

Covered Bond Markets:
An Analysis of Their Impact on
Mortgage Underwriting

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ABSTRACT

This thesis analyzes how the prevalence of covered bond and mortgage backed securities issuance in 17 countries in Europe as well as the United States is related to mortgage defaults in those countries during the recent housing boom and bust cycle from 2000 to 2010. It documents the differences between European housing systems and the American model, particularly in terms of Europeans' use of covered bonds as a mortgage funding tool in comparison with the American reliance on MBS. The findings establish a significant positive correlation between covered bond issuance for a given country during the housing boom from 2000 to 2007 and default rates in that country during the bust from 2008 to 2010, even when controlling for various economic and housing structure variables. Conversely, they show a significant negative correlation between MBS issuance and default rates, over these same time periods. These relationships are also significant if default rates are pooled across countries and analyzed on a yearly basis between 2000 and 2010. Further, there remains a significantly negative correlation even when pooled default rates are analyzed using panel regressions to account for any missing cross country differences. Despite their significant correlation to default rates, covered bond and MBS issuance do not appear to have other significant impacts on housing statistics like mortgage debt to GDP ratio, increases in real home prices, and homeownership rates. Indeed, though the findings establish significant relationships between covered bond and MBS issuance and default rates, they identify the strength of recourse by mortgage lenders as an even more important factor that is strongly negatively correlated with mortgage default rates. The study suggests that though covered bonds may increase the stability of the American housing system marginally, structural changes to strengthen recourse are necessary to substantially reduce American default rates to the levels enjoyed by European nations.

Thank You

I would like to thank Professor Stijn van Nieuwerburgh for his help and guidance throughout this entire project. I am further indebted to Professor Nieuwerburgh and fellow NYU Professors Viral Acharya, Matthew Richardson, and Lawrence White for their terrific book Guaranteed to Fail, which was a never-ending resource and guide in the writing of this thesis. I would also like to thank Professor Marti Subrahmanyam and Advisor Jessica Rosenzweig for organizing this terrific program. Finally, I would like to thank Jimmy Myatt, Pratik Mehta, Avinash Nagaraja, Ellen Yang and all of my friends who provided an amazing sounding board and support network to enable this thesis.

FOREWORD

While studying abroad in Berlin in the fall of 2010, I was struck by a strange feature of the recent global financial crisis. Several times, professors or even everyday Germans whom I encountered would mention to me, with some pride, that, unlike the United States or the United Kingdom, Germany did not have a housing crisis in its domestic market. Nor was Germany alone in this respect. Though many European banks were threatened by their holdings of American MBS or caught up in the financial dominos of the larger crisis, many European housing markets avoided the type of housing bubble and bust experienced by the United States and some of their fellow Europeans. Yet, apart from a stereotypical line about German frugality, no one seemed able to explain to me how the Germans were able to do it? This paper is an attempt to explain one potential reason for a portion these disparities, the use of covered bonds.

I. Introduction

The housing crisis struck the United States in 2007 and 2008 like a hurricane. From real-estate brokers, to government agencies to the largest banks in the country, it seemed no one was immune from the fallout. Eventually, it would go on to create the worst financial panic and recession since the Great Depression. While this crisis had many causes, “toxic” mortgages and the mortgage backed securities (MBS¹) they were packaged into in the United States have been widely seen as, at the very least, a major source of this crisis. Commercial banks and mortgage lenders were in a race-to-the-bottom to lend to ever-weaker borrowers in the quest to fill financial markets’ insatiable desire for mortgage credit. Or so the story goes. Yet, if these lenders knew that MBS were filled with such terrible mortgages, why did they keep so many of these securities on their own books?² If the moral hazard contained in separating mortgage originators and holders was so pernicious, originators should have held as few of those securities as possible. The myth that housing prices would never go down explains these holdings to an extent, but it fails to explain the mountain of bad mortgage debt, which the banks owned.

In comparison to the American mortgage market, many European housing markets were spared from a similarly large bust, with notable exceptions in Ireland, Spain and the United Kingdom. While there are many differences between the American and the various European housing systems, one of the most important is in how they fund mortgages. American mortgages are funded primarily through MBS. In contrast, many European nations make use of a similar security known as a covered bond. This bond allows banks to, in effect, securitize and sell bonds backed by mortgages to investors. However, unlike MBS, covered bonds (CBs) seek to remedy

¹ Unless noted, the term mortgage backed securities and acronym MBS in this thesis will refer to only Residential Mortgage Backed Securities not securities backed by commercial mortgages

² 50% of AAA non-GSE MBS were held within the financial sector in 2008. Acharya et al. Guaranteed to Fail. 2011. Princeton UP. 49.

the problem of moral hazard by forcing the underwriting bank to guarantee these bonds with its own credit. Thus, in theory the bank is forced to be more prudent in the underwriting of the mortgages in that security than it would for a normal MBS. In turn, safer underwriting should prevent the extension of credit to so many unworthy borrowers and lead to lower default rates.

This paper seeks to determine whether or not covered bonds did indeed play a significant role in limiting mortgage defaults between the years 2000 to 2010. It will also look at the impact of the prevalence MBS on default rates during the same period. In contrast to CBs, one would expect a country's default rate to be positively correlated to the relative amount of MBS in a particular mortgage market. The findings support these relationships. The issuance of CBs as a proportion of total mortgage lending in 18 countries during the housing boom of 2000 to 2007 is significantly negatively correlated to the corresponding default rates in those countries during the bust of 2008 to 2010. This cross-country analysis also shows that the proportion of MBS issuance in one of these countries in the boom years is significantly positively correlated with default rates during the bust. These findings remain statistically significant even when controlling for various economic and structural housing market factors that are unique to each country. Similar, though weaker, results are found using the amount of CBs or MBS outstanding as a proportion of total outstanding residential loans instead of issuance. Additionally, when pooling yearly the default rates of all 18 countries between 2000 and 2010, the results show that the relative amounts of CB and MBS issuance leading up to a given year significantly impacts (negatively if greater CB issuance and positively if greater MBS issuance) the amount of mortgage defaults in that year. Importantly, the relative prevalence CB and MBS do not appear to have other significant impacts on housing market characteristics like mortgage debt to GDP ratios, real housing price changes, and homeownership rates. The results of this analysis also

show that the strength of recourse mortgage lenders have towards defaulted borrowers is also significantly negatively correlated with default rates. Indeed, the strength of recourse in a country appears to play the biggest role in explaining the relative differences in default rates among countries in the sample.

This thesis will examine what these findings mean for current attempts to reform the American system of housing finance. It will also look at what these results indicate the impact of the development of a CB market in the United States would be, in light of the proposed United States Covered Bond Act currently under consideration by Congress. Further, the Dodd-Frank Wall Street Reform and Consumer Protection Act mandates that 5% of the credit risk of non-qualifying MBS be held by the mortgage originators.³ Given that covered bonds force originators to keep 100% of the credit risk of the security, this paper will attempt to determine whether Dodd-Frank's "skin in the game" provision is likely to have any impact on underwriting practices and default rates. Since the crisis and subsequent collapse of the housing market, Americans have been reliant on the two bailed-out government sponsored enterprises (GSEs) Fannie Mae and Freddie Mac to insure or purchase 90% of new mortgage loans.⁴ Economists of every stripe, as well as the Obama Administration, have questioned the wisdom of a private industry so reliant on government guarantees. Still, with little market appetite for private-label MBS, many worry that alternative sources of housing finance would not be able to meet market demand without dramatically higher mortgage rates and less mortgage credit availability. This paper will examine whether covered bonds are a potential solution to this problem by effectively securitizing mortgages without creating another race-to-the-bottom in underwriting standards.

³ Center for Responsible Lending. "Summary of Key Provisions: Dodd-Frank Wall Street Reform and Consumer Protection Act." <www.responsiblelending.org>. 1 Dec 2010. 4.

⁴ Data for the first half of 2010. Acharya et al. Guaranteed to Fail. 2011. Princeton UP. 9.

This thesis is structured as follows. Sections II and III will focus on the background of covered bonds and their place within the broader framework of European housing finance. Building on this background, Section IV will examine prior research on this topic. Based on this research and economic theory, Section V will hypothesize the impacts we expect to see in this study. Sections VI will examine the data used to conduct this analysis. Then, Sections VII will analyze the key findings on the impact of the propensity CB and MBS on mortgage default rates in a cross-country analysis. Section VIII will discuss other findings including pooled and panel analyses of the relationship between CB and MBS propensity and default rates as well as looking at other housing characteristics as dependent variables that might be impacted by CB and MBS. Finally, Section IX will draw conclusions from these results as well as make recommendations for the future of covered bonds in the United States. Additionally, it will offer thoughts on further topics of research in this field.

II. WHAT IS A COVERED BOND?

Covered bonds are not a mainstream mortgage financing tool in the American toolkit. However, this type of security has become one of the largest sources of housing finance in Europe. Covered bonds were first used to finance public works projects in the 1700s in Prussia, predating the first MBS products by over 200 years.⁵ As of the end of 2010, the covered mortgage bond market contained more than 1.7 Trillion Euro in bonds outstanding issued in 19 countries in Europe, as well as Canada, New Zealand and the United States.⁶ While covered bonds are still used to finance the public sector (notably in Germany), as well as other types of assets, today covered bonds fund primarily mortgages.⁷ Though some of the specifics vary from

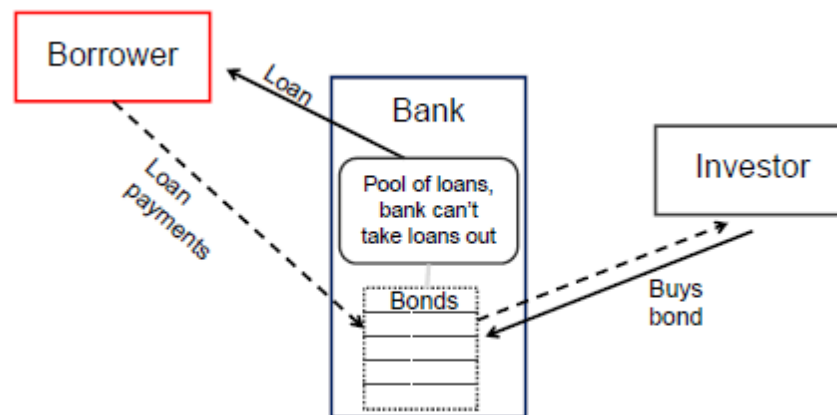
⁵ Kaelberer, Wolfgang, ed. 2011 European Covered Bond Fact Book. European Covered Bond Council. 2011. 98.

⁶ Id. at 458 and 459.

⁷ Id. at 458.

country to country and will be discussed in detail later, the basic concept of a covered bond is a relatively simple extension of banks' normal role in providing mortgage credit. It begins with a bank making normal mortgage loans. However, these loans are placed into a special ring-fenced account known as a covered pool. The bank then issues bonds that are collateralized by this pool to investors. Thus, the bank has essentially used these bonds as collateral to receive new funding. These bonds are generally over-collateralized by the assets in the covered pool.

Figure 1: Covered Bond Process



Source: Federal Reserve Bank of Chicago. Carbo-Valverde et al. 23.

Crucially, covered bonds are backed not only by the covered pool, but also by the bank's balance sheet. This backing can take one of two forms. First, the issuer is required (usually by specific covered bond laws, regulations or security covenants) to keep the present value of the cash flows of the mortgage pool at least as large as the present value of cash flows due under the covered bond. Consequently, if mortgages in the pool are pre-paid or default, the issuer will replace those loans with other ones of similar maturity to ensure that the present value of covered pool remains above that of the covered bonds. Second, the bonds are considered general obligations of the bank. This entails that the bank must meet its interest payments out of its general funds; if mortgages in the pool go into arrears, the bank must keep paying interest and principal on the bond. These measures provide significant incentive for the issuer to use strong

underwriting practices for the mortgages placed into the covered pool. Investors only need to worry that the CB will default if the issuing bank defaults. Even in this eventuality, the holders of the CB are protected because the covered pool has been ring-fenced in the bank's assets. This means that if the bank is insolvent the bondholders have recourse to the pool's assets, which are regulated to include only loans below a maximum loan-to-value threshold. These assets can be liquidated to pay off the remaining obligations to the bondholders. If the covered pool's assets are not equal to the remaining obligations of the bond, then bondholders become unsecured creditors for the remaining amount due in a bankruptcy procedure.

This general process for covered bonds is the norm across Europe. However, there are several exceptions to this rule. Most notably, Denmark, the largest issuer of outstanding mortgage covered bonds, uses covered mortgage bonds to fund the vast majority of its housing market in a slightly different way. In Denmark, a new bond is issued by one of four authorized mortgage banks through tap issuance on a 1-to-1 basis with a newly originated loan.⁸ Because of this link, a mortgage borrower is not only able to refinance his mortgage if interest rates fall, but is also able to buy back his mortgage at lower than par if interest rates rise and the market value of the bond falls below par. Significantly, this allows a borrower to reduce the loan-to-value (LTV) percentage, building a cushion of positive equity. The positive equity helps cushion a future downturn in housing prices.⁹ In addition to Denmark, the United Kingdom also has a unique twist on the covered bond framework. In the U.K., covered bonds are known as “structured covered bonds,” which unlike their European cousins are issued by a bank and then sold to special purpose entities similar to those used in the United States to issue mortgage

⁸ Tap issuance allows the mortgage bank to link each loan with certain amounts of bonds issued under an open ISIN code, which are pooled and sold to investors the following day. For a more detailed description see the [2011 European Covered Bond Fact Book](#). European Covered Bond Council. 2011. 213.

⁹ Lea. “Alternative Forms of Mortgage Finance.” 14 Apr 2010. 18.

backed securities. However, these CBs remain the obligations of the issuer, and only become the obligation of the SPE's covered assets if the issuer defaults¹⁰. Thus, in the U.K. the SPE is used as a method to ring-fence the covered assets as opposed to a method to reduce the issuer's exposure to the assets as in the United States.

Those familiar with the process of mortgage securitization in the United States will recognize the similarities between MBS securitization and the covered bond process. Both products are a source of mortgage funding that allows a bank to receive cash for the mortgages it holds on its balance sheet. They also give investors other than banks a vehicle to lend to homebuyers. However, there are significant differences between the two systems. First, apart from the U.K., covered bonds remain on the balance sheets of the originating bank, while MBS products are sold to a special purpose entity (SPE), which then sells the MBS to investors. In the United States, often this process involved the selling of mortgages to Fannie Mae or Freddie Mac in order to gain a government guarantee and regulatory capital relief.¹¹ This treatment of CBs as obligations of the originating bank is quite different from MBS, which are the obligations of a bankruptcy-remote SPE. (See Figure 2) The originating bank no longer has any obligation on loans in an MBS sold to the SPE and pooled in an MBS.¹² Thus, there is a significant problem with moral hazard in MBS. The explanation that this originate-to-distribute (OTD) model encouraged banks to create unsound mortgages solely to place them in MBS and collect a fee for servicing the mortgages without bearing any credit risk on the underlying mortgages, remains prevalent.¹³ This sentiment was supported in academic circles by Keys et al (2010) and

¹⁰ "Review of the UK's Regulatory Framework for Covered Bonds." FSA. April 2011. 11.

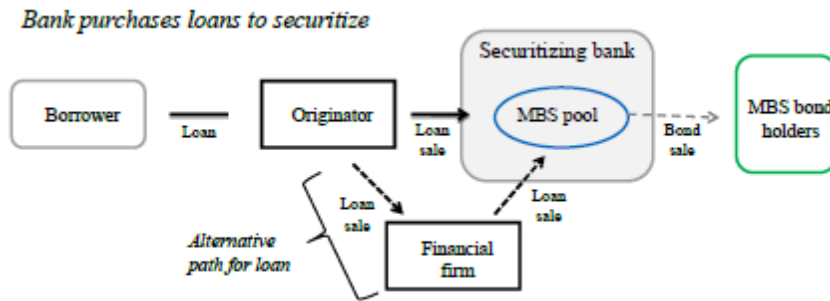
¹¹ Acharya et al. Guaranteed to Fail. 2011. Princeton UP. 24.

¹² Credit and liquidity guarantees did provide recourse to the bank's balance sheet in some instances, if only to preserve the issuer's reputation. Acharya, Schnabl and Suarez. "Securitization without Risk Transfer." 20 Oct 2011.

¹³ Zandi, Mark. "Fannie and Freddie Don't Deserve Blame for the Bubble." Washington Post. 23 Jan 2012.

Purnandanam (2011), which found that the OTD business models were positively correlated with riskier underwriting. Covered bonds hope to eliminate this problem by forcing banks to retain the credit risk of their mortgages. Yet, this comes at the potential cost of higher mortgage rates as banks are forced to hold more capital on their balance sheets against the risk of their obligation under the covered bond.

Figure 2: MBS Process

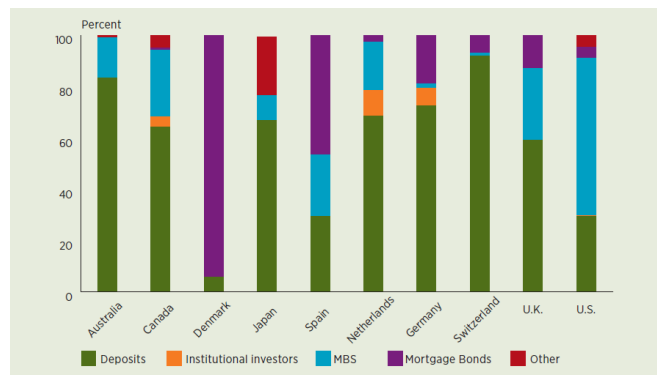


Source: Federal Reserve Bank of Chicago. Carbo-Valverde et al. 22.

III. OVERVIEW OF EUROPEAN AND AMERICAN HOUSING SYSTEMS

Differences in how mortgages are funded are a key distinction between the American and European housing systems. Figure 3 illustrates some of the large differences in mortgage funding between the United States, Europe and other developed countries.

Figure 3: International Mortgage Funding Sources



Source: EMF, IMF and CMCH¹⁴

¹⁴ Lea. "Alternative Forms of Mortgage Finance." 14 Apr 2010. 18.

While the United States relies primarily on MBS to fund almost two-thirds of its housing, covered bonds are responsible for almost all mortgage finance in Denmark as well as significant amounts in Germany, Spain and the United Kingdom. In turn, these disparate housing funding methods connect to the structural characteristics of housing markets in these countries.

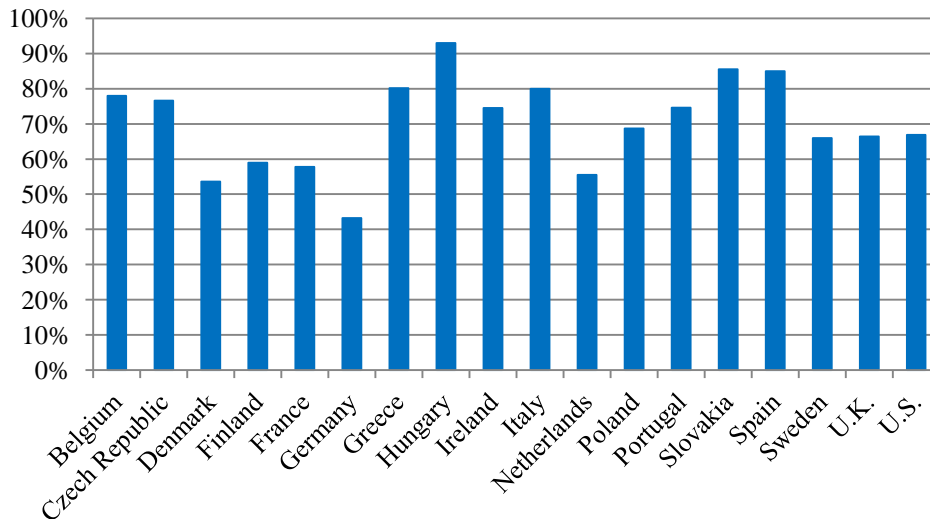
Key among these differences is the amount of support a government gives to the housing industry. This support can take the form of direct subsidies to special groups of homebuyers (first-time buyers, low-income groups) as well as preferential tax treatment such as deductibility of mortgage interest and property taxes. Profits on home sales can also be exempted from capital gains taxes. The most overt support to the housing market comes in the form of government agencies, which provide mortgage guarantees or actual credit for housing investment. Outside of the United States with its gigantic Government Sponsored Enterprises,¹⁵ only the Netherlands, Canada and Japan have similar government agencies. However, for this study, which does not look at Canada or Japan, the Netherlands' housing agency (Nationale Hypotheek Garantie or NHG) does not engage in mortgage funding but is only an insurer. The insurance it provides, furthermore, is explicitly recognized as an obligation of the Dutch government. Thus, in the eyes of almost all observers, the United States government supports housing far more than most European countries. Indeed, according to the IMF's Index of Government Participation,¹⁶ only the Netherlands and Finland can compare to American levels of housing support. See Appendix Table 1 for full data. In exchange for this support of mortgage markets, governments do not seem to have gotten much bang for their buck. As shown in Figure 4, there is wide disparity in homeownership rates among various European nations and the United States. However, these

¹⁵ This paper does not specifically address the role of the GSEs in mortgage funding in the United States, but is heavily reliant for background on the subject on Acharya, van Nieuwerburgh, Richardson and White for their analysis of the GSEs in *Guaranteed to Fail*.

¹⁶ A more thorough analysis of this metric is found in Section VI section of this thesis. "Housing Finance and Financial Stability." *Global Financial Stability Report*. IMF. April 2011. 126.

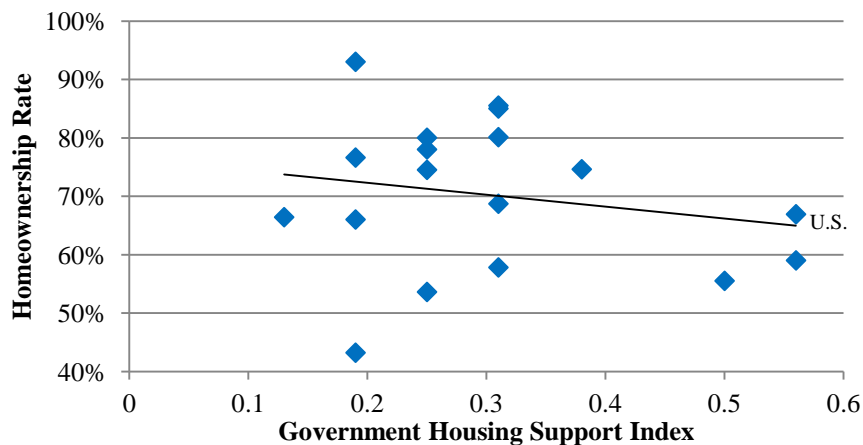
rates are actually negative correlated with the amount of support the government gives to housing in these countries, as illustrated in Figure 5. Therefore, it would appear that government impact on mortgage markets is more closely tied to structural factors than direct support.

Figure 4: Comparison of Homeownership Rates



Source: Source: EMF Hypostat 2010

Figure 5: Homeownership vs. Government Housing Support



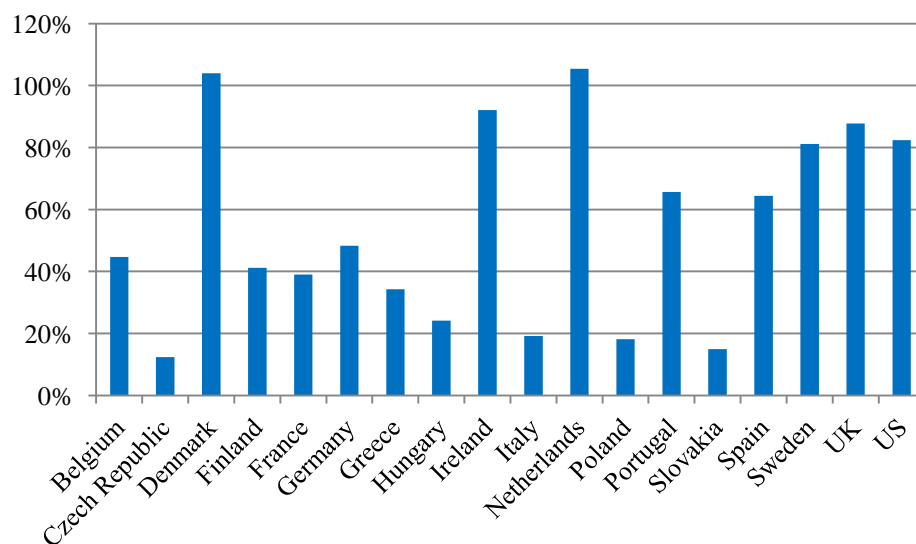
Source: EMF, IMF, CMCH

Given the lack of apparent impact of government measures to increase homeownership, perhaps the variation in the source of mortgage funding across countries is better explained by other structural differences. One possible structural factor may be the level of recourse that

lenders have to recover the balance of a defaulted mortgage loan from borrowers. This recourse can take the form of claims on the borrower's current assets besides the property or even claims on the borrower's future income. In many parts of the United States, mortgage loans are essentially non-recourse loans where lenders can only take possession of the mortgaged property to recover losses. This lack of recourse has created an incentive for borrowers to "stereotypically" walk away when their homes have negative equity (loan value is worth more than the value of the home). Meanwhile, the standard in Europe is for stronger recourse with a majority of nations allowing recourse to both other assets and future income. See Section V for a country by country analysis of recourse. Research in the United States (Ghent and Kudlyak 2009) and in Europe (Duygan and Grant 2006) has shown that strength of recourse is significantly negatively related to mortgage default rates. Thus, recourse could partially explain why default rates were much lower in Europe than the United States during the financial crisis.

Similar to recourse, different loan-to-value regulations play a key role in how different mortgage markets function. While in the United States there is no legal limit on LTV ratios, the historical average was 75% of a home's value, this percentage went much higher during the housing boom as the OTD model and GSE involvement pushed mortgage originators to lower underwriting standards (Acharya et al. 2011). Conversely, in Europe mortgage lenders are much more strongly regulated to keep within strict limits of loan-to-value ratios on mortgages.¹⁷ This could also be a potential explanation for lower European default rates. One might expect these limits to also result in smaller mortgage markets as defined by mortgage debt to GDP. However, a look at European countries in Figure 6 illustrates that this is not necessarily the case. In fact, countries with strong LTV regulations like the Netherlands and Denmark carry more mortgage debt than the U.S.

¹⁷ "Housing Finance and Financial Stability:" Global Financial Stability Report. IMF. April 2011. 117.

Figure 6: Comparison of Mortgage Debt to GDP Levels

Source: EMF Hypostat 2010

Another key structural difference between the United States and Europe is the type of mortgage products available in each country. There are three primary types of mortgage products available across these markets. American mortgage offerings are dominated by the 30 year fixed-rate mortgage (FRM). While other markets like France and Denmark have significant proportions of long-term FRMs, none are as reliant on long-term FRMs as the United States.¹⁸ Meanwhile in Europe there is wider a variety of mortgage offerings. Adjustable rate mortgages (ARMs) are much more prevalent in markets in the United Kingdom, Spain and Ireland.¹⁹ A third type of product found in Europe is the “rollover” mortgage which begins as a fixed rate product for 5 to 10 years and then is adjusted to a new market rate. This type of security is prominent in Germany, the Netherlands, and increasingly in Denmark.²⁰ Unlike American mortgages, European mortgages (except in Denmark) often carry a significant prepayment

¹⁸ “Housing Finance and Financial Stability:” *Global Financial Stability Report*. IMF. April 2011. 117.

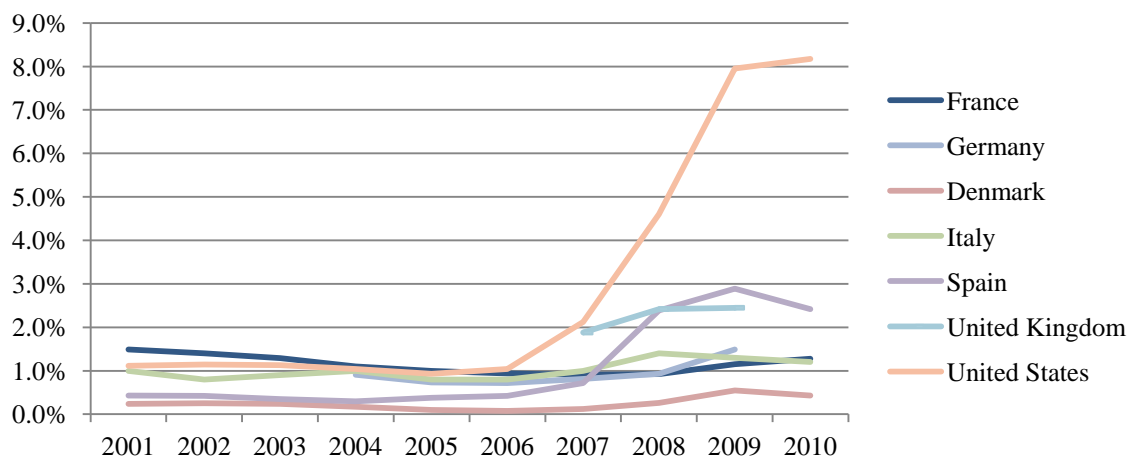
¹⁹ Lea. “Alternative Forms of Mortgage Finance.” 14 Apr 2010. 6.

²⁰ Id. at 6.

penalty that compensates lenders for lost interest income when a mortgage is refinanced at par.²¹ In spite of these differences, Lea (2010b) does not find that they significantly impact default rates in these countries, given that there is little observable pattern between mortgage funding types and default rates across countries.

It is widely recognized that the 2008 housing crisis began and was most severe in the United States. Figure 7 illustrates this by comparing the default rates in the United States with several major European markets from 2001 through 2010.²² We can also see that American default rates were toward the top of the spectrum in the pre-crisis years. This elevated default rate affected the financial sector through the failure of securities backed by these mortgages.

Figure 7: Comparison of Mortgage Default Rates



Sources: EMF, European Commission, Fitch Ratings

Anecdotal evidence shows that mortgage backed securities in the United States experienced significant defaults in comparison to European markets. In fact, the Danish covered bond market experience no defaults (despite a larger housing boom).²³ Crucially, the Danish market also never froze during the crisis (Realkreditradet 2009). Post-crisis, covered bond

²¹ “Housing Finance and Financial Stability” *Global Financial Stability Report*. IMF. April 2011. 117.

²² Data for this chart is explained extensively in Section VI of this paper.

²³ Lea. “Alternative Forms of Mortgage Finance.” 14 Apr 2010. 18.

issuance has recovered more strongly than private label MBS issuance in the United States, although this is in part because the European Central Bank has begun accepting covered bonds as collateral from troubled European Banks. However, records of mortgage security defaults are inconclusive in determining the effect of covered bond and MBS prevalence on individual mortgage defaults as security default could be caused by under-collateralization or other structural issues in the security rather than the mortgages themselves.

IV. PRIOR RESEARCH ON COVERED BONDS

Academic research on covered bonds has been largely limited to broad comparisons of mortgage markets across countries and more specific comparisons of CBs and MBS. These studies have largely focused on the qualitative structural differences between these markets. Of this work, Michael Lea's overview of mortgage finance systems across countries provides one of the best analyses. Further, Jay Surti's analysis of CBs versus MBS gives a very useful analysis of the relative strengths and weaknesses of each type of security and lays out a potential path towards the creation of a CB market in the United States. Yet, the scope of quantitative research has been quite narrow. Carbo-Valverde, Rodriguez-Fernandez, and Rosen (2011) have conducted one of the first quantitative studies at the individual bank level on the motivations for MBS and CB issuance as well as their relationship to bank defaults in the crisis. However, there is still little quantitative research on covered bonds, a hole that this thesis hopes to help fill.

In his research on international mortgage markets, Lea (2010a, 2010b) created a terrific overview of the key differences between a variety of developed mortgage finance markets. The 2010a and 2010b papers rely on essentially the same macro housing data and research to analyze different aspects of international mortgage finance and their impact. In "Alternative Forms of Mortgage Finance:" Lea looks into the government policies towards housing in twelve developed

countries. After comparing the countries across a spectrum of performance metrics and measures of government intervention he finds that all of America's government involvement in housing markets has not paid off in neither stability of mortgage markets nor significantly higher homeownership rates.

Based on this underperformance, he looks at four other mortgage finance systems and their suitability as a guide for future American housing policy. First, he describes Denmark's covered bond market. As discussed earlier this system allows borrowers to not only pre-pay when interest rates are low but also to buy back their mortgage at below-par rates when interest rates are high allowing them to reduce the likelihood of negative home equity. He posits that this feature could explain Denmark's low default rate and lack of mortgage bond failures during the crisis. Lea goes on to conclude that despite the catch-22 problem of removing government guarantees, the Danish system provides a plausible route for the United States, allowing it to keep a system of fixed-rate mortgages while achieving the goal of making sure underwriters have skin-in-the-game. Second, he looks at the covered bond system used elsewhere in Europe, particularly Germany, France and Spain. He finds that the European CB model would significantly reduce the government's role in mortgage finance and would create a "liquid, simple and low risk security to fund housing." However, Lea does not discuss what drawbacks such a move could have, such as higher mortgage rates or decreased mortgage availability.

In "International Comparison of Mortgage Product Offerings," Lea finds that in many respects, the American mortgage market is unique in its reliance on fixed-rate mortgages and hostility towards pre-payment penalties. He attributes this reliance on FRMs is in part caused by government-backed secondary mortgage markets. Expanding upon this theme, he contends that more exotic mortgage products incorporating longer terms, interest-only periods, flexible

payments or adjustable-rate mortgages do not appear correlated with higher default rates in countries where these products are more prevalent. He concludes that the Dodd-Frank Act's hostility towards these alternative mortgage products is misguided. Rather, he points the finger for America's high default rate during the crisis at its lack of full-recourse on mortgage loans and mis-matching of products with borrowers through poor underwriting practices. As opposed to eliminating non-fixed-rate products, he recommends that stricter underwriting standards and stronger recourse would be the best ways to improve the American housing market.

Surti (2010) focuses on the reasons why CBs should be part of the post-crisis American housing finance system. He qualitatively discusses the superiority of CBs to other types of mortgage funding and proposes a regulatory framework as well as steps to help facilitate the development of this market in the United States. The key point of his findings is CBs' ability to increase lending standards so as to combat the moral hazard problem inherent in the originate-to-distribute (OTD) model of MBS. However, his findings fail to quantify how sharp the increase in lending standards would be, a question this thesis will attempt to address. Further, he acknowledges that CBs require greater capital commitments from banks than MBS, and have the potential to lead to higher mortgage rates for borrowers. While there is mixed academic research to support the OTD model's ability to lower mortgage rates (pro see Naranjo and Toevs (2002), con see Heuson et. al. (2001) and Lehnert et. al. (2008)), Surti acknowledges that a tradeoff between underwriting standards and mortgage rates between CBs and MBS likely exists. Despite this tradeoff, he argues that CBs are the best solution in the marketplace by providing market liquidity for housing investment while maintaining strong underwriting practices. He also points out that CBs are flexible, taking on multiple structures to allocate pre-payment and

interest rate risk to the issuers (as with German Pfandbriefe) or investors (Danish CBs) and allowing that risk to be taken on by the party most willing to accept it.

In his conclusion, he suggests that the United States needs dedicated CB legislation in order for the market to expand. He proposes that the legal framework should address how CB pools are treated in the event of an issuer default to ensure that investors have timely access to the secured pool of covered assets. In his opinion, this framework should also include a maximum LTV regulation and a more conservative housing assessment process, as in European countries. He also suggests that the Federal Home Loan Banks could play a role in sparking the CB market in the United States by issuing their securities in the form of CBs. However, Surti's assertions beg the question of whether European style LTV ratios and valuation methods would make American MBS as safe as European CBs. Thus, his qualitative analysis only goes so far in providing policy recommendations for the American housing system, but it fails to identify whether it is CBs or regulations, which have made European markets safer.

Carbo-Valverde, Rodriguez-Fernandez, and Rosen examine the similarities and differences between covered bonds and MBS at the individual bank level. Their sample contains 711 banks in France, Germany, Italy, Spain, the U.K., and the U.S. with over one billion dollars in total assets; 121 issued covered bonds, and 107 issued MBS from 2003-2007. Using bank financial statements and CB and MBS issuance data, they find that CBs are more often issued to increase a bank's liquidity as shown by a reduction in loan-to-deposit ratio after the issuance. Conversely, MBS are more likely to be issued by a bank trying to reduce risk as shown by a decrease in loan provisions after an MBS issuance. This makes sense given that CBs provide liquidity without changing a bank's risk profile, while MBS completely remove the credit risk of securitized mortgages from the bank's balance sheet. Importantly, it also suggests the possibility that banks

knowingly put their worst mortgages into their MBS products to remove those risks from their balance sheets, although this cannot be proved with certainty from the results. Further, they found that MBS issuance was more closely related to agency problems than CBs through evidence of “herd” behavior among banks issuing MBS. Often one bank would quickly follow after others who had issued MBS to take advantage of good market conditions. This pattern was not found for banks issuing CBs. In their last and perhaps most pertinent finding for this thesis, Carbo-Valverde, Rodriguez-Fernandez, and Rosen found that banks who issued MBS during 2006-2007 were significantly more likely to require a government bailout during the financial crisis than the normal bank. CB issuance had no such relationship with future bailouts. While this provides circumstantial evidence towards banks issuing MBS being more risky than banks issuing CBs, it does not prove that those MBS products were what brought down the bank, or that those mortgages were riskier than mortgages in the CB. Indeed, the authors speculate that the issuance of MBS is acting as a proxy for a bank’s participation in the wide variety of financial engineering that went sour during the crisis.

V. HYPOTHESIS

My hypothesis is that CB issuance should be negatively correlated with mortgage defaults during the 2008-2010 crisis across countries. CB’s skin-in-the-game, which prevents moral hazard, should keep issuers in countries with large CB markets from participating in a race-to-the-bottom in mortgage underwriting. The use of CBs would also allow banks to fund themselves and increase liquidity without having to compete in MBS markets that became caught up in the originate-to-distribute model. One would expect that this inverse relationship between CBs and default rates would be particularly strong during the peak of the housing boom from 2005 to 2007. CB issuers were prevented by regulation and their own credit exposure from

pushing underwriting standards too far in the same manner that MBS issuers did. Thus, MBS issuance should be positively correlated with defaults due to its inherent moral hazard problem. Similarly, one expects this relationship would be stronger during the peak boom years from 2005 through 2007. Levels of outstanding CBs and MBS in a country should follow the same basic pattern. However, their relationship with defaults will most likely be weaker than the issuance's relationship as outstanding bonds include a much larger portion of older CBs and MBS that were issued before the housing bubble and the emergence of the OTD model for MBS.

One would expect that CB and MBS issuance remains a significant factor in predicting default rates on a yearly basis even outside of the crisis's peak. Again, this relationship should take the form of CB issuance predicting lower default rates and MBS issuance predicting higher default rates. Although basis outside of the crisis these relationships will likely be much weaker than during the crisis peak of defaults, one would expect that the inherent moral hazard effects that differentiate CBs and MBS do not go away even in good times. This impact is expected to be felt from long term trends in CB and MBS issuance and not one year spikes.

This moral hazard issue would also lead one to believe that high CB issuance would encourage lower levels of mortgage indebtedness, slower changes in housing prices and slightly lower levels of homeownership in each country. All of these relationships are expected because of CBs connection to prudent underwriting practices, which do not encourage the flood of borrowing that fuels bubbles in mortgage debt, home prices, and home ownership. In contrast, as seen in the United States before the crisis, MBS can create these bubbles and so should lead to highly volatile housing prices, high levels of mortgage debt and high homeownership rates as lenders push more and more renters to buy homes.

Moving away from CB and MBS issuance one would expect that a government's support for housing would increase default rates during both the crisis and on a normal yearly basis. Most of the government policies supporting housing are designed to encourage citizens to buy homes and lenders to lend to them. By encouraging mortgage lending and borrowing by poorer borrowers, one would expect that government housing support would contribute to higher default rates when these marginal borrowers are inevitably the first to default in economic downturns. Conversely, higher levels of recourse in a country should significantly decrease the number of defaults by giving homeowners reasons not to default on their loans even when they have negative equity in them. This is supported by earlier research showing similar trends in Europe and the United States. Together, these structural variables combined with CB and MBS issuance and economic variables like real GDP growth and real housing price changes should predict the level of defaults experienced throughout the crisis.

VI. DATA

To test this hypothesis, I examine data from 18 countries, 17 European nations and the United States. First, I use data from the European Mortgage Federation's (EMF) Hypostat 2010 book on the yearly issuance of covered bonds by country divided by the EMF's data on each country's gross new residential mortgage loans to create a "CB Issuance Share" or (CBI) for each sample country from 2001 through 2010. Similarly, data on MBS issuance for the United States is attained from Securities Industry and Financial Markets Association (SIFMA), while the Association for Financial Markets in Europe (AFME) provided similar data for the European nations in the sample. When divided by gross new mortgage loans, as before with CBs, this data allowed me to calculate the "MBS Issuance Share" or (MBSI). Table 1 shows the complete list of countries in the sample as well as various data sources for them.

Table 1: Selected Data and Sources

Country	Default Rates		Recourse		Gov. House. Support	
	Source	Type	Source	Value	Source	Value
Belgium	EMF	90 Day	EMF	1.00	IMF	0.25
Czech Republic	EC	90 Day	Regression Estimate	0.65	IMF	0.19
Denmark	EMF	90 Day	EMF	1.00	IMF	0.25
Finland	EC	90 Day	Regression Estimate	0.16	CMHC	0.56
France	EMF	60 Day	CMHC	0.50	IMF	0.31
Germany	Fitch	30 Day	EMF	1.00	IMF	0.19
Greece	EC	90 Day	EMF	1.00	ECBC	0.31
Hungary	EMF	90 Day	Regression Estimate	0.60	IMF	0.19
Ireland	EC	90 Day	EMF	1.00	IMF	0.25
Italy	EMF	90 Day	Regression Estimate	0.55	IMF	0.25
Netherlands	Fitch	30 Day	CMHC	1.00	IMF	0.5
Poland	EMF	90 Day	Regression Estimate	0.47	IMF	0.31
Portugal	EMF	90 Day	EMF	1.00	ECBC	0.38
Slovakia	EC	90 Day	Regression Estimate	0.39	IMF	0.31
Spain	EMF	90 Day	Fitch	0.50	IMF	0.31
Sweden	EC	90 Day	IUHF	1.00	ECBC	0.19
U.K.	EC	90 Day	CMHC	1.00	IMF	0.13
U.S.	EC	90 Day	Ghent & Kudlyak	0.00	IMF	0.56

Sources: EMF: European Mortgage Federation, EC: European Commission, Fitch Ratings, CMHC: Canadian Mortgage Housing Corporation, IUHF: International Union of Housing Finance, IMF: International Monetary Fund, ECBC: European Covered Bond Council

Following on this approach, amounts of outstanding covered bonds and MBS were available from the same sources and are divided by the total amount of residential mortgage debt reported by the EMF in the same country to calculate country by country MBS and CB outstanding percentages (MBSO and CBO), respectively. One caveat is that the MBS data covers purely residential MBS while the CB data contained CBs with both commercial and

residential mortgages.²⁴ Thus, the values are not perfectly comparable. However, because covered bond issuers can include commercial mortgages and residential mortgages in the same covered bond, this problem is almost impossible to correct. The IMF uses the same data and acknowledges that this problem is largely unsolvable. Since covered bond statistics include some commercial mortgages and banks can also place mortgages into covered bonds in later years after they are originated, CBI is not necessarily upper-bounded at 1.²⁵

These various proportions of CBs and MBS issued and outstanding show the various relative importance of CB and MBS funding on each of the mortgage markets in the sample, providing the key independent variable regressed against default rates. Significantly, each of the markets in the sample has at least some CB outstanding between 2001 and 2010, while 14 of the countries had MBS outstanding during the same period. Issuance data was not available for two countries in the sample, Portugal and Slovakia, and so they were not included in the issuance regressions. The sample is designed to give a fair comparison of the impact of covered bonds and MBS in markets where both products exist. However, it does include the four countries without MBS to provide stronger statistical evidence and to recognize that countries do have the choice to reject one system in favor of the other.

Data on mortgage defaults, the key dependent variable in this analysis, was gathered from a variety of sources. The primary data source was the EMF's 2011 Study on Non-Performing Loans in the EU. This report contains information on defaults in 8 countries in the sample from 2001 through 2009 or 2010. It defines default rate as the percentage of loans in a country over 90 days in arrears (DR). This definition is held true for all the countries from the EMF report except France, which includes a 60 day arrears rate. Similarly, data on defaults for 8 other

²⁴ Kaelberer, Wolfgang, ed. 2011 European Covered Bond Fact Book. European Covered Bond Council. 2011. 148.

²⁵ In this sample, only Denmark breaks above the 1 barrier.

countries in the sample is from the European Commission's 2011 staff working paper on measures to avoid foreclosure procedures.²⁶ Although this source only contains data on 2008 through 2010, it is still illustrative of DR during the crisis and uses the same 90 day arrears definition as the EMF data. Finally, data on Germany and the Netherlands and from Fitch Ratings was gathered from Lea (2010a). Unfortunately, this data only included the rate of mortgages 30 days in arrears. While it would obviously be ideal to have the French, German and Dutch data for 90 days in arrears to maintain consistency throughout the sample this data was still included since their default rates will show the relative increase in defaults during the crisis. Directionally the data should give the same results.

Other independent variables added as controls are real GDP growth (RGDP) from the OECD and changes in real housing prices (RHP) calculated using housing price data from the Bank of International Settlements adjusted for inflation data using OECD CPI data.²⁷ Further data on other aspects of housing markets like mortgage debt to GDP and homeownership rates come from the 2010 EMF Hypostat. Finally, data on structural variables was not as uniform. Government housing support data is gathered from the IMF's 2011 "Housing Finance and Financial Stability" paper. It calculates an index value using a weighted average of various measures of government housing support (GHS). These measures and the formula used to calculate them can be found in Appendix Table 1. For recourse (REC), the level of recourse was coded as one of three outcomes. A "1" designates a country whose lenders have full recourse to a borrower's other assets and future income. A ".5" designates a country whose lenders only have recourse to other assets while a "0" indicates a country where mortgages are no-recourse or where recourse is so difficult as to make it practically impossible to enforce. The United States

²⁶ "National Measures and Practices to Avoid Foreclosure Procedures for Residential Mortgage Loans." [European Commission](#). 31 March 2011.

²⁷ Thank you to Professor Van Nieuwerburgh and David Kohn for assembling this data on housing prices.

was the only country to rate a “0” on this scale. Recourse data comes from the EMF²⁸, CMCH²⁹, Fitch Ratings³⁰ and the International Union of Housing Finance³¹ for 12 of the sample countries.

While regressions are run using just this data, I also use other methods to increase the sample size by estimating values for the remaining recourse and government housing support data points. First, for government housing support, I use the ECBC 2011 Factbook as well as the CMCH³² data to establish the various government policies used to calculate the IMF index for the missing countries and then calculate the index myself using the formula given by the IMF. Second, for the missing recourse data I run a regression of recourse against government housing support, mortgage debt to GDP ratio, and homeownership rates. This regression had an R² of .5532. Its results are used to estimate the value of the recourse variable for the six countries without recourse data. Using the IMF and my imputed values for GHS and REC, I run another set of regressions, which allow for expanded data sets to be used given the amount of data points that had to be thrown out before due to missing information.³³

VII. MAIN RESULTS

Using this data, I test my hypotheses using a variety of different regressions. All of these regressions bar two make use of a type of regression known as a Tobit regression. The two other regressions, the panel and RHP analyses, use linear regression. A Tobit regression is a type of censored regression which adjusts for the fact that the default rate cannot go below zero, thus skewing the normal linear regression by stopping the dependent variable at a single point which

²⁸ EMF data was classified by Professor Michael Lea in “International Comparison of Mortgage Product Offerings.” Research Institute for Housing America. Sept 2010. 32.

²⁹ Asselin, Andre. Canadian Mortgage Housing Corporation. “A Canadian Perspective on Housing Finance in the World.” 2009. 5.

³⁰ Alloway, Tracy. “Fitch on Spanish Mortgage Walkaways.” Financial Times. <www.ft.com>. 28 Jan 2011.

³¹ Hendershott, Patric and Bengt Turner. “The Determinants of Mortgage Default Contrasting the American and Swedish Experiences.” International Union of Housing Finance.

³² Asselin, et al. “Review of Finland’s Housing Policy.” Canadian Mortgage Housing Corporation.

³³ These regressions using estimated values are marked with an * in the regression results.

many of the variables cluster around.³⁴ The Tobit regression gives the regression the proper amount of statistical power, which is otherwise lost due to the zero bound.

In this analysis, I also create a difference variable which takes the CB issuance or outstanding share minus the MBS percentage, creating difference in issuance shares (DI) or difference in outstanding shares (DO), respectively. These two variables capture the predicted inverse impact of CBs on default rates by inverting the positive impact of MBS so both effects are in the same direction. This allows one to better compare the overall mortgage funding system in each country whether they are mostly funded with CBs (highly positive DI or DO, such as Denmark) or MBS (highly negative DI or DO, such as the U.S).

As illustrated in formula (1), these regressions examine the impact of a country's average CBI, MBSI, and DI in past years against the average default rates in that country in the current year. Thus, they seek to examine whether past CB and MBS issuance or outstanding shares impact how the country's mortgages performed during a given period. This is done because, while current economic conditions will impact default rates, it is past underwriting standards that impact current defaults as lower quality borrowers do not immediately default on their mortgages.

$$\text{General Regression Formula: } DR_{t,i} = \alpha + \beta \text{AverageCBI}_{(t-n, t-2, t-1),i} + \gamma X_{t,i} + \kappa S_i + E_t$$

CBI represents any of (CBI, MBSI, CBO, MBSO, DI, DO)
 X = Economic Controls (RHP, RGDP)
 S = Structural Controls (GHS, REC)
 t = year of defaults i = country

(1)

Furthermore, these regressions control for several variables to isolate the variation in default rates caused by CBs or MBS. Economic variables like RHP and RGDP (collectively X) are used to adjust for the fact that mortgages usually default less when home prices are rising

³⁴. "Stata Data Analysis Examples: Tobit Analysis." UCLA Academic Technology Services
 <<http://www.ats.ucla.edu/stat/stata/dae/tobit>>.

(houses can be sold to pay off the mortgage at a profit) or the economy is doing well. As shown in formula (1), these economic variables are for the same year as the default rate as current economic conditions will have the largest impact on defaults. Structural variables like GHS and REC (collectively S) are used to control for the differences in default rates that are caused by these structural policies in an individual country regardless of mortgage funding sources or economic conditions. These factors remain constant regardless of year in this model. All together, these aspects are the basis of the regression used for the main analysis, formula (1). The dependent variable (DR) for a given country and time period is regressed on the average of a CB or MBS variable over a preceding time period in that country, controlling for the country's economic performance during the time period of the defaults, and its structural characteristics.

ISSUANCE 2000-2007

$$\text{AverageDR}_{(2008-2010),i} = \alpha + \beta \text{AverageCBI}_{(2000-2007),i} + \gamma \text{AverageX}_{(2008-2010),i} + \kappa S_i + \varepsilon_i$$

CBI represents any of (CBI,MBSI,DI)

(2)

The results of the regressions of DR from 2008 to 2010 on average CBI, MBSI or DI from 2000 to 2007, shown in formula 2, clearly illustrate effects of CB and MBS issuance on mortgage defaults. As illustrated in Table 2, though not significant when only regressed on DR individually, CBI is significantly negatively correlated at the .021 and .058 confidence levels respectively when controlling for either only economic variables in column 2, economic variables and GHS in column 3, or the economic and structural variables in column 4. A change from 0% covered bond issuance to 100% covered bond issuance would have lowered default rates during the crisis by about 1.89%, 1.70%, and 1.22% in columns 2, 3, and 4, respectively, according to this model. Importantly, the result is expressed as a percent of defaults not as a percent change in the rate of defaults. This result is most significant when only controlling for

economic variables in column 2, with its higher coefficient and stronger significance. However, this is likely because, without controlling for structural variables, some of the variation caused by these structural variables is being picked up by CBI. Nevertheless, even after controlling for structural characteristics in column 4 the coefficient remains large (-1.22%) and is significantly different from zero at the .058 level. Saying that this would decrease default rates 1.22% indicates that, for example, the default rate would decrease from 3.72% to 2.50%. This is a large impact given that the average default rate across our 18 country sample was only 2.14%. Thus, taken literally, the model predicts that over half of these defaults could potentially have been prevented through a 100% CB model.

Table 2: Cross-Country Issuance Analysis

Variables	Average Default Rate from 2008-2010 (in %)			
	(1)	(2)	(3)	(4)
CB Issuance Share (2000-2007)	-1.18%	-1.89%	-1.70%	-1.22%
	(.281)	(.021)	(.031)	(.058)
Real Housing Price Change		-0.11%	-0.10%	-0.09%
		(.001)	(.002)	(.058)
Real GDP Growth		0.30%	0.26%	0.24%
		(.060)	(.091)	(.001)
Government Housing Support			0.06%	0.09%
			(.197)	(.012)
Recourse				-2.41%
				(.034)
Constant	2.43%	2.13%	1.97%	3.64%
	(<0.001)	(.002)	(.003)	(<0.001)
N	16	16	16 ⁺	16 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

Variables	Average Default Rate from 2008-2010 (in %)			
	(1)	(2)	(3)	(4)
MBS Issuance Share (2000-2007)	6.01%	4.70%	5.23%	3.55%
	(.032)	(.055)	(.020)	(.065)
Real Housing Price Change		-0.08%	-0.06%	-0.06%
		(.015)	(.042)	(.484)
Real GDP Growth		0.12%	0.04%	0.09%
		(.490)	(.783)	(.013)
Government Housing Support			0.10%	0.11%
			(.042)	(.020)
Recourse				-2.25%
				(.009)
Constant	1.35%	0.91%	0.61%	2.59%
	(.028)	(.217)	(.347)	(.015)
N	16	16	16 ⁺	16 ⁺

Variables	Average Default Rate from 2008-2010 (in %)			
	(1)	(2)	(3)	(4)
Difference in Issuance Shares (2000-2007)	-1.48%	-1.76%	-1.64%	-1.19%
	(.108)	(.010)	(.011)	(.029)
Real Housing Price Change		-0.10%	-0.09%	-0.09%
		(.001)	(.002)	(.092)
Real GDP Growth		0.24%	0.20%	0.20%
		(.108)	(.152)	(.001)
Government Housing Support			0.07%	0.09%
			(.136)	(.017)
Recourse				-2.21%
				(.024)
Constant	2.29%	1.76%	1.64%	3.26%
	(<0.001)	(.004)	(.005)	(.001)
N	16	16	16 ⁺	16 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

In contrast the MBS model shows significant positive correlation between MBSI and DR in all four regressions. All four models predict an increase from 0% MBSI to 100% MBSI should correspond to an increase in a country's default rate of between 3.55% and 6.01%. Like the CBI results, the magnitude of the coefficient and its statistical power decrease going left to right from column 1 to 2 to 4, with statistical significance decreasing from the .032 to the .055 to the .065 level, respectively. Breaking this trend, the model that controls for economic variables and GHS in column 3 shows MBS share significant at the .02 level. This increased significance

is likely because of the impact of the United States impact as an outlier with high unusually high MBSI and GHS. However, even when controlling for both economic and structural control variables, MBSI's coefficient is still significantly non-negative at a .065 confidence level. Furthermore, at 3.55% its coefficient is over twice the magnitude of CBI's in the same model, and over twice the average 2008 to 2010 DR of the countries in our sample of 2.18%. Thus, this model shows a severe impact of a country's reliance on MBS to fund mortgages on its default rates. While this result speaks to the scale of the moral hazard problems that befell MBS markets during the housing boom, this also explains the success of markets using CBs. Because these markets relied on covered bond for a portion of their non-deposit mortgage funding, many of these countries did not need to rely so heavily on MBS products. Thus, they received not only the increased stability of covered bonds but also avoided the disaster in MBS markets.

The results of DI model capture these two related impacts of MBSI's positive correlation to defaults and CBI's negative correlation to defaults. DI has a significantly negative correlation with DR when adjusting for both economic and structural variables in columns 2 and 4. The coefficients of these two results are about as negative as the CBI results at -1.76% and -1.19% for columns 2 and 4. For the DI variable this indicated that going from 0% CBI and 50% MBSI to 50% CBI and 0% MBSI or a similar change of 100% in CBI minus MBSI should correspond with a large 1.19% decrease in default rates. Further, statistical significance is stronger in the DI results than either the CBI or MBSI results in columns 2 and 4. The DI results are significantly non-negative at the .01 level for column 2 and the .029 level for column 4. While it does not have as strong a coefficient as the other two models, DI's results are more strongly significant, suggesting that it is a safer predictor of what happened during the crisis than CB issuance or MBS issuance alone.

Beyond the issuance variables, there are also informative results from the model in the control variables. In the adjusted full model in column 4, with all economic and control variables used, the same story emerges for the control variables in the CBI, MBSI, and DI results. RHP has a consistent significantly negative correlation with defaults as one would expect, except in the adjusted MBS model. The DI and CBI models project an approximately .06 to .09% decrease in the default rate for every percentage point increase in real home prices, significant at the .058 and .092 levels, respectively. Surprisingly, RGDP is positively correlated with default rates in column 4 of all three models, with significance at least at the .013 and an average coefficient of .13% per 1% of RGDP difference. While we would expect economic growth to decrease defaults, these results could be caused by reverse causality where the high default rates experienced in countries like the United States encouraged economic stimulus packages to feed economic growth from 2008-2010, even though defaults remained high. GHS is not significant when considered with only the economic variables in column 3 in the CBI and DI models, but is significantly positively correlated with DR at the .042 significance level in the MBSI model with a coefficient of .10%. This significance is likely caused by the United States with its high MBSI and DR. In all three models, government housing support becomes significantly positive at the .05 level in column 4. While the relationship becomes significant in the full model, the coefficient is still very small. An increase from no government support to maximum government support would only yield approximately a .1% increase in defaults. The impact of government housing support on default rates is trivially small. Finally, recourse of mortgage lenders plays the biggest role in determining default rates. With significance at approximately the .01 level, we find that recourse is heavily negatively related to defaults. On average, a nation going from no recourse to full recourse to assets and future income would

expect to see a -2.29% decrease in the mortgage rate. This finding supports prior research on high levels of recourse discouraging mortgage defaults.

CROSS-COUNTRY ANALYSIS: ZOOMING IN

Table 3: Cross-Country Analysis: Zooming In

Variables	Average Default Rate from 2008-2010 (in %)					
	Cov. Bonds	RMBS	Difference	Cov. Bonds	RMBS	Difference
Issuance Share (2005-2007)	-1.24%	5.35%	-1.53%	-1.24%	2.84%	-1.09%
	(.251)	(.020)	(.075)	(.055)	(.090)	(.035)
Real Housing Price Change				-0.09%	-0.06%	-0.08%
				(.001)	(.021)	(.001)
Real GDP Growth				0.26%	0.09%	0.20%
				(.048)	(.500)	(.090)
Government Housing Support				0.09%	0.11%	0.09%
				(.041)	(.010)	(.028)
Recourse				-2.40%	-2.23%	-2.21%
				(.012)	(.026)	(.018)
Constant	2.52%	1.30%	2.36%	3.77%	2.63%	3.33%
	(<0.001)	(.029)	(<0.001)	(<0.001)	(.017)	(.001)
N	16	16	16	16 ⁺	16 ⁺	16 ⁺

Note: Values in parentheses are p-values. The ⁺ symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

$$\text{AverageDR}_{(2008-2010),i} = \alpha + \beta \text{AverageCBI}_{(2005-2007),i} + \gamma \text{AverageX}_{(2008-2010),i} + \kappa S_i + \varepsilon_i$$

CBI represents any of (CBI,MBSI,DI)

(3)

Zeroing in on the period many people believe to have been the root cause of the crisis, were CB and MBS issuance during the peak of the housing boom from 2005 to 2007 a significant impact on default rates during the crisis? Regression formula 3, uses almost identical inputs as the previous regression to help answer this questions, but narrows the window of the issuance variables from 2005-2007. Once again, the results of this analysis, in Table 3, prove significant. The CB and DI results in the right three columns controlling for economic and structural variables show similar coefficients to the 2000-2007 results, at -1.24% and -1.09%, respectively, and significance at the .055 and .035 levels. However, MBSI's coefficient drops substantially in this peak model to 2.84% (from 3.55% in the 2000-2007 results), falling in significance from the .065 to the .09 level. This change could be explained by the increase in

MBSI in traditional CB countries during the peak of the housing boom. While this issuance changed MBSI rate during 2005 to 2007, it likely did not build up enough scale to impact default rates during the crisis. Still, these results indicate that CBI and MBSI during this peak period played a major role in determining the rate of mortgage defaults during the crisis. The control variables also display similar directions and significance as in the 2000-2007 results. While the coefficients in this regression very similar to the 2000-2007 results, the 2005-2007 relationships illustrate that a peak housing bubble did not seem to cause CB underwriters to follow MBS issuers down the rabbit hole of risky lending. This provides reason to believe that the protections contained in CBs to encourage sensible lending practices remain robust even in the face of intense competitive pressure to take advantage of an unprecedented housing boom.

CROSS-COUNTRY ANALYSIS: OUTSTANDING STOCK

$$\text{AverageDR}_{(2008-2010),i} = \alpha + \beta \text{AverageCBO}_{(2007),i} + \gamma \text{AverageX}_{(2008-2010),i} + \kappa S_i + \varepsilon_i$$

CBI represents any of (CBO,MBSO,DO)

(4)

Table 4: Cross-Country Outstanding Share Analysis

Variables	Average Default Rate from 2008-2010 (in %)					
	Cov. Bonds	RMBS	Difference	Cov. Bonds	RMBS	Difference
Outstanding Share (2007)	-1.38%	5.43%	-1.87%	-1.55%	2.89%	-1.32%
	(.371)	(.026)	(.097)	(.109)	(.090)	(.059)
Real Housing Price Change				-0.09%	-0.06%	-0.08%
				(.001)	(.013)	(.001)
Real GDP Growth				0.18%	0.12%	0.16%
				(.059)	(.199)	(.079)
Government Housing Support				0.09%	0.12%	0.10%
				(.037)	(.007)	(.020)
Recourse				-2.50%	-2.26%	-2.30%
				(.009)	(.019)	(.014)
Constant	2.45%	1.49%	2.33%	3.59%	2.78%	3.25%
	(<0.001)	(.006)	(<0.001)	(<0.001)	(.002)	(<0.001)
N	18	18	18	18 ⁺	18 ⁺	18 ⁺

Note: Values in parentheses are p-values. The ⁺ symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

The outstanding stock of CBs and MBS in a market on the eve of the crisis in 2007 also appears to be correlated with cross-county default rates during the crisis. However, looking at

the controlled models in the right three columns, the CBO is not significant at the .1 level in this analysis, with only about half the statistical power as the CBI values with a p-value of .109.

Meanwhile, MBS outstanding follows along almost the exact same lines as the issuance models with a 2.89% coefficient and significance at the .09 level. This leaves the DO model in a half-way position with a slightly larger coefficient than the DI of -1.32% but with less statistical power in its significance level of .059. The control variables maintain the relationship to defaults seen in the issuance models. One possible explanation for the weakness of the CBO results is that the CBO data contains older pre-2000 CBs, which were issued when there was less of an active MBS market with little use of the originate-to-distribute model. Thus, the comparative difference between the CBO and the stock of other types of mortgage funding is not as great as between CBI and other mortgage lending, which is tilted more towards the boom years.

VIII. SECONDARY FINDINGS

POOLED ANALYSIS

The cross-country issuance results show significant correlations between CBI and MBSI and mortgage default rates. Was this relationship the result of the once in a lifetime housing bust from 2008-2010? Or is this a longer term trend that is observable outside the bust?

Unfortunately, the data does not support a look at issuance difference across countries over a long-term year period. The data from 2000 to 2010 will always be colored by the extraordinary housing cycle of that time. However, by expanding the window of default rates outside the crisis, it is possible to get a broader view of these relationships throughout the entire housing cycle from boom to bust. To establish the correlation between CB and MBS issuance and mortgage default rates, four different models are used to regress individual yearly default rates

going back to 2000. Observations from all countries for all available years in the sample are pooled together for this analysis.

$$DR_{(t,i)} = \alpha + \beta \text{AverageDI}_{(2000,2001,\dots,t-1),i} + \gamma X_{(t,i)} + \kappa S_i + \varepsilon_{(t,i)}$$

Range of DI Average:	2000+ Model:	(2000, 2001, ... t-1)
	1-Yr Prior Model:	(t-1)
	1-Yr Prior Model:	(t-3, t-2, t-1)
	1-Yr Prior Model:	(t-5, ... t-1)

(5)

As opposed to each country having one data point in the cross-country models, formula 5 illustrates how each observation in this pooled model is the default rate for a specific country in a specific year (ex. Spain, 2005). These default rates are regressed on the DI to capture the combined negative impact of CB issuance and positive impact of MBS issuance on default rates more fully. They are also regressed on the economic control variables for that specific country and year as well as the structural control variables for the country. Further, each of the four different models draws upon a different time period of DI, as the different Ranges of the DI average show in formula 5. The first model uses all issuance data after 2000 up to the year before the year of the default rate in the observation. Therefore, a 2006 default rate would be regressed against issuance from 2000 through 2005. The three subsequent models use data on issuance from 1, 3 and 5 years before the default rate in question.

The results of these four regression models show very similar results. As in the cross-country analysis, DI is significantly negatively correlated to DR. Following the cross-country results, the coefficient of DI decreases in magnitude as more variables are added. On average between the four models, it decreases .83% in column 1, to .81% in column 2, to .74% in column 3, and .63% in column 4 due to the increase in observations. The coefficient is only about half of what it was in the cross-country models from 2008-2010. However, this must be taken into account in light of a far lower average DR in this data sample. This -.63% change in DR

predicted from a 1.0 change in DI is still about half of the 1.23% average default rate of this sample, approximately the same relative magnitude of the cross-country models. While the pooled rates have a similar magnitude to the cross-country analysis they are more significant with all four models significant at the .001 level in each column. This data only shows the results of one historically unique housing cycle and is not exactly a representative sample of average default rate behavior. Yet, these results strongly indicate that the DI is significantly negatively correlated to default rates with a predicted point value of -.63% and non-zero with confidence at the .001 level.

RHP and RGDP are both significant at the .01 and .05 levels, respectively. For RHP, its average column 4 coefficient of -.04% is about half what it was in the cross-country models at, likely because the swings in home prices were not as dramatic before the crisis as during it.

Table 6: Pooled Analysis

Variables	2000+ Model			
	Default Rate			
	(1)	(2)	(3)	(4)
Difference in Issuance Shares	-0.80%	-0.80%	-0.70%	-0.61%
	(<0.001)	(<0.001)	(<0.001)	(.003)
Real Housing Price Change		-0.04%	-0.04%	-0.04%
		(.004)	(.004)	(.002)
Real GDP Growth		-0.09%	-0.09%	-0.09%
		(.051)	(.049)	(.045)
Government Housing Support			1.36%	0.59%
			(.160)	(.583)
Recourse				-0.65%
				(.111)
Constant	1.33%	1.51%	1.08%	1.77%
	(<0.001)	(<0.001)	(.001)	(0.001)
N	113	113	113 ⁺	113 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

1-Year Prior Model

Variables	Default Rate			
	(1)	(2)	(3)	(4)
Difference in Issuance Shares	-0.70%	-0.69%	-0.74%	-0.56%
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Real Housing Price Change		-0.04%	-0.04%	-0.04%
		(.004)	(.004)	(.002)
Real GDP Growth		-0.08%	-0.09%	-0.09%
		(.053)	(.050)	(.045)
Government Housing Support			1.12%	0.29%
			(.243)	(.785)
Recourse				-0.68%
				(.087)
Constant	1.32%	1.50%	1.14%	1.88%
	(<0.001)	(<0.001)	(.001)	(.001)
N	113	113	113 ⁺	113 ⁺

3-Year Prior Model

Variables	Default Rate			
	(1)	(2)	(3)	(4)
Difference in Issuance Shares	-0.87%	-0.85%	-0.74%	-0.66%
	(<0.001)	(<0.001)	(.001)	(.003)
Real Housing Price Change		-0.04%	-0.04%	-0.04%
		(.011)	(.010)	(.007)
Real GDP Growth		-0.09%	-0.09%	-0.09%
		(.063)	(.060)	(.055)
Government Housing Support			1.34%	0.47%
			(.227)	(.700)
Recourse				-0.75%
				(.100)
Constant	1.40%	1.54%	1.12%	1.92%
	(<0.001)	(<0.001)	(.003)	(.002)
N	97	97	97 ⁺	97 ⁺

5-Year Prior Model

Variables	Default Rate			
	(1)	(2)	(3)	(4)
Difference in Issuance Shares	-0.95%	-0.91%	-0.78%	-0.70%
	(<0.001)	(<0.001)	(.003)	(.007)
Real Housing Price Change		-0.04%	-0.04%	-0.04%
		(.025)	(.022)	(.022)
Real GDP Growth		-0.08%	-0.08%	-0.08%
		(.126)	(.117)	(.111)
Government Housing Support			1.74%	0.69%
			(.187)	(.635)
Recourse				-0.87%
				(.119)
Constant	1.50%	1.56%	1.02%	1.97%
	(<0.001)	(<0.001)	(.022)	(.009)
N	79	79	79 ⁺	79 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

RGDP is negatively related to defaults in the pooled model with a coefficient of -.09% as opposed to positively correlated with mortgage defaults in the crisis models. This reinforces the theory that the reason for the latter positive correlation had to do with crisis measures. The other structural control variables are more difficult to interpret in the yearly model. GHS has trivial significance either when controlled alone with the economic variables in column 3 or when including recourse in column 4. Between 2000+, 1, 3, and 5 year models there is little significant variation. The 5 year model has the highest coefficient while the 1 year model has the most significant p-value. However, these differences are not very wide and there does not appear to be a plausible explanation for this variation other than slight differences in the sample for each model as some values are exclusive of data from years, which do not have the appropriate number of years with DI or DR data preceding them. For example, in 2003 there were no data points for the 5 years model as there was only 3 years of DI data for the countries in the sample.

PANEL ANALYSIS

One potential explanation for the strong negative correlation between DI and default rates in the cross-country and pooled analyses is the possibility that DI is only picking up the structural differences between countries that not accounted for in GHS and REC. In order to test whether this is the case, a panel regression is used. As shown in formula 6, the panel regression calculates a unique constant, α_i , for each individual country. Thus, all the observations for, as an example France, will have the same constant, but the constants for observations from France and Germany will be different. As found in Table 7, the results of this regression show that DI is still significantly inversely correlated with DR even when using a panel regression.

$$DR_{(t),i} = \alpha_i + \beta \text{AverageDI}_{(2000,2001,\dots,t-1),i} + \gamma X_{(t),i} + \kappa S_i + \varepsilon_{t,i} \quad (6)$$

Table 7: Panel Analysis**Panel 2000+ Model**

Variables	Default Rate			
	(1)	(2)	(3)	(4)
Issuance Difference	-1.30%	-1.41%	-0.70%	-1.56%
	(.009)	(.003)	(<0.001)	(.003)
Real Housing Price Change		-0.03%	-0.04%	-0.03%
		(.015)	(.004)	(.017)
Real GDP Growth		-0.09%	-0.09%	-0.09%
		(.008)	(.051)	(.008)
Government Housing Support			1.36%	-1.07%
			(.166)	(.721)
Recourse				0.13%
				(.916)
Constant	1.52%	1.64%	1.08%	1.88%
	(<0.001)	(<0.001)	(.001)	(.238)
R ²	12.66%	24.60%	29.06%	22.03%
N	113	113	113 ⁺	113 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

In column 4, the impact of DI on DR is actually greater than in the pooled model with a -1.56% coefficient, significant at the .003 level. Further as one would expect, GHS and REC are not significant as their impact is collected by the panel regression. Conversely, RHP and RGDP are both significantly negatively correlated to DR. This makes sense since economic variables are one of the key determinants of default rates in a given country from year to year. Overall the panel regressions have an R² of 24.60%, 29.06%, and 22.03% in columns 2, 3 and 4, respectively. Thus, the panel regression clearly shows that DI's inverse correlation to DR is not the product of differences between countries but is highly likely being caused by DI rates.

OTHER DEPENDENT VARIABLES

After establishing the relationship between CBs, MBS and default rates, one must consider that these securities could impact mortgage markets ways besides default rates. One potential impact of using CBs or MBS could be the amount of housing debt a country carries relative to its income (MTG/GDP). One would expect that CBs do not generate as much housing

debt as MBS given the tighter credit standards on CBs. When MTG/GDP is regressed on 2000-2007 DI or 2007 and 2010 DO, as shown in formulas 7 and 8, the results do not show a significant correlation.

$$\text{MTG/GDP}_{(t),i} = \alpha + \beta \text{AverageDI}_{(2000,2001,\dots,2007),i} + \kappa S_i + \varepsilon_{t,i} \quad (7)$$

$$\text{MTG/GDP}_{(t),i} = \alpha + \beta \text{AverageDO}_{(t),i} + \kappa S_i + \varepsilon_{t,i} \quad (8)$$

Table 8: Analysis of Mtg. Debt to GDP Ratios

Variables	2007 Mtg. Debt to GDP		2010 Mtg. Debt to GDP	
	2000-07 Diff. in Issuance	2007 Outstanding	2000-07 Diff. in Issuance	2010 Outstanding
Test Variable	1.23%	-20.24%	2.42%	-7.24%
	(.922)	(.206)	(.845)	(.613)
Government Housing Support	-0.98%	-1.16%	-1.10%	-1.10%
	(.278)	(.190)	(.256)	(.250)
Recourse	28.08%	45.15%	31.91%	46.14%
	(.198)	(.030)	(.177)	(.042)
Constant	0.34%	20.48%	37.46%	24.39%
	(.056)	(.166)	(.050)	(.139)
N	16 ⁺	16 ⁺	16 ⁺	16 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

The results in Table 8 also illustrate that structural measures do not appear to have a consistent effect on MTG/GDP. Even though REC is significantly in the two regressions using outstanding differences in 2007 and 2010, it is positively related to levels of mortgage debt. This is surprising given that one would expect strong recourse to prevent excess lending. This leads one to conclude that this is likely due to the outliers of countries with strong recourse and high levels of MTG/GDP, such as Denmark and the Netherlands.

Similarly there does not seem to be a statistically significant relationship between RHP and the DI and DO before or after the housing bubble burst. These findings are also surprising given the common narrative that excess lending to fuel MBS issuance helped increase housing prices in the United States. However, Denmark, which despite its heavy reliance on CBs had one of the largest increases in housing prices during the bubble, illustrates that housing prices in

the boom could rise no matter the source of mortgage funding in a market. Stranger still is the lack of a significant relationship among structural factors and RGDP on RHP. This suggests that market factors such as consumer confidence, housing supply and demand or perhaps a wider asset bubble were more closely tied to RHP than factors in mortgage finance markets.

$$\Delta RHP_{(t),i} = \alpha + \beta \text{AverageDI}_{(2000,2001,\dots,t-1),i} + \beta_2 \text{RGDP} + \kappa S_i + \varepsilon_{t,i} \quad (8)$$

$$\Delta RHP_{(t),i} = \alpha + \beta \text{AverageDO}_{(t),i} + \beta_2 \text{RGDP} + \kappa S_i + \varepsilon_{t,i} \quad (9)$$

Table 9: Analysis of Real Housing Price Changes

Variables	2000-2007 Real Housing Price Change		2007-2010 Real Housing Price Change	
	2000-07 Diff. in Issuance Shares	2007 Outstanding Difference in Shares	2000-07 Diff. in Issuance Shares	2010 Outstanding Difference in Shares
Test Variable	10.77%	16.91%	-1.97%	-3.59%
	(.538)	(.490)	(.639)	(.837)
Real GDP Growth	0.81%	0.31%	3.38%	3.07%
	(.414)	(.763)	(.033)	(.003)
Government Housing Support	-0.07%	0.18%	-0.61%	-0.58%
	(.954)	(.894)	(.261)	(.268)
Recourse	-15.09%	-9.77%	3.98%	3.39%
	(.608)	(.748)	(.753)	(.779)
Constant	38.73%	42.60%	-3.11%	-4.12%
	(.258)	(.247)	(.781)	(.654)
N	16 ⁺	17 ⁺	16 ⁺	17 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

Finally, there also appears to be no relationship between DI and DO and homeownership rates (HR) across the sample of countries. Additionally, neither GHS nor levels of REC are significantly related to homeownership. This suggests that HR is more a function of cultural factors like the desirability of homeownership for the population than it is a function of structural housing market factors. However, one structural housing variable that is not discussed in this paper is government support and incentives towards the rental housing market. These incentives to rent could potentially have a significant impact on homeownership rates.

$$HR_{(t),i} = \alpha + \beta \text{AverageDI}_{(2000,2001,\dots,2007),i} + \kappa S_i + \varepsilon_{t,i} \quad (10)$$

$$HR_{(t),i} = \alpha + \beta \text{AverageDO}_{(2010),i} + \kappa S_i + \varepsilon_{t,i} \quad (11)$$

Table 10: Analysis of Homeownership Rates

Variables	Homeownership Rate	
	2000-07 Diff. in Issuance Shares	2010 Outstanding Difference in Shares
Test Variable	-6.87%	1.19%
	(.261)	(.878)
Government Housing Support	0.33%	0.43%
	(.431)	(.325)
Recourse	-2.64%	-9.03%
	(.792)	(.350)
Constant	71.18%	75.69%
	(<0.001)	(<0.001)
N	16 ⁺	16 ⁺

Note: Values in parentheses are p-values. The + symbol signifies that the regression uses estimated values for missing Government Housing Support and Recourse Data.

IX. CONCLUSION

In this thesis, I find that countries with substantial covered bond markets experienced significantly lower mortgage default rates during the 2008-2010 financial crisis than countries with less developed CB markets. These results remain significant when controlling for economic and mortgage market structure variables such as changes in real housing prices and real GDP growth, mortgage recourse and government support for housing. The opposite is true for the prevalence of mortgage backed securities, which is significantly positively correlated with mortgage default rates. These relationships are not just found in the bust between 2008 and 2010. Rather, a pooled analysis of default rates shows that a country's mortgage funding system (as described by the difference between the proportion of CBs and MBS it issues) is still a significant factor in predicting default rates with CBs pushing default rates down while MBS increases a country's default rate. Similarly, the findings cannot be explained by latent country specific variables. As a panel analysis shows, the correlation between the difference in CB and MBS issuance remains significantly inversely correlated to mortgage default rates even when a panel regression adjusts for differences between each country. This analysis shows the impact of covered bonds structure on limiting poor quality mortgage lending and subsequent increase in mortgage default rates that occurred in MBS markets during the housing boom. The results are

consistent with the idea that covered bond issuance share is a proxy for lower maximum LTV ratios, in effect, more prudent underwriting. Since data on maximum LTV ratios across countries is not readily available, the covered bond share may well be a good proxy for max LTV. Additionally, these results also highlight the importance of mortgage recourse as the single largest factor in predicting mortgage default rates.

What does this mean for the United States' attempts to fix its housing finance system? First, the evidence suggests that the introduction of covered bonds into the American market would increase the stability of the American mortgage system, lowering default rates and preventing the financial chaos caused by failing MBS products in 2008. According to these findings, even if the American market were to increase its difference in CB and MBS issuance by one standard deviation of our sample of 18 countries, or approximately .55, this would only predict a decrease in defaults of only -.35% change in the American default rate. In comparison, America's average default rate from 2000 to 2010 was 2.7%. Thus, even creating a robust covered bond market by switching over 20% of American mortgage funding to covered bonds would likely only reduce American default rates by about 13% over their recent averages. In the sample, this would in effect be the equivalent of switching from Italy's mortgage funding system with a difference in issuance shares of -.17 to the Germany's mortgage funding system with its difference in issuance shares of .36. However, the difference between German and Italian mortgage default rates is only .09%, even less than the model's projections.

From a policy standpoint, this conclusion also suggests that the Dodd-Frank Act's call for mortgage originators to keep 5% of the credit risk of securitized non-qualifying mortgages on their balance sheets is quite toothless. Looking at the predictions of the pooled model, this 10%

change in the difference between MBS and what would effectively be a CB (the 5% remaining on the balance sheet) would predict only a .04% reduction in America's mortgage default rate.

These findings suggest that the development of a significant covered bond market would have over eight times the impact on mortgage default rates than the Dodd-Frank Act's provisions. However, they also suggest that a far more decisive move to lower American default rates would be to switch the United State to a European-style full-recourse mortgage system. This move could lower American default rates by about .85% without causing significant disturbances in U.S. mortgage funding markets. Yet, neither the creation of an American covered bond market nor an increase in mortgage recourse would come for free. Both moves could involve a significant tradeoff in the form of reduced mortgage availability and higher mortgage rates. In order to better understand the risk and reward of these policies, future research could focus on quantifying these costs to help policy makers to be better informed about these decisions as they continue to search for the best model for the American housing finance system.

APPENDIX

Table 1: Index of Government Participation in Housing Finance Markets

Category Weight	Government Support Categories and Weights ¹										
	Category (A)–(D)			Category (E)	Category (F)–(G)		Category (H)				
	0.0625	0.0625	0.0625	0.0625	0.25	0.125	0.125	0.25			
Subcategory Weight	Subsidies to Buyers through Savings Accounts Contributions or through Preferential Fees			Subsidies to Selected Groups, Low and Middle Income	Provident Funds Early Withdrawal for House Purchases	Housing Finance Funds, Government Agency Provides Guarantees, Loans	Tax Deductibility of Mortgage Interest	Capital Gains Tax Deductibility	State-owned Institution Majority Market Player in Mortgage Lending > 50 percent	Index of Government Participation (higher weight to subcategory H)	Alternative Index of Government Participation (equal weights to the eight subcategories)
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	
Emerging and newly industrialized economies											
Brazil	1	1	1	1	1			1	0.75	0.75	
Chile	1	1			1				0.38	0.38	
China			1	1				1	0.38	0.38	
Croatia		1					1		0.19	0.25	
Czech Republic ²		1					1		0.19	0.25	
Hungary		1					1		0.19	0.25	
India	1		1		1		1		0.63	0.63	
Indonesia	1		1		1			1	0.63	0.50	
Malaysia			1	1	1				0.38	0.38	
Mexico ³	1	1	1	1	1				0.50	0.63	
Poland	1						1	1	0.31	0.38	
Russia			1		1		1		0.44	0.38	
Singapore			1	1	1	1		1	0.75	0.63	
Slovak Republic ²		1			1				0.31	0.25	
Slovenia ²		1					1		0.19	0.25	
South Africa			1			1			0.31	0.25	
South Korea			1		1	1			0.44	0.38	
Taiwan Province of China	1	1	1			1			0.31	0.50	
Thailand	1				1	1		1	0.69	0.50	
Average											
(percent of countries in A-H and regional average of index in I-J)	42	47	58	26	63	58	11	26	0.40	0.41	
Advanced economies											
Australia	1	1	1					1	0.31	0.50	
Austria ³	1	1	1						0.19	0.38	
Belgium						1	1		0.25	0.25	
Canada				1	1		1		0.44	0.38	
Denmark						1	1		0.25	0.25	
France		1				1	1		0.31	0.38	
Germany		1					1		0.19	0.25	
Ireland						1	1		0.25	0.25	
Italy						1	1		0.25	0.25	
Japan					1	1			0.38	0.25	
Netherlands					1	1	1		0.50	0.38	
Spain ³		1				1	1		0.31	0.38	
United Kingdom							1		0.13	0.13	
United States			1		1	1	1		0.56	0.50	
Average											
(percent of countries in A-H and regional average of index in I-J)	14	36	21	7	29	64	86	0	0.29	0.31	

Sources: Housing Finance Network; Merrill Lynch Guide to Emerging Mortgage and Consumer-Credit Markets, Vol 1; Crowe and others (2011b); IMF staff estimates.
¹Cells marked with "1" indicate the existence of the government participation measure; column (I) = 0.0625*(A)+(B)+(C)+(D) + 0.25*(E) + 0.125*(F) + (G) + 0.25*(H); Column (J) = 0.125*(sum of (A)–(H)).

²These countries are currently classified as advanced economies; they were emerging economies during the pre-crisis years.

³Government support in Mexico is available to workers only in the formal sector. Subsidies through downpayments in Spain, rather than through savings accounts contributions. An Austrian housing assistance scheme (Wohnbauförderung) supports mostly low-income and some first-time buyers.

Source: "Housing Finance and Financial Stability:" Global Financial Stability Report. IMF. April 2011. 126.

Table 2: Comparison of Housing Market Structures

Economy	Main Lenders ¹	Mortgage Funding		Mortgage Loan Features				
		Deposits/Other	Covered Bonds/ Residential Loans Ratio (percent)	Residential Mortgage- Backed Securities/ Residential Loans Ratio (percent)	Predominant Interest Rate Type	Maximum LTV on New Loans ²	Typical Loan Term (years)	Prepayment Penalties ³
Australia	Bank and nonbank specialist "mortgage originators"; building societies and credit unions; mortgage brokers (30 percent)	Mainly, plus wholesale funds		16.7	Variable	90–100	25	Change in cost of funds
Austria	Banks and Bausparkassen (mainly savings banks)	Mainly	7.0	3.1	Fixed	80	25–30	
Belgium	Banks	Mainly		29.9	Fixed	100	20	
Canada	Banks and specialized nondepository and mortgage brokers (31 percent)	Mainly (banks); securitization (nonbanks)	1.0	31.0	Mixed	80 [95]	25–35	Higher of lost interest or three months, beyond a pre-specified penalty-free limit
Denmark	Mortgage and retail banks		114.7	0.1	Mixed	80	30	Yield maintenance on short-term fixed with noncallable bonds
France	Mortgage and retail banks	Mainly (banks)	22.5	1.8	Fixed	100	15–20	Maximum six months interest or 3 percent of outstanding balance
Germany	Banks and Bausparkassen (mainly savings banks)	Mainly	19.0	1.8	Fixed	80	20–30	Interest margin damage and reinvestment loss on fixed rate
Ireland	Banks and building societies and mortgage brokers	Mainly (banks)	15.6	29.6	Variable	100+	21–35	
Italy	Banks	Mainly	2.1	30.8	Mixed	80	20	
Japan	Banks and specialized mortgage institutions	Mainly		4.0	Mixed	70–80	20–30	None
Netherlands	Banks and mortgage banks and brokers (60 percent)	Mainly	3.6	30.8	Fixed	125	30	Yield maintenance on fixed rate
Portugal	Banks	Mainly, plus wholesale funds	14.5	27.3	Variable	90	25–35	
Spain	Banks (commercial and savings) and mortgage brokers (55 percent)	Some, plus covered bonds and securitization	45.6	24.1	Variable	100	30	2.5 percent up to yield maintenance on fixed rate; 0.5 percent on variable rate
Sweden	Bank and mortgage institutions	Some, plus covered bonds	53.7	0.3	Variable	80–95	30–45	
United Kingdom	Banks and building societies and mortgage brokers (60 percent)	Mainly	14.0	31.2	Variable	110	25	2–5 percent of amount repaid
United States	Banks and mortgage brokers (68 percent 2004; 10 percent 2010)	Mainly securitization	0.1	64.1	Fixed	100+	30	Up to 5 percent on ARMs only

Sources: Housing Finance Network; Lea (2010b); Crowe and others (2011b); Warnock and Warnock (2008); European Mortgage Federation; Federal Reserve Board; Reserve Bank of Australia; Bank of Canada; European Securitization Forum; European Central Bank (2009).

¹Banks include commercial and savings banks.

²Maximum with insurance or for covered bonds in brackets; average for Japan and Sweden.

³ARM = adjustable rate mortgages; LTV = loan to value. There is complete waiver in certain circumstances, for instance, if the property is sold (Germany), hardship or relocation of the borrower (Netherlands), or the borrower is unemployed (France).

Source: "Housing Finance and Financial Stability:" Global Financial Stability Report. IMF. April 2011. 117.

BIBLIOGRAPHY

- 2011 EMF Study on Non-Performing Loans in the EU. European Mortgage Federation. Brussels: December 2011.
- 2011 European Covered Bond Fact Book. European Covered Bond Council. Brussels: 2011.
- Acharya et al. Guaranteed to Fail. 2011. Princeton University Press.
- Acharya, Schnabl and Suarez. “Securitization without Risk Transfer.” 20 Oct 2011.
- Alloway, Tracy. “Fitch on Spanish Mortgage Walkaways.” Financial Times. <www.ft.com>. 28 Jan 2011
- “Annual Review 2010/11.” Association for Financial Markets in Europe (AFME). 30 Sep 2011.
- Asselin, Andre. “A Canadian Perspective on Housing Finance in the World.” Canadian Mortgage Housing Corporation. 2009. 5.
- Asselin, et al. “Review of Finland’s Housing Policy.” Canadian Mortgage Housing Corporation.
- Carbo-Valverde, Rodriguez-Fernandez, and Rosen. “Are Covered Bonds a Substitute for Mortgage-Backed Securities?” FRB of Chicago. March 2012.
- Duygan, Burcu and Charles Grant “Household Debt Repayment Behavior: What role do Institutions Play”, FRB of Boston Quantitative Analysis Unit Working Paper No. 08-3, March 2008.
- Ghent, Andra C. and Marianna Kudlyak. “Recourse and Residential Mortgage Default: Theory and Evidence from U.S. States.” FRB of Richmond Working Paper No. 09-10, July 2009.
- Hendershott, Patric and Bengt Turner. “The Determinants of Mortgage Default Contrasting the American and Swedish Experiences.” International Union of Housing Finance.
- Heuson, A., W. Passmore, and R. Sparks, (2001), “Credit Scoring and Mortgage Securitization: Implications for Mortgage Rates and Credit Availability”, Journal of Real Estate Finance and Economics, Vol. 23, pp. 327–63.
- “Housing Finance and Financial Stability.” Global Financial Stability Report. IMF. April 2011.
- Hypostat 2010: A Review of Europe’s Mortgage and Housing Markets. European Mortgage Federation. Brussels: November 2011.
- Kaelberer, Wolfgang, ed. 2011 European Covered Bond Fact Book. European Covered Bond Council. 2011.

- Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig, 2010, “Did Securitization Lead to Lax Screening? Evidence From Subprime Loans,” *Quarterly Journal of Economics*.
- Lea, Michael. “Alternative Forms of Mortgage Finance.” Harvard Joint Center for Housing Studies National Symposium. 14 Apr 2010.
- Lea, Michael. “International Comparison of Mortgage Product Offerings.” Research Institute for Housing America. Sept 2010.
- Lehnert, A., W. Passmore, and S. Sherlund, (2008), “GSEs, Mortgage Rates, and Secondary Market Activities”, *Journal of Real Estate Finance and Economics*, Vol. 36, pp. 279–84.
- Naranjo, A., and A. Toevs, (2002), “The Effects of Purchases of Mortgages and Securitizations by Government Sponsored Enterprises on Mortgage Yield Spreads and Volatility”, *Journal of Real Estate Finance and Economics*, Vol. 25, pp. 173–95.
- ”National Measures and Practices to Avoid Foreclosure Procedures for Residential Mortgage Loans.” European Commission. 31 March 2011.
- Purnanandam, Amiyatosh, 2011, “Originate-to-Distribute Model and the Subprime Mortgage Crisis,” *Review of Financial Studies*, forthcoming.
- “Review of the UK’s Regulatory Framework for Covered Bonds.” FSA. April 2011. 11.
- “Summary of Key Provisions: Dodd-Frank Wall Street Reform and Consumer Protection Act.” Center for Responsible Lending. <www.responsiblelending.org>. 1 Dec 2010.
- Surti, Jay. “Can Covered Bonds Resuscitate Residential Mortgage Finance in the United States?” IMF. WP/10/277, December 2010.
- “Stata Data Analysis Examples: Tobit Analysis.” UCLA Academic Technology Services <<http://www.ats.ucla.edu/stat/stata/dae/tobit>>.
- “The Traditional Danish Mortgage Model.” Realkreditradet. 2009.
- “Property Price Statistics.” Bank for International Settlements. <www.bis.org/statistics>. January 2012.
- “U.S. Structured Finance Statistics.” Securities Industry and Financial Markets Association (SIFMA). <<http://www.sifma.org/research/statistics>>. Dec 2011.
- Zandi, Mark. “Fannie and Freddie Don’t Deserve Blame for the Bubble.” Washington Post. 23 Jan 2012.