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Abstract

This paper provides a comprehensive investigation of the determinants of US dollar-denominated long-term debt issuance by European banks. The database used allows the drivers of foreign-currency issuance identified in the literature, including variables at the individual firm (e.g. bank) level, to be explored. The analysis covers overall US dollar issuance as well as Yankee debt issuance, which is defined in this paper as bonds denominated in US dollars issued in domestic US markets by non-US issuers. In addition, issuance determinants are investigated during both crisis and non-crisis periods. The main findings are the following. European banks issue US dollar debt to naturally hedge their US dollar assets (with US dollar exposures obtained from BIS international banking statistics), but they also make extensive use of deviations in covered interest parity and even in uncovered interest parity, particularly after the crisis. There is also evidence that banks issue in US dollars for strategic reasons and that heightened volatility has a negative impact on US dollar issuance. Bank-specific variables are also relevant drivers of US dollar debt issuance: banks with higher asset growth, with a banking subsidiary in the United States and with a high credit rating are more likely to issue in US dollars than others. Bank-specific structures, as captured by deposit and loan ratios, also have a relevant impact on US dollar funding activity in some cases. The results are robust to alternative econometric specifications and to different definitions of covered and uncovered cost savings.

Keywords: bank funding, foreign currency debt issuance, US dollar-denominated debt, interest rate parity, banking crisis, Europe.

JEL Classification: G21, G32, F3, G01, O52.

Resumen

En este estudio investigamos los determinantes de las emisiones denominadas en dólares de deuda a largo plazo por parte de la banca europea. Para ello empleamos una base de datos que permite explorar los factores que, según la literatura, explican las emisiones en moneda extranjera. Incluimos además variables a nivel individual bancario. Nuestro análisis se centra no solo las emisiones en dólares, sino también las emisiones de *Yankees*, que se definen en este trabajo como bonos denominados en dólares emitidos en el mercado interno de Estados Unidos por emisores no estadounidenses. Además, nuestra investigación cubre tanto el período previo como el período posterior a la crisis. Nuestras conclusiones más importantes son las siguientes. Los bancos europeos emiten deuda en dólares para realizar coberturas en balance de sus activos en dólares (dichas coberturas se obtienen de las estadísticas de banca internacional del BPI), pero también aprovechan, sobre todo tras la crisis, las desviaciones en la paridad cubierta de tipos de interés e, incluso, de la paridad no cubierta de tipos de interés. También encontramos indicios de que los bancos europeos emiten en dólares por motivos estratégicos y de que una alta volatilidad en los mercados tiene consecuencias negativas para las emisiones en dicha moneda. Adicionalmente, encontramos que algunas variables a nivel individual bancario son significativas: aquellos bancos que registran un crecimiento, que tienen filiales bancarias en Estados Unidos o que cuentan con una alta calificación crediticia tienen más probabilidad de emitir en dólares. Ciertas medidas de estructura de balance bancario, como la ratio de depósitos y de préstamos, son también importantes factores explicativos de la financiación bancaria en dólares. Nuestros resultados son robustos a diferentes especificaciones econométricas y a diversas definiciones de ahorros en cobertura y en no cobertura.

Palabras clave: financiación bancaria, emisión de deuda en moneda extranjera, deuda denominada en dólares estadounidenses, paridad de tipos de interés, crisis bancarias, Europa.

Códigos JEL: G21, G32, F3, G01, O52.

1 Introduction

The US dollar has been the dominant international currency for many decades. An indicator of the role of the US dollar as an international currency is the extent to which it is used as a funding currency by foreign firms. For example, by the end of 2014, around 60% of the total amount outstanding of international debt securities was denominated in US dollars, increasing from a share of 45% in 2001 (European Central Bank [ECB], 2015)[1]. Moreover, the importance of the US dollar as an issuing currency has increased since the 2007-2008 financial crisis, aided by the very low interest rate environment in the US. In contrast, the proportion of international debt securities issued in euros has been constantly declining since 2007, although a recovery has been recorded since 2012. By sector, the most important foreign issuers in US dollars are banks, which account for roughly one third of total gross issuance since 1999, according to Dealogic data.

Another important characteristic of the international status of a currency is how sophisticated the financial markets of the country of origin are. The US domestic market is one of the largest and deepest financial markets in the world (Fabozzi, 2005). An important segment of this market is the so-called Yankee market, or bonds denominated in US dollars issued by non-US headquartered companies and marketed in the US[2]. According to Societe Generale (2012), this market has increased in significance in recent years and is now comparable in size to the US high yield bond market. The most important issuers of Yankees traditionally were European banks. However, their dominance started to dwindle after the global financial crisis, as corporations from other countries gained weight in the Yankee sector. This notwithstanding, the absolute and relative amounts of US dollar-denominated bonds issued by European banks quickly recovered from its low in 2008 and peaked in 2011. After the new lows recorded in 2012, issuance picked up strongly again in 2013 and 2014. Yankee bonds followed suit.

At the same time, European and US banks have been at the epicenter of the global financial and euro area financial crises. One of the lessons learned from these crises is how quickly liquidity problems can turn into solvency issues for any banking institution (Caruana and van Rixtel, 2012). The failure of a single bank can easily bring others down, ultimately leading to a systemic banking crisis. Another lesson learned is that sovereign debt woes can very quickly spill over to the banking system and lead to banking and currency crises. Therefore, it is undisputed that a safe, well-regulated and properly funded banking system is a necessity to safeguard financial stability and economic growth.

Given the importance of European banks in the US dollar bond market and their role played in the recent financial crises, the goal of this paper is to determine what the major drivers have been of US dollar-denominated bond issuance by these institutions. In doing so, we will focus both on total US dollar issuance and on Yankee issuance. In order to achieve our goal, we will use a unique database of around 5,500 US dollar-denominated bonds issued by 59 banks from Switzerland, the United Kingdom and the euro area.

Besides providing new insights in the role of the US dollar as an international funding currency, the paper also sheds light on changes in bank funding structures. Even though the latter has gained importance in research after the global financial crisis, the determinants of debt issuance by banks have, rather surprisingly, remained largely unexplored (see Van Rixtel, Romo Gonzalez and

1. The growing weight of the US dollar as a funding currency occurred in spite of the creation of the euro in 1999, a firm candidate to challenge the position of the US dollar as the dominant international currency (Goldberg, 2010).

2. This is the definition of Yankee bonds we will use in this article. See section 2.2 for a narrower definition.

Yang, 2015). As far as we are aware of, the recent developments in US dollar issuance by European banks have not been studied before. We intend to fill this gap with this paper.

This study also contributes to the specific literature on the determinants of foreign-currency-denominated debt as well as that focused on the issuance of bonds in foreign markets, especially with respect to US dollar markets. Most of these studies deliberately exclude banks. Those that include banks use proxies for foreign currency exposures, or utilize some balance sheet indicators which, however, are often more appropriate for non-financial companies. In contrast, we will use bank-specific direct measures for US dollar exposures, albeit on a country basis. We use the BIS international banking statistics for these exposures, which arguably are the best data available for this purpose, as bank-specific data-sources such as Bankscope and SNL do not provide information on currency exposures. Moreover, most of the aforementioned studies do not cover the global financial crisis of 2007-2009 and the subsequent euro area financial crisis of 2010-2012. Our data cover both the pre-crisis and crises periods. Hence, we are able to test the determinants of US dollar issuance by European banks during normal and crisis episodes. Moreover, we will also measure the impact of bank-specific characteristics on US dollar issuance.

The main conclusions are the following. European banks issued US dollar- denominated long-term debt for opportunistic reasons, exploiting Covered Interest Parity (CIP) deviations and to a lesser extent, Uncovered Interest Parity (UIP) deviations. Hedging of US dollar exposures was also an important driver of US dollar issuance, and to a certain degree, higher liquidity increased the likelihood of banks obtaining long-term funding in US dollars. Worse financial market conditions and higher volatility had a negative impact on US dollar borrowing. In spite of this, certain bank-specific characteristics remained relevant also after the crisis began and were key to have access to US dollar markets. Finally, our results show that some of these conclusions change when only Yankee bonds are examined.

The remainder of this paper is structured as follows. Section 2 provides an overview of the relevant literature and lays out the hypotheses of the paper. Section 3 describes the database, the dependent and explanatory variables and the main developments of US dollar issuance and of covered cost savings during the sample period. Section 4 explains the econometric model used, while the results are discussed in section 5. Finally, section 6 concludes.

2 Literature review

Previous studies have identified various explanations for the decision of a firm to issue foreign currency bonds. These motivations can be broadly divided into three: 1) on-balance sheet hedging of foreign currency exposures; 2) opportunistic issuance in order to realize lower issuance costs and 3) strategic drivers. They will be described in section 2.1. Section 2.2 presents the different markets in which a US dollar-denominated bond can be issued and briefly discusses the studies that specifically investigate why issuing firms choose for a particular primary market. Section 2.3 discusses other explanatory variables which according to the literature may drive foreign currency issuance as well.

2.1 Optimal hedging, opportunistic and strategic issuance of foreign currency debt

The most frequently mentioned motivation for the issuance of debt denominated in a foreign currency is that it serves as a natural hedge to assets that are denominated in a similar foreign currency, i.e. to perform on-balance sheet hedging. Literature on risk management and optimal hedging deals from a theoretical perspective with the underlying drivers of the insurance and hedging decisions of firms (Smith and Stulz, 1985 and Nance, Smith and Smithson, 1993). On the empirical side, many studies provide evidence of foreign currency exposure being an important driver for the issuance of foreign currency denominated debt by industrial firms. These papers use firm-specific balance sheet information to proxy for this exposure. Kedia and Mozumdar (1999) find that US companies with a larger number of subsidiaries abroad issue more foreign currency bonds. Keloharju and Niskanen (2001) argue that the share of exports to net sales is a significant determinant of the currency denomination decision of debt issuance by Finnish companies. Allayannis, Brown and Klapper (2003) show that there is a positive and significant correlation between foreign currency debt and the EBIT and cash reserves generated abroad for a sample of East-Asian firms.

As for financial institutions, many authors consider that banks completely hedge their positions using different instruments (e.g. McGuire and von Peter, 2009a and 2009b; Fender and McGuire, 2010; Ivashina, Scharfstein, and Stein, 2015) and that they have incentives to do so. For example, Ivashina et al. (2015) argue that if banks were to leave currency risks unhedged, they would face an additional regulatory capital charge. Hence, it can be expected that hedging is an important driver of US dollar-denominated bonds issued by European banks.

More recent studies suggest that firms issue foreign currency debt opportunistically to take advantage of CIP and UIP deviations in international markets. These deviations can create so-called *"covered"* or *"uncovered"* cost savings or "bargains" when issuing debt (see sections 3.2.2 and 3.2.3). Moreover, opportunistic issuance of foreign currency denominated debt can lead a company to diverge from its optimal hedging policy or even to issue foreign currency debt when there are no operating incentives to do so. The most important exponents of this literature are McBrady and Schill (2004 and 2007), McBrady, Mortal and Schill (2010), Habib and Joy (2010) and Black and Munro (2010). Covered cost savings can be economically significant: McBrady and Schill (2004) estimated a total of $230 million in annual borrowing cost savings to companies issuing in the most common currencies in the international bond market between 1991 and 2003[3].

3. To be fair, the literature on foreign currency debt issuance has been dealing with uncovered cost savings in one way or in other for already a long time. For instance, some early studies already developed the "decision funding portfolio" models for multinationals in order to assess the impact of the difference of interest rates across countries on total foreign currency issuance (see e.g. Faro and Jucker, 1973; Kawai, 1981 or Johnson, 1988).

In principle, covered cost savings are potentially positively related to US dollar issuance by non-US banks, as in the case of non-financial companies. Moreover, one could argue that banks should be more receptive to reap the benefits from covered cost savings than non-financial firms, given that they should have better knowledge of and access to the various financial markets involved, most importantly derivatives markets. In support of this hypothesis, Black and Munro (2010) find that covered cost savings are the most important driver of offshore issuance, particularly for financial firms. Additionally, some anecdotal evidence points to positive covered cost savings as the main drivers of Yankee issuance by banks during the global financial crisis (e.g. Moody's, 2011 and JP Morgan, 2015).

However, other studies yield different results. McBrady and Schill (2004 and 2007) find that debt currency denomination is strongly and positively related to what they call "bargains in covered yields" for non-financial firms, sovereigns and agencies. On the contrary, issues denominated in a particular currency are negatively related to covered interest "bargains" of that currency when financial companies are considered. The authors argue that this is due to banks adopting a counterparty position in foreign currency swaps. Habib and Joy (2010) reject the hypothesis that covered cost savings play an important role in foreign currency denominated debt issuance, also when financial issuers are considered.

As for uncovered cost savings, the evidence of the impact of unhedged interest rate differentials on foreign currency funding decisions of firms is not fully conclusive (see e.g. Keloharju and Niskanen, 2001; Cohen, 2005; McBrady and Schill, 2004 and Siegfried, Simeonova and Vespro, 2007). Interestingly, Habib and Joy (2010) and Johnson (1988) show that uncovered cost savings play a very important role in the choice of foreign currency when issuing bonds, particularly in the case of financial firms.

Finally, companies may strategically issue in a foreign currency to gain access to deeper, more liquid or more complete markets; to a wider investor base or to markets characterized by beneficial tax practices and capital controls (Keloharju and Niskanen, 2001). For example, borrowers from many emerging economies may have access to international capital markets only by issuing in foreign currencies (Eichengreen and Hausmann, 1999)[4]. Additionally, given that transaction costs in more liquid markets are lower (as long as these costs are a decreasing function of volumes), firms would prefer to issue foreign currency denominated debt in related liquid markets over more illiquid options (Munro and Wooldridge, 2009 and Hale, Jones and Spiegel, 2014). For instance, Hale and Spiegel (2009) consider that foreign "vehicle currencies" such as the US dollar are useful to reduce administrative costs, given their economies of scale. Kedia and Mozumdar (1999) and Siegfried et al. (2007) find that higher liquidity or larger market capitalization in a specific foreign currency market is positively related to the choice of this foreign currency as currency of issuance, because of lower transaction costs.

It could be argued that liquidity in US dollar markets is not an important issue for European issuers, because their domestic markets should be, in general, liquid enough. However, some authors show that domestic and international markets offer different financial services. More specific, bonds issued in foreign markets are generally larger than bonds issued in domestic markets, not only for issuers from developing countries but also for issuers from developed countries (Gozzi, Levine, Martinez Peria, and Schmukler, 2012)[5]. On top of this, liquidity in some domestic European markets was very low during

4. These authors describe this as the "original sin", which they define as the "…situation in which the domestic currency cannot be used to borrow abroad or to borrow long-term, even domestically" (p. 3).

5. These authors do not confirm this results (in some cases) in Gozzi, Levine, Martinez Peria and Schmukler (2015).

the euro area financial crisis, when markets were even closed for some of the highest-rated issuers (Caruana and Van Rixtel, 2012).

2.2 Literature on US domestic and Eurodollar markets

A firm willing to issue in US dollars can opt for any of the following markets. First, the firm can sell its bond in the offshore or Eurodollar market. Eurodollar bonds are issued outside any jurisdiction, denominated in US dollar and do not have to comply with the US Securities and Exchange Commission (SEC) regulations. Because of the latter, underwriters cannot sell Eurodollar bonds to US investors until these bonds are "seasoned" issues, which effectively locks out US investors from the Eurodollar primary market.

The second option is to issue in the US domestic market. If this is the case, the firm has to choose in which format. Yankee bonds (in a narrow sense) are publicly placed in the US and comply with the regulations of the SEC. These issuers have to abide by costly disclosure rules in order to gain access to one of the historically most liquid markets in the world and to a very large and sophisticated investor base (Gao, 2011 and Miller and Puthenpurackal, 2001). If the costs of Yankees outweigh the benefits, a firm can also opt for a SEC-unregistered so-called 144A bond, whose regulatory and informational requirements are notably lower. However, these bonds cannot be sold to the general public in the US and, they can be initially resold only to Qualified Institutional Buyers (QIBs). Moreover, the issuer can also opt for a traditional private placement in the US under Regulation D of the US Securities Act of 1933[6]. Needless to say, liquidity in the regulation D and 144A markets is lower than in the Yankee segment. This notwithstanding, 144A bonds have become a quick door to the US domestic market for foreign issuers (Chaplinsky and Ramchad, 2004)[7].

Literature addressing the drivers of issuance in one market or the other can be grossly divided in two. On the one hand, we have those studies that investigate agency cost theories in the context of domestic US markets. Information asymmetries could be larger for non-domestic firms and, therefore, issuers from countries more culturally distant (Zhu and Cai, 2014) or with poor investor protection laws (Miller and Puthenpurackal, 2001) pay significant premiums in Yankee markets, whereas issuers that have already built a good reputation or disclosed significant information (i.e. seasoned investors and companies listed in the US stock market) pay significantly less. On the other hand, other studies focus on how differences in relative issuance costs (both yields and underwriting fees) in different markets affect the choice of firms on where to issue (e.g. Kim and Stulz, 1988; Miller and Puthenpurackal, 2001; Gao, 2011 and Resnick, 2012).

In our sample, a very significant share of US dollar bonds is marketed in the US (see Figure 5.a in Appendix A). Given that regulation for US marketed bonds is different than that for bonds issued in the Eurodollar market (see Fuertes and Serena, 2016), we conduct separate regressions for the former. Our aim is to find out whether US marketed bonds are driven by the same factors that determine total US dollar bond issuance, which also includes Eurodollar bonds. Should the factors be similar for these two groups, we can discard potential distortive effects from regulation in total US dollar issuance.

2.3 Firm characteristics and macroeconomic and financial market conditions variables

This section reviews the main findings in the literature on other potential drivers of foreign currency issuance, which are here mostly used as controls. These include bank-specific characteristics, macroeconomic variables and financial market condition indicators.

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6. Regulation D contains some exceptions to the registration of securities with the SEC for firms issuing in the US. See SEC (2015).
7. A firm can also issue a global bond. See Fabozzi (2005). The portion of the global bond sold by foreign investors in the US is considered a Yankee bond whereas the other is considered a Eurodollar bond. Liquidity in this market is very high (Resnick, 2012).

The size of the issuer is probably a very important driver of total (US dollar-denominated) issuance. Agency cost and risk management theories and most empirical literature evidence suggest that larger firms issue more in foreign currencies than smaller firms (Keloharju and Niskanen, 2001; Kedia and Mozumdar, 2003; Allayannis et al., 2003 and Siegfried et al., 2007) or need to hedge more (Nance et al., 1993 and Hillier, Grinblatt and Titman, 2012). Related to size, it has been shown that banks actively manage their balance sheets (Adrian and Shin, 2010) and, in consequence, commercial banks issue more (short-term) debt when their total assets increase, in order to keep a certain leverage ratio constant ("leverage targeting").

As for the specific balance sheet structure of banks, Van Rixtel et al. (2015) find evidence of the deposit ratio being negatively related to total debt issuance and confirm that banks issue debt to overcome deposit supply constraints. The authors also prove that the loan ratio is positively related to total long-term debt issuance, pointing at maturity matching by banks, as loan portfolios of banks tend to have rather longer-term maturities.

There is no consensus in the literature about the impact of leverage on foreign currency denominated debt issuance. On the one hand, research on risk management theories showed that highly leveraged firms are more likely to hedge at least when they have high costs of financial distress (see Hillier et al., 2012), while the empirical literature seems to support the notion of a positive impact of leverage on foreign currency debt issuance (e.g. Gozzi et al., 2015 and Esho, Sharpe and Webster, 2007). On the other hand, net-worth acts as a proxy for creditworthiness of a borrower in an asymmetric information context as explained in Hubbard (1998) or in Costly-State-Verification models (e.g. Williamson, 1986). In consequence, higher leverage (or a lower equity ratio) could reduce the likelihood of issuance of foreign currency denominated instruments.

The sign of the impact of the market-to-book value of equity (MTB) on US dollar-denominated debt issuance is not clear either. Agency theory predicts that MTB is negatively related to foreign currency debt issuance; Allayannis et al. (2003) find evidence of this. However, MTB measures growth opportunities and consequently risk management theories would predict a positive sign of the coefficient for this variable (Kedia and Mozumdar, 2003 and Hillier et al., 2012).

Many European banks have one or more subsidiaries or branches registered in the US. European banks with a bank office in the US may face less information asymmetries when issuing in the US, because the Federal Reserve itself examines branches of foreign banks (Federal Reserve Bank of New York [FRBNY], 2007). Moreover, a bank that is willing to pay the costs of higher scrutiny is "signaling" to potential investors its quality and creditworthiness, in line with the general theories of financial market signaling of Ross (1977) and Leland and Pyle (1977). Furthermore, a foreign office can be a rough proxy for US dollar exposure. Hence, it is expected that banks with banking representation in the US are more likely to issue US dollar-denominated debt. On the other hand, foreign offices allow the parent banks to have a larger deposit base denominated in US dollars and have access to some Federal Reserve facilities. This would reduce the need to issue US dollar long-term debt for hedging reasons. Thus, a negative sign can be expected as well.

The impact of the macro-economic and financial environment on the funding currency choice of firms has been investigated explicitly in the literature. Hale et al. (2014) show that the probability of issuing in a domestic currency (which is not a global funding currency) is negatively associated with sovereign risk, debt-to-GDP and inflation. Black and Munro (2010) find that the financial crisis reduced overall issuance rather than shifting the location of issuance. In the context of foreign currency debt issuance as a hedging device, McBrady et al. (2010) argue that firms will hedge more when the economy associated with that currency suffers an economic shock, meaning that they would issue more in that currency. In contrast, ECB (2008) argues that the strength of the business cycle will have a positive impact on the share of debt securities issued in that particular currency by foreign issuers.

2.4 Hypotheses

This study will test the following hypotheses.

First, European banks act opportunistically by exploiting violations of CIP to achieve covered cost savings. More specifically, as argued in section 2.1 and 3.2.3, it is expected that for banks covered cost savings are more relevant than uncovered cost savings.

Second, European banks issue long-term US dollar-denominated debt for on-balance sheet or natural hedging purposes; or, in other words, European banks issue bonds in US dollars to hedge their US dollar exposures (or assets).

Third, banks issue bonds denominated in US dollars for strategic reasons. Hence, when liquidity in US dollar markets is high, European banks issue more US dollar debt in order to exploit lower transaction costs.

In testing these hypotheses, we control for macroeconomic and financial market conditions as well as for some bank-specific characteristics. These controls allow exploring whether US dollar issuance by European banks was affected by general financial market and macroeconomic conditions only or if bank-specific characteristics played a role as well.

Additionally, regressions for the US marketed bond subsample are conducted separately.

Finally, we divide the sample in pre- and crisis periods to test whether different drivers of US dollar issuance by European banks existed in these periods.

3 Data, dependent and explanatory variables, and descriptive statistics

This section describes the dataset used in this paper for the dependent variable (subsection 3.1) as well as the most relevant independent variables (subsection 3.2). Sections 3.3 and 3.4 review the main developments of overall US dollar and Yankee issuance and of the covered cost savings, respectively. Our goal is to provide the reader with a complete picture of developments during the sample period in order to better interpret the results in section 5.

3.1 Bank sample, database and dependent variable

The sample used for this paper consists of the most frequently issuing European banks between 1999 and 2013, as recorded in the Debt Capital Markets (DCM) database of Dealogic. Qualifying banks must have issued at least 200 bonds per individual bank since 1999. This is the same database used in Van Rixtel et al. (2015). The sample includes 59 banks from 11 euro area countries (Austria, Belgium, Germany, Spain, France, Greece, Ireland, Italy, Luxembourg, Netherlands and Portugal), Switzerland and the United Kingdom. Given that we have balance sheet data at a quarterly frequency only since 2005, we restrict the sample to Q1 2005 - Q1 2013. The full list of the names of the individual banks including bank nationality and bank-type is presented in Appendix C, Table 9.

Banks are considered at the group level (i.e. on a consolidated basis) and not by each of their subsidiaries. This is the optimal approach for the study of US dollar debt issued by banks: As Siegfried et al. (2007) argue, group level characteristics are the most important ones to explain the funding decision of subsidiaries, given the possibility of intragroup transfers when a specific subsidiary has a funding deficit[8]. Accordingly, the nationality of a bank is defined as the country where the parent is headquartered. The largest national sample is the German one with nineteen banks, followed by France and the United Kingdom (both seven banks). Most banks in the sample are commercial banks (33), followed by public savings banks (11), mortgage banks (8) and cooperative banks (7). The large number of public savings banks is due to the importance of public-sector banks in Germany.

Our database has been cleaned manually to take into account mergers, acquisitions and sales of banking groups and subsidiaries. A major complication was the “reconstruction” of issuance data by those banks that went bankrupt or sold to others after 1999. Including these banks in the sample makes the database more complete and corrects for any potential “survival bank bias” in the results. Unfortunately, Dealogic reclassifies bonds issued backwards in time when the original issuing bank disappears, and assigns all bonds to the acquiring bank, including those issued before the date of the takeover. As we want to link issuance to bank-specific information, it is clear that this needs to be corrected. This correction can only be done manually for each individual bond issue. We used Bankscope, SNL, bank-specific information from the three rating agencies (Fitch, Moody’s and S&P) and publications from the banks in the sample to make this adjustment[9].

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8. European banks follow different internationalization and funding strategies when expanding abroad. For instance, Spanish banks in our sample are classified as multinational banks with a decentralized funding structure (McCauley, McGuire and von Peter, 2010). This implies a lower degree of intragroup funding than that of banks with a more centralized structure (as in the case of many French and German banks). Consequently, for Spanish banks and other decentralized banks, studying each bank subsidiary on a separate basis may be more accurate. Additionally, according to McCauley et al. (2010), decentralized multinational banks are relatively less exposed than others to swap and wholesale markets' distress. This would imply a lower sensitivity of decentralized banks to covered cost savings when compared to centralized banks. That said, the asset-liability management of many international banks is coordinated on a centralized basis, which would make the study of a bank on a consolidated basis still relevant for the purposes of this paper (see, for example, PricewaterhouseCoopers, 2009).

9. Detailed information on this database is found in Van Rixtel et al. (2015).

The database includes unsecured senior, subordinated, covered and government guaranteed bonds. It includes medium-term notes (MTNs), which are offered continuously under an issuance programme, with a range of different maturities of up to thirty years. However, securitizations and bonds issued by Special Purpose Vehicles (SPVs)[10], bond exchanges, convertibles and short-term debt are excluded. We concentrate on long-term debt, which according to the definition used by Dealogic includes debt instruments with an original maturity of 18 months and longer.

For the dependent variable, we focus on the subset of investment-grade US dollar-denominated bonds issued between January 2005 and March 2013. Following McBrady and Schill (2004) and Habib and Joy (2010), we restrict the sample to fixed-coupon bonds (see also Appendix B-1). There are 5,498 tranches in the database that meet these criteria of which 2,741 are classified as Yankee bonds. According to Dealogic, Yankee bonds are debt instruments denominated in US dollars, issued by non-US institutions and marketed in the US. Notice that this definition is more comprehensive than the one given in section 2.2. Consequently, Yankee bonds, in what follows, include SEC registered bonds but also 144A and private placements in US markets. To avoid exchange rate distortions, we transform the amounts of bonds denominated in US dollar to euros using the fixed EUR-USD exchange rate at the beginning of 2005. Finally, to normalize issuance, the amount of US dollar-denominated bonds issued is divided by each bank's total assets for all periods considered.

Descriptive statistics of the dependent variables are reported in panel A of Table 2. Mean issuance of all US dollar bonds and of Yankee bonds is higher for Swiss and British banks than for euro area banks, in line with the substantial US dollar issuance activity of these countries (see section 3.3). The largest quarterly amount issued in US dollars by any single bank was approximately 5% of total assets (issued by NIBC Holding in the third quarter of 2009). Given the high heterogeneity of banks in the euro area, standard deviations of US dollar issuance are higher for euro area banks than for Swiss or British banks.

3.2 Explanatory variables

3.2.1 OPTIMAL HEDGING: NATURAL OR ON-BALANCE SHEET HEDGING

As explained in section 2.1, hedging may be important for both non-financial and financial firms, since hedging allows firms to cover themselves from unwanted fluctuations in exchange rates. Moreover, banks could face additional regulatory incentives to hedge against exchange rate movements. Formally, the "net position exposure" in US dollars for a bank can be summarized as follows [11] (Saunders and Cornett, 2011):

$$\text{(USD assets – USD liabilities)} = \text{Net USD assets} \tag{1}$$

USD assets may include bonds and/or loans denominated in US dollars whereas USD liabilities comprehends US dollar-denominated debt issued by banks. A bank is long in US dollars if the difference in Equation (1) is positive, and short if this position is negative.

10. The allocation of SPVs to their corresponding banking group or sponsors at each quarter is complicated by the scarce information available for these vehicles and their relationship to each banking group. In other words, should we have included securitizations, the database would be less reliable and prone to mistakes. In any case, a rough inspection (that is, without taking into account acquisitions and sales of banks' subsidiaries) shows that the issuance of (fixed-coupon) mortgage and asset backed securities denominated in US dollars was only relevant for five banks in our sample: Banco Santander, Credit Suisse, UBS, Deutsche bank and Royal Bank of Scotland.

11. For the purpose of this paper, focus is placed on the asset and liability positions in US dollars of banks and the trading book is ignored for the explanations. Hence, Equation (1) abstains from trading activities in US dollars.

Equation (1) can be expanded as follows. There are two ways in which banks can protect themselves against fluctuations in the US dollar: Through on-balance sheet (or natural) hedging, which has been the topic of discussion up until now, or through off-balance sheet hedging. In consequence, if a bank fully hedges its US dollar exposure on the asset side of its balance sheet (A_i), it may do so through a combination of foreign exchange (FX) and currency swaps (W_i) (off-balance sheet hedging) and/or direct borrowing in the foreign currency (L_i) (on-balance sheet hedging) such that (McGuire and von Peter, 2009b):

$$A_i = L_i + W_i \qquad (2)$$

Hence, US dollar-denominated long-term debt (i.e. the dependent variable in this study) would be classified as part of L_i in Equation (2). Therefore, in order to check whether a bank issues to hedge or for any other motive, an appropriate indicator for A_i is needed. However, accounting ratios such as foreign sales to total sales or net foreign income to total income, which are frequently used in the literature for non-financial companies, do not accurately reflect the exposure to exchange risk for banks.

In order to measure A_i more accurately, we use data on international claims as reported by the BIS locational banking statistics by nationality. More specifically, the BIS data employed in this paper include international claims of European banks denominated in US dollars to all sectors, excluding interoffice positions. Although this indicator is very precise, it suffers from some flaws. First, the BIS data are available only on a country basis, instead of on a bank-basis. This implies that for certain countries, particularly those with many banks in our database (e.g. Germany), US dollar exposures might not reflect the actual US dollar exposures for smaller and less internationalized banks. Second, a maturity breakdown for US dollar exposures is not used in this paper[12]. Thus, whereas the US dollar issuance data that we use for the dependent variable have a long-term maturity (L_i) (above or equal to 1,5 years, see section 3.1), the data on US dollar-denominated claims (A_i) include short-term as well as long-term assets. Hence, this may result in inaccuracies if banks simultaneously match their liabilities with the currency denomination and the maturity of their assets denominated in US dollars[13]. Finally, local claims in local currency (i.e. claims denominated in US dollars by subsidiaries located in the US) are not included either[14,15].

Measuring off-balance sheet hedging (W_i) is even more complicated, since data on derivatives positions for banks are difficult to obtain. Therefore, this variable will be not controlled for, at least not directly. In principle, it can be expected that the relationship between off-balance sheet hedging (W_i) and US dollar issuance or on-balance sheet hedging (L_i) is negative. This is what is inferred from Equation (2). An example of the use of currency swaps for hedging purposes would imply the creation of a "synthetic foreign currency" or "synthetic US dollar" bond, as described in Habib and Joy (2010) (See Figure 1 in Appendix A, where vertical arrows represent the cash market and the horizontal arrows the payments in a currency swap by a euro area bank). Unfortunately, the interaction between

12. The maturity breakdown of US dollar claims can be proxied by the type of counterparty sector on which these claims are made, as maturities of loans to banks are normally shorter than those of loans to non-banks (see McGuire and von Peter, 2009a and b, and Fender and McGuire, 2010).

13. However, a maturity mismatch between assets and liabilities is part of the asset transformation function of banks (Saunders and Cornett, 2011). Additionally, McGuire and von Peter (2009a and 2009b) and Fender and McGuire (2010) describe the existence of what they call the *US dollar funding gap* (i.e. a maturity mismatch between claims and liabilities denominated in US dollars) for European banks until at least 2009. In spite of this, we still expect that long-term US dollar claims are a more accurate measure for US dollar exposures for our purposes than the one currently used in this paper.

14. Non-inclusion of US dollar local claims by subsidiaries in the US could make our US dollar exposure measure not fully representative for decentralized banks. See footnote 8.

15. All flaws, except for the first one, can be partially corrected. We expect to do so in a future version of this paper.

different hedging instruments is not so straightforward as in Equation (2), because derivatives can be used for opportunistic reasons as well, as in the case of the creation of "synthetic domestic currency" debt or "synthetic euro" bonds (Figure 2, Appendix A). In this case, currency swaps and US dollar-denominated debt can be positively related to each other. See section 3.2.2 for further details on this.

3.2.2 EXPLOITING CIP ARBITRAGE OPPORTUNITIES: "COVERED" OR "HEDGED" BORROWING COST SAVINGS

Covered cost savings and the arbitrage of CIP are potentially very relevant for banks, as currency swaps can be used for hedging against exchange rate risk. The most common expression of CIP as explained in textbooks is designed for the short-run and, in consequence, based on FX forward rates. However, forward FX contracts are liquid only in the short-term and, in consequence, these are not useful for the hedging of currency risk of bonds. For our study, the alternative long-run version of CIP based on currency swap rates derived by Popper (1993) is more relevant:

$$i - i_{*} = c - c_{*} \quad (3)$$

where i is the domestic currency interest rate for a specific period; i_{*} is the foreign currency interest rate, and c and c_{*} are the currency swap rates for the domestic and the foreign currency, respectively.

Equation (3) implies the following: If CIP holds, a bank which covers its position through currency swaps should be indifferent between borrowing in the domestic currency or in the foreign currency (i.e. US dollar for European banks). If CIP does not hold, international investors and borrowers would have an opportunity to make riskless profits through arbitrage until the cost of borrowing in domestic currency equals the cost of hedged borrowing in US dollars. Hence, CIP, in theory, should always hold.

In practice, however, CIP often does not hold. Popper (1993) and Fletcher and Taylor (1996) show that CIP in the long run holds, but only after controlling for transaction costs. They also find that deviations from CIP in the long run are larger than those in the short run. According to Munro and Wooldridge (2009), most studies investigating long run CIP show that deviations on average are small, but that episodes of large fluctuations do occur, which can be quite persistent as well. Moreover, as we discuss in section 3.4, during periods of severe financial distress, large and persistent deviations from CIP are not uncommon. This is for example reflected in large deviations from zero in cross-currency basis swap (CCBS) spreads (see Figure 3, Appendix A, for euro-US dollar CCBS spreads)[16].

Turning now to the specific explanatory variable used in this paper, covered cost savings exist if the spread between bond yields and swap rates of the domestic and the foreign currency is different from zero, i.e. when CIP does not hold (McBrady and Schill, 2007). These authors define the covered cost savings that may be obtained when borrowing as ε^{c}:

$$\varepsilon^{c} = (i - c) - (i_{*} - c_{*}) \quad (4)$$

A particular interesting situation would be the case in which the spread $(i - c)$ is larger than $(i_{*} - c_{*})$. In this case, the bank reduces its borrowing costs by ε^{c} through creating "synthetic domestic currency" debt or, in other words, by raising domestic currency-denominated debt in the swap market instead of in the cash market. For example, if the difference in Equation (4) is positive, a euro area

16. As explained in section 3.4 and in appendix B-1, CCBS spreads are a component of Equations (3) and (4).

bank could realize cost savings ε^c by issuing a US dollar-denominated bond and swap the proceeds into euros, instead of issuing directly in euros (Figure 2, Appendix A[17]). Moreover, this would be an interesting arbitrage operation for any bank, regardless of its hedging motives, to raise US dollar-denominated debt. Therefore, a positive ε^c should promote US dollar issuance, *ceteris paribus*.

Obtaining data on c is not straightforward, since it has to be built from a breakdown of different swaps. Appendix B-1 explains how data on c and c_* can be obtained, as well as which specific data are used to calculate CIP and covered cost savings. Additionally, the setting just described here is appropriate for two currencies only: The domestic currency and the US dollar as a foreign currency. As we argue in section 3.3, a multicurrency framework is useful in some cases[18].

3.2.3 EXPLOITING UIP ARBITRAGE OPPORTUNITIES: "UNCOVERED" OR "UNHEDGED" BORROWING COST SAVINGS

Uncovered cost savings arise whenever UIP does not hold. UIP assumes that risk neutral market participants will not cover themselves against currency risk, because exchange rates will adjust to the point where the interest earned on a foreign currency security is the same as that made on a domestic security. More specifically, UIP may be expressed in the following way:

$$i - i_* = S_1^e - S_0 \tag{5}$$

where S_0 is the current exchange rate (domestic currency to US dollar) and S_1^e is the expected future exchange rate when we consider one period only (T=1). However, according to most empirical studies, UIP does not hold in international markets (e.g. Mussa and Goldstein, 1993). Contrary to what UIP predicts, the lower yielding currency tends to depreciate or does not appreciate enough to counteract the gains made by the borrower in the cheaper currency. Since UIP does not hold, one would expect that a bank that issues in the low-yield currency while leaving its currency risk unhedged can make the following uncovered cost savings (Habib and Joy, 2010):

$$\varepsilon^u = (i - i_*) - (S_1^e - S_0) \tag{6}$$

Consequently, uncovered cost savings and the issuance of foreign currency denominated bonds may be positively related, especially for less risk-averse banks.

At the same time, borrowers generally may be reluctant to be exposed to exchange rate fluctuations. Hence, they may be less interested in benefiting from uncovered cost savings when compared to covered cost savings, as in the latter case they are hedged against exchange rate risk. Thus, covered cost savings potentially may have a larger direct impact on US dollar-denominated bond issuance by European banks than uncovered cost savings.

This is not to say that uncovered cost savings are not important for issuers of bonds. Investors (i.e. the buyers of the bonds) may not believe that UIP holds and thus may invest in the bonds denominated in the currency that offers the highest return. Indeed, Cohen (2005) shows that issuers cater to investors' needs and issue in the highest yielding currency, in spite of higher funding costs, because they either do not share the same beliefs as investors or are able to hedge the

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17. Notice that both Equations (3) and (4) can be seen as a replication of the total payments that a bank would face in case it raises "synthetic domestic currency" debt through the use of a fixed-for-fixed currency swap or a cross-currency swap (CCS).
18. See Appendix B-2 for more details on this.

exchange rate risk through derivatives. This could result in uncovered cost savings being associated negatively with US dollar-denominated issuance by European banks.

We calculate the interest rate differentials in UIP as the spread between the government bonds' yields to maturity of the country where each bank is headquartered and the yield to maturity of the corresponding US Treasury bond. This is the approach followed in most of the relevant literature (e.g. Cohen, 2005; McBrady and Schill, 2004 and 2007, and Siegfried et al., 2007). Hence, we assume that it is an approximation of the returns that investors could make in each domestic market. Additionally, we assume that exchange rate follow a random walk ($S_1{}^e - S_0 = 0$; see Black and Munro, 2010). This approach takes into account the difficulty of modeling exchange rate expectations, for which several approaches are available[19]. Moreover, it is unclear how spot exchange rate variations influence issuance of long-term debt instruments. For instance, one could expect that an issuer is more attracted to borrow in a weakening currency (see e.g. Shin, 2015). However, Cohen (2005) concludes that a stronger US dollar attracts bond issuance denominated in this currency by foreign companies.

Finally, to avoid endogeneity issues, we follow McBrady and Schill (2007) and Habib and Joy (2010) and consider covered and uncovered cost savings variables at the beginning of each quarter. Bank-specific variables are lagged one quarter for the same reason.

3.2.4 BANK-SPECIFIC CHARACTERISTICS

In section 2.3 we briefly reviewed some of the predictions in the existing literature about the impact of bank-specific variables on foreign currency denominated debt issuance. In this study, we specifically control for bank-specific characteristics in our regressions. In doing so, we can compare our results for these variables with those in the relevant literature.

In our paper, relative issuance, or issuance in terms of total assets, is investigated instead of absolute issuance. As a result, the size of the issuer is indirectly taken into account in the estimations. In addition, we directly control for "leverage targeting" and include the growth of total assets for each bank as a control variable, as in Van Rixtel et al. (2015).

As data on deposits and loans denominated in US dollars are not available at the individual bank level[20], the relevance of hypotheses regarding "deposit supply constraints" or "maturity matching" by banks cannot be tested directly (see Van Rixtel et al., 2015). Instead, the overall loan and deposit to assets ratios (i.e. for all loans and deposits, not only those denominated in USD) are included as explanatory variables in order to control for differences in business models and hence differences in balance sheet structures between the banks in our sample.

We will also control for the capital ratio of each bank. This ratio allows us to indirectly study the impact of leverage on US dollar-denominated debt issuance by European banks. The sign of this variable is uncertain a priori and it will be explored in the paper.

We also include the market-to-book value of equity (MTB) as an explanatory variable for the listed banks in our sample. The sign of the impact of this variable on US dollar-denominated debt issuance is not clear either and hence our approach to the expected sign of this variable is exploratory as well.

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19. See Habib and Joy (2010) for a summary of these approaches.

20. In fact, should data on loans denominated in US dollar be available for individual banks, it could be used as a proxy for total US dollar exposure instead. Regarding US dollar loan exposures of European banks, Ivashina et al. (2015) show that syndicated lending denominated in US dollar by euro area banks was reduced more than euro lending during 2011-2012.

We also include a dummy variable which takes the value of one when a European bank owns a banking office in the US and zero otherwise. As with other variables, the impact of having bank representation in the US on US dollar-denominated debt issuance is not clear, although arguments in favor of a positive impact on US dollar issuance seem stronger.

In addition, in order to further control for information asymmetries and creditworthiness of firms, the regressions will also include the credit rating of the issuing banks (as in Kedia and Mozumdar, 2003)[21].

Panel B in Table 2 presents some descriptive statistics for these and other independent variables. The bank-specific variables depict considerable heterogeneity across banks, both in terms of size and funding structures. The biggest bank has assets of more than €2.5 trillion, which is almost 500 times larger than the size of the smallest bank. The average deposits to assets ratio is around one third with a large dispersion (between minimum of 0.01 % and maximum of 82%). The mean capital ratio is over 4%, ranging between a maximum of around 15% and a minimum of -0.4%[22]. Finally, the mean rating is 16, which implies A+ in Fitch and S&P and A1 in Moody's. The lowest rating is 4 (CCC+ or Caa1) for Alpha Bank. The highest rating is 20 (AAA or Aaa) and was obtained by three banks (Hypo Tirol Bank, Oberoesterreichische Landesbank and Rabobank).

3.3 Development of US dollar-denominated long-term debt issuance by European banks

The absolute amount of US dollar-denominated bonds issued by the banks in our sample steadily increased between 1999 and 2007. With the aggravation of the global financial crisis in September 2008, both relative and absolute US dollar issuance by these banks retrenched significantly and recorded a historical low of 2% of their total bond issuance. However, US dollar bank debt exploded afterwards, peaking between the second half of 2010 and first quarter of 2011 (18% of total issuance and $46,271 million). It fell significantly again during specific episodes of the euro area financial crisis (particularly, in the third quarter of 2011 and second quarter of 2012), amid high quarterly volatility. US dollar issuance peaked again in relative terms by the end of the sample period (23% in the fourth quarter of 2012) and stabilized afterwards (Figure 4.a in Appendix A).

By country, the UK has been the single largest issuer of US dollar bonds (representing around one third of total US dollar issuance on average), followed by Germany, the Netherlands and Switzerland. In the euro area, Germany was the largest issuer of US dollar bonds before the crisis. After 2008, however, the largest issuers were the Netherlands and France (Figure 4.b, Appendix A). The reduction in the dominance of Germany was in line with the decline in total bond issuance activity of German banks, and followed the abolishment of government guarantees for the Landesbanken in 2005 as well as the bankruptcies of some German banks in 2007-2009 (Van Rixtel et al., 2015). In consequence, the share of euro area core countries[23] in total US dollar bond issuance by the banks in our sample fell significantly after the third quarter of 2008 whereas the share of peripheral countries[24] increased slightly, mainly driven by the two Spanish banks in the sample (Banco Santander and BBVA). The latter finding contrasts with the decline in total issuance (in all currencies) by peripheral banks during the same period.

The main driver of the surge in US dollar-denominated debt issuance was the increase in Yankee issues (Figure 5.a, Appendix A). The proportion of Yankee issuance to total US dollar debt

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21. For more details on these variables, see Table 1 in Appendix A.

22. Negative capital ratios were recorded for Hypo Real Estate Holdings in the fourth quarter of 2008 and first quarter of 2009. It became a fully owned subsidiary of the German Special Financial Market Stabilization Fund (SoFFin) in 2009, after receiving large sums of capital and liquidity public support.

23. Core euro area countries in this paper are Austria, Belgium, Germany, France, Luxembourg and the Netherlands.

24. Peripheral euro area countries in this study are Spain, Italy, Ireland, Portugal and Greece.

issued increased from 56% between 2005 and 2007 to more than 67% after 2008. Moreover, a significant amount of US marketed debt was launched in the format of 144A compliant bonds. The increase in Yankee bond issuance was not only a European bank phenomenon. According to market reports, many issuers from other countries and from other sectors also jumped to the US market, even when many of these companies had no operational link with the US (e.g. Avery, 2011; BNP Paribas, 2012; Standard and Poor's, 2013 and ABN Amro, 2014).

Our data also allow for an investigation of the overall currency composition of total bond issuance by the banks in our sample between 2005 and 2013. Figure 5.b in Appendix A shows that euro area banks primarily issued either in euros or in US dollars. In contrast, only 53% and 46% of bonds issued by British and Swiss banks, respectively, were denominated either in domestic currency or in US dollars, on average. In both countries, the weight of the euro as a foreign currency was particularly important[25]. In order to take into account the significant role of the euro in British and Swiss banks' funding activity, we use the multicurrency framework (see Equations (13) and (14) in Appendix B-2) for the calculation of CIP and UIP for Swiss and British banks in most of our regressions.

3.4 Evolution of covered cost savings

To better understand what actually drove covered cost savings during our sample period, we rewrite Equation (4) as follows:

$$\varepsilon^{C} = (i - i_{*}) - (c - c_{*}) = (i - i_{\$}) - (Z - Z_{\$}) - \alpha \qquad (7)$$

The first term in brackets represents interest rate differentials. If issuing in US dollars $(i_{\$})$ is cheaper and/or issuing in the domestic currency is more expensive (i), issuance of "synthetic domestic currency" debt will generate cost savings, ceteris paribus. The second term in brackets is the difference between the domestic currency (Z) and the US dollar interest rate swap (IRS) rates $(Z_{\$})$. If the US dollar IRS rate increases and/or the domestic currency IRS rate decreases, savings obtained by issuing "synthetic domestic currency" debt increase, everything else constant. This is so because the European bank will either receive more or pay less in the currency swap (as in Figure 2, Appendix A). Hence, if the cross-currency basis swap (CCBS) spread (α) decreases or turns more negative, then covered cost savings increase, ceteris paribus. These three components are depicted separately in Figure 6.a in Appendix A.

In the following analysis of the actual development of covered cost savings we concentrate on euro area banks, as they constitute the bulk of the banks in our sample. The evolution of covered cost savings for euro area banks can be divided into three different periods (Figure 6.b, Appendix A). In the first period, between 2005 and the end of 2007 (the "pre-crisis" period), covered cost savings were negative but relatively close to zero. In this phase, α was almost zero, funding in US dollars was more expensive than funding in euros, while the US dollar IRS rate was higher than the corresponding euro rate. As the latter two components balanced each other more or less out, covered cost savings were relatively flat.

The second period starts at the end of 2007 and lasts until the end of 2010, approximately. These three years roughly coincide with the global financial crisis and the beginning of the euro area financial crisis and were characterized by substantial negative covered cost savings. The CCBS spread turned negative and reached a historical record low immediately after the fall of Lehman Brothers. Normally, a negative CCBS spread would have turned covered savings positive, but the latter fell into

25. ECB (2011) shows that large British and Swiss banks are among the top foreign issuers of debt denominated in euros.

negative territory, due to the interaction and size of the differentials between IRS rates and interest rates. More specifically, from mid-2008 onwards, funding in US dollars relative to euros became even more expensive than before and, this time, the IRS rate differential was not acting as a counterbalance. On the contrary, IRS rates drove covered cost savings even more into negative territory because now $Z > Z_{\$}$.

Why was the euro IRS rate larger than the US dollar IRS rate? IRS rates can be decomposed into two components: A Treasury bond yield and a spread (the "IRS spread" from now on). When examining these two components separately, it can be inferred that between 2007 and mid- 2010, the euro IRS spread tended to be lower than the US dollar IRS spread, although the difference shrank over time. Hence, the positive difference between the IRS rates of these two currency areas was mainly driven by the difference between government bond yields: Yields of European government bonds were higher than US Treasury yields until the end of 2009 and this (and not IRS spreads) drove the positive IRS differential ($Z > Z_{\$}$) during most part of this period. Relatively low US Treasury yields were associated with the expansionary monetary policy stance of the Fed coupled with safe-haven flows into US government bonds.

Given the importance of IRS spreads in the development of covered cost savings, we explore these spreads in more detail. IRS spreads are affected by the default risk in interbank markets, by the shape of the yield curve, by the cost of financial intermediation, by the supply of corporate debt and by counterparty default risk; moreover, the importance of these factors is time-varying (Brown, Harlow and Smith, 1994 and Apedjinou, 2003). More specifically, if we assume that IRS spreads mostly reflect the creditworthiness of the major swap providers or the banks belonging to the US dollar LIBOR and EURIBOR panels, then IRS spread differentials could reflect until mid-2010 the higher creditworthiness of EURIBOR banks versus US dollar LIBOR banks (Remolona and Wooldridge, 2003 and PIMCO, 2008). However, it has been highlighted in the literature that one factor explaining deviations from (short-term) CIP during the crisis was precisely the increase of default premia of European banks relative to US banks (see below), at least with respect to borrowing in US dollars. Therefore, other factors could have driven the IRS spread differential between these two currency areas instead. Explaining with more precision which were the main drivers of the IRS swap rates during the crisis is beyond the scope of this paper.

The third and final period spans the end of 2010 until the first quarter of 2013 (i.e. the end of our sample period). It was characterized by frequent bouts of positive covered cost savings, as well as by the worsening of the euro area financial crisis. Wholesale funding in euros became more expensive than that in US dollars in this period. Indeed, the euro area sovereign tensions, their spillover to the banking sector, financial fragmentation and tail risks of disintegration of the euro area, especially at the end of 2011 and in the summer of 2012, increased euro area market yields relative to US dollar yields. Moreover, funding markets closed completely for some banks and reduced issuance in euros (ECB, 2013). Additionally, IRS rates differentials continued being positive, at least until the first quarter of 2012. This time, the euro IRS spread was clearly higher than the US dollar IRS spread. Similar to the pre-crisis period, the IRS and interest rate differentials were cancelling each other out. As a result, the negative CCBS spread remained as the main driver of the positive covered cost savings during the third period.

Finally, deviations from CIP were also very large for the British pound and Swiss Franc. For illustrative purposes, Figures 6.c and d (Appendix A) show the evolution of covered cost savings for the Swiss franc, the British pound and the relative US dollar issuance of Swiss and British banks.

Given the development of covered cost savings in the currency areas considered, a question that follows is what caused the deviations from CIP as reflected in the negative CCBS spreads and why were they not corrected through arbitrage. Some papers study in detail what drove short-term CIP deviations during the crises of 2008 and 2012. Some of the reasons for CIP deviations mentioned in these studies are: The increase in the credit default premium of European banks relative to US banks; the drought in US dollar short-term markets in 2007-2008; US dollar shortage in bank funding markets during the financial crises of 2008 and 2012; the misreporting of LIBOR rates; and related problems to arbitrage deviations from CIP (see Amatatsu and Baba, 2008; Baba, Packer and Nagano, 2008; Coeffey, Hrung and Sarkar, 2009; BIS, 2010; Moody's, 2011 and Bottazzi, Luque, Pascoa and Sundaresan, 2011 and 2013)[26]. Even though these studies concentrate on short-term CIP, their insights are still valuable for the long-run. For instance, Baba et al. (2008) argue (based on Granger causality tests) that deviations from short-term CIP spilled over to cross-currency basis swaps when European institutions realized that funding pressures could last for a long period. That was the time when they turned from short-term FX swaps to longer-term US dollar funding through cross-currency basis swaps (see also Moody's, 2011). This is visible in Figure 3, Appendix A, according to which the trough of the five year (euro-US dollar) CCBS spreads coincided with the lows of the CCBS spreads with shorter tenors, particularly in 2008.

More recently, CCBS spreads have turned negative again, particularly since 2015. Contrary to CIP deviations during the 2008 and 2012 crises, the renewed CCBS spread widening occurs at a time with no apparent bank funding or liquidity distress (Figure 3, Appendix A). Therefore, other drivers have been cited, such as regulatory reforms hampering CIP arbitrage or divergent monetary policies between the US and the euro area. For a review of these drivers, see e.g. BIS (2015), Barclays (2015) and Nomura (2015).

26. The aim of this paper is not to investigate the drivers of CIP deviations. CIP deviations, as reflected in very negative CCBS spreads in 2008 and 2012, are taken as a *fait accompli*.

4 Empirical methodology

As we have argued, US dollar-denominated debt issuance can be motivated by many factors. The theoretical and empirical literature reviewed in previous sections, which is concentrated on non-financial corporations, points at hedging, opportunistic or strategic considerations as the main motivations, among others, for debt issuance denominated in foreign currency. Additionally, characteristics specific to banks which are the subject of our study, as well as financial market and macroeconomic variables should be considered as well. Hence, a multivariate econometric analysis is needed to disentangle the impact of these factors on the choice for US dollar and Yankee issuance by European banks. This section presents the empirical strategy used to estimate and asses these impacts.

Both US dollar and Yankee issuance observations are continuous variables that take the value zero in some quarters and a wide range of positive values in others. These dependent variables can be further characterized as describing the observed choice made by a particular bank after solving an optimization problem. For some of these banks the optimization will result in choosing not to issue a US dollar-denominated bond in a certain quarter. This kind of response variable is a corner solution outcome (Wooldridge, 2002) and a censored regression or Tobit model is the approach that best handles this situation. The corner solution and the censoring situations lead to the same Maximum Likelihood estimator and the Tobit model is useful for both cases (Baum, 2006).

A Tobit model in a panel data setting can be formalized in terms of a latent variable as follows (Verbeek, 2012):

$$y^*_{i,t} = x'_{i,t}\beta + \alpha_i + u_{i,t}, \text{ where } i = 1,2,\ldots,N;\ t = 1,2,\ldots,T \tag{8a}$$

$$y_{i,t} = y^*_{i,t} \quad \text{if } y^*_{i,t} > 0 \tag{8b}$$

$$y_{i,t} = 0 \quad \text{if } y^*_{i,t} \leq 0 \tag{8c}$$

where $y_{i,t}$ is the dependent variable, $y^*_{i,t}$ is the latent variable observed only when being positive, $x'_{i,t}$ is a vector of independent variables, $\boldsymbol{\beta}$ is a vector of unknown coefficients, and α_i and $u_{i,t}$, are independent and identically normally distributed, independent of $x_{i,1},\ldots,\ x_{i,T}$ with zero means and variances $\sigma^2_{\propto}$ and σ^2_u, respectively. The parameters $\boldsymbol{\beta}$ can be interpreted as both the impact of a change of the independent variable on the probability of non-zero issuance and as the impact of a change of the independent variable on the amount of issuance. Both will have the same sign[27]. This notwithstanding, non-linear models estimated parameters do not reflect the real change of the dependent variable when the independent variables change by one unit. That said, signs are informative enough to gauge the direction of the impact of each explanatory variable on US dollar and Yankee issuance.

The presence of the individual effects α_i makes the estimation of non-linear models complicated due to the incidental parameter problem. The incidental parameter problem will prompt inconsistent estimates of $\boldsymbol{\beta}$ and α_i, provided that T does not go to infinity. Hence, an alternative estimation approach is required. The usual solution is to maximize a "conditional likelihood function"

27. For the sake of simplicity, when explaining the results in section 5, we do this in terms of the likelihood or probability of US dollar issuance.

based upon β and a sufficient statistic of α_i. The lack of a sufficient statistic of the fixed individual effects makes it impossible to estimate both Probit and Tobit models in fixed effects. Hence, the Tobit model in a panel setup such as used in our study will be a random-effects model.

More specifically, the dependent variable is a function of the following explanatory variables:

$$\text{USD ISSUANCE}_{it} = f(\text{COVERED Cost}_{rt}, \text{UNCOVERED Cost}_{jt}, \text{USD Exp}_{jt-1}, \text{USD Liq}_{t-1}, \text{FINANCIAL GENERAL}_{t}, \text{MACRO-FINANCIAL COUNTRY}_{jt}, \text{BANKSPEC}_{i,t-1}, \lambda_j, \mu_{year}) \quad (9)$$

where "USD ISSUANCE$_{it}$" is the total amount of bonds denominated in US dollars issued by bank *i* in quarter *t*. For Yankee bond specifications, "YANKEE ISSUANCE$_{it}$" is defined as the total amount of Yankee bonds issued by bank *i* in quarter *t*. Both dependent variables are scaled by total assets of bank *i* in quarter *t*. "COVERED Cost$_{rt}$" are covered cost savings, which in most specifications are different for the euro and non-euro countries (*r*) and by quarter *t*. "UNCOVERED Cost$_{jt}$" are uncovered cost savings, which vary by country *j* (but not for Switzerland and the UK, in the multi-currency framework[28]) and by quarter *t*. "USD Exp$_{jt-1}$" are the US dollar exposures or claims denominated in US dollars of banks, while "USD Liq$_{t-1}$" is total liquidity of US dollar market, defined as the proportion of bond issues denominated in US dollars over issuance in all currencies worldwide (for USD ISSUANCE$_{it}$) or the proportion of Yankees over total US dollar issuance (for YANKEE ISSUANCE$_{it}$). "USD Exp$_{jt-1}$" changes by country *j* and time *t-1*, whereas "USD Liq$_{t-1}$" is only time variant. "FINANCIAL GENERAL$_t$" include two time variant indicators of financial market conditions or proxies for financial market tensions: The US dollar LIBOR-OIS spread and the European stock market volatility VSTOXX. "MACRO-FINANCIAL COUNTRY$_{jt}$" includes a set of time variant macroeconomic variables related to each country *j*, such as sovereign CDS spreads and GDP growth. "BANKSPEC$_{i,t-1}$" is a group of time variant characteristics specific to each bank *i*. Following the convention in the literature, firm characteristics enter the regression with their values in the previous quarter to *t*, in order to avoid endogeneity and inconsistency of the estimators (see Van Rixtel et al., 2015). Finally, λ_j and μ_{year} are country and year fixed effects, respectively, and are used whenever possible so that issuance of US dollars cannot be attributed to any differences across countries or years.

28. See appendix B-2 for more details on this.

5 Results

5.1 Results for US Dollar issuance

Table 3 in Appendix A presents panel Tobit estimations for the ratio of total US dollar issuance of bank *i* to its assets as the dependent variable (USD $ISSUANCE_{it}$).

The first and second columns of Table 3 show the results for the main direct drivers of US dollar issuance. In both columns, the covered cost savings' coefficients (*COVERED* $Cost_{rt}$) are positive and significant, meaning that the increase in covered cost savings increases the probability of issuance of bonds denominated in US dollars by European banks. This suggests that European banks issued "synthetic domestic currency" debt in order to reduce funding costs, even when there was no operational link to the US. In other words, European banks acted opportunistically when choosing to issue in US dollars and made an opportunistic use of derivatives to hedge the associated exchange rate risk. This coincides with most of the anecdotal evidence suggesting that opportunistic motivations were behind the strong increase of US dollar-denominated bond issuance during the crisis (see several market reports). The significance of this variable remains in the 1% and 5% range even when more explanatory variables are added.

For uncovered cost savings (*UNCOVERED* $Cost_{jt}$), the results are somewhat less clear. Except in columns (5) and (6), we do not find strong statistical significance for the uncovered interest rates differential variable. This result suggests that European banks, when they decided to issue in an unhedged fashion, they preferred to do so in the lower yielding currency. In conclusion, even when we find support for the hypothesis of uncovered cost savings driving US dollar issuance, the evidence is significantly less robust than for covered cost savings.

The US dollar exposure variable (*USD* Exp_{jt-1}) is positive and significant in almost all regressions. This implies that natural or on-balance sheet hedging and currency risk management were important reasons to issue debt in US dollars for European banks, as most of the literature suggests for non-financial firms. This notwithstanding, it is necessary to interpret this result carefully, given the rough proxy for US dollar exposures that we use here. As for the strategic motivation, our proxy for liquidity of US dollar markets (*USD* Liq_{t-1}) is positive and significant, but only in some cases, and then only at the 10% level. Hence, there is only limited evidence of lower transaction costs in US dollar markets stimulating the issuance in this currency[29].

In columns (3) and (4) of Table 3, we add the US dollar LIBOR-OIS spread (*LIBOR* OIS_{USDt}) as a control for financial market conditions (FINANCIAL $GENERAL_t$ in Equation (9)). As expected, a wider US dollar LIBOR-OIS spread significantly lowers the probability of issuing in US dollars in almost all specifications. Market intelligence in recent years has suggested that US dollar markets have been an alternative to domestic debt markets for European issuers during various episodes of severe financial stress (such during some of the most severe stressful periods of the euro area financial crisis in 2011 and 2012). However, the results presented in Table 3 show that US dollar markets were not immune to financial market distress either[30].

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29. With the goal of further analyzing this hypothesis, we will explore alternative measures of liquidity of US dollar markets in a future version of this paper.

30. In addition, the US dollar LIBOR-OIS spread is an indicator of "illiquidity waves" in the US interbank markets during the global financial crisis (Sengupta and Man Tam, 2008). Hence, the US dollar LIBOR-OIS spread may be considered as an additional proxy for liquidity of US dollar markets. These variables (USD Liq_{t-1} in Table 3 and LIBOR OIS_{USDt}) are negatively and significantly correlated (correlations not shown).

In columns (3) and (4) we also add two controls for country-specific macroeconomic conditions (MACRO-FINANCIAL $COUNTRY_{jt}$ in Equation (9)): The home country GDP (GDP_{jt}) and the sovereign CDS spreads ($CDS\ SOV_{jt}$). The coefficients of these two variables are not statistically significant. Van Rixtel et al. (2015) find that sovereign CDS spreads were negatively associated with long-term debt issuance for a similar sample of banks to the one used here. Our results suggest that US dollar issuance activity by European banks may have been less affected by sovereign woes than, for example, issuance of bonds denominated in the domestic currencies.

Finally, columns (5) and (6) of Table 3 add bank-specific controls ($BANKSPEC_{i,t-1}$ in Equation (9)). Column (5) includes the whole set of banks of our sample[31] whereas column (6) only includes listed banks. The positive and significant coefficient of total assets' growth ($GR\ TA_{it-1}$) in both specifications confirms the importance of "leverage targeting". This is so in spite of considering only US dollar issuance instead of total bonds denominated in all currencies, as in Van rixtel et al. (2015). Furthermore, banks' credit ratings ($RATING\ AV_{it-1}$) and a bank subsidiary in the US ($SUBS_{it-1}$) are positively and significantly associated with total US dollar-denominated bond issuance. Hence, European banks that were perceived as more risky could have faced more information asymmetries and, hence, issued less US dollar-denominated debt than higher rated banks and/or banks with presence in the US.

Our results indicate that the balance sheet structure of banks is a relevant driver of US dollar issuance. The coefficient of the deposit ratio ($D\ TA_{it-1}$) is negative and significant, supporting the hypothesis that less sophisticated, retail oriented European banks issued less debt denominated in US dollars. Likewise, the coefficient of the loan ratio ($L\ TA_{it-1}$) is positive and significant (at 10%). However, the coefficients of the capital ratio ($K\ TA_{it-1}$) and market-to-book value of equity (MTB_{it-1}) are not significant. Finally, Table 3 shows that the coefficient of the US dollar LIBOR-OIS spread is not significant in the subsample of listed banks in column (6). This suggests that this type of banks was more resistant to market distress during our sample period. Alternatively, part of this distress may be captured by the market-to-book value of equity, which incorporates market equity prices in its construction.

5.2 Results for Yankee issuance

Table 4 in Appendix A shows our results for Yankee issuance of bank *i* to its assets as the dependent variable (YANKEE $ISSUANCE_{it}$). Columns (1) to (4) of Table 4 include the direct drivers of US dollar issuance as well as our financial and macroeconomic conditions' controls (FINANCIAL $GENERAL_t$ and MACRO-FINANCIAL $COUNTRY_{jt}$ in Equation (9)). The positive and significant coefficient of covered cost savings ($COVERED\ Cost_{rt}$) provides support to the hypothesis that Yankee bond issuance was driven by opportunistic reasons. Hence, European banks used the US market to issue "synthetic domestic currency" debt to save in covered funding costs, in spite of the different regulatory requirements for US marketed issues vis-à-vis Eurodollar bonds. The coefficients on uncovered cost savings ($UNCOVERED\ Cost_{jt}$) are never significant, which suggests that deviations from UIP were less relevant for the issuance of Yankees than deviations from CIP. The coefficient of the US dollar exposure variable ($USD\ Exp_{jt-1}$) is not significantly related to Yankee debt either. Thus, European banks did not issue in the US with the aim of hedging the exchange-rate risk of their assets. If compliance and registering costs were higher in the US than in the Eurodollar market during the sample period, then European banks could have opted for the latter market to

31. Two banks are excluded in column (5) due to missing data for one or more explanatory variables: Groupe Caisse d' Epargne and Banque et Caisse d'Epargne de l'Etat Luxembourg.

match the currency of their assets and liabilities[32]. The coefficient for liquidity (*USD* Liq_{t-1}) is not significant either. As explained in section 5.1, evidence supporting the "strategic" hypothesis is relatively weak.

Given that Yankees are marketed in the US, we incorporate the US GDP growth rate (GDP_{USt}) as an additional explanatory variable[33]. The negative and significant sign of this variable in columns (5) and (6) of Table 4 suggests that when the US grew less or was in recession, the probability of Yankee issuance by European banks increased. This could be explained following McBrady et al. (2010), according to whom companies hedge more when the economy associated with that currency suffers an economic shock. Hence, it seems that European banks saw greater need to hedge when the US economy slowed or entered into recession.

The coefficient on the US dollar LIBOR-OIS spread (*LIBOR* OIS_{USDt}) is negative but only significant in column (4)[34]. A better proxy for financial market conditions when Yankee debt issuance is used as the dependent variable is stock market volatility ($VSTOXX_t$). The latter has a negative and significant impact on the likelihood of Yankee issuance by European banks. Thus, even when the US domestic markets could have acted as a shelter for European banks in times of high market distress, Yankee issuance was not completely immune to volatile market conditions.

Columns (5) and (6) of Table 4 add bank-specific variables ($BANKSPEC_{i,t-1}$ in Equation (9)). As in Table 3, column (6) only includes listed banks. Only three bank-specific variables are significantly associated with Yankee debt issuance by European banks. These are total assets' growth (*GR* TA_{it-1}), a bank subsidiary in the US ($SUBS_{it-1}$) and the market-to-book value of equity (MTB_{it-1}). The coefficients of the first two have the expected sign. Interestingly, the coefficient of the market-to-book value is now significantly negative (at 10%). This is in line with the results of Allayannis et al. (2003) and with the sign predicted for this variable by the agency cost theories. However, another proxy for information asymmetries, banks' credit ratings (*RATING* AV_{it-1}), is not significantly associated with Yankee issuance. In contrast to the results for total US dollar debt issuance, the coefficients of the deposit ratio (*D* TA_{it-1}) and the loan ratio (*L* TA_{it-1}) are never significant drivers of Yankee issuance.

5.3 Results for total US Dollar issuance in the pre-crisis and crisis Period

In Table 5 we divide the sample between the pre-crisis period (columns (1) and (3)) and the crisis period (columns (2) and (4)). We then repeat the regressions for total US dollar issuance (USD $ISSUANCE_{it}$) based on the set of explanatory variables used in column (5) of Table 3. We also show the results for all countries of our sample (columns (1) and (2)) as well as for the subsample of euro area countries (columns (3) and (4)). Macroeconomic and financial market conditions were very different for the pre-crisis and crisis period. Moreover, the impact of financial and macroeconomic conditions on US dollar issuance could have been different for countries inside the euro area and for those outside, particularly during the euro area financial crisis. Hence, regressions for these two periods and for these two country areas are conducted separately; their results are shown in Table 5[35].

The following results stand out. First, covered cost savings (*COVERED* $Cost_{rt}$) are positively and significantly associated with US dollar bond issuance, but only in the crisis period. This result suggests that European banks arbitraged CIP deviations through the issuance of "synthetic domestic

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32. When country dummies are removed from the regressions, the US dollar exposure variable is positive and significant at the 5%-10% level (results not shown). Therefore, as explained in section 5.1, results related to the hedging hypothesis have to be interpreted carefully.

33. This variable is generally not significant when total US dollar issuance is the dependent variable.

34. This variable is not significant either when bank-specific variables are included (results not shown).

35. The number of observations for the two periods considered decreased considerably. Hence, the findings in Table 5 should be interpreted with caution.

currency" debt, but only when these deviations were large enough to generate substantial covered cost savings. In the same vein, Barclays (2015) concludes that "tactical" cross-border issuance took place in 2014-2015 only when the "funding cost differential (post-swap) reached circa 10 bp" (p. 7). Second, the coefficient of uncovered cost savings ($UNCOVERED\ Cost_{jt}$) is positive and significant only in the crisis period and for the euro area countries. Uncovered cost savings were larger during the crisis period, particularly for some euro area countries, for which government bond yields were substantially higher than the US Treasury bond yields. Hence, larger uncovered cost savings had a positive impact on the likelihood of US dollar-denominated debt issuance in the crisis period, but evidence is weaker than for covered cost savings. Third, stock market volatility ($VSTOXX_t$) was negatively and significantly related to US dollar-denominated bond issuance by euro area banks in the crisis period. Hence, this variable is only significant for the crisis period, when volatility was unusually high[36]. Fourth, the coefficient of the US dollar exposure variable ($USD\ Exp_{jt-1}$) is never significant[37], whereas there is certain evidence (at 10%) supporting the hypothesis of "strategic" issuance of US dollar-denominated debt in the crisis period ($USD\ Liq_{t-1}$). Fifth, our proxy for the ECB covered bond purchase program ($CBPP_t$) is negatively and significantly associated with US dollar issuance by euro area banks (at 10%)[38]. Van Rixtel et al. (2015) and Beirne et al. (2011) provide evidence of the success of this programme in stimulating covered bond issuance in the euro area. Our results suggest that, given that only euro denominated covered bonds were eligible for purchase, this programme may have reduced the need to issue bonds denominated in US dollars by banks from the euro area.

Finally, the coefficients of total assets' growth ($GR\ TA_{it-1}$), bank subsidiary in the US ($SUBS_{it-1}$) and banks' credit ratings ($RATING\ AV_{it-1}$) are (generally) significantly positive for both periods. The latter result shows that, in spite of the high financial tensions of the crisis period, banks perceived as stronger by investors had better access to US dollar markets than weaker banks. Moreover, the fact that the latter banks issued less US dollar-denominated debt could explain why deviations from CIP persisted for so long: A massive issuance of "synthetic domestic currency" debt could have quickly reduced the CCBS spreads back to zero through the increase of the amount of US dollars available for swap lending, *ceteris paribus*[39]. Finally, some proxies for the balance sheet structure of banks ($D\ TA_{it-1}$ and $L\ TA_{it-1}$) are significant (with the expected sign), but only in the pre-crisis period[40]. Hence, this result suggests that only the bank-specific characteristics related to the bank financial strength were relevant for US dollar issuance during the crisis period.

5.4 Robustness tests

5.4.1 FIXED-EFFECTS LOGIT ESTIMATIONS

The results shown in sections 5.1, 5.2 and 5.3 are based on Tobit estimations and, therefore, they are calculated following a random-effects setup. In such a framework, results are consistent as long as the bank-specific fixed effects, α_i, and other independent variables, $x'_{i,t}$, are uncorrelated.

Of course, we could think of some unobserved but important bank-specific effects for our dependent variable that are potentially correlated with the observed independent variables. For instance, the managers' ability of a certain bank cannot be properly measured and may have an impact on e.g. the capital ratio of a bank or its total assets' growth. In order to control for these bank-specific effects, we present additional estimations for total US dollar and Yankee bond issuance based on a fixed-effect Logit model. In this model, total US dollar-denominated debt issuance or Yankee

36. VSTOXX is also negative and significant in the crisis period when used for the whole sample of banks.

37. As in Table 4, significance of US dollar exposure in the crisis period is at the 10% level when country dummies are removed.

38. The first purchase programme (CBPP1) took place between May 2009 and June 2010 and the second (CBPP2) between November 2011 and October 2012.

39. Of course, other market participants may be involved in the arbitrage of CIP deviations.

40. However, the coefficient of the capital ratio ($K\ TA_{it-1}$) is negative and significant (at 10%) in the crisis period for euro area banks.

issuance are binary response variables taking only two values: One when a bank issues, and zero otherwise. Any binary choice model can be formulated as follows:

$$y^*_{i,t} = x'_{i,t}\beta + \alpha_i + u_{i,t}, \text{ where } i = 1,2,\ldots,N;\ t = 1,2,\ldots,T \quad (10a)$$

$$y_{i,t} = 1 \text{ if } y^*_{i,t} > 0 \quad (10b)$$

$$y_{i,t} = 0 \text{ if } y^*_{i,t} \leq 0 \quad (10c)$$

Where the error term $u_{i,t,}$ is identically and independently distributed across individual banks and time, is independent of $x'_{i,S}$ and follows a certain distribution function F (logistic in this case). The big advantage of controlling for omitted variable bias[41] with the fixed-effects Logit estimation comes at a cost. Fixed-effect estimators only exploit the within information of the data, which implies that those banks that never issued in US dollars or those that issued in all quarters are discarded for the estimation. This leads to a significantly lower number of observations, particularly in the case of Yankee issuance. Additionally, fixed-effects estimated parameters are less efficient than random effect parameters and, as in all binary choice models, the information on how much a bank issues is discarded. The latter is particularly problematic in the case of total US dollar issuance.

Table 6 shows our findings for the fixed-effect Logit estimations of US dollar-denominated bond issuance (USD ISSUANCE$_{it}$). The positive and significant coefficient of covered cost savings (*COVERED Cost$_{rt}$*) in almost all specifications provides additional support for the hypothesis of opportunistic issuance of US dollar-denominated bonds by the banks in our sample. Furthermore, uncovered cost savings (*UNCOVERED Cost$_{jt}$*) are positive and significant only in some specifications, which confirms the lower importance of uncovered US dollar bond issuance by European banks. The on-balance sheet hedging hypothesis finds support in the overall positive and significant (at 1%) coefficients on the US dollar exposure variable (*USD Exp$_{jt-1}$*). As in our main results of section 5.1, evidence supporting the "strategic" motivation for US dollar-denominated debt issuance (*USD Liq$_{t-1}$*) is somewhat weaker.

The sign and significance of the coefficients for our control variables for financial and macroeconomic conditions is similar to our results in section 5.1 (FINANCIAL GENERAL$_t$ and MACRO-FINANCIAL COUNTRY$_{jt}$ in Equation (9)). However, this time we find some evidence on the coefficients of higher sovereign CDS spreads (*CDS SOV$_{jt}$*) negatively and significantly affecting US dollar-denominated debt issuance (column (3)). Finally, for the bank-specific explanatory variables, only total assets' growth (*GR TA$_{it-1}$*) and banks' credit ratings (*RATING AV$_{it-1}$*) are positive and significant[42].

Table 7 presents the results for the fixed-effect Logit estimations of Yankee bonds (YANKEE ISSUANCE$_{it}$). The most important difference with respect to the results in Table 4 is in the coefficient of the banks' credit ratings variable (*RATING AV$_{it-1}$*), which is now negative and significant. This suggests that financially weaker European banks may have had better access to Yankee markets than the stronger ones, in spite of the potential higher information asymmetries of the first. Some market reports confirm this result. For example, Standard and Poor's (2013) argue that lower rated issuers were able to tap Yankee markets in 2012 given "easier deal execution if the European market is shut"

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41. For Logit estimations, results are reported with robust standard errors, which are equivalent here to clustering standard errors by banking group.

42. The lower significance of the coefficients of other bank-specific variables may be related to the loss of observations in the Logit estimations. See footnote 43.

(p. 8). In consequence, banks perceived as financially weak (i.e. with a low rating) could have issued in the US whenever European markets were closed for them due to high financial stress[43].

5.4.2 ALTERNATIVE DEFINITIONS OF COVERED AND UNCOVERED COST SAVINGS AND IMPORTANCE OF REDEMPTIONS

In this section, we provide additional Tobit estimations of total US dollar-denominated bond issuance ($USD\ ISSUANCE_{it}$) based on alternative indices for the interest rates of covered cost savings in a two-currency framework, as in Equations (4) and (6)[44] (columns (1) to (3) of Table 8). We also add US dollar-denominated debt redemptions as an additional explanatory variable to the baseline regression (column (4) of Table 8).

In column (1) of Table 8 we estimate the significance of covered cost savings using as an alternative the Bank of America Merrill Lynch (BofAML) Eurodollar banking index for the foreign currency interest rate (i_*) (see Equation (4)). The coefficient of covered cost savings (*COVERED* $Cost_{rt}$) in column (1) is still positively and significantly associated with total US dollar debt issuance. In column (2) of Table 8, the covered cost savings' domestic interest rate (i) is based on a subsample of bonds denominated in euros, issued by euro area banks and with an original maturity between 5 and 10 years. Likewise, the US dollar interest rate (i_*) is calculated from a subsample of US dollar-denominated bonds, issued in the US domestic market by euro area banks and with an original maturity from 5 to 10 years[45]. The results of column (2) still provide support for the opportunistic issuance of US dollar-denominated bond issuance, although at the 10% level for the covered cost savings.

The multicurrency definition of covered and uncovered cost savings (see Appendix B-2) used for Tables 1 to 7 can be defined in different ways[46]. Therefore, as a robustness check, column (3) of Table 8 shows the results for the two-currency model while using the same interest rates for covered and uncovered costs savings as in Tables 1 to 7. The results obtained in column (3) of Table 8 are very similar to our findings in previous sections. Interestingly, the coefficient of uncovered cost savings (*UNCOVERED* $Cost_{jt}$) in columns (1) to (3) is always positive and significant (at 1%). In a two-currency setting, uncovered cost savings are the specific government bond yield spreads of the country where a bank is headquartered with respect to the US Treasury bond, also for Switzerland and the United Kingdom. Hence, uncovered cost savings in Table 8 are fully capturing the specific country premium for individual European banks.

Finally, column (4) in Table 8 adds total US dollar-denominated debt redemptions as an explanatory variable, while defining the rest of the variables as in section 5.1. Van Rixtel et al. (2015) find evidence of the "roll-over" hypothesis for a sample of banks very similar to ours. According to this hypothesis, bond redemptions are positively correlated to total bond issuance by banks. Hence, the willingness of bank *i* to replace US dollar debt maturing in a specific quarter *t*, may increase its US dollar bond issuance for that quarter *t*, *ceteris paribus*. However, the exact amount of US dollar-denominated debt redeemed by each bank *i* in each quarter *t* is not known. Our proxy for US dollar bond redemptions ($MAT_{i,t-1}$) is based on the original maturity at the moment of issuance of US dollar-

43. Alternatively, the negative and significant sign of the banks' credit ratings could be the result of the loss of more than 30 banks with no within variation in Yankee issuance. The number of banks excluded in the fixed-effects Logit estimations of total US dollar-denominated bonds is significantly less (11 groups).

44. See section 3.2.2 and Appendix B-1 for more details.

45. Bonds used for the definition of interest rates in column (2) in Table 8 are a subsample of the euro and US dollar BofAML banking indices used in previous sections for the definition of i and i_*. The results of this specification are for the euro area countries only. The interest rates are averaged by nationality.

46. For example, we could have used a weighted average for the interest rates and for the currency swap rates based on debt issuance activity by nationality.

denominated debt issued after 1999 (i.e. our proxy does not take into account early redemptions or call options; neither does it include bonds issued before 1999). The coefficient of this variable is not significant. Hence, we do not find evidence of the "roll-over" hypothesis for total US dollar-denominated bonds issued by European banks.

6 Summary and conclusions

What drives US dollar bond issuance by European banks? Few studies address the motivations driving foreign currency borrowing by banks or include both the global financial and the euro area financial crises in their period of research. In this study, we attempt to fill this gap by focusing on the issuance in one particular currency, the US dollar, and on one geographical area, Europe, for both the pre-crisis and crisis periods. To the best of our knowledge, this is the first study that specifically investigates the major determinants of long-term US dollar debt issuance by European banks. For our investigation, we use a unique database containing around 5,500 US dollar-denominated bonds, which has been manually cleaned for mergers, acquisitions, spin-offs and disposals of subsidiaries and branches. This database is then matched with bank-specific balance sheet information at the consolidated level. This allows us to control for bank-specific characteristics in our regressions, while investigating the main direct drivers of US dollar-denominated bond issuance.

The findings in this study can be summarized as follows. First, arbitrage and cost considerations played a very important role in US dollar-denominated debt issuance by European banks: European banks issued US dollar-denominated debt opportunistically in order to reduce funding costs by taking advantage of deviations from CIP and, to a certain extent, from UIP. This is particularly true for the crisis period, when deviations from CIP for the European currencies were at their highest. This is the first time, to the extent of our knowledge, that evidence on opportunistic issuance of US dollar bonds by European banks has been found. Moreover, our findings on opportunistic issuance are robust to different frameworks and definitions of the components of covered and uncovered cost savings. Additionally, in spite of the different regulatory requirements for Yankee bonds, Yankee issuance was motivated by deviations from CIP as well. In addition, European banks issued in the US dollar as a lower yielding currency, but preferred to hedge the associated exchange rate risk in swap markets. This explains why results for uncovered cost savings are generally weaker than for covered cost savings. Second, we find evidence that European banks issued long-term US dollar-denominated debt for on-balance sheet or naturally hedging purposes. As proxies for US dollar-denominated asset exposures we used data from the BIS international banking statistics. Thus, European banks issued US dollar-denominated bonds to match US dollar assets. However, we did not find evidence for on-balance sheet hedging with respect to the issuance of Yankee bonds. This was also not significant for sub-sample period estimations (pre-crisis and crisis periods). In any case, our results for the hedging hypothesis should be interpreted carefully, given the flaws of our proxy for the US dollar exposure of European banks.

Third, there is some evidence that banks acted strategically and issued US dollar-denominated bonds when liquidity in US dollar markets was high and, hence, transaction costs were low. This is an interesting finding because European banks are located in countries with developed and deep domestic markets. We find no evidence of strategic issuance of Yankee bonds.

Other results in this paper are the following. European banks were less likely to issue long-term US dollar-denominated debt in periods of high financial tensions, particularly in the crisis period. Thus, US dollar markets were relatively resilient, but not immune to market instability. Sovereign CDS spreads and domestic macroeconomic conditions did not significantly prevented European banks from issuing US dollar-denominated bonds. Lower economic growth in the US increased the likelihood of Yankee issuance by European banks. This may be due to European banks willing to hedge more when the US economy slows or falls into recession.

Interestingly, some bank-specific characteristics had a very significant impact on the likelihood of US dollar debt issuance by European banks, both in the pre-crisis and the crisis period. Banks which were expanding their assets ("leverage targeting"), with a higher rating and with a banking subsidiary in the US were associated with a higher probability of issuing US dollar-denominated bonds. There is also evidence that European banks' specific asset-liability structure (deposit and loan ratios) had a significant impact on the likelihood of their US dollar-denominated debt issuance activity, particularly in the pre-crisis period. That said, the results for the capital ratio on US dollar-denominated debt issuance are generally more inconclusive. The coefficient of the market-to-book value of equity is usually not significant, except for Yankee bonds, for which it is negative and significant. In general, bank-specific characteristics seem to have played a less relevant role for Yankee issuance by European banks. Moreover, we do not find conclusive evidence of larger information asymmetries negatively affecting the likelihood of Yankee debt issuance by European banks.

In conclusion, European banks issued US dollar-denominated debt for opportunistic reasons, for on-balance sheet hedging purposes and, to a certain extent, for strategic motivations. High financial distress in markets reduced the access to US dollar markets of European banks, which at the same time were not discriminated by the macroeconomic situation of their country of origin (as indicated by insignificant results for the sovereign CDS spread). These were, with the exception of hedging, factors common to all European banks.

In addition, certain bank-specific characteristics were highly significant as well: Banks that continued to grow significantly and were perceived as stronger had better access to US dollar markets than moderately expanding and weaker banks. This may also explain why CIP and UIP deviations persisted for so long.

As mentioned before, deviations from CIP have persisted until today. What caused these deviations and how they affect US dollar debt issuance is a topic for future research.

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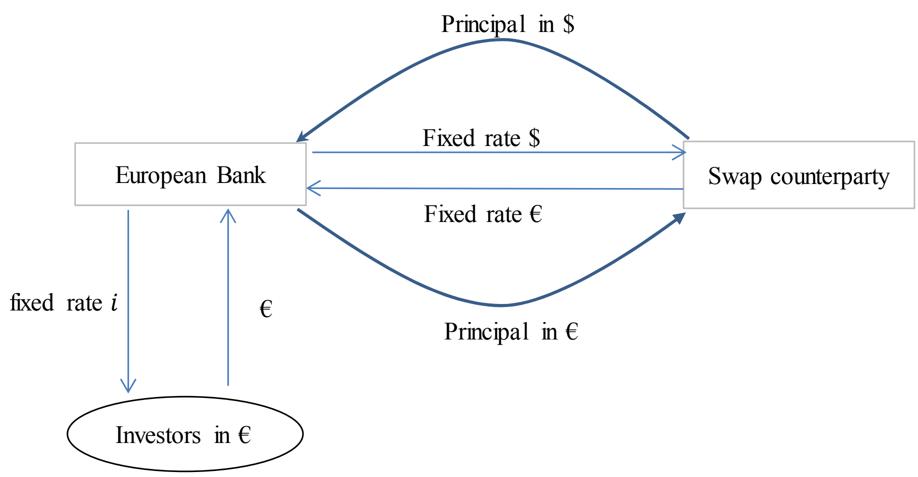
Appendix A

Table 1 Summary List of Dependent and Independent Variables

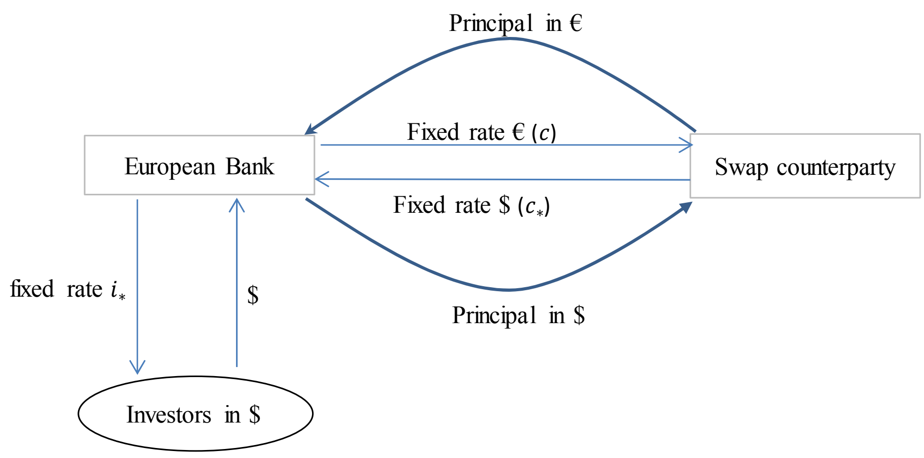
Period: Q1 2005 – Q1 2013		Source
USD ISSUANCE$_{it}$	Total amount of USD denominated fixed-coupon bonds issued by bank *i* in quarter *t*, scaled by its total assets.	Dealogic DCM
YANKEE ISSUANCE$_{it}$	Total amount of Yankee fixed-coupon bonds issued by bank *i* in quarter *t*, scaled by its total assets.	Dealogic DCM
COVERED Cost$_{rt}$ (ε^c)	Covered cost savings at the beginning of each quarter *t,* by currency. Averaged in multicurrency framework for Switzerland and the UK. In natural logarithm.	Bloomberg, BofAML, Barclays; Constructed
UNCOVERED Cost$_{jt}$ (ε^u)	Pre-tax YTM spread between 5-year benchmark country *j* government bond and US Treasury bond at the beginning of quarter *t*. Averaged in multicurrency framework for Switzerland and the UK. In natural logarithm.	Bloomberg, constructed
USD Exp$_{jt-1}$	Amount outstanding of gross claims (assets) of European banks denominated in USD against all sectors (other banks, non-banks and monetary authorities) excluding interoffice positions. Positions by nationality *j* in quarter *t* -1. In natural logarithm.	BIS locational statistics, constructed
USD Liq$_{t-1}$	Proportion (as fraction of unity) of global non-public sector USD bonds, excluding securitizations and exchange offers, as of total issuance in all currencies in quarter *t-1*. For Yankees: Total USD marketed bonds over total USD bonds.	Dealogic DCM
GDP$_{USt}$	US GDP growth (as fraction of unit) in quarter *t.*	US Bureau of Economic analysis
LIBOR OIS$_{USDt}$	One year USD LIBOR-OIS spread, in quarter *t* (as fraction of unity).	Datastream, Bloomberg
VSTOXX$_t$	Average implied stock market volatility (VSTOXX) in quarter *t.*	Datastream
CDS SOV$_{jt}$	Average sovereign CDS spread (as fraction of unity) of country *j* in quarter *t.*	Datastream
GDP$_{jt}$	GDP growth (as fraction of unit) in country *j* in quarter *t*.	Datastream
CBPP$_t$	Dummy for Covered Bond Purchase Programme ECB in quarter *t.*	ECB
GR TA$_{it-1}$	Quarterly increase in total assets of bank *i*.	Bankscope, SNL and bank reports
RATING AV$_{it-1}$	Average of the stand-alone ratings published by Fitch, Moody's and S&P for bank *i* in quarter *t-1.* Ratings scaled from "0" to "20", representing C/Ca and AAA/Aaa,	Rating agencies
K TA$_{it-1}$	Ratio of total equity to total assets of bank *i* in quarter *t-1.*	Bankscope, SNL and bank reports
L TA$_{it-1}$	Ratio of total loans to total assets of bank *i* in quarter *t-1.*	Bankscope, SNL and bank reports
D TA$_{it-1}$	Ratio of total customer deposits to total assets of bank *i* in quarter *t-1.*	Bankscope, SNL and bank reports
MTB$_{it-1}$	Market capitalization divided by book value of equity of each bank *i* in quarter *t-1.*	Bankscope
SUBS$_{it-1}$	Dummy for banking office in the US. A banking office can be any bank subsidiary or branch in the US, as well as a New York state investment company. Bank representative offices excluded.	Federal Reserve, Structure and Share Data for U.S. Offices of Foreign Banks
MAT$_{i,\ t-1}$	Total USD denominated bonds maturing in quarter *t-1*, by bank *i*, scaled by its total assets.	Dealogic DCM

Figure 1 Creation of a synthetic US dollar bond by a euro area bank



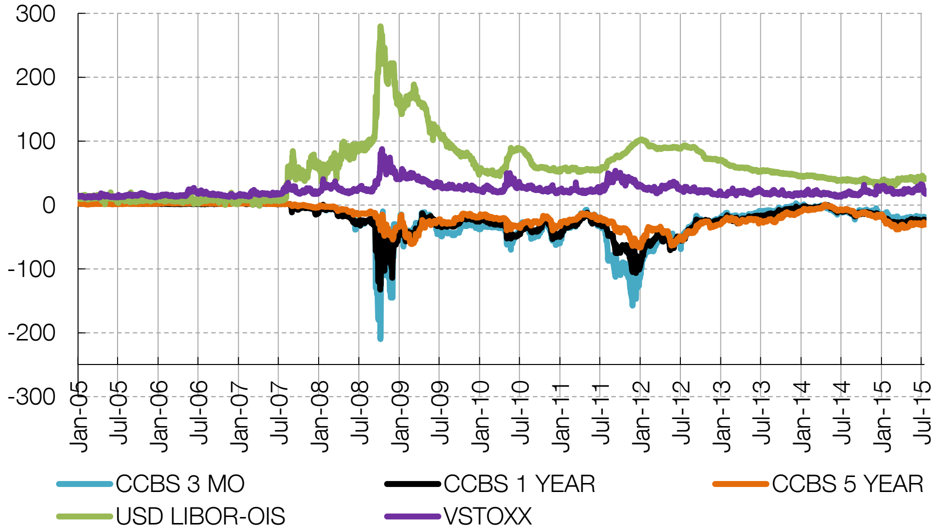
For the sake of simplicity, the broker or dealer that usually intermediates between the two swap counterparties is not included.

Figure 2 Creating a synthetic euro bond by a euro area bank



For the sake of simplicity, the broker or dealer that usually intermediates between the two swap counterparties is not included

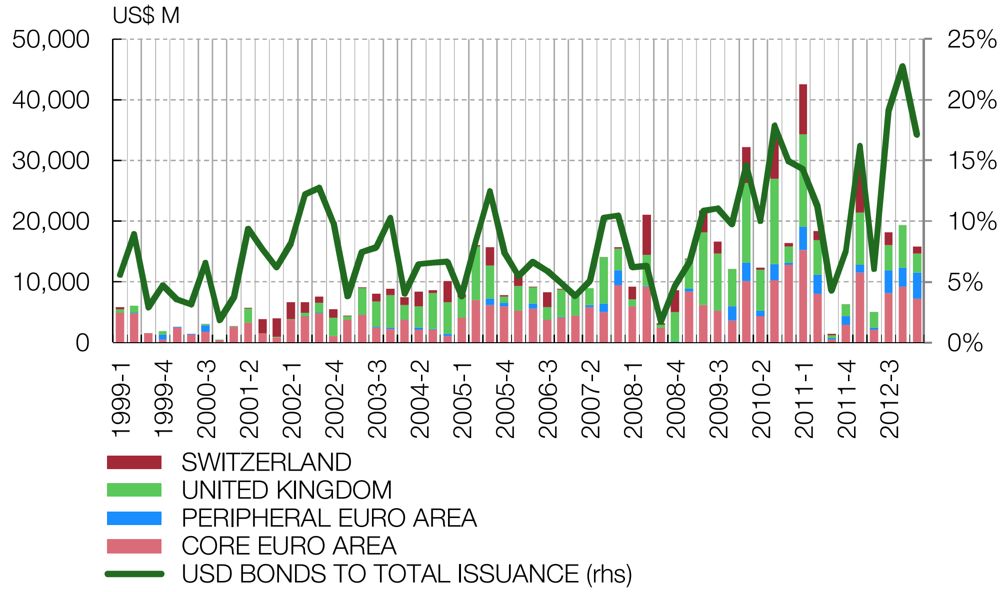
Figure 3 Cross-currency basis swap spreads (euro-US dollar) for different maturities and financial distress indicators



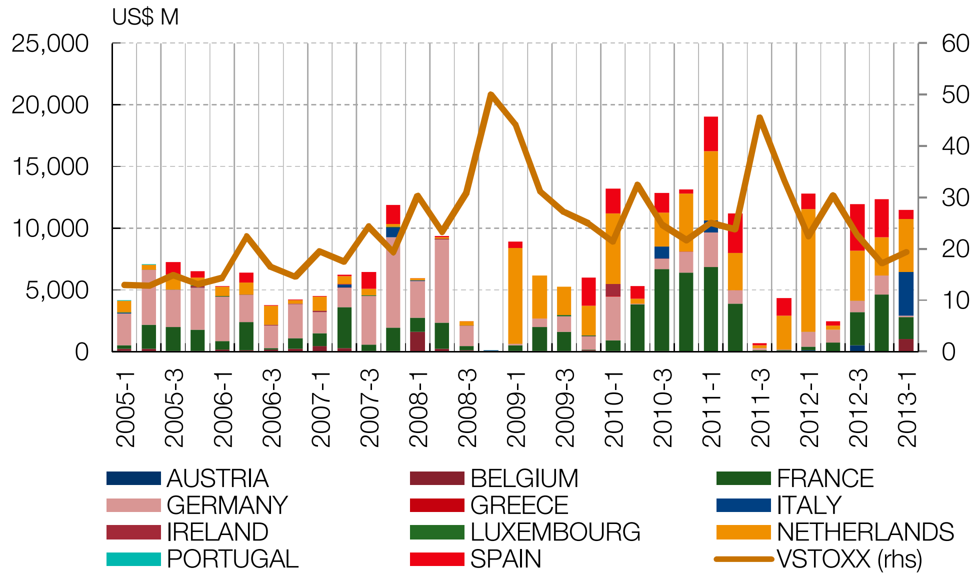
Source: Bloomberg, Datastream. All series in basis points except VSTOXX (price index).

Figure 4 Absolute and relative US dollar issuance by European Banks by areas or countries (a) and absolute US dollar issuance by euro area countries and implied stock market volatility (b)

(a)



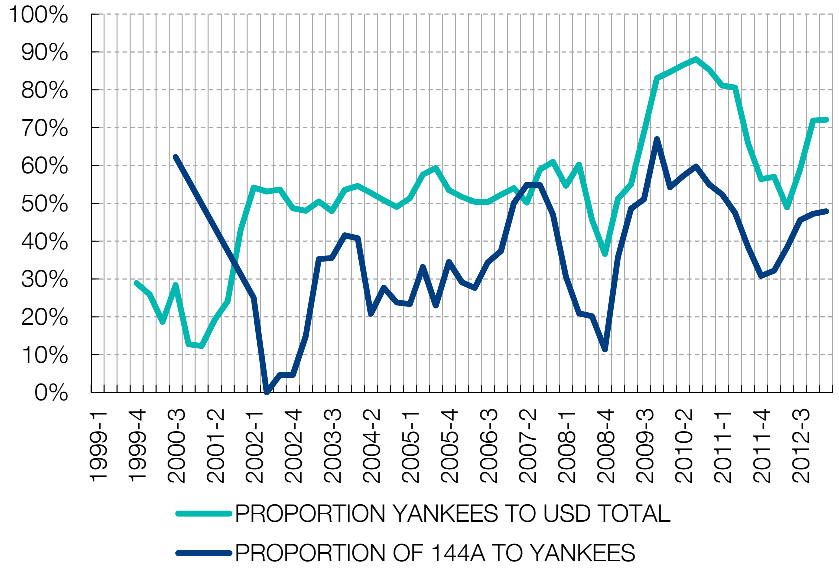
(b)



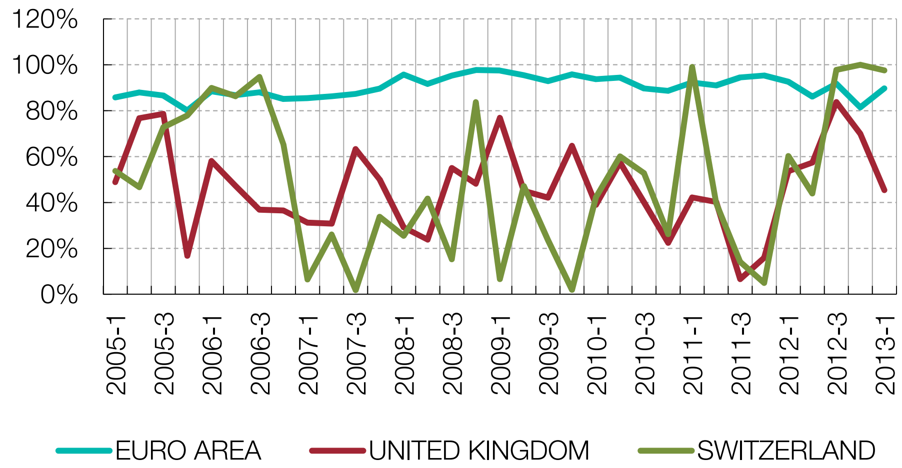
Source: Dealogic, Datastream. Relative issuance includes Sweden.

Figure 5 Yankee and 144A issuance over total US dollar issuance or Yankees (a) and total US dollar and domestic currency issuance over total issuance by area or country (b)

(a)

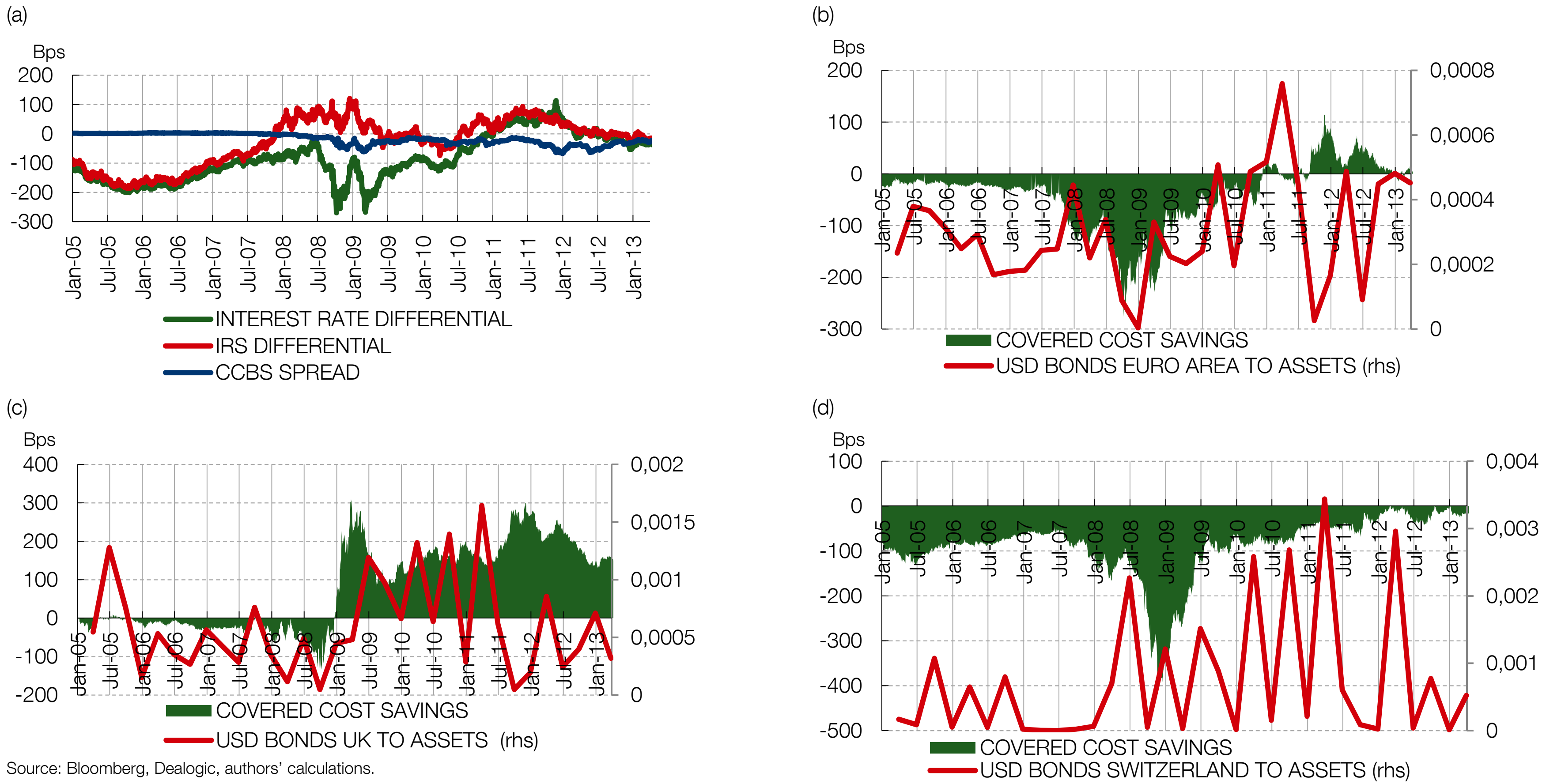


(b)



Source: Dealogic.

Figure 6 Evolution of covered cost savings in the euro area (a and b), in the United Kingdom (c) and Switzerland (d)



Source: Bloomberg, Dealogic, authors' calculations.

Table 2 Summary Statistics

Panel A: Dependent variables and covered cost savings				
Variable	Mean	Std. Dev.	Min.	Max.
Euro area				
USD ISSUANCE$_{it}$ (ratio)	0.0002512	0.001525	0	0.051165
YANKEE ISSUANCE$_{it}$ (ratio)	0.0001237	0.0013954	0	0.051165
COVERED Cost$_{rt}$ (ε^c) (log)	0.0035083	0.2287242	-0.3640386	0.7551973
United Kingdom				
USD ISSUANCE$_{it}$ (ratio)	0.0006035	0.0011025	0	0.0067606
YANKEE ISSUANCE$_{it}$ (ratio)	0.0005126	0.0010674	0	0.0067606
COVERED Cost$_{rt}$ (ε^c) (log)	0.114031	0.2022069	-0.1819795	0.4747718
Switzerland				
USD ISSUANCE$_{it}$ (ratio)	0.0007788	0.0013221	0	0.0064463
YANKEE ISSUANCE$_{it}$ (ratio)	0.0005821	0.0010142	0	0.0039446
COVERED Cost$_{rt}$ (ε^c) (log)	-0.0441427	0.4041743	-0.5531265	1.078246
Panel B: Other explanatory variables				
UNCOVERED Cost$_{jt}$ (ε^u) (log)	0.1177229	0.5805348	-3.171945	4.591615
USD Exp$_{jt-1}$ (log)	12.78216	1.4245	7.528869	14.21533
USD Liq$_t$ (ratio)	0.4633894	0.0433174	0.3506544	0.5491365
GDP$_{USt}$ (fraction of unity)	0.0134848	0.0274453	-0.082	0.049
LIBOR OIS$_{USDt}$ (fraction of unity)	0.0062063	0.0047729	0.0008317	0.0213586
CDS SOV$_{jt}$ (fraction of unity)	0.0089434	0.053657	0.0001225	1.973562
GDP$_{jt}$ (fraction of unity)	0.0102961	0.0276911	-0.0897697	0.0817825
VSTOXX$_t$	24.34333	9.143433	12.76202	49.98715
Total assets (€ Million)	505,622.7	558,782.2	5,545	2,586,700
GR TA$_{it}$ (fraction of unity)	0.0103385	0.0573029	-0.2287615	1.034294
RATING AV$_{it}$	16.0814	1.715747	4	20
K TA$_{it}$ (Capital ratio)	0.041181	0.0215679	-0.0040382	0.1478847
D TA$_{it}$ (Deposit ratio)	0.3232984	0.1433863	0.0000992	0.8206281
L TA$_{it}$ (Loan ratio)	0.4816153	0.1600251	0.0815938	0.9834084
MTB$_{it}$ (Market-to-book ratio)	1.170864	0.7357273	-0.4123841	3.690599
MAT$_{i,t-1}$ (ratio)	0.0003532	0.0010428	0	0.0129644

Table 3 Tobit Model for All European Countries, US Dollar Bonds

USD ISSUANCE$_{it}$ VARIABLES	(1) Tobit	(2) Tobit	(3) Tobit	(4) Tobit	(5) Tobit	(6) Tobit
COVERED Cost$_{rt}$ ($\boldsymbol{\varepsilon^c}$)	0.0042***	0.0034***	0.0031**	0.0026**	0.0028***	0.0022***
	(0.0012)	(0.0012)	(0.0013)	(0.0013)	(0.0008)	(0.0007)
USD Exp$_{jt-1}$	0.0009**	0.0008*	0.0010**	0.0009**	0.0003	0.0006***
	(0.0004)	(0.0004)	(0.0005)	(0.0004)	(0.0003)	(0.0002)
UNCOVERED Cost$_{jt}$ ($\boldsymbol{\varepsilon^u}$)		-0.0002	0.0001	-0.0002	0.0004*	0.0004**
		(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
USD Liq$_{t-1}$		0.0040*	0.0021	0.0024	0.0028*	0.0024*
		(0.0024)	(0.0027)	(0.0025)	(0.0015)	(0.0013)
LIBOR OIS$_{USDt}$			-0.1087***	-0.1156***	-0.0402*	-0.0097
			(0.0394)	(0.0403)	(0.0223)	(0.0191)
CDS SOV$_{jt}$			-0.0027		0.0003	-0.0013
			(0.0043)		(0.0027)	(0.0024)
GDP$_{jt}$				-0.0084		
				(0.0068)		
GR TA$_{it-1}$					0.0027***	0.0021***
					(0.0007)	(0.0006)
RATING AV $_{it-1}$					0.0002***	0.0001*
					(0.0001)	(0.0001)
D TA$_{it-1}$					-0.0024***	-0.0029***
					(0.0009)	(0.0008)
L TA$_{it-1}$					0.0014*	0.0014*
					(0.0008)	(0.0008)
K TA$_{it-1}$					0.0039	
					(0.0063)	
SUBS$_{it-1}$					0.0012***	0.0013***
					(0.0003)	(0.0003)
MTB$_{it-1}$						0.0001
						(0.0001)
Constant	-0.0143***	-0.0152***	-0.0158***	-0.0145***	-0.0117***	-0.0103***
	(0.0043)	(0.0047)	(0.0051)	(0.0047)	(0.0032)	(0.0026)
Observations	1,721	1,689	1,626	1,689	1,420	893
Number of banks	59	58	58	58	57	35
Country dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Tobit regression for all European countries where the dependent variable is the ratio of total US dollar issuance to bank assets. Standard errors in parentheses. *** p < 0.01, ** p <0.05, * p <0.1. Multicurrency model for covered and uncovered cost savings for Swiss and British banks. Suffix *i* refers to bank *i* , suffix *j* to country *j*. Country *j* is the country where the headquarter of bank *i* is located.

Table 4 Tobit Model for All European Countries, Yankee Bonds

YANKEE ISSUANCE$_{it}$ VARIABLES	(1) Tobit	(2) Tobit	(3) Tobit	(4) Tobit	(5) Tobit	(6) Tobit
COVERED Cost$_{rt}$ (ε^c)	0.0074***	0.0074***	0.0072**	0.0071***	0.0031**	0.0025**
	(0.0025)	(0.0025)	(0.0028)	(0.0026)	(0.0012)	(0.0011)
USD Exp$_{jt-1}$	0.0003	0.0003	-0.0000	0.0003	0.0001	0.0002
	(0.0010)	(0.0011)	(0.0013)	(0.0011)	(0.0006)	(0.0005)
UNCOVERED Cost$_{jt}$ (ε^u)		-0.0001	0.0005	0.0001	-0.0000	0.0001
		(0.0006)	(0.0008)	(0.0007)	(0.0004)	(0.0003)
USD Liq$_{t-1}$		-0.0021	0.0017	0.0020	0.0070	0.0029
		(0.0101)	(0.0119)	(0.0110)	(0.0050)	(0.0045)
GDP$_{USt}$			-0.0178	-0.0133	-0.0192***	-0.0160***
			(0.0116)	(0.0108)	(0.0046)	(0.0041)
LIBOR OIS$_{USDt}$			-0.1622	-0.1960**		
			(0.1027)	(0.0991)		
VSTOXX$_t$					-0.0001***	-0.0001***
					(0.0000)	(0.0000)
CDS SOV$_{jt}$			-0.0263		0.0048	0.0001
			(0.0422)		(0.0179)	(0.0154)
GDP$_{jt}$				-0.0212		
				(0.0167)		
GR TA$_{it-1}$					0.0039***	0.0024**
					(0.0012)	(0.0010)
RATING AV $_{it-1}$					-0.0001	-0.0000
					(0.0001)	(0.0001)
D TA$_{it-1}$					-0.0021	-0.0024
					(0.0017)	(0.0016)
L TA$_{it-1}$					0.0007	-0.0016
					(0.0016)	(0.0016)
K TA$_{it-1}$					-0.0071	
					(0.0136)	
SUBS$_{it-1}$					0.0030***	
					(0.0008)	
MTB$_{it-1}$						-0.0005*
						(0.0003)
Constant	-0.0296	-0.0283	-0.0274	-0.0308	-0.0179	-0.0097
	(0.5135)	(0.4906)	(0.6071)	(0.6398)	(0.4375)	(0.1999)
Observations	1,721	1,689	1,626	1,689	1,420	893
Number of banks	59	58	58	58	57	35
Country dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Tobit regression for all European countries where the dependent variable is the ratio of Yankee issuance to bank assets. Standard errors in parentheses. *** p < 0.01, ** p <0.05, * p <0.1. Multicurrency model for covered and uncovered cost savings for Swiss and British banks. Suffix *i* refers to bank *i*, suffix *j* to country *j*. Country *j* is the country where the headquarter of bank *i* is located.

Table 5 Tobit Model for All European Countries and Euro Area by Period, US Dollar Bonds

$USD\ ISSUANCE_{it}$	(1)	(2)	(3)	(4)
	Tobit	Tobit	Tobit	Tobit
VARIABLES	All countries	All countries	Euro area	Euro area
	Before crisis	After crisis	Before crisis	After crisis
$COVERED\ Cost_{rt}$ ($\boldsymbol{\varepsilon^c}$)	0.0075	0.0027***	-0.0047	0.0023***
	(0.0077)	(0.0008)	(0.0138)	(0.0009)
$USDExp_{jt-1}$	-0.0001	0.0003	0.0002	0.0005
	(0.0010)	(0.0004)	(0.0011)	(0.0004)
$UNCOVERED\ Cost_{jt}$ ($\boldsymbol{\varepsilon^u}$)	-0.0004	0.0003	-0.0002	0.0005**
	(0.0022)	(0.0002)	(0.0020)	(0.0003)
$USD\ Liq_{t-1}$	-0.0012	0.0042*	-0.0007	-0.0006
	(0.0036)	(0.0021)	(0.0032)	(0.0025)
$LIBOR\ OIS_{USDt}$	0.0603	-0.0223		
	(0.1184)	(0.0303)		
$VSTOXX_t$			0.0000	-0.0000***
			(0.0000)	(0.0000)
$CDS\ SOV_{jt}$	-0.1476	0.0006	-0.1703	-0.0005
	(0.2310)	(0.0031)	(0.2327)	(0.0042)
$CBPP_t$				-0.0005**
				(0.0003)
$GR\ TA_{it-1}$	0.0042***	0.0019*	0.0049***	0.0025
	(0.0011)	(0.0011)	(0.0012)	(0.0016)
$RATING\ AV_{it-1}$	0.0002*	0.0004***	0.0003**	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$D\ TA_{it-1}$	-0.0046***	0.0003	-0.0069***	0.0019
	(0.0012)	(0.0009)	(0.0016)	(0.0013)
$L\ TA_{it-1}$	0.0022**	-0.0004	0.0014	0.0005
	(0.0011)	(0.0008)	(0.0013)	(0.0010)
$K\ TA_{it-1}$	0.0051	-0.0103	0.0033	-0.0162*
	(0.0093)	(0.0076)	(0.0105)	(0.0098)
$SUBS_{it-1}$	0.0014***	0.0008***	0.0018***	0.0006*
	(0.0004)	(0.0002)	(0.0005)	(0.0003)
Constant	-0.0057	-0.0120***	-0.0086	-0.0124**
	(0.0115)	(0.0046)	(0.0123)	(0.0050)
Observations	540	880	478	727
Number of banks	54	54	46	45
Country dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES

Tobit regression for all European countries where the dependent variable is the ratio of total US dollar issuance to bank assets. The crisis period starts in the second quarter of 2008. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Multicurrency model for covered and uncovered cost savings for Swiss and British banks. Suffix *i* refers to bank *i* , suffix *j* to country *j*. Country *j* is the country where the headquarter of bank *i* is located.

Table 6 Fixed-Effects Logit Model for All European Countries, US Dollar Bonds

USD ISSUANCE$_{it}$ VARIABLES	(1) Logit FE	(2) Logit FE	(3) Logit FE	(4) Logit FE	(5) Logit FE	(6) Logit FE
COVERED Cost$_{rt}$ ($\boldsymbol{\varepsilon^c}$)	3.4099***	2.3216**	2.0105*	1.6389	3.7496***	4.3356***
	(1.0207)	(1.0745)	(1.1652)	(1.1268)	(1.2183)	(1.4232)
USD Exp$_{jt-1}$	1.6494***	1.6014***	1.6902***	1.6710***	0.8825	1.8627***
	(0.4387)	(0.4820)	(0.5017)	(0.4947)	(0.7668)	(0.6491)
UNCOVERED Cost$_{jt}$ ($\boldsymbol{\varepsilon^u}$)		-0.2336	0.1392	-0.2536	0.8937**	0.7792*
		(0.2094)	(0.3418)	(0.2632)	(0.4080)	(0.4055)
USD Liq$_{t-1}$		5.7317**	3.3196	3.7244*	2.8114	2.2327
		(2.2634)	(2.3207)	(2.1484)	(2.2924)	(3.0876)
LIBOR OIS$_{USDt}$			-112.2249***	-115.0372***	-121.0181***	-107.9650**
			(36.3257)	(40.9775)	(40.9762)	(54.8170)
CDS SOV$_{jt}$			-2.0749**		2.4510	-2.4629
			(0.9545)		(2.1309)	(2.4714)
GDP$_{jt}$				-6.8997		
				(7.4162)		
GR TA$_{it-1}$					4.4602***	4.9201***
					(1.5838)	(1.8454)
RATING AV $_{it-1}$					0.5444***	0.2174
					(0.1785)	(0.1900)
D TA$_{it-1}$					-2.7745	-1.7610
					(3.4945)	(4.1711)
L TA$_{it-1}$					1.1756	2.5388
					(3.2878)	(4.3321)
K TA$_{it-1}$					13.4372	
					(18.1498)	
SUBS$_{it-1}$					0.0431	-0.7802
					(0.4940)	(0.5568)
MTB$_{it-1}$						-0.3786
						(0.4093)
Observations	1,448	1,416	1,359	1,416	1,193	770
Country dummies	NO	NO	NO	NO	NO	NO
Year dummies	YES	YES	YES	YES	YES	YES

Fixed-effects Logit regressions for all European countries where the dependent variable takes 1 whenever bank *i* issues a bond denominated in US dollars in quarter t, and zero otherwise. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Multicurrency model for covered and uncovered cost savings for Swiss and British banks. Suffix *i* refers to bank *i*, suffix *j* to country *j.* Country *j* is the country where the headquarter of bank *i* is located.

Table 7 Fixed-Effects Logit Model for All European Countries, Yankee Bonds

YANKEE ISSUANCE$_{it}$ VARIABLES	(1) Logit FE	(2) Logit FE	(3) Logit FE	(4) Logit FE	(5) Logit FE	(6) Logit FE
COVERED Cost$_{rt}$ ($\boldsymbol{\varepsilon^c}$)	4.6276***	4.6583***	4.6067***	5.1242***	3.0507**	2.8507*
	(0.9763)	(1.0221)	(1.1220)	(1.0290)	(1.4328)	(1.6111)
USD Exp$_{jt-1}$	0.8143	0.8347	0.6975	0.8182	0.6033	1.0377
	(0.7576)	(0.7112)	(0.8562)	(0.7180)	(0.8107)	(1.1700)
UNCOVERED Cost$_{jt}$ ($\boldsymbol{\varepsilon^u}$)		-0.0000	0.4347	0.1124	-0.2585	-0.3699
		(0.3832)	(0.4546)	(0.3777)	(0.5167)	(0.5338)
USD Liq$_{t-1}$		-1.3516	5.8622	3.9096	10.1380	7.0121
		(4.1301)	(6.0886)	(5.7187)	(7.2722)	(7.3580)
GDP$_{USt}$			-18.335***	-16.014***	-24.103***	-20.911***
			(5.4813)	(4.9784)	(6.4731)	(6.9016)
LIBOR OIS$_{USDt}$			-70.4978	-67.1989		
			(51.1415)	(52.6185)		
VSTOXX$_t$					-0.0889***	-0.0821**
					(0.0319)	(0.0361)
CDS SOV$_{jt}$			-31.5395		-4.5744	-13.0181
			(20.6783)		(23.8004)	(30.1496)
GDP$_{jt}$				-2.7531		
				(11.6165)		
GR TA$_{it-1}$					4.9500***	4.7206***
					(1.4806)	(1.7653)
RATING AV $_{it-1}$					-0.3414***	-0.3754***
					(0.1242)	(0.1261)
D TA$_{it-1}$					-7.9922**	-5.1316
					(4.0492)	(4.3196)
L TA$_{it-1}$					-3.8581	-6.7377
					(4.9110)	(5.5908)
K TA$_{it-1}$					38.4284	
					(28.4933)	
SUBS$_{it-1}$					11.6819***	
					(1.5098)	
MTB$_{it-1}$						-0.8438*
						(0.5044)
Observations	792	792	738	792	677	546
Country dummies	NO	NO	NO	NO	NO	NO
Year dummies	YES	YES	YES	YES	YES	YES

Fixed-effects Logit regressions for all European countries where the dependent variable takes 1 whenever bank *i* issues a Yankee bond in quarter t, and zero otherwise. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Multicurrency model for covered and uncovered cost savings for Swiss and British banks. Suffix *i* refers to bank *i* , suffix *j* to country *j*. Country *j* is the country where the headquarter of bank *i* is located.

Table 8 Alternative Covered and Uncovered Cost Savings and Maturity of US dollar Bonds

USD ISSUANCE$_{it}$ VARIABLES	(1) Tobit Eurodollar index	(2) Tobit Euroarea index	(3) Tobit Two-currency framework	(4) Tobit Maturity
COVERED Cost$_{rt}$ ($\boldsymbol{\varepsilon^c}$)	0.0020***	0.0010*	0.0018***	0.0028***
	(0.0006)	(0.0005)	(0.0006)	(0.0008)
USD Exp$_{jt-1}$	0.0003	0.0003	0.0003	0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
UNCOVERED Cost$_{jt}$ ($\boldsymbol{\varepsilon^u}$)	0.0006***	0.0006***	0.0006***	0.0004*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
USD Liq$_{t-1}$	0.0026*	0.0025	0.0028*	0.0028*
	(0.0015)	(0.0017)	(0.0015)	(0.0015)
LIBOR OIS$_{USDt}$	-0.0586***	-0.0698***	-0.0530**	-0.0402*
	(0.0218)	(0.0260)	(0.0219)	(0.0223)
CDS SOV$_{jt}$	-0.0013	-0.0015	-0.0020	0.0003
	(0.0038)	(0.0042)	(0.0044)	(0.0027)
GR TA$_{it-1}$	0.0025***	0.0028***	0.0026***	0.0027***
	(0.0007)	(0.0009)	(0.0007)	(0.0007)
RATING AV $_{it-1}$	0.0003***	0.0003***	0.0003***	0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
D TA$_{it-1}$	-0.0024***	-0.0020*	-0.0024***	-0.0024***
	(0.0009)	(0.0011)	(0.0009)	(0.0009)
L TA$_{it-1}$	0.0015*	0.0020**	0.0015*	0.0014*
	(0.0008)	(0.0010)	(0.0008)	(0.0008)
K TA$_{it-1}$	0.0053	0.0015	0.0050	0.0039
	(0.0063)	(0.0073)	(0.0063)	(0.0063)
SUBS$_{it-1}$	0.0012***	0.0011***	0.0012***	0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
MAT$_{i,\ t-1}$				0.0164
				(0.0511)
Constant	-0.0113***	-0.0123***	-0.0116***	-0.0117***
	(0.0031)	(0.0035)	(0.0031)	(0.0032)
Observations	1,420	1,205	1,420	1,420
Number of banks	57	48	57	57
Country dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES

Tobit regression for all European countries where the dependent variable is the ratio of total US dollar issuance to bank assets. Standard errors in parentheses. *** p < 0.01, ** p <0.05, * p <0.1. Two-currency model for covered and uncovered cost savings in all columns except in (4). Suffix *i* refers to bank *i*, suffix *j* to country *j*. Country *j* is the country where the headquarter of bank *i* is located.

Appendix B

Appendix B-1. Constructing long-term CIP and the covered cost savings variable

In this section, we explain in detail how we construct the covered cost savings variable in our study[47]. Particularly relevant is how we "construct" the currency swap rates c and c_* in Equation (4). A swap is defined as a "periodic exchange of cash flows under specified rules" (Sundaram and Das, 2010, p.571). There are different types of swaps. In an interest rate swap (IRS), two counterparties exchange interest payments in a common currency based on a given notional principal. Should the interest payments be in different currencies, then the swap is called a currency swap. Unlike in IRSs, in currency swaps there is usually an exchange of principals in the two currencies at the beginning and at the end of the contract (i.e. the principal is not notional) (Flavell, 2010).

The currency swap rate c in Equation (4) is specifically derived from a fixed-for-floating (currency) swap or Cross-Currency Compound Swap (CCCS). We follow the methodology of e.g. McBrady and Schill (2007) and Habib and Joy (2010)[48] and define the CCCS rate as the sum of two different swaps rates: A domestic currency IRS rate (Z) and a floating-for-floating or Cross-Currency Basis Swap (CCBS) spread, represented by α. Both Z and α are available in Bloomberg. The payments of an IRS and a CCBS for a European bank demanding euros are depicted in Figures 7 and 8, respectively:

Figure 7 An Interest Rate Swap

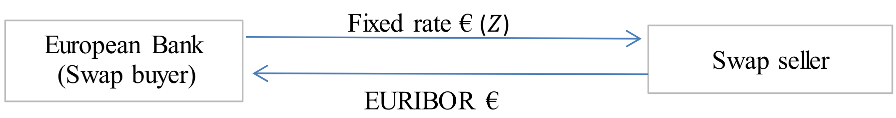
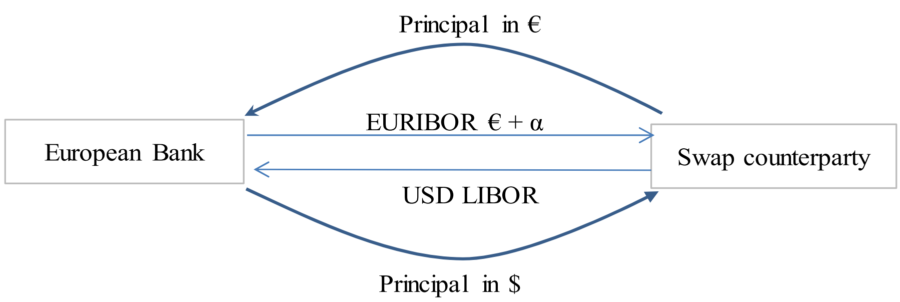


Figure 8 Cross-Currency Basis Swap



Contrary to McBrady and Schill (2007) and Habib and Joy (2010), we use both the domestic currency IRS rate (Z) and the CCBS spread α for the calculation of c in Equations (3) and (4). Due to data constraints, these authors only considered the corresponding IRS swap rates for the construction of the covered cost savings variable. However, not considering the CCBS spreads, particularly after

47. The components of CIP and UIP are expressed in natural logarithms, as explained in Table 1.
48. One reason to follow their methodology is data constraint on currency swaps.

2008, would imply missing important developments in covered cost savings, as explained in section 3.4. Therefore, we calculate the currency swap rate c in the following way:

$$c = Z + \alpha \tag{11}$$

For the calculation of the currency swap rate for the foreign currency (in our case, the foreign currency is always the US dollar), we need the US dollar IRS. For this IRS, the US dollar LIBOR rate is exchanged in return of fixed interest rate payments denominated in US dollars:

$$c_* = Z_\$ \tag{12}$$

Notice that the combination of the payments and receipts of the domestic currency IRS, the CCBS and the US dollar IRS, results in a cross-currency swap (CCS) as in the definition of CIP for the long run made by Popper (1993) (see footnote 17).

For the currency swap rates c and c_*, we use, whenever possible, five-year CCBSs and five-year IRSs[49]. For the euro, the CCBS is based on the exchange of the 3-month Euribor against the 3-month US dollar LIBOR flat (i.e. there is no spread added to the US dollar LIBOR). The euro IRS is based on the exchange of the 3-month Euribor and the corresponding fixed rate denominated in euros. The CCBS for British and Swiss banks are defined in similar terms (3-month domestic currency LIBOR versus 3-month US dollar LIBOR). However, the British Pound and the Swiss Franc IRSs exchange fixed interest rate payments for the corresponding 6-month domestic currency LIBOR. In order to avoid the mismatch between the payments of the CCBS (3-month domestic currency LIBOR) and the corresponding domestic currency IRS (6-month domestic currency LIBOR), the 3-month-6-month LIBOR basis swap is used to correct the British Pound and the Swiss Franc IRSs rates. However, we have corrected these IRS rates only since 2008, due to data constraints. In any case, the results of our regressions with and without the mentioned correction are very similar (results not shown).

For interest rates, we use corporate investment grade secondary bond yields as in Black and Munro (2010) and McBrady et al. (2010). More specifically, we use the yield to maturity of several Bank of America Merrill Lynch banking indices (BofAML indices). The euro and the British Pound banking BofAML indices (used for i) track the performance of euro and British pound investment-grade debt, respectively, publicly issued by banks in the Eurobond market or in the national domestic market. To qualify for this index, the bond must have at least 18 months to final maturity when issued (which matches the maturity of our sample) as well as a fixed-coupon schedule and a certain minimum amount outstanding. For the Swiss interest rate (i), we use the Barclays Swiss corporate index instead, due to data constraints. Finally, the US dollar banking BofAML index (used for i_*) includes investment-grade US dollar-denominated bonds issued in the US market by US and non-US banks.

Our choice of indices for the US dollar and the domestic currency interest rates (i_* and i) may be criticized in three ways. First, the US dollar banking BofAML index used for i_* is based on bonds issued only in the US market. Even when many of the US dollar-denominated bonds in our sample are Yankees (on average, Yankees are 62% of total US dollar issuance, see Figure 5.a in Appendix A), many others are Eurodollar bonds. In addition, the yield of the Eurodollar banking BofAML index is

49. This allows for an easier comparison of our results with the results of McBrady and Schill (2004 and 2007). Moreover, the median maturity of the US dollar-denominated bonds in our data is 6 years. In contrast, average maturity of these bonds is approximately 9 years. However, given the large dispersion of these maturities (ranging from 1,5 years to more than 40 years and even to perpetuity), we consider that a robust measure to outliers is more informative. For the calculation of the currency swap rates for Swiss banks we use ten-year CCBSs and ten-year IRSs due to the impossibility of applying logarithms to the Swiss 5-year swap rate c after it turned negative in 2012.

significantly lower than that of our index for i_* between 2008 and 2009, while being very similar to the latter for the rest of our sample period. Second, all the BofAML indices used in this paper are based on bonds issued by banks from different nationalities e.g. the investment grade US dollar BofAML banking index include US dollar bonds issued by non-European banks; similarly, the euro banking BofAML index includes euro bonds issued by non-euro area banks. Thus, these indices may not be fully representative of the real interest rates faced by European banks during our sample period. Finally, the bonds included in the BofAML indices used for this paper do not necessarily have a five-year maturity, as is the case for most of our currency swaps.

Taking these three problems into consideration, we conduct some robustness checks with alternative indices for the interest rates (i_* and i) of covered cost savings. The results of these robustness tests are presented in Table 8 and summarized in section 5.4.2.

Appendix B-2. A multi-currency framework for CIP and UIP

McBrady and Schill (2007) and Habib and Joy (2010) modify Equations (4) and (6) to "accommodate a choice among multiple currencies" (Habib and Joy, 2010, p. 625), in what they call the multi-currency model or framework. Hence, in a multi-currency framework we rewrite Equation (4) for covered cost savings as follows:

$$\varepsilon^{c} = (\bar{\imath} - \bar{c}) - (i_* - c_*) \qquad (13)$$

Where $\bar{\imath}$ is an average of the domestic currency interest rates and $\bar{c}$ is an average of the currency swap rates for the domestic currencies.

For uncovered cost savings in a multi-currency setting, we rewrite Equation (6) as:

$$\varepsilon^{u} = (\bar{\imath} - i_*) \qquad (14)$$

Where $\bar{\imath}$ is calculated as in Equation (13), but using government bond yields instead of banking indices, as explained in section 3.2.3.

Notice that the authors mentioned above employ the whole set of currencies available in their sample to construct the averaged variables in Equations (13) and (14). In this paper, we calculate these averages using the Swiss Franc, the British Pound and the euro interest rates instead. Equations (13) and (14) are used for the construction of covered and uncovered cost savings, respectively, of all British and Swiss banks. Hence, for the British and Swiss banks, covered and uncovered cost savings take the same value (i.e. they do not change by nationality of the bank) except in columns (1) and (3) of Table 8. For the euro area banks, the value of covered cost savings does not change by nationality either, but is different from that of British and Swiss banks (i.e. we use Equations (4) and (6) for the banks headquartered in a euro area country).

Appendix C

Table 9 List of banks

Name	Country	Type
1.Landesbank Baden-Wuerttemberg (LBBW)	Germany	Public savings bank
2.Barclays plc	UK	Commercial bank
3.HSBC Holdings plc	UK	Commercial bank
4.Commerzbank AG	Germany	Commercial bank
5.Lloyds Banking Group plc	UK	Commercial bank
6.UBS AG	Switzerland	Commercial bank
7.Royal Bank of Scotland Group plc	UK	Commercial bank
8.Rabobank Nederland	Netherlands	Cooperative bank
9.BPCE SA	France	Cooperative bank
10.NorddeutscheLandesbank Girozentrale	Germany	Public savings bank
11.UniCredit SpA	Italy	Commercial bank
12.BNP Paribas SA	France	Commercial bank
13.Landesbank Hessen-Thueringen Girozentrale	Germany	Public savings bank
14.Banco Santander SA	Spain	Commercial bank
15.BayernLB Holding AG	Germany	Public savings bank
16.Deutsche Bank AG	Germany	Commercial bank
17.Bank AG Deutsche Zentral-Genossenschaftsbank	Germany	Cooperative bank
18.Intesa Sanpaolo SpA	Italy	Commercial bank
19.Credit Agricole SA	France	Cooperative bank
20.KBC Group NV	Belgium	Commercial bank
21.Societe Generale	France	Commercial bank
22.HSH Nordbank AG	Germany	Public savings bank
23.WGZ BANK AG Westdeutsche Genossenschaftsban	Germany	Cooperative bank
24.Raiffeisenlandesbank Oberoesterreich AG	Austria	Public savings bank
25.Groupe Credit Mutuel CEE	France	Cooperative bank
26.Credit Suisse Group	Switzerland	Commercial bank
27.Muenchener Hypothekenbank eG	Germany	Mortgage bank
28.Banque et Caisse d'Epargne de l'Etat Luxembourg	Luxembourg	Commercial bank
29.Banco Bilbao Vizcaya Argentaria SA (BBVA)	Spain	Commercial bank
30.SNS Reaal NV	Netherlands	Commercial bank
31.Bank of Ireland	Ireland	Commercial bank
32. NIBC Holding NV	Netherlands	Commercial bank
33.Raiffeisen Zentralbank Oesterreich AG	Austria	Cooperative bank
34.Oberoesterreichische Landesbank AG	Austria	Public savings banks
35.Caixa Geral de Depositos SA (CGD)	Portugal	Commercial bank
36.Mediobanca - Banca di Credito Finanziari	Italy	Commercial bank
37.Banco BPI SA	Portugal	Commercial bank
38.Standard Chartered plc	UK	Commercial bank
39.Aareal Bank AG	Germany	Mortgage bank
40.Banca Carige SpA	Italy	Commercial bank
41.Alpha Bank AE	Greece	Commercial bank

Table 9 List of banks (cont.)

42.Erste Group Bank AG	Austria	Commercial bank
43. Nationwide Building Society	UK	Mortgage bank
44.ABN AMRO Bank NV	Netherlands	Commercial bank
45.Hypo Tirol Bank AG	Austria	Mortgage bank
46.Banca Monte dei Paschi di Siena SpA	Italy	Commercial bank
47.Caisse Centrale du Credit Immobilier de France	France	Mortgage bank
48.Hypo Real Estate Holding AG	Germany	Mortgage bank
49.ING Groep NV	Netherlands	Commercial bank
50.Fortis group	Belgium	Commercial bank
51.Dresdner Bank AG	Germany	Commercial bank
52.Deutsche Schiffsbank AG	Germany	Mortgage bank
53.HBOS plc	UK	Commercial bank
54.Landesbank Sachsen Girozentrale – Sachsen LB	Germany	Public savings bank
55. WestLB AG	Germany	Public savings bank
56.Depfa Bank plc	Germany	Mortgage bank
57.LBB Holding AG-Landesbank Berlin Holding	Germany	Public savings bank
58.Dekabank Deutsche Girozentrale	Germany	Public savings bank
59.Groupe Caisse d'Epargne	France	Commercial bank

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