETF Survey, 2009

6 The actual realised tracking error and costs may vary across products; the cheapest exposure is most often available through index futures.

the eurozone countries has been under intense scrutiny since the inception of the world financial crisis, and especially the Greek sovereign debt crisis. The bonds, previously perceived by the market as almost riskless, are now seen as a mixed interest rate and credit risk product. Sovereign debt ETFs appeared on the market a few years after the equity ETFs. In the period of great market turbulence ETFs provide the most liquid way for retail and small institutional investors to gain exposure to performance of a particular segment of the sovereign debt market. Importantly, due to divergence in country spreads, ETFs that track performance of various eurozone sovereign debt indices started showing significantly different performance depending, primarily, on index composition and country exposure. Yet, to the best of our knowledge, no serious research on ETFs of eurozone sovereign debt has appeared in the academic literature to date. The aim of this paper is to fill that gap.

The sovereign debt market of the eurozone countries has, until recently, been characterized by a relatively illiquid and informationally inefficient microstructure in which preferred players have had a significant informational advantage over the rest of the investors. Introduction of electronic trading platforms made the market much more efficient and led to the possibility of the creation of investible debt indices. Indices are based upon realized transactions in real time electronic trading. Such transactions reflect market activity of a wider group of investors than was previously the case. As a result, index values reflect the market consensus on the securities in question more fully than before. Moreover, discrepancy between the values of securities used for index calculation and the values of securities available to investors has significantly diminished. Thus contemporary bond index funds can track index performance much more closely than before. Small replication (or tracking) error is fundamental for development of the index fund industry and ETFs in particular.

Several families of indices that comprehensively cover the sovereign debt of the eurozone countries are in existence today. For most of these indices there exist corresponding ETFs that replicate them. These funds cater to a wide range of investors. In this paper we analyze the composition, risk characteristics, and performance of the most significant ETFs listed in Europe that are tracking indices of eurozone sovereign debt. This is, to the best of our knowledge, the first paper to do so.

The remainder of the paper is organized as follows. In Section 2 we describe the data, present main index families and index selection rules and study their risk characteristics including aggregate country exposure. We then analyze movements in interest rates and CDS spreads and use the results to explain the evolution of the indices under consideration. In Section 3 we present the ETFs that track those indices, study characteristics of leading ETF providers, and analyze their tracking performance. Section 4 summarizes and concludes.

2. EUROZONE SOVEREIGN DEBT INDICES

Performance analysis of eurozone sovereign debt ETFs starts with selection criteria for targeted benchmark indices. These criteria include rules that specify the number of benchmark constituents, eligible bond issues, weights, aggregate country exposure, etc. Once the benchmark is selected the movements of constituent interest rates are analyzed. Together with the index composition, they determine the evolution of a sovereign bond index. In order to determine how closely an ETF tracks the targeted index, tracking error is typically calculated. Tracking error is one of the most important characteristics of an index (tracking) fund. By choosing an index ETF, an investor chooses index characteristics that s/he wants exposure to. Thus, her/his satisfaction increases with a decrease in tracking error. The main task of a fund manager is to find an optimal tradeoff between closeness of index replication and the cost of replication.

2.1. Data

There are four dominant providers of eurozone sovereign debt indices: Barclays Capital, Markit, EuroMTS and Deutsche Borse. The most well known families of indices are: Barclays Term, Markit iBoxx, EuroMTS EMTX, and eb.rexx. In constructing indices, index providers utilize different price sources including all relevant trading platforms currently operating in Europe. Of all indices constituting the stated families we analyze those that are tracked by ETFs, the subject of the paper. Typically, only standard coupon bonds that are redeemed on a fixed maturity date are eligible for inclusion into indices. One exception is Markit iBoxx Benchmark indices, which can also include standard discount (stripped) bonds. In order to be included in an index, time to maturity of a bond has to be at least 1 year. We analyze ETFs of the three leading European providers: iShares (funds that track Barclays Term, Markit iBoxx Liquid Capped, and eb.rexx Government Germany indices), db x-trackers (Markit iBoxx benchmark indices) and Lyxor Asset Management (EuroMTS EMTX indices). The chosen ETFs are listed on multiple exchanges in Europe. For consistency we use data from the German listings. All indices that we consider belong to the class of total return indices, i.e. indices where all coupon payments are reinvested. In order to analyze the quality of tracking performance by various ETFs (see Section 3), we use end-of-day Net Asset Values (NAVs). The principal source of our data is Bloomberg and the official websites of ETF and index providers[7]. Our sample of ETFs covers daily data for the period between 2nd January 2007 and 19th May 2010. For funds that did not exist on 2nd January 2007, the date of their inception is used as the first date of the corresponding time series.[8] The data source on representative long-term sovereign interest rates is the website of the European Central Bank.

2.2. Index families and selection rules

Barclays capital is one of the leading global index providers.[9] It pioneered the concept of a *term index*. In contrast to standard market indices, term indices have stricter inclusion criteria regarding both the original time to maturity and remaining time to maturity. They include only bonds with remaining time to maturity near to their original time to maturity, rather than selecting all bonds in an index maturity range. As a result term indices have very similar yields, duration, and risk/return characteristics to standard maturity-based indices, but are more compact and more liquid.

International Index Company (IIC) develops and runs the Markit iBoxx bond indices. A distinctive feature of iBoxx bond indices is a multi-contributor real-time pricing (i.e. pricing that takes into account price information from multiple trading platforms). Ten leading banks provide bid-ask quotes in real-time. iBoxx also calculates and publishes consolidated bond prices once per minute each trading day. Quotes are processed to eliminate outliers. The hierarchical Markit iBoxx index structure allows drill-downs to reach the required level of exposure.

---

7 We are grateful to Dr Drago Indjic at Sunningdale Capital for his assistance in data gathering.

8 All db x-tackers ETFs started trading in May and June 2007 except for db short iBoxx index, which started trading in May 2008. Funds iShares Barclays 5-7 i 10-15 started trading in April 2009, while Lyxor EuroMTS 15+ started trading in June 2007.

9 Unlike equity indices, fixed income indices are more complex, as bonds are typically not traded on organized exchanges. An additional complication is that bond investments are, by their very nature, finite maturity instruments. Each index family is created by an institution who then licenses the index IP, trademark etc. to an investment bank or brokerage. Note that the EFFAS family of bond indexes is a rare example of an index created by a professional association and hence easily accessible from Bloomberg, unlike many other bond indices whose distribution is limited to clients of investment banks.

Exposure to the eurozone sovereign debt market as a whole is tracked by three index families: iBoxx EUR Sovereigns[10] (benchmark indices), iBoxx EUR Liquid Sovereigns[11] (liquid indices), and iBoxx EUR Liquid Sovereigns Capped (liquid indices with upper limits of constituent number and concentration risk). Benchmark indices comprise overall and maturity indices (the latter focused on particular ranges of maturities). These indices have a relatively large number of constituents and offer broad market exposure. However they incur relatively high costs. Liquid indices are a subset of the standard benchmark indices. They share the construction methodology with the corresponding benchmark indices but have higher liquidity demands. For this reason they limit the number of constituents. Liquid indices are intended to reduce tracking and hedging costs relative to benchmark indices. The weight of a single eurozone country in an iBoxx Liquid Sovereign Capped index is capped at 20%. To complete its offer Markit also runs and publishes the Short iBoxx EUR Sovereigns index. It offers exposure to the inverse performance of the iBoxx EUR Sovereigns index.

EuroMTS indices are the product of EuroMTS Limited. EuroMTS is well known for managing the MTS platform, one of the largest electronic markets in the eurozone. There are country-specific (for instance, MTS France or MTS Germany) and Europe-wide (EuroMTS) platforms. The local country system provides opportunities for trading off-the-run and on-the-run securities, while the EuroMTS platform offers trading only in on-the-run securities. EuroMTS indices are priced using real-time quotes from the MTS platform. More than 200 financial institutions contribute real time price quotations. EuroMTS indices are developed with the primary aim of being transparent, real-time, and tradable. Sovereign eurozone debt is covered by the EMTX index family (overall and maturity indices).

The eb.rexx Government Germany index family[12] includes only the most liquid standard coupon bonds issued by the German government. Indices are calculated using the quotes from the Eurex Bonds platform, one of the leading European electronic bond platforms. The Eurex bonds platform is part of the Eurex electronic system. The system integrates bond, repo, and derivative markets through its clearing and settlement system. This benefits investors exposed to

---

10 For more details about Markit iBoxx benchmark indices see http://indices.markit.com/download/products/guides/Markit_iBoxx_EURBenchmark_Guide.pdf

11 For more details about Markit iBoxx Liquid and Liquid Capped indices see http://indices.markit.com/download/products/guides/Markit_iBoxx_EURLiquid_Guide.pdf

12 For more details about eb.rexx indices see:
http://www.dax- indices.com/EN/MediaLibrary/Document/ebrexx_L_3_8_e.pdf

both cash and derivative positions. Indices are based on selection criteria that ensure high liquidity for underlying bonds, thus facilitating the tracking.

From Table 1 we can see that index families that target the same maturity segment may in fact have very different composition, and thus very different risk and return characteristics.

Table 1. Comparison of index selection rules

Index family	Price source	Price contribution	Price type	Minimum amount outstanding	Ranking rule	Exposure	Eligible countries	Coupon investment
Barclays Term	Barclays capital	daily	mid prices	€ 2 billion	at least lowest investment grade, lower than Standard & Poor's and Moody's	max 30% per issue	France, Germany, Italy, Netherlands, Spain	until the end of month at a 1M Euro LIBOR - 15bp; reinvested monthly at rebalancing
iBoxx EUR Sovereign	Consortium	per minute	bid prices	€ 2 billion	at least at investment grade of Standard & Poor's, Moody's and Fitch		euro zone	reinvested monthly at rebalancing
iBoxx EUR Liquid Sovereign Capped				€ 4 billion		max 20% per country, max one issue per issuer, max 3 (5) bonds per country		
EuroMTS	MTS markets	per 30 seconds	best bid price	€ 2 billion	-	max 2 issues per issuer	Austria, Belgum, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal Spain	reinvested overnight
eb.rexx Government Germany	Eurex Bonds	per minute	best bid price	€ 4 billion	at least lowest investment grade	max 30% per issue	Germany	reinvested monthly at rebalancing

Table 2 shows the aggregate country exposure for various families of indices. We exclude eb.rexx indices since they track only German government debt. We also exclude the Short iBoxx index as it refers to the same basket of securities (but to inverse exposure) as the iBOXX € Sov index. Table 2 also shows which ETF providers replicate the analyzed index families.

Table 2. Aggregate country exposure of indices

	Germany	Italy	France	Spain	Belgium	Netherlands	Greece	Portugal	Austria	Ireland	Finland
iShares											
Barclays Term 1-3	32.61	42.11	11.07			14.2					
Barclays Term 3-5	32.21	23.68	30.8	13.31							
Barclays Term 5-7	48.04	25.04	12.74			14.18					
Barclays Term 7-10	56.56	7.95	29.89			5.6					
Barclays Term 10-15	9.32	41.41	30.28	6.97		12.02					
Barclays Term 15-30	29.41	34.78	21.69	9.7		4.43					
iBoxx€ Liq Sov Cap 1.5-2.5	20.32	19.97	20.2	7.98	4.35	9.53	13.86			3.78	
iBoxx€ Liq Sov Cap 2.5-5.5	20.29	20.09	20.47	19.99	13.03		6.13				
iBoxx€ Liq Sov Cap 5.5-10.5	20.47	20.32	20.29	19.88	0	13.12	5.93				
iBoxx€ Liq Sov Cap 10.5+	20.62	19.77	20.13	19.26	14.49	5.74	0				
iBoxx€ Liq Sov Cap 1.5-10.5	20.4	20.21	20.28	19.84		11.9	7.37				
db-trackers											
iBoxx € Sov	21.56	23.71	20.9	9.44	5.91	5.37	3.94	2.19	3.72	2.03	1.13
iBoxx € Sov 1–3	25.09	24.39	19.8	11.07	5.73	5.5	3.79	1.77	1.16	1.03	0.67
iBoxx € Sov 3–5	24.38	17.22	19.8	10.96	7.15	5.43	4.2	2.3	4.3	2.05	0
iBoxx € Sov 5–7	21.11	20.08	22.38	6.84	8.62	5.95	3.91	2.5	5.69	1.73	1.2
iBoxx € Sov 7–10	19.32	25.34	21.15	8.31	4.27	5.8	4.52	2.52	4.06	3.05	1.66
iBoxx € Sov 10–15	4.33	26.01	23.43	7.2	5.83	6.58	5.75	4.82	7.22	7.55	1.28
iBoxx € Sov 15+	23.86	30.08	21.31	9.36	4.6	3.71	2.4	0.86	3.36		0.46
iBoxx € Sov 25+	22.01	20.7	31.03	11.6		4.92	4.44	2.29	3.01		
Lyxor											
EuroMTS 1-3Y	23.67	23.35	21.76	11.46	6.16	4.3	4.56	0.91	1.26	1.84	0.73
EuroMTS 3-5Y	24.1	18.03	21.19	8.95	7.55	6.05	3.72	2.56	4.69	1.34	1.83
EuroMTS 5-7Y	20.78	16.91	23.55	6.09	8.89	6.17	5.53	2.75	6.17	1.91	1.24
EuroMTS 7-10Y	18.57	24.17	19.6	9.06	4.11	5.58	5.27	3.26	3.9	4.36	2.13
EuroMTS 10-15Y	2.12	31	23.22	5.16	6.79	8.48	5.26	4.62	8.38	4.97	0
EuroMTS 15Y+	22.25	28.95	21.32	10.96	5.26	3.73	2.28	0.86	3.6		0.78

2.3. Movements in sovereign interest rates and CDSs

There are two main market factors that impact movements of a eurozone government bond portfolio. One is the dynamics of interest rates. Another is the dynamics of spreads over the German government bonds, since they are perceived as a benchmark of quality within the eurozone.[13]

Yields of government bonds issued by different eurozone governments featured tight spreads and high correlations for a prolonged period of time.[14] With the first signs of the global financial crisis the spreads of several countries rose sharply while correlations dropped. Graph 1 illustrates monthly changes in annual 10-year government bond yields (in percents) issued by 8 eurozone countries in the period January 2001 - April 2010. Notice that starting from mid-2008 eurozone countries can be grouped into those with increasing and those with decreasing yield trends (see Graph 1). Germany was singled out as the country offering a safe haven for eurozone bond investors. We observe a decline in German government

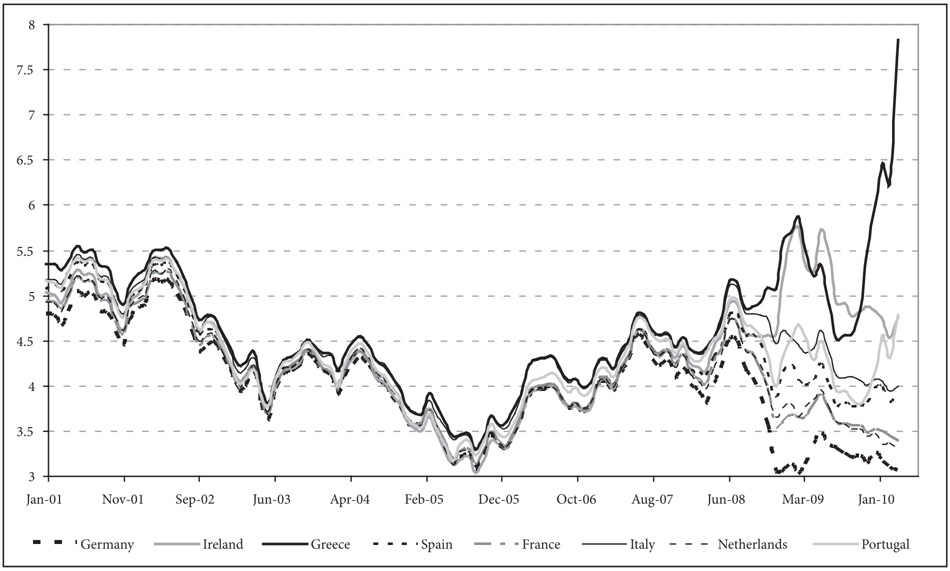
---

13 Alternatively one may use the Euro LIBOR yield curve as a benchmark (see Beber, Brandt and Kavajecz (2006))

14 A standard method for estimating the yield curve is discussed, by Drenovak and Urošević (2010), among others.

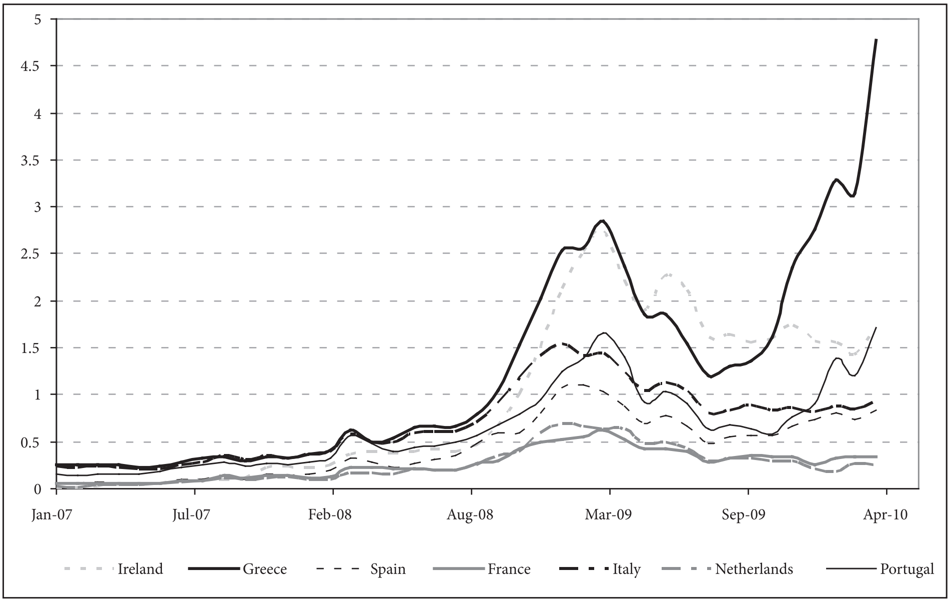
bond yields by more than 150 bps in less than a year, under high demand pressure. French bonds also benefited from this investor sentiment, but less so than German bonds.

Graph 1. 10-year eurozone government bond yields, January 2001 - April 2010



Graph 2 illustrates monthly changes in government bond spreads over German government bond yields for the same 10-year bonds in the period between January 2007 and April 2010. Between January 2001 and May 2008 the maximum 10-year bond yield spread in the eurozone was not higher than 60 bps for the sample of 11 selected eurozone countries. With the onset of the global crisis, maximum spreads rose to as high as 477 bps in April 2010 (for Greece). The relative performance of different bond indices tracking European government bonds has diverged as well, depending on the index composition (primarily, depending on the aggregate country exposure).

Graph 2. Spreads of 10-year eurozone government bond yields over German government bonds, January 2007-April 2010



It is well known that the most important factors that influence government bond spreads are credit risk and liquidity risk. The relative importance of the two risk factors may differ across the pool of investors and may significantly change over time. Knowledge of the relative importance of liquidity and credit risk is important for an investor defining an investment strategy in the sovereign bond market. Suppose, for example, that an investor is averse to credit risk but not to liquidity risk (for example, s/he plans to keep the bond until it matures). In that case, s/he can benefit from investing in higher yield bonds if s/he knows that the higher yield (or, equivalently, the higher spread) is primarily due to the lower liquidity of the issue.

Beber, Brandt and Kavajecz (2006) analyze ten eurozone countries and find that most of the spread in sovereign bond yields is explained by differences in credit quality. However liquidity plays a nontrivial role, especially for low credit risk countries and during times of heightened market uncertainty. The destination of large flows in and out of the bond market is determined almost exclusively by liquidity reasons. The authors also suggest that credit risk has a higher influence on spreads for bonds with longer maturity. This is to be expected since default is less probable in the short than in the long run.

In a later study Schwarts (2009) finds that on average 77% of sovereign spread is explained by liquidity. The research covers the period between April 2007 and March 2008. This is the period just prior to the official onset of the world financial crisis[15]. The author confirms previous findings that effects of the credit risk on spreads are somewhat higher for longer maturities.

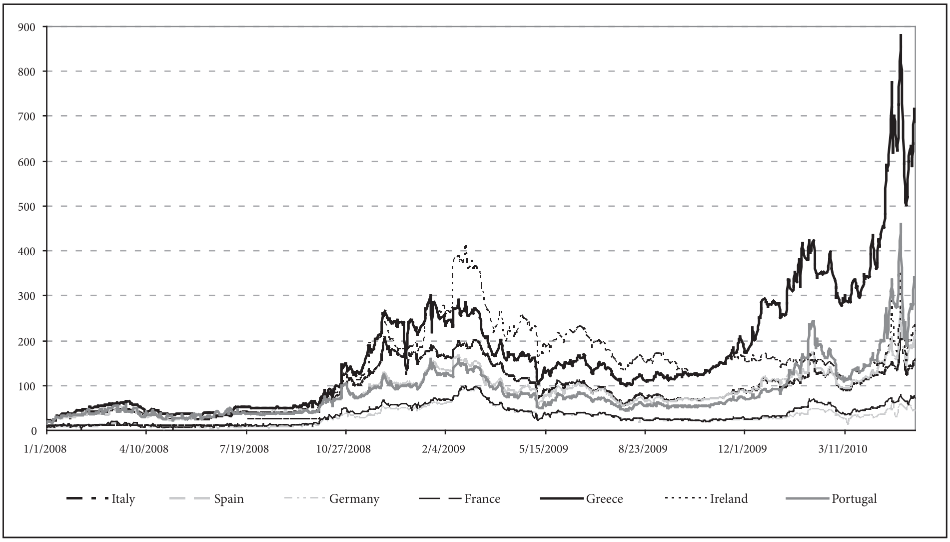
In the post-Greek debt crisis period, Schuknecht, Hagen and Wolswijk (2010) suggest that markets penalize fiscal imbalances much more strongly since the default of Lehman Brothers. Price elasticity of deficit differentials (in terms of GDP) has increased 3-4 times, while price elasticity of differentials in the level of debt (as a fraction of GDP) has increased around 7-8 times during the post-Lehman crisis period. Their study covers the period up to May 2009. As we have seen in Graph 2, the highest variability of spreads has been precisely in the period between October 2008 and May 2009. Attinasi, Checherita and Nickel (2009) find that the following factors are most likely to explain the surge in the eurozone spreads in the period between July 2007 and March 2009: international risk aversion, expected fiscal position, liquidity, and the announcements of bank rescue packages. As yield spreads diverged sovereign bond investors realized that what they thought was a simple interest rate product ended up being both an interest and a credit risk product. That means that in making investment decisions investors need to pay close attention to both interest rate and credit and liquidity risks. In particular lower spreads do not necessarily translate into lower total risk for all investors. Our analysis of the interest rate volatility of 10-year eurozone government bonds (unreported) allows us to conclude that higher demand for German government debt significantly raised its volatility, making it one of the most volatile bond classes in the eurozone (second only to Greek government debt).

Market consensus on creditworthiness of a bond issuer is, perhaps, best seen in credit default swap (CDS) spreads. It is the CDS spreads that have a lead in driving prices of outstanding issues and determining the yields of future bond issues. The reason is the central position that the CDS market plays with respect to other markets. Debt, equity, and derivatives market participants all transact in the CDS market. Being one of the key links between these structurally separate markets, the CDS market reacts fast to news affecting the credit position of a bond issuer.

15 The default of Lehman Brothers in September 2008 is commonly designated as the official begining of the crisis. However money markets in the USA started exhibiting stress in August 2007. At the time of drafting this paper in October 2010 it is unknown if any of the weakest EU zone economies (the so-called "PIGS") will be allowed to default.

Graph 3 shows daily changes in 5-year CDSs for the riskiest eurozone countries, as well as France and Germany, over the period 1 January 2008 - 19 May 2010.[16]

Graph 3. Daily changes in 5-year sovereign CDSs, 1 January 2008-19 May 2010

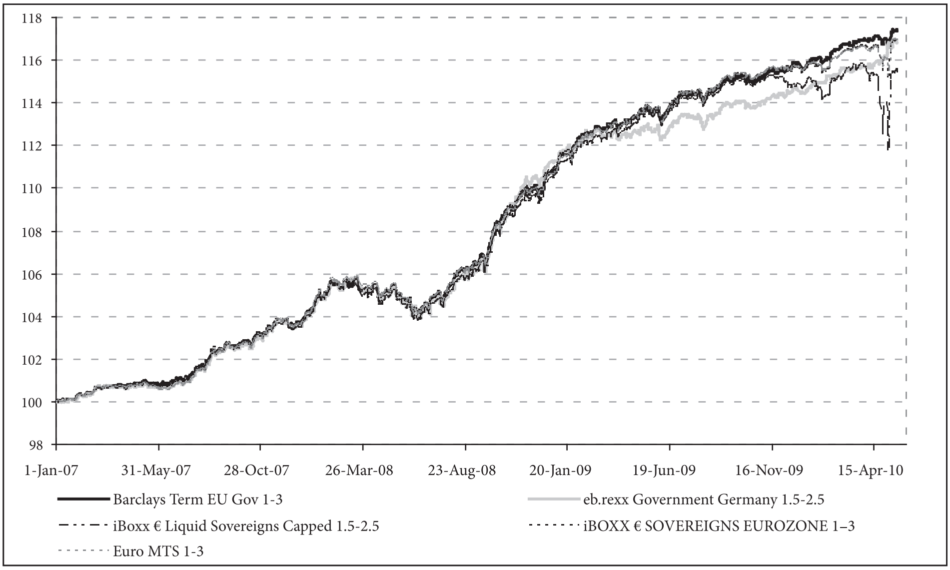


We observe that Greece and Portugal have had the highest increase in CDS spreads on their government debt (see Graph 3). It is logical to anticipate that funds that were exposed the most to these two countries (see Table 2) were the most impacted by this.

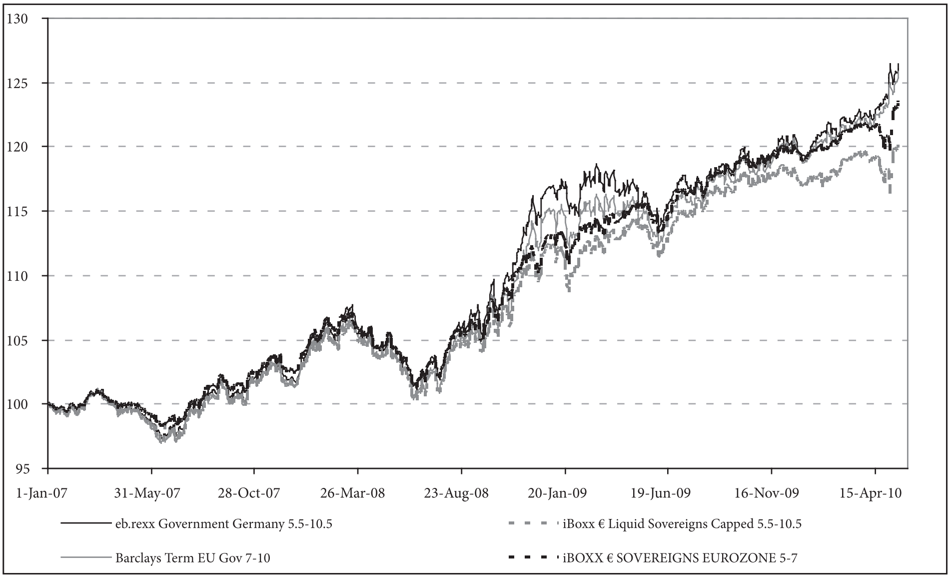
The preceding analysis gave us insight into the principal factors explaining the movements of eurozone sovereign debt portfolios. Graphs 4-7 illustrate the resulting evolution for a selected subsample of analyzed indices over the period 2 January 2007-19 May 2010. All indices are initially set at 100.

16 Five-year CDSs are most frequently used in various analyses since they are the most liquid CDS instruments.

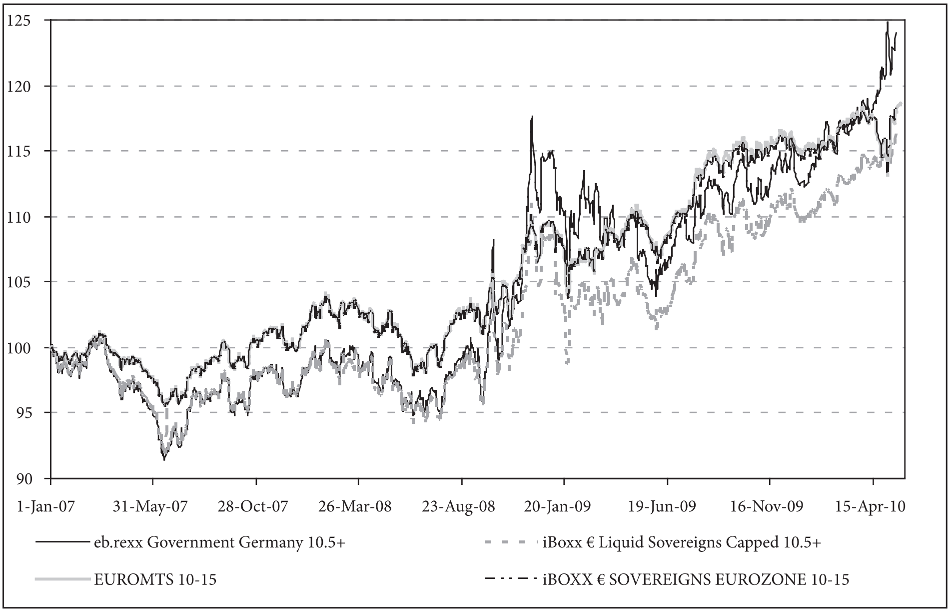
Graph 4. 1-3 year maturity eurozone sovereign debt indices



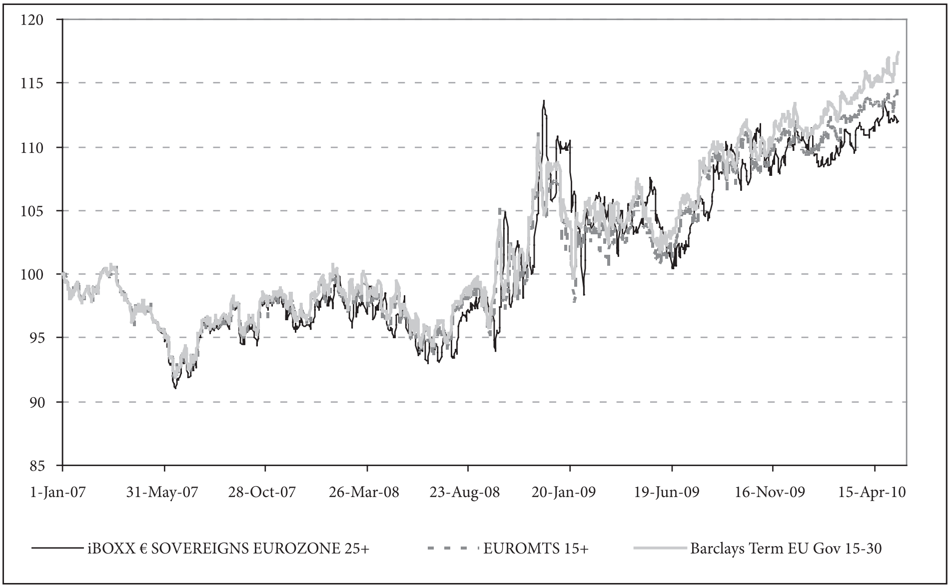
Graph 5. 5-10 year maturity eurozone sovereign debt indices



Graph 6. 10+ year maturity eurozone sovereign debt indices



Graph 7. 15+ year maturity eurozone sovereign debt indices



Several important conclusions can be drawn from these results. Performance differences increase with fund duration and are significantly affected by index composition. From Graph 4 we observe that indices targeting the shortest maturity segment delivered almost identical performances regardless of their country exposure. The greatest variability in Graph 4 for the period April – mid-May 2010 has iBoxx € Liquid Sovereigns Capped 1.5-2.5. Its exposure to Greek debt is 13.86%, which is the heaviest exposure to Greek debt of all funds in our sample (see Table 2). During the same period Greece experienced the highest increase in CDS spread (Portuguese debt had the next highest increase). We observe similar index patterns for all Markit iBoxx indices. They have simultaneous exposure to Greek and Portuguese government bonds. On the other hand Liquid Capped indices are exposed to Greek but not to Portuguese debt. Consider, for instance, the movement of iBoxx € Sovereigns eurozone 10-15 and EuroMTS 10-15 for the same period, April-May 2010 (see Graph 6). These are indices with the highest exposure to Portuguese debt (4.82% and 4.62%, respectively) and higher than 5% exposure to Greek debt. These indices had the most pronounced fall among their peers (they all had similar evolution patterns). Clearly, it is important to discern spillover patterns of credit into market risk.[17]

The level of price volatility of funds is primarily determined by the maturity segment (which is a bond portfolio feature). This issue will be discussed within the context of tracking quality in Section 3 (see Table 4).

3. EUROZONE SOVEREIGN DEBT ETFS

3.1. Basic characteristics

We will now state particular features of ETFs that may affect their tracking performance, cost efficiency, and liquidity.

One of the key differences between ETFs is in the replication technique they employ. It is either physical (in-kind) or synthetic (swap-based) replication. The fund manager of a physically-based ETF replicates its index through acquisitions of securities held in it. In this case the fund portfolio consists of all or of a representative (optimized) sample of securities when the index is too large (and therefore incurs high transaction costs) or when markets are less liquid.

17 The oposite, namely a particular type of spillover of market into credit risk, is discussed in Božović et al (2009).

A synthetic ETF, on the other hand, lends its assets (typically a sub-portfolio of a benchmark) to a counterparty via a collateralized repurchase agreement, and then swaps the yield on that loan for the total return of the underlying index. The yield on the loan is based on LIBOR with or without a spread (the spread, if any, is reflected in the fund performance as an additional cost).

While physical replication is more intuitive and transparent, synthetic replication is generally assumed to provide better tracking ability and enable issuers to track harder-to-access parts of the market, although at the expense of increased counterparty risk. Evidence shows that proper conclusions related to the advantages and drawbacks of a particular replication technique can only be made on a case-by-case basis. Our aim is to highlight the differences in tracking quality.

ETFs from the iShares family are based on full physical replication. They distribute part of the income. iShares track three eurozone sovereign debt index families: Barclays Term indices, iBoxx Liquid Sovereigns Capped indices, and eb.rexx Government Germany indices. iShares ETFs tracking Barclays Term indices are domiciled in Ireland. Their average TER (total expense ratio) equals 0.20% and they distribute income semiannually. ETFs tracking iBoxx and eb.rexx indices are domiciled in Germany. Their average TER[18] equals 0.16% and they distribute income up to 4 times per annum.[19] db x-trackers are swap-based ETFs. db ETFs are domiciled in Luxemburg and their average TER equals 0.15%. The db ETF family[20] replicate iBoxx Sovereign benchmark indices (there is a total of 9 such funds). db funds are total return funds, meaning that they reinvest all of their income back into the fund. Last but not least, Lyxor ETFs are swap-based ETFs. Lyxor ETFs are domiciled in France and their average TER equals 0.165%. The Lyxor ETF range[21] replicate EuroMTS indices (total of 6 funds).

18 Details about iShares ETFs refer to May 2010; Source: http://de.ishares.com/en/rc/literature/ishares-factsheets

19 For ETFs which distribute part of the income there are both price NAV and total return NAV time series available (that is, without and with income reinvestment). One must include income reinvestments to analyze tracking performace relative to a total return index.

20 Details about db ETFs refer to May 2010. godine; Source: http://www.etf.db.com/DE/ENG/etf_list/overview.html?inreiter=undefined&inetfgruppe=0&inattributneu=6&inreset=1&utm_source=Iphone&utm_medium=en_insti&utm_campaign=Renten

21 Details about Lyxor ETFs refer to May 2010; Source http://www.lyxoretf.co.uk/homeukpro0/services/factsheets/

Different types of replication require different levels of market activity[22]. For example, iShares are involved in securities lending while db and Lyxor funds are not.[23] There are other differences in operational risks: for example, Lyxor platforms provide explicit cash management and replicate (rather than just execute) trades initiated by active managers, etc.

Assets under management (AUM) of the funds in our sample are, in most cases, of the order of hundreds of million of euros. Funds tracking the shortest maturity segment are the funds with the highest AUM levels in general (average over €1 billion). ETFs tracking longer maturity segments (over 10 year of maturity) and those with shorter history have lower levels of AUM.[24]

3.2. Tracking performance

Tracking error is the single most important factor in the analysis of an index fund performance. It measures the difference between the return of a fund and its underlying (benchmark) index. The difference is often referred to as active risk. Smaller tracking error means better tracking performance of the fund with respect to its underlying index. In this section we study determinants of tracking quality for eurozone sovereign bond ETFs. In particular we analyze how different fund characteristics (replication method, maturity segment, fund composition, etc) affect the tracking errors of ETF funds.

One simple way to define tracking error is to calculate the difference in returns between the fund and the index (also referred to as active return) at the end of a certain period of time. However passive investing is about gaining exposure as accurately as possible to all index characteristics, and not just to match the value at the end of the investment horizon. One way to do this is to compare volatilities (or some other relevant statistic) of the fund with that of the benchmark. However that would ignore co-movement between the two for the time period in question. Having this in mind, tracking error (TE) is commonly defined as the standard

---

22 The counterparty risk considerations are beyond the scope of the present paper.

23 db ETFs do not lend their assets, but part of the lending revenues of the swap counterparty is passed on to the funds. The advantage of this approach is that only the swap counterparty faces borrower default risk.

24 For instance, in May of 2010, well established short-maturity fund iShares eb.rexx 1.5-2.5 had AUM of around €1.3 billion, Lyxor EuroMTS 1-3 around €1.03 billion. On the other hand, longer maturity funds db iBoxx 10-15, 15+, 25+ had roughly €30 million average AUM while iShares Markit iBoxx € Liquid Sovereigns Capped 10.5+ has AUM of roughly €22 million.

deviation of the difference between the return on the portfolio and that of the benchmark,[25] that is, the standard deviation of the active return (see (1)):

$$TE = \sqrt{Var\left(r_P - r_B\right)} \quad (1)$$

Equation (1) is the most frequently used performance measure of index funds. Note that it describes variability in active returns but provides no information on a fund's under- or over-performance vis-à-vis the benchmark index. It ranks equally both positive and negative active returns of the same magnitude. Thus as a performance measure (1) is more appropriate for tracking (index) funds and less appropriate for active funds. For the latter *beating* and not *tracking* the benchmark is the goal.

Tracking error (1) measures co-movement of portfolio returns with that of a benchmark. Indeed, it can be expressed as a function of the standard deviation of fund returns σ_P, benchmark returns σ_B and correlation between the fund and benchmark returns:

$$\rho_{P,B}\text{: } TE = \sqrt{\sigma_P^2 + \sigma_B^2 - 2\sigma_P\,\sigma_B\,\rho_{P,B}}\,. \quad (2)$$

Clearly, TE is reversely related to the correlation between the portfolio and the benchmark, as should be the case.

Our tracking performance analysis makes an important contribution in that it:

- Emphasizes important distinctions between physical and synthetic replication for ETFs
- Studies the relation between bond portfolio interest rate sensitivity (which increases with maturity) and tracking performance
- Shows that the correlation between funds' and their benchmarks' returns dominantly affects TE values.

As we said before, in order to compare performance of ETFs with the corresponding benchmark portfolio one can compare directly the end-of-period returns. Note that index ETFs, with few exceptions, underperform the corresponding indices. Table 3 shows, for the years 2007 to 2009, maximum and minimum annual

---

25 See Alexander (2008), Bacon (2008) and Martellini et al (2003) for more details on TE measurement.

returns and max/min underperformance with respect to the benchmark index, in aggregate, for the index families we are focusing on.[26]

Table 3. Annual returns and underperformance of ETFs

	min/max ETF annual return in %			max/min underperformance in bps		
iShares	2007	2008	2009	2007	2008	2009
Barclays	-3.42/3.52	6.42/12.8	2.23/5.13	26/19	31/24	27/21
eb.rexx	-3.59/3.52	7.13/18.44	-1.59/3.47	13/-11	47/19	15/-12
iBoxx	-3.29/3.42	6.48/11.53	1.19/5.34	12/3	27/18	11/6
db-trackers	-	6.68/10.77	1.83/5.29	-	18/15	16/14
Lyxor	-0.2/3.55	6.48/10.76	2.13/5.34	20/0	18/15	17/-5

The results in Table 3 highlight the distinction between ETFs that employ physical replication and those that employ synthetic replication. In the period 2007-2009 annual (under)performance of iShares funds (which all employ physical replication) differs widely: there are funds that underperformed their benchmarks very significantly (2-3 times the corresponding TER, in 2008) as well as those that over-performed their benchmarks (in 2007 and 2009). There seems to be no connection between the maturity segment and the level of underperformance, suggesting that more detailed analysis should also involve these funds' activities in securities lending. On the other hand underperformance of most db and Lyxor funds (which all employ swap-based replication) for the same period is of the order of TER, with tight differences across the range of their funds. For example, in 2008 underperformance for db funds was in the range 15-18 bps and in 2009 14-16 bps vs. 19-47 and (-12)-15 bps for iShares eb.rexx indices. Three of Lyxor ETFs actually outperformed their benchmarks in 2009 (we have mentioned earlier that Lyxor employ active cash management). We conclude that a swap contract can provide balanced quality of tracking (in terms of difference in returns) across the whole range of ETFs on offer. This can be explained by the fact that db and Lyxor funds have a single swap counterparty (Deutsche Bank and Societe Generale, respectively) and thus, presumably, the same types of swap contracts for all of their ETFs.[27]

26 The negative sign in the table indicates that the funds in question actually out-performed their benchmarks.

27 Our conversations with market professionals indicate that this may be the case, but we have no actual data on the swap contract details.

In Table 4 we present the number of index constituents[28], tracking errors for the ETFs we are focusing on, and volatilities of ETFs and benchmark indices. Volatility calculations assume 252 trading days per annum. To calculate the tracking error we use equation (1). We provide average three-month TE of monthly returns for the whole period and for the years 2008, 2009, and 2010 separately. Average TE is by convention stated in basis points. In Table 4 we also present ETFs' volatilities for the whole period and index volatilities for the whole period, as well as separately for the years 2008, 2009, and 2010. Volatility is, by convention, given in per cents.[29]

From Table 4 one can observe that more volatile higher maturity segments have typically higher levels of tracking error (the only outlier in the sample is db iBoxx € Sov 5-7).

Note that the level of underperformance is positively correlated with fund volatility and is more pronounced for funds which employ physical replication. Table 4 shows that volatilities across the whole range of indices were higher in 2008 than in 2009. In Table 3 we find the same for underperformance. However returns were also several times higher in 2008 than in 2009. Therefore we also conclude that underperformance per unit of return in 2008 is actually lower. The reason is that every fund faces some fixed costs regardless of actual market conditions. Clearly the dominant part of underperformance is related to the level of TER. For example, in 2009 underperformance across the whole range of funds was of the order of TER. Funds with the highest underperformance were the iShares Barclays Term indices funds (in the range 21-27 bps). These funds also had the highest TER (20 bps).

---

28 The number of constituents is calculated for the same dates as the ones used to obtain the aggregate country exposure in Table 2.

29 Volatility is presented as annualized standard deviation of daily returns, that is as a result of the formula $stdev(r_i)\sqrt{252}$ where r_i stands for daily returns. This scaling formula is market convention, but formally it can be applied only with the assumption that returns are not autocorrelated. If instead returns are positively (negatively) autocorrelated the estimated volatility is lower (higher) than the actual. See Alexander (2008).

Table 4. Tracking errors and volatility of indices and ETFs

		Average 3-month TE (in bps)					Volatility (in %)				
			Daily returns				Fund	Index			
	No. of assets	Monthly returns	Whole period	2008	2009	2010	Whole period	Whole period	2008	2009	2010
iShares											
Barclays Term 1-3	10	1.23	0.77	1.37	0.44	0.20	1.51	1.50	2.00	1.25	1.14
Barclays Term 3-5	15	1.96	1.53	3.02	0.59	0.54	3.15	3.13	4.08	2.73	1.89
Barclays Term 5-7	9	2.38	2.29		3.48	0.83	3.27	3.29	-	3.75	2.17
Barclays Term 7-10	13	2.80	2.33	5.08	0.36	0.76	5.44	5.44	6.51	5.49	3.39
Barclays Term 10-15	14	3.32	2.95		4.43	1.12	4.71	4.70	-	5.15	3.74
Barclays Term 15-30	30	4.69	4.08	8.77	0.62	0.68	9.29	9.32	11.25	9.58	5.02
iBoxx€ Liq Sov Cap 1.5-2.5	15	1.97	1.87	2.28	1.55	1.72	2.49	2.57	2.15	1.27	5.81
iBoxx€ Liq Sov Cap 2.5-5.5	15	2.63	2.52	2.81	2.93	2.11	3.11	3.14	3.64	2.41	4.55
iBoxx€ Liq Sov Cap 5.5-10.5	15	7.05	5.30	4.26	6.02	1.75	5.02	5.22	6.04	4.70	5.18
iBoxx€ Liq Sov Cap 10.5+	15	17.46	12.80	7.90	16.61	2.10	9.10	9.74	11.06	9.89	4.79
iBoxx€ Liq Sov Cap 1.5-10.5	25	6.03	4.65	3.96	5.29	1.72	4.54	4.72	5.57	4.04	4.99
eb.rexx 1.5-2.5	6	1.77	1.89	2.33	1.92	1.33	1.59	1.63	2.13	1.44	1.02
eb.rexx 2.5-5.5	12	3.15	2.57	2.63	3.56	1.47	3.08	3.18	3.88	3.08	2.14
eb.rexx 5.5-10.5	10	6.54	4.84	4.11	9.18	1.62	5.18	5.33	6.01	5.73	3.95
eb.rexx 10.5+	10	15.66	11.78	14.23	20.09	2.38	10.49	10.79	12.35	11.39	8.79
eb.rexx DE	25	2.77	2.90	3.09	4.28	1.44	3.52	3.58	4.24	3.61	2.51
db x-trackers											
short iBoxx	252	4.54	4.38	6.81	4.81	0.56	4.40	4.40	5.40	3.95	3.58
iBoxx € Sov	252	3.49	3.32	4.85	2.72	0.48	4.27	4.25	5.13	3.95	3.58
iBoxx € Sov 1–3	60	1.57	1.53	2.05	1.01	0.60	1.68	1.67	1.97	1.23	2.40
iBoxx € Sov 3–5	48	3.03	3.07	4.67	2.03	0.65	3.29	3.26	4.00	2.64	3.69
iBoxx € Sov 5–7	33	5.34	5.03	9.03	2.71	0.39	4.38	4.34	5.27	3.84	4.30
iBoxx € Sov 7–10	47	4.10	3.81	6.20	2.63	0.55	5.30	5.27	6.16	4.95	5.11
iBoxx € Sov 10–15	24	4.55	4.34	6.74	3.55	0.51	6.46	6.44	7.42	6.14	6.53
iBoxx € Sov 15+	44	6.33	6.40	7.69	7.56	0.79	9.21	9.20	11.04	9.59	4.85
iBoxx € Sov 25+	18	9.45	9.42	13.86	9.20	1.30	11.08	11.02	13.22	11.54	5.87
Lyxor											
EuroMTS 1-3	20	10.08	9.54	12.76	9.07	7.37	1.75	1.67	1.90	1.40	2.16
EuroMTS 3-5	22	20.33	19.34	25.15	20.07	13.27	3.30	3.13	3.77	2.73	3.28
EuroMTS 5-7	20	28.61	26.94	32.61	28.39	19.82	4.46	4.30	4.96	4.05	4.41
EuroMTS 7-10	22	34.78	32.65	38.86	34.22	24.02	5.26	5.11	5.76	4.99	5.01
EuroMTS 10-15	18	44.40	40.72	49.46	43.12	29.60	6.48	6.34	7.04	6.36	6.24
EuroMTS 15+	36	15.77	12.87	15.88	5.68	8.09	10.31	10.28	12.81	10.07	5.39

In Table 5 we present ranges of correlation coefficients between daily returns on funds and their respective benchmarks for the whole period and for the years 2008 and 2009, for different index families.

Table 5. Correlation ranges for the index families focused on[30]

		iShares				
		Barclays Term	iBoxx € Liq Sov Cap	eb.rexx	db x-trackers	Lyxor
Max	Whole period	0.994	0.990	0.989	0.987	0.959
	2008	0.991	0.992	0.994	0.990	0.980
	2009	1.000	0.981	0.979	0.989	0.991
Min	Whole period	0.974	0.939	0.957	0.964	0.411
	2008	0.987	0.983	0.964	0.947	0.385
	2009	0.999	0.933	0.925	0.977	0.375
Median	Whole period	0.992	0.976	0.982	0.980	0.424
	2008	0.989	0.991	0.992	0.979	0.466
	2009	1.000	0.964	0.975	0.979	0.437

As can be concluded from Tables 4-5 the lowest average volatilities, lowest average TE values, and highest correlation coefficients with benchmark indices have iShares funds that replicate Barclays Term indices. Most likely this can be attributed to the compact index structuring approach and to the full physical replication. By comparing different index providers one finds that iShares benchmarks have the smallest numbers of constituents and also the lowest average TE (relative to the funds of the other two providers that track the index of the same or similar maturity segment). iShares funds replicate compact Barclays Term indices, iBoxx Liquid Sovereign Capped indices (the most liquid and diversified portfolios in the iBoxx index family), and eb.rexx indices (which consist only of German debt, the most liquid debt in the eurozone). Indices are chosen to match the type of replication. As we said, iShares employ full physical replication. So in order to have accurate tracking of the index, a small number of very liquid securities (with tight bid-ask spreads) is required.

In comparison with iShares funds, db and Lyxor funds track indices with more constituents and more complex country exposures (and, also, employ swap-based replication). Our analysis shows that Lyxor funds performances have considerably higher average TE compared to those of the other two providers. Such tracking error values cannot be explained by a greater complexity in underlying indices, higher volatility, or the number of assets in the indices. Instead it can be almost entirely explained by lower correlation between the fund and benchmark returns. As we have seen in Table 5, correlations for db funds are slightly smaller than or

30 For Lyxor ETFs all correlation coefficients are between 0.411 and 0.424, except for the Lyxor EuroMTS 15Y+ fund for which the correlation equals 0.959, for the whole period. See the discussion below.

equal to those of iShares funds. On the other hand correlation coefficients for Lyxor funds are as low as 42% for the whole period (with one exception). The difference is considerable and drives the differences in TE values. The exception that proves the rule, Lyxor EuroMTS 15+, the fund that started 6 months later than other Lyxor funds, has a correlation coefficient equal to 99% and TE of 8.09 bps in 2009. This should be compared with the TE for Lyxor EuroMTS 10-15 with correlation equal to 44% and TE which is as high as 29.60 bps.

Obviously with swap replication strategy it is the swap contract that defines the characteristics of fund replication. Therefore to estimate performance quality of such funds it would be crucial to know the details of the swap contract, especially the provisions that determine what part of the portfolio is physically replicated and what part is covered by the swap contract[31].

To support the presented findings we go back to the key difference between physical and synthetic replications. Physical replication involves taking possession of most or all of the positions of the benchmark portfolio. In this case, fund and benchmark returns are highly correlated (they would be identical if expenses and income from other activities were excluded). This leads to low variability in active returns, and therefore to low TE. The level of underperformance is determined by costs which involve TER, sampling costs, cash drag,[32] costs of index constituents change, and so on, as well as by the level of additional income-producing activities such as securities lending. In these factors one should be able to find sources of differences in under/overperformance across the iShares family of funds.

In the case of synthetic ETF, balance (consistency) in underperformance over the whole range of ETFs of the same provider and difference in correlation coefficients among providers can only be explained by details of the swap contract. We must emphasize that knowing the details of the swap contract is crucial for a fuller analysis of a synthetic ETF and its risks.

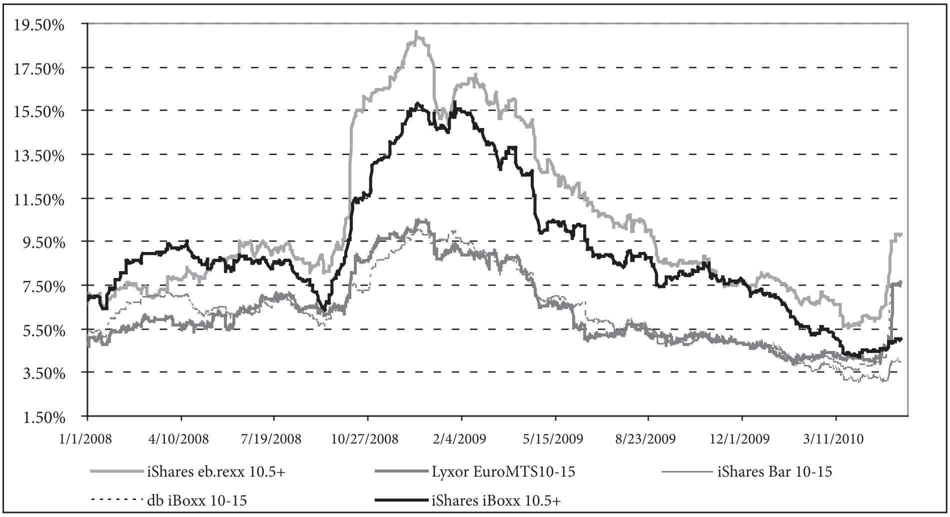
Graph 8 depicts the evolution of volatilities (calculated as annualized 3-month standard deviation of daily returns) for ETFs targeting 10+ year bond maturities, for the period between 1 January 2008 and 19 May 2010.

---

31 In cases when the fund manager takes part in swap collateral lending one should also analyze the structure of the collateral basket. However no data on this is readily available in the market.

32 Cash drag refers to the negative impact that cash positions in a fund's portfolio have on its performance

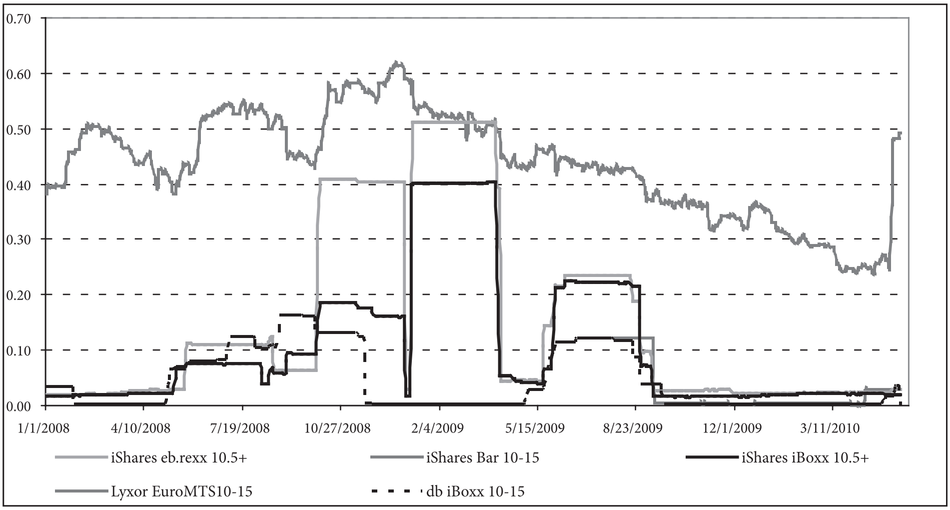
Graph 8. Evolution of volatilities for ETFs targeting 10+ year bond maturities



The fact that volatilities of iShares eb.rexx 10.5+ ETFs have been the highest is related to the fact that they contain solely German government debt securities. As stated above, interest rates on German government debt, in the period in question, have been the second most volatile (after the Greek debt interest rates) in our sample of eurozone countries. Other indices are more diversified and have lower exposure to volatile German debt relative to indices targeting the other segments that we are focusing on (see Table 2).

Graph 9 depicts patterns of three-month daily TEs for the ETFs given in Graph 8, for the same period. It shows that the level of the TE is positively correlated to interest rate volatility. Namely, spikes of volatility (see Graph 8) have their counterpart in increased TE values. An exception to this rule is Lyxor ETFs, which have, clearly, a very different pattern of tracking performance with respect to other ETF fund families.

Graph 9. Patterns of three-month daily TEs (in bps) for the ETFs targeting 10+ year bond maturities



As one last remark, one should bear in mind that iShares funds distribute income, so the total return NAV that we employed in our TE calculations and the NAV of the fund are not the same thing. Unlike iShares, db and Lyxor reinvest all income. For these funds, total return NAV and NAV are the same values. A choice between distribution of income and reinvestment is not clear cut. On one hand income distribution provides periodic income for investors and leads to higher realized return in falling markets. On the other hand when an index is rising reinvesting provides a more reliable way to lock in positive returns.

4. SUMMARY AND CONCLUSIONS

To the best of our knowledge ours is the first academic paper that attempts to systematically analyze the microstructure and performance of eurozone sovereign debt ETFs. The sheer number of such funds in existence, their relative transparency, liquidity, and total assets under management make them an interesting investment class. In times of market distress and high uncertainty investors typically rebalance their portfolio towards less risky and more liquid assets. It appears that these trends have spurred the development of the eurozone sovereign debt ETF market in the past several years. The number of new indices and ETFs is still growing to meet the demand for different risk/reward profiles.

We show that selection rules can result in significantly different paths for two, at first glance, similarly structured indices. In particular funds with heavy exposure to the riskiest sovereign issuers (Greece and Portugal in particular) have very different historical performance in comparison with funds that exclude the risky issuers. Therefore in an environment of widening sovereign CDS spreads and divergent yield trends, understanding the selection rules of a benchmark index is crucial for understanding fund performance.

We demonstrate that eurozone sovereign debt index ETFs are efficient tracking vehicles. Consequently investors are in a position to choose between a variety of customized exposures and income distribution patterns and between two different replication methods (physical vs. synthetic replication) without departing significantly from the performances of targeted benchmarks. Our analysis shows that at the level of total return NAV physical replication provides consistent tracking through time, and that the level of underperformance is affected by additional fund activities. Typically these funds periodically distribute part of their income to investors. The consistency of swap-based replication depends on details of the swap contract and results in tight underperformance, determined by TER, over the range of the corresponding ETFs.

Fees usually play an important role in making investment decisions. They tend to significantly affect active returns, for both physical and swap-based ETFs. Each type of ETF's TER has numerous components so that neither of the two replication methods always leads to a lower TER. While physical replication ETFs face trading costs, swap-based ETFs have an additional swap fee. At the same time securities lending markets are continually developing in Europe and offering new opportunities for fund managers. This is often a significant source of additional income for an ETF, but also additionally complicates performance analysis. Both swap-based and physical replication ETFs can potentially benefit from this income. The difference is that for the swap-based ETF the swap contract determines how much of this income will be kept by the investment bank, and how much will transferred to the ETF investor.

There are several issues left for future research. For investors in eurozone sovereign debt, counterparty risk has become a real concern in the past couple of years. In the case of a swap-based ETF there is always the collateral that the swap counterparty provides, but it does not eliminate the risk completely. In addition, there is often little transparency when it comes to collateral assets. Since different providers have different policies for swap contracts[33] it is very important that investors properly assess counterparty risk when ranking swap-based ETFs. On the other hand securities lending also brings counterparty risk.

Another interesting subject is the study of the liquidity of ETFs. While physical replication ETFs enjoy multiple authorised participants who can create and redeem shares, a swap-based ETF is limited to the swap counterparty. So investors in physical-replication ETFs are supposed to benefit from tighter bid/ask spreads and greater volume, as there is a more competitive market for the shares. During times of heightened market volatility this may lead to higher trading costs for swap-based ETFs.

Last but not least, it is important to study how to optimally structure and hedge portfolios of eurozone sovereign debt using ETFs. This would have to take into account that eurozone sovereign bonds are no longer a pure interest rate product but more a mixed credit-interest rate product. These and other interesting topics await future research.

REFERENCES

Alexander, C. (2008). *Market Risk Analysis: Practical Financial Econometrics*. West Sussex, England: John Wiley & Sons.

Alexander, C., & Barbosa, A. (2008). Hedging index exchange traded funds, *Journal of Banking & Finance* 32, 326–337.

Amenc, N., & Goltz, F. (2009). The Way Ahead for Exchange-Traded Funds: Results from a European Survey, *Journal of Alternative Investments*, 12 (1), 50-54.

Attinasi, M., Checherita, C., & Nickel, C. (2009). What explains the surge in euro area sovereign spreads during the financial crisis of 2007-09? ECB Working paper No. 1131, December.

Bacon, C. (2008). *Practical Portfolio Performance Measurement and Attribution*. West Sussex , England: John Wiley & Sons.

Barclays Global Investors (2009). *ETF Landscape Industry Review*, August 2009. Retrieved from http://www.blackrock.co.uk

33 ETF providers usually impose overcollateralisation requirements to protect themselves and margins vary. The exchanges impose margin and position limits as well.

Beber, A., Brandt, W. M, & Kavajecz, A. K. (2006). Flight-to-Quality or Flight-to-Liquidity? Evidence from the Euro-Area Bond Market, National Centre of Competence in Research Financial Valuation and Risk Management, Working Paper No. 309.

Blitz, D., Huij, J., & Swinkels L. (2010). The Performance of European Index Funds and Exchange-Traded Funds, *European Financial Management*, doi: 10.1111/j.1468-036X.2010.00550.x

Božović, M., Urošević, B., & Živković, B. (2009). On the Spillover of Exchange-Rate Risk into Default Risk, *Economic Annals*, 54 (183), 32-50.

Dellva, W. L. (2001). Exchange-Traded Funds Not for Everyone, *Journal of Financial Planning*, 14 (4), 110-124.

Drenovak, M., & Urošević, B. (2010). Modelling the Benchmark Spot Curve for the Serbian Market, *Economic Annals*, 55 (184), 29-57.

Engle, R., & Sarkar, D. (2006). Premiums–discounts and exchange traded funds, *Journal of Derivatives* 13 (4), 27–45.

Gastineau, G. (2004). The benchmark index ETF performance problem, *Journal of Portfolio Management*, 30, 96–103.

Kostovetsky, L. (2003). Index mutual funds and exchange traded funds: A comparison of two methods of passive investment. *Journal of Portfolio Management*, 29, 80–92.

Martellini, L., Priaulet P., & Priaulet, S. (2003). *Fixed-income securities*. West Sussex, England: John Wiley & Sons.

Poterba, J., & Shoven, J.B. (2002). Exchange traded funds: A new investment option for taxable investors. *American Economic Review*, 92, 422–427.

Rompotis, G. (2008). Performance and Trading Characteristics of German Passively Managed ETFs, *International Research Journal of Finance and Economics*, 15, 210-223.

Rompotis, G. (2009). Interfamily competition on index tracking: The case of the vanguard ETFs and index funds. *Journal of Asset Management*, 10 (4), 263-278.

Schuknecht, L., von Hagen, J., & Wolswijk, G. (2010). Government bond risk premiums in the EU revisited. The impact of the financial crisis, ECB Working paper No. 1152, February.

Schwarz, K. (2009). Mind the Gap: Disentangling Credit and Liquidity in Risk Spreads, Wharton School, Working Papers, September.

The EDHEC European ETF Survey 2009 - May 2009 Retrieved from http://faculty- research.edhec.com/jsp/fiche_document.jsp?CODE=1243345332051&LANGUE=1

Received: October 19, 2010
Accepted: November 08, 2010