ESSAYS IN CORPORATE FINANCE AND BANKING

A DISSERTATION
SUBMITTED TO THE FACULTY OF
UNIVERSITY OF MINNESOTA
BY

AMANDA RAE HEITZ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

ADVISERS: JOHN H. BOYD AND ANDREW WINTON

DECEMBER 2015

Acknowledgements

First and foremost, I'd like to thank John H. Boyd for everything that he has done for me throughout my time being a student at the University of Minnesota. I could not have asked for a better adviser, mentor, friend, and all around good guy to guide me through this entire process of ups and downs. I also want to sincerely thank Tracy Wang and Andrew Winton for everything that they have done for me as well. I could not have completed this project without their guidance, mentorship, and skills. I feel extremely fortunate to have been able to learn from the best. Furthermore, I'd like to thank my other two committee members, Ross Levine and Terry Hurley for helpful feedback and suggestions.

I'd also like to thank my family for their support. This would not have been possible without my father constantly encouraging me and my mother supporting me. I also want to thank my Uncle Art and Aunt Vern for their encouragement.

Additionally, I'd like to thank Loren Gragert, who has been by my side through all of the daily ups, downs, tears, and smiles. Thank you for celebrating my small victories with me all along the way.

Thank you to everyone who believed I was capable of completing this feat, especially recent friends I made in Minnesota and long-time friends from the Chicago-area.

Dedication

For Grandma Evans, who I know has been watching me from heaven.

Abstract

This dissertation focuses on corporate finance and banking. Chapter 1 examines the way creditor rights affect borrower financing and investment decisions. By utilizing a sample of over 1.5 million public and privately held firms within Europe, it is the most comprehensive analysis of the impact of creditor protection on the demand side of the credit market. The heterogeneity within this sample also allows for a more detailed understanding of the ways different types of firms are impacted. I find that greater levels of creditor protection overall lead to higher firm leverage, especially for firms with lower tangible assets. Smaller firms are able to borrow more when the secured creditor is paid first, which leads to higher investment. However, firms with high levels of tangible assets that operate in economies with stronger creditor rights fear inefficient liquidation, which leads them to decrease their financial leverage as well as cash-flow risk, even if it means pursuing unprofitable projects. Creditor rights also amplify the agency conflict between debt and equity holders in the sense of the risk-shifting literature and lead to increased risk-taking and decreased profitability for highly levered firms.

Chapter 2 focuses on the policy of Too-Big-To-Fail banks. While the policy of Too-Big-To-Fail has received wide attention in the literature, there is little agreement regarding economies of scale for financial firms. We take the stand that systemic risk increases when the larger players in the financial sector have a larger share of output. Calculations indicate that the cost to the macro-economy due to increased systemic risk is always much larger than the potential benefit due to scale economies. When distributional and

intergenerational issues are considered, the potential benefits to economies of scale are unlikely to ever exceed the potential costs due to increased risk of a banking crisis.

Table of Contents

List of Figures

List of Tables

Chapter 1

Efficient Contracting, Creditor Rights, and Corporate Finance: An International Perspective[1]

Chapter 1 Summary

This paper examines the way creditor rights affect borrower financing and investment decisions. By utilizing a sample of over 1.5 million public and privately held firms within Europe, it is the most comprehensive analysis of the impact of creditor protection on the demand side of the credit market. The heterogeneity within this sample also allows for a more detailed understanding of the ways different types of firms are impacted. I find that greater levels of creditor protection overall lead to higher firm leverage, especially for firms with lower tangible assets. Smaller firms are able to borrow more when the secured creditor is paid first, which leads to higher investment. However, firms with high levels of tangible assets that operate in economies with stronger creditor rights fear inefficient liquidation, which leads them to decrease their financial leverage as well as cash-flow risk, even if it means pursuing unprofitable projects. Creditor rights also amplify the agency conflict between debt and equity holders in the sense of the risk-shifting literature and lead to increased risk-taking and decreased profitability for highly levered firms.

---

[1] I cannot thank my advisers, John H. Boyd, Andrew Winton, and Tracy Yue Wang, enough for their guidance, patience, and helpful comments. I'd also like to thank Ross Levine, Philip Bond, Raj Aggarwal, Lamont Black, Yingmei Cheng, Rebel Cole, J. Anthony Cookson, Ted Fee, Murray Frank, Sara Holland, Abu Jalal, Joonho Kim, John Pokorny, Lingling Wang, Hongda Zhong, Yue Qiu, Edward D. Van Wesep, Julie Wu, Celim Yildizhan, and seminar participants at DePaul University (Driehaus), Federal Reserve Bank of Boston, Federal Reserve Bank of Richmond, Federal Reserve Board of Governors, Florida State University, Pepperdine University (Graziadio), San Diego State University, University of Georgia (Terry), University of Colorado at Boulder (Leeds), University of Hawaii (Shidler), University of Minnesota (Carlson), University of Wisconsin at Milwaukee (Lubar), Tulane University (Freeman), Any remaining errors are my own responsibility.

Chapter 1 Introduction

The relationship between investor protection and economic development has received a considerable amount of attention since the seminal cross-country study conducted by La Porta, Lopez-de-Silanes, and Shleifer (1998). The bulk of the existing finance literature pertaining to creditor rights focuses on the way they affect investors. A large body of theoretical literature examines the supply side of the credit market and formalizes the idea that lenders are more likely to extend credit when they have the ability to force repayment, seize collateral, or even remove management (Townsend, 1979; Aghion and Bolton, 1992; Hart and Moore, 1994, 1998).

The cross-country empirical study by Djankov, McLiesh, and Schleifer (2007) confirms the theory's predictions and finds that greater investor protection is associated with more aggregate private credit. Though the theory literature has given considerable attention to the way creditor protection affects creditors, there has been little focus regarding the way creditor protection affects borrower financing and investment decisions, especially outside of bankruptcy, which is the primary goal of this study.

This study is the most comprehensive study examining the effects of creditor rights on the demand side of the credit market. This analysis is conducted using an extensive panel of over 1.5 million public and private European firms from the Amadeus Database, which is the ideal setting for the analysis, since investor protection varies dramatically across Europe. I examine over 4.3 million firm-year observations that span twenty developed and emerging market countries. Over 99% of the final sample is privately held firms that are most likely to be impacted by the country-level creditor rights variables. The heterogeneity within this data set allows me to perform cross-sectional tests to examine specific hypotheses suggested by the existing finance literature. These cross-sectional tests are also able to be performed using country-level fixed effects to allow for better identification than the previous literature.

Additionally, the elements of the creditor rights index[2] proposed by La Porta, Lopez-de-Silanes, and Shleifer (1998) are examined separately. Many papers only examine the aggregate index as a whole, but for the demand side of the loan market, it is not obvious that all elements of the index influence borrower decision-making in the same way. In fact, whether the secured creditor has absolute priority over the government or employees, has a particularly large effect on firm financing and investment decisions. By examining the creditor rights components separately, this study provides insight as to which components matter more for financing and investment and ultimately drive the effect of the aggregate index.

The first empirical task presented in this paper is to understand how creditor rights impact firm leverage. I utilize the cross-sectional variation within the sample to test whether firms that cannot access credit easily have higher leverage when creditors are better protected. Stronger creditor protection is associated with higher firm leverage overall, and cross-sectional tests indicate that it is easier for firms that have less collateral, as proxied by levels of tangible assets, are able to acquire more loans when creditor rights are higher. Smaller firms are also able to obtain more credit in countries where the secured creditor is paid first, though other aspects of the creditor rights index are associated with more borrowing by larger firms. In subsequent analysis, I will use an

[2] The index components consist of restrictions on reorganization, no automatic stay of assets, secured creditor paid first, and management removal.

instrumental variable framework to better understand the relationship between creditor protection and borrower leverage.

The second empirical task this paper has is to gain a better understanding of the way creditor rights impact firm investment policy outside of bankruptcy. To the extent that firms are able to borrow more, I examine whether they invest the additional capital into tangible assets to grow their business. I find that when the secured creditor is paid first, small firms increase investment in tangible assets.

I also examine whether creditor rights contribute to overall firm cash-flow risk and profitability, since stronger creditor rights give investors more power in determining the bankruptcy and liquidation processes. There are two views on the ways creditor rights may affect firm risk-taking. Acharya, Amihud, and Litov (2011) suggest that when creditor rights are high, firms reduce risk-taking, even if it means pursuing unprofitable projects, because they fear inefficient liquidation. However, granting debt holders more power may worsen the agency conflict between debt and equity holders. The risk-shifting literature (Jensen and Meckling, 1976), suggests that as this agency conflict worsens, the firm will pursue riskier projects with lower mean returns.

The empirical results indicate that when investor protection is higher, firms with high levels of tangible assets reduce cash-flow risk and realize lower profitability, consistent with the hypothesis that they are trying to reduce the likelihood of inefficient liquidation. However, for firms where the agency conflict between debt and equity holders is most severe, as evidenced by high leverage ratios, creditor lead to increased cash-flow risk and decreased profitability overall. This is consistent with the risk-shifting literature, suggesting creditor rights amplify this the agency conflict presented in this literature.

With a few exceptions, the majority of the existing empirical literature examining the effects of creditor rights on the loan market either interprets aggregate national data or focuses on supply-side data with only a few exceptions. Unfortunately, these data sets do not provide very much insight regarding how creditor rights affect the demand side of the loan market. Since equilibrium is determined by both supply and demand forces, it's important to gain a better understanding of the demand side of the credit market in order to fully understand the implications of creditor rights on the entire economy.

This paper belongs to a growing literature examining the impact of investor protection on creditors and debtors and arrives at three main contributions. First, this paper adds to the understanding of the way creditor rights impact the entire demand side of the credit market by including private firms, and thus allowing for a set of more generalized conclusions regarding the way creditor rights impact borrowers to be drawn. The few existing studies examining the demand-side of the market analyze large publicly traded companies, which are problematic for a few reasons. These firms have access to more substitute types of financing, such as the equity and international debt markets. As a result, they may be less sensitive to the local creditor rights environment. In addition, these firms represent only a small proportion of the firms within a given economy, and examining them does not give a complete picture of the way creditor rights affect the majority of firms.

Second, this paper adds to a very small literature examining how creditor rights affect investment policy outside of bankruptcy. This paper examines multiple outcome variables, and the cross-sectional tests provide insight regarding the way creditor rights affect different types of firms. Finally, the paper analyzes the individual components of the creditor rights index and finds that they influence borrowers in different ways. These results can provide important insights for developing countries that are actively reforming their bankruptcy laws and creditor protections in order to boost their credit markets.

2 Literature Review

As previously mentioned, much of the existing theoretical literature examining creditor rights focuses on the way investors respond to increased protection. Theoretical literature has come to the conclusion that investor rights encourage creditors to extend more credit. When investors are able to seize collateral or recover more of their losses in bankruptcy, they can afford to take more risk and make more loans, though Stiglitz and Weiss (1981) suggests that creditors may ration some borrowers. One empirical cross-country study has found that more private credit exists in countries with greater creditor rights (Djankov, McLiesh, and Schleifer, 2007).

On the supply side of the loan market, it has been shown that as investor protection increases, creditors extend more loans and lend to more risky borrowers, especially when government guarantees are in place (Djankov, McLiesh, and Schleifer, 2007; Houston, Lin, Lin and Ma, 2010; Jayaraman and Thakor, 2013 and Boyd and Hakenes, 2013). Creditors also monitor less when they have more rights (Jayaraman and Thakor, 2013) and play an active role in the governance of corporations, even outside of default states (Nini, Smith, and Sufi, 2009, 2012). The existence of more investor protection has also been associated with lower interest rates charged and longer loan maturities (Qian and Strahan, 2007 and Bae and Goyal, 2009). On the demand side of the market, borrowers may adjust their borrowing and investment decisions based on these effects. More recently, a small number of studies examining borrower-level studies have emerged, though these studies reach conflicting conclusions and suffer from a number of empirical challenges.

The empirical evidence relating creditor rights to borrower leverage is often contradictory. Acharya, Amihud, and Litov (2011) find that as creditor rights are higher, firms reduce risk-taking by engaging in diversifying acquisitions and reducing financial leverage. Within G-7 countries, Rajan and Zingales (1995) show that bankruptcy codes that favor debtors do not by themselves lead to a lower use of debt, and Acharya and Subramanian (2009) find evidence of lower leverage in public technologically innovative industries at the firm-level for their sample when investor friendly bankruptcy codes are in place. Acharya, Sundaram, and John (2011) develop a model linking bankruptcy codes to capital structure choices and find that that the difference in leverage choices under a relatively equity-friendly bankruptcy code (such as the US's) and one that is relatively more debt-friendly (such as the UK's) is a decreasing function of the anticipated liquidation value of the firm's assets. Brown, Jappelli, and Pagano (2009) and Giannetti (2003) find a positive relationship between creditor rights and firm leverage in their samples consisting primarily of unlisted firms. At the individual loan-level, Bae and Goyal (2009) examine individual loan data from syndicated bank loans and find evidence that suggests smaller loans are granted in lower creditor rights environments, though these results do not appear statistically significant in their tests.

There are two main views on the way creditor rights may influence borrower risk-taking. First, the risk-shifting literature, focusing on the agency conflict between debt holders and equity holders, finds that as debt holders have more to gain in bankruptcy and equity holders have less to lose (higher creditor rights), the equity holders take on more risk and invest in projects that have higher variances, despite the projects having lower means (Jensen and Meckling, 1976). Second, Acharya, Amihud, and Litov (2011) suggest that stronger creditor rights cause firms to pursue a risk-reducing strategy, where they are willing to pursue risk-reducing strategies such as diversifying acquisitions, even if they are not profitable. The law literature (Adler, 1992) suggests that as firms approach bankruptcy, stronger creditor rights may induce them to take on more risk, but ex ante, more investor protection causes a reduction in risk-taking, which is a combination of the two proposed hypotheses.

Many of the studies previously mentioned view leverage as a way to reduce firm risk-taking. Outside of reduced leverage, a small group of studies have examined the relationship between creditor protection and other measures of firm risk-taking, such as cash-flow risk. John, Litov, and Yeung (2008) find evidence that better investor protection leads to increased risk-taking for manufacturing firms from 39 countries, and both Allen and Gale (1997) and Acemoglu and Zilibotti (1997) argue that economies that provide more risk-sharing lead to more risk-taking and ultimately growth. Acharya and Subramanian (2009) find that creditor friendly bankruptcy codes prohibit innovation.

Furthermore, it has been suggested that creditor rights are negatively related to profitability. Jensen and Meckling (1976) suggest that when equity holders have less to gain in bankruptcy states, they will pursue projects with more risk, despite having lower mean returns. Acharya, Amihud, and Litov (2011) also find that in high creditor rights environments, diversifying acquisitions are followed by lower profitability and that their announcement induces more negative stock price reaction.

The existing papers examining the link between creditor rights and borrower leverage reach varying conclusions, as discussed above, partially because the samples that they examine are dramatically different from one another. The borrower-level studies that find a negative relationship between investor protection and firm leverage primarily examine large public firms in developed economies with established equity markets, which could act as substitutes for bank loans (Acharya and Subramanian, 2009 and Acharya, Amihud, and Litov, 2011).

In a stark contrast, Brown, Jappelli, and Pagano (2009) examine small firms in emerging market countries and find that creditor rights are positively associated with firm leverage. This finding could be evidence of supply-side increases in lending leading, but it could also be indicative of an increase in firm demand for loans. Because of these large sample variations and differing conclusions, there is a need to examine the impact of creditor rights on multiple outcome variables with a more representative set of public and private firms that span economies with varying levels of development and investor protection.

3 Empirical Design

3.1 Tangibility, Size, and Firm Leverage

The primary goal of this study is to understand the impact creditor rights have on firm-level leverage. First, an ordinary least squares framework is utilized in order to understand the overall relationship between creditor rights and firm borrowing. After gaining an overall impression of the way creditor rights affect firm leverage, more specific hypotheses regarding the channels that creditor rights could affect firm borrowing are tested.

Creditor rights may lead to higher leverage because creditors are more willing to provide credit. However, they may also decrease borrowing. If firms fear inefficient liquidation, they may decrease leverage as a risk-reduction technique. I am specifically testing the way creditor rights interact with these firm characteristics, so it is possible to use country and year fixed effects. By including country fixed effects, unobserved country-specific factors are removed.

First, I examine the way creditor rights affect the leverage of firms where a high percentage of the firm consists of tangible assets. I suspect that firms that cannot offer as much collateral, as proxied by asset tangibility, are able to obtain more loans when creditor rights are higher. In order to test this hypothesis, I examine the interaction between creditor rights and asset tangibility. I expect a negative relationship between the interaction term and firm leverage. However, there is an alternative story for the negative relationship between the interaction term and firm leverage.

Acharya, Amihud, and Litov (2011) suggest that creditor rights cause firms to reduce leverage as a risk-reduction technique because they fear inefficient liquidation. If a firm is approaching bankruptcy, equity holders are interested in continuing firm operations, while debt holders may choose to liquidate the firm. If the assets of the firm are primarily in property, plants, equipment, or other tangible assets that can easily be sold, the creditors may be more likely to liquidate the firm, sell off the assets, and recover their claims. However, if the firm is primarily invested in intangible assets, such as research and development, even if the creditor liquidates the firm, the creditor may only be able to recover a small claim amount. This may make creditors more likely to allow the firm to continue operations. This is an alternative explanation for a negative relationship between the interaction term and firm leverage, but further analysis will be discussed in section 3.2 to understand if leverage is really being used as a risk-reduction technique by these firms.

Second, I examine the way creditor rights affect the leverage of small firms, a sample that has primarily been unanalyzed within the existing literature with the exception of Giannetti (2003) and Brown, Jappelli, Pagano (2009). It may seem like a paradox that creditor rights have been shown to be associated with more private credit in an economy (Djankov, McLiesh, and Schleifer, 2007), yet lower levels of firm borrowing (Acharya, Amihud, and Litov, 2011). Acharya, Amihud, and Litov (2011) focuses on the way large public firms, that have access to more types of substitute debt such as equity, reduce leverage when creditor rights are higher. I focus on a group of firms that are private and without access to the equity market. If more private credit exists when creditor rights are higher, it may be extended to small firms that have difficulty acquiring credit. I expect that creditors are particularly willing to lend to small firms that have low levels of assets when they are paid first. On the other hand, larger firms, which presumably have less difficulty accessing credit because they have higher levels of assets, may be able to obtain more credit in debtor-friendly economies.

3.2 Creditor Rights and Loan Utilization

The next portion of this paper is dedicated to understanding whether creditor rights affect firm investment decisions outside of bankruptcy. I examine the impact creditor rights have on firm investment in tangible assets, cash-flow risk, and profitability outside of bankruptcy states. Nini, Smith, and Sufi (2009, 2012) find evidence that debtors are able to influence borrower investment decisions outside of bankruptcy states, and more creditor friendly bankruptcy codes have been shown to be associated with more instances of bankruptcy (Claessens and Klapper, 2005). Investor protection may be an important determinant when borrowers are choosing the types of projects to pursue.

First, I examine whether firms are increasing their capital expenditures as a results of greater creditor rights. The empirical evidence shows that the firms in my sample have higher leverage when there are greater levels of investor protection. The next set of empirical tests "follows the money" and attempts to understand if a portion of this money is invested in tangible assets. Furthermore, if firms with low levels of tangible assets or total assets are able to acquire more loans, these specific groups may investing more in tangible assets.

Next, I examine the effect creditor rights have on firm cash-flow risk and profitability. Acharya, Amihud, and Litov (2011) suggest that firms may decrease risk-taking and realize less profitability when investor protection is high because they are afraid that the creditor will quickly liquidate them in the process of bankruptcy. The risk-shifting literature (Jensen and Meckling, 1976) suggests that as equity holders have less to lose in bankruptcy, they are more likely to engage in riskier projects with lower mean returns. The law literature, especially Adler (1982) suggests that ex ante, creditor rights cause firms to decrease risk but that they encourage firms to increase risk-taking as they approach bankruptcy.

I first focus on the impact creditor rights have on firms with high asset tangibility by examining the way the interaction between creditor rights and tangibility impact firm leverage. If the interaction term is negative, this could indicate that firms with lower asset tangibility are able to acquire more credit when investor protection is greater, though it could also mean that those with high levels of asset tangibility are reducing leverage as a risk-reducing strategy. If the predictions of Acharya, Amihud, and Litov (2011) hold, I would expect firms with high liquidation values, as proxied by tangible assets, that operate in economies with high creditor rights to reduce cash-flow risk as well as leverage.

I next focus on the impact creditor rights have on firms where the agency conflict between debt and equity holders is most severe, which is for highly levered firms. If creditors have the ability to approve reorganization, this gives them more power to determine whether the firm will be allowed to reorganize and continue operating or liquidate. Similarly, if there is no automatic stay of assets in place, the secured creditor is paid first, or management is removed, the equity holders lose power either in the times before bankruptcy or during the proceedings, worsening the conflict between debt and equity holders. I expect that the agency conflict is magnified when in environments with high levels of creditor rights. Specifically, I expect that the interaction between creditor rights and leverage to negatively affect firm cash-flow risk and profitability.

3.3 Creditor Rights and Firm Leverage: Instrumental Variable Analysis

In subsequent analysis, I use an instrumental variable framework in order to better understand the impact creditor rights have on firm leverage. One of the main determinants of firm loan demand is the price that they pay for this debt. I estimate a firm-level interest rate to approximate the amount it costs a firm to obtain additional debt.

However, this price is endogenously determined by both supply. In addition, the creditor rights environment may also impact the interest rates, indicating that these variables are correlated. Banks may charge lower interest rates when they are more likely to be able to recover collateral. Alternatively, they may extend more credit to a pool of riskier borrowers, which may raise overall interest rates charged.

Including the endogenous interest rate in ordinary least squares regression framework subjects the estimation to the well-known problem of simultaneous equations within the ordinary least squares framework. The coefficient on the endogenous variable, the interest rate, as well as any variables correlated with the endogenous one, such as creditor rights, are biased. In order to alleviate this bias and obtain a more accurate understanding of the way creditor rights impact firm borrowing, it's necessary to use a more appropriate econometric framework.

I utilize an instrumental variable framework to account for the endogeneity of the interest rate. The instrument, bank concentration, impacts the interest rate but does not impact firm demand for loans. The second stage coefficient on the interest rate indicates the effect that an exogenous change in interest rates has on firm leverage. In addition, the unbiased second stage creditor rights coefficients indicate a more accurate impact creditor rights have on firm leverage.

4 Data and Variables of Interest

The primary data source for this analysis is the 2012 Amadeus Database by Bureau Van Dijk. This database has extensive data on nearly public and private company in Europe. This database is ideal for this study because it has a wide variety of firms, large and small, public and private, spanning multiple industries, and operating in countries with varying levels of economic development. By analyzing such a comprehensive sample, it is possible to analyze the cross-sectional variation in the way creditor rights affect different types of firms.

Amadeus provides consolidated balance sheet data when it is available and unconsolidated balance sheets otherwise. Companies with unconsolidated balance sheets report an affiliate's net assets as a long-term investment on their balance sheets, resulting in a lower leverage ratio. The firms reporting unconsolidated balance sheets consist of less than 1% of the total sample and do not drive the findings within the paper. When unconsolidated balance sheets are utilized, results are unchanged. Bureau Van Dijk standardizes this balance sheet information with the goal of the data being comparable across countries. The data is approved by practitioners, leading accounting firms, and passes a rigorous verification process. Though this data set is comprehensive, it does have a few problems that need to be addressed.

The Amadeus data is designed to be comparable across countries, but there are cross-country differences in the classification and disclosure requirements between countries. German accounting standards place a great deal of value on conservatism, which could mean that assets of the firms within Germany are undervalued relative to asset values in other European countries. Furthermore, expenditure in research and developments is not required to be disclosed on the firm balance sheets in many countries, and Bureau Van Dijk cannot acquire data for small firms in Switzerland. Bureau Van Dijk does not reconstruct unreported variables, which could introduce biases. This data set has a great deal of missing information, especially for small private firms, which limits the sample. As with any cross-country study, it's important to consider the comparability of balance sheet data, though both academics and practitioners have relied on this data set for analysis.

Another problem of this data set is the issue of survivorship. If a firm does not report financial information for four years following the last included filing, it is dropped from the database. Furthermore, Bureau Van Dijk only provides eight years of data for a given company. Once the ninth year of data is available, the first year of data is dropped. I use the 2012 version of Amadeus, which restricts the analysis to the years 2006-2011.

Amadeus also provides industry-level information in the form of three-digit NACE codes. NACE is the European standard of industry classification. Industry dummy variables are constructed for each two-digit NACE code. Financial firms with a NACE codes of 65 or 66 are dropped. The data consist of 1,624,761 public and private non-financial firms present in twenty countries from the Amadeus database for the six years between 2006 and 2011. The sample comprises of 4,656,320 firm-year observations. Table 1 shows the composition of the firms in the final sample. In total, there are twenty countries within the sample, and these countries vary in terms of size, geographic location, and economic development. There are 1,621,949 private firms in the final sample and only 2,818 public ones. A firm is considered publicly traded if it has a ticker symbol, though these firms make up less than 1% of the total sample.

Table 1 shows the twenty European countries in the sample and the types of creditor rights that are present in each economy. Previous papers utilizing the Global Vantage database (Acharya, Amihud, and Litov, 2011 and Acharya and Subramanian, 2009) have only examined publicly traded companies, and previous literature has shown that there are substantial differences between public and private companies (Classens and Tzioumis, 2006 and Giannetti, 2003).

4.1 Creditor Rights Variables

The creditor rights index was originally proposed by La Porta, Lopez-de-Silanes, and Shleifer (1998). Later, Djankov, McLiesh, and Shleifer (2007) extended this index to 129 countries over the years 1978-2003. The La Porta, Lopez-de-Silanes, and Shleifer (1998) Index was available for a single cross-section of countries in the year 1998. The Djankov, McLiesh, and Shleifer (2007) version of the index codes insolvency procedures slightly differently and provides a time series variation of this variable, though these indexes are very highly correlated. The Djankov, McLiesh, and Shleifer (2007) index has four components of the creditor rights index, each taking a value of 0 or 1, where higher variables indicate more investor protection. The index was constructed on January of each year between 1978 and 2003. This study utilizes the most recent 2003 values from the Djankov, McLiesh, and Shleifer (2007) study.

The first element of the creditor rights index is whether or not restrictions, such as creditor consent, exist when a borrower files for reorganization. The existence of such restrictions means that the value of Reorg for country c in year 2003 takes on the value of 1. The second element of the index is whether or not secured creditors are able to seize their collateral once a reorganization petition is approved or whether the courts impose an automatic stay of assets. If there is no automatic stay of assets in place and secured creditors can immediately seize collateral, the variable *NoAutostay* is 1. If the secured creditor is paid first out of the proceeds of liquidating a bankrupt firm, the value of Secured is 1. In certain countries, the government or employees have absolute priority over secured creditors. I believe that this element of the creditor rights index most closely relates to the agency conflict mentioned by Jensen and Meckling (1976). The final component of the index, Manages, takes a value of 1 if management is removed during times of bankruptcy and an administrator is appointed by the courts to run the firm. The creditor rights index, Crights has four components, and each component takes on a value of 0 or 1. If the component has a value of 1, this means that the creditors have more power. The aggregate index ranges from 0 (low creditor protection) to 4 (high creditor protection).

It is important to note that creditor rights are not an equilibrium quantity determined by supply and demand of credit. LaPorta, Lopez-de-Silanes, Shleifer, and Vishny (1998) show that creditor rights are largely determined by legal origin, which was imposed at the time of colonialism and colonization at the inception of the country. Both La Porta, Lopez-de-Silanes, and Shleifer (1998) and Djankov, McLiesh, and Shleifer (2007) find that laws change slowly and that there is a high degree of persistence in the creditor rights index over the 25-year time period between 1978-2003. Because the most recent data point is 2003, this is the year that is utilized in this study. This variable is an accurate representation of the creditor rights environment within my sample period, since this index is very stable. Country fixed effects are not able to be included, since there is only one variable of creditor rights available for each country. Even if the creditor rights data were available for each year in this study, if it was unchanged, the country-level fixed effects would have also controlled for this effect. However, the cross-sectional analysis, which focuses on the interaction between creditor rights and a firm-level variable, does utilize country and year fixed effects, allowing me to control for any country-level unobservable factors.

The majority of the previous empirical literature examines the aggregate index, paying little attention to the individual components. To my knowledge, there are only a limited number of previous papers that examine the individual components (Houston, Lin, Lin, and Ma, 2010; Claessens and Klapper, 2005; Bae and Goyal, 2009; and Acharya, Amihud, and Litov, 2011). It is important to examine the individual index components of the index because it is possible that only one or two elements are driving the findings in the previous literature that only examine the aggregate index. It's also possible that the individual components have different effects on borrowers. I also suspect that the element of the creditor rights index that indicates whether the secured creditor is paid first has the strongest impact on the way creditors lend, which would strongly influence firm balance sheet leverage.

Table 1 shows the individual creditor rights components for each country in the data set. The median firm in the sample has a creditor rights index value of about 2. Table 1 shows that there is considerable variation in which elements of the creditor rights index are present in each country. La Porta, Lopez-de-Silanes, and Shleifer (1998) show that creditor rights are not necessarily measures of economic development. For example, both France and Germany are developed economies, yet Germany has a creditor rights index value of 3 and France has a creditor rights score of 0. Thus, it is unlikely that the results are driven by the differences in economic development.

4.2 Firm-Level Variables

The final sample consists of 1,624,761 public and private non-financial firms present in twenty countries from the Amadeus database for the six years between 2006 and 2011. The initial dependent variable of interest is individual firm borrowing during a given year. Within the empirical framework, the supply side of the debt market consists of all debt issued by banks, bond holders, and any other secured or unsecured creditor. The ideal data would consist of information regarding each type of debt a firm has, including information pertaining to each bond and loan contract. Using this ideal data set, it would be possible to calculate the exact amount of secured debt that a firm has, its type, and the overall price that a firm pays to acquire this debt. Unfortunately, accounting standards do not require disclosure of this detail, which means it is necessary to approximate debt demanded and interest rates paid.

Using Amadeus balance sheet data, it is feasible to estimate the total amount of borrowing ($FDebt$) that a firm holds. The two most common ways for a firm to acquire debt is either to obtain a loan or issue debt. Since the majority of the firms in the sample are small and private, most of the debt on their balance sheets is likely bank loans. The two components of total firm borrowing ($FDebt$) consist of non-current liabilities in long-term debt and current liabilities in loans. Unfortunately, due to data limitations, I do not have information on the specific types of debt contained within each component. There is no way for me to discern secured from unsecured loans or the types of bonds that firms may be holding. This measure also does not account for commercial paper, though the majority of sample firms are small, private, and unlikely to hold commercial paper. This would bias the leverage estimates down, though this bias is likely negligible.

Total borrowing is scaled by firm assets (*FAssets*) in order to control for any size effects that may supersede controlling for size alone. The dependent variable in the demand regressions firm-level leverage, *FirmLeverage*, is defined as the ratio of firm loans to total assets. Firms with negative equity and leverage values greater than 1 are removed, and the leverage variable is winsorized at the 1% level in each tail. Table 2 shows that the average firm in the sample has $5 million in assets, $1.4 million in loans, and a leverage ratio of about 0.3. In contrast, the median firms has only $1 million in assets and under $200,000 in loans. Many of the firms in this sample are very small private firms, yet there are a few very large firms that skew the overall distribution.

It is not surprising that many of the sample firms have a heavy reliance on debt, since the sample consists almost entirely of private firms that cannot easily access equity markets (Berger and Udell, 1998) and depend primarily on funding from commercial banks along with the equity of the principle owner (Berger and Udell, 2002). However, each of these variables is very right skewed.[3] There are a few firms in each country that are very large, which is what drives the skewness of many variables. The heterogeneity within this sample provides ample opportunities for analysis. The summary statistics are shown in Table 2.

[3] Robustness checks completed in Section 7 will show that even after accounting for this skewness, the results are still unchanged.

When a borrower is determining the amount debt to acquire, one of the most important factors will be the price of the loan or interest rate. If the data allowed, it would be best to use individual debt contracts in order to estimate the average cost that each firm could acquire additional debt. Instead, the existing data can only create a proxy for how much it would cost an individual firm to acquire additional capital. I call this variable the firm-level interest rate, *IRCorp*. Using the Amadeus Database, I obtain information on the total interest the firm has paid, which is paid on both loans and bonds. The estimated firm-level interest rate is calculated by taking the ratio of the total interest the firm has paid, *InterestPaid*, to total debt, *FDebt* .

The Dealscan database contains loan-level data for a cross section of syndicated commercial loans that are a minimum of $100,000. Loans of this size would be unobtainable for many of the firms in the sample, considering $100,000 is more than the total loans that 40% of the sample firms have on their balance sheets. This study is motivated by the idea that it is important to examine firms of all types, including small firms that are most likely affected by the local creditor rights environments. Bae and Goyal (2009) examine loan-level data from the DealScan database and find no relationship between creditor rights and loan size or maturity, but they do find that greater investor rights lead to lower interest rates. I acknowledge this data limitation but realize that this is a tradeoff where I compromise loan-level details from the Dealscan for a much wider range of firms that vary substantially in terms of size, countries, and sample composition.

This interest rate is subject to a number of problems, such as the different accounting standards that countries may have, differences in collateral, and underwriting.

Additionally, it is impossible to determine the rates paid on bonds or even the types of loans that firms are holding. Though this interest rate is subject to a variety of problems and biases, I believe that when considering firm financing and investment decisions, the firm-level interest rate is an important variable that has previously been omitted by many previous leverage studies. I expect this interest rate to have a highly significant negative relationship with *FirmLeverage*, indicating that firms borrow more when interest rates are lower. Firm-level interest rates that are either less than 0 or greater than 1 are truncated, and the distribution is winsorized at the 1% level. I find that the median firm in the sample is able to obtain a loan at about 5.4%, though the average is almost twice as high, which is due to the fact that many of the firms within this sample are small and operating in emerging market countries. This rate is especially high for private firms in Ukraine, Slovak Republic, and the Czech Republic.

In subsequent regressions, I analyze the way firms utilize the additional capital that they demand outside bankruptcy states. For the investment analysis, the dependent variables of interest are Investment, Risk, and Profitability. Investment is defined as the annual increase in gross fixed assets scaled by total assets in the beginning of the year (Desai, Foley, and Hines, 2009; Asker, Farre-Mensa, and Ljungqvist, 2015 and Badertscher, Shroff, and White, 2013). Because net assets are reported on the balance sheet, I calculate the change in gross assets by computing the difference between net fixed assets and adding incremental depreciation. I scale this measure by total assets to arrive at the proxy for investment. Unfortunately, a number of firms in this sample do not report incremental depreciation, which means I lose several firm-year observations, as can be seen by the Table 2 summary statistics. The average firm in the sample has an investment ratio of 5%, while the median firm is at 1.9%.

This measure of investment is subject to a number of additional criticisms that should be acknowledged. Both capital expenditures and mergers and acquisitions lead to increases in fixed assets, though research and development does not. As previously mentioned, many European countries are not required to disclose research and development on their balance sheets, which is a limitation of this measure. Existing studies examining investment policies of private firms similarly examine changes in gross fixed assets. The proxy for profitability is measured as earnings before depreciation and taxes normalized by total assets, *EBITDA*/*FAssets*. I also examine a three-year estimate of firm cash-flow risk, *Risk*, which is defined as the standard deviation of *EBITDA*/*FAssets* for the year before, during, and after the year of analysis. I also conduct robustness checks analyzing the standard deviation of the previous three years, as in Faccio, Marchica, and Mura (2011). Because this metric for risk examines three years of data, firms without 2005 data are unable to compute risk measurements. This is the reason a small group of firm-year observations are dropped from the sample when examining firm risk.

In each regressions, I also control for a subset of firm-level characteristics, which are primarily taken from by Myers (1977) and Boot, Aivazian, Demirğuç-Kunt, and Maksimovic (2001). These firm-level controls include total firm assets (in log form), *LogFAssets*, in order to control for any size effects. The variable *TanAssets* measures the percentage of total assets that are recorded as fixed assets, which proxies for collateral. The average firm in the sample has 25% of its assets listed as tangible, while the median firm has about 16%. Tobin's Q, which is the ratio of the market value of the firm's total assets to its book value, is typically an indicator of investment opportunity, but given that 99% of firms in the sample are privately held, it is not possible to compute a market value. As a result, I proxy for investment opportunities by defining a variable, Growth, that is computed by examining the natural log of the increase in sales growth.

The finance literature examining private companies commonly proxies for investment opportunities in this way (Shin and Stulz, 1998; Lehn and Poulsen, 1989; Whited, 2006; Whited and Wu, 2006; Bloom, Bond, and Van Reenen, 2007; Asker, Farre-Mensa, and Ljungqvist, 2015 and Badertscher, Shroff, and White, 2013). I also examine firm age, Age, as defined as the amount of years since incorporation in order to proxy for firm reputation. Diamond (1991) shows that firm reputation can affect financing choices when the firm becomes sufficiently mature to be able to access the bond market. The average firm age in the sample is 15 years, while the median firm is 12 years old, indicating that most firms in the sample are quite established and are not start-ups. All firm-level control variables are winsorized at the 1% level, except *ROA* and *Growth* which are winsorized at 5% to curtail the skewness and outlier influence. In total there are a total of 4,656,320 firm-years in the sample spanning twenty countries.

4.3 Country-Level Controls

A selection of macro-level controls is included for all firm-level regressions that are designed to control for the macro lending environment. These country-level variables attempt to control for differences in economic development across countries, and they are shown in Panel B of Table 2. When deciding how much debt a firm demands, it may consider the ease of pursuing a debt substitute, such as going to the equity market. Large public firms, in particular, have greater access to domestic bond markets, as well as the international bond market. This may be an attractive substitute for bank debt, if the bond markets are well developed and easily accessible. The Bankscope database by Bureau Van Dijk contains balance sheet data for almost every public and private bank within a given country. This database is extremely comprehensive and contains data for banks for each country within the Amadeus sample. I use this database in order to obtain the total number of bank loans within a given country for each year of the analysis. By aggregating the individual bank data contained within Bankscope, I am able to estimate total size of bank loans within a country, *TotalBankLoans*. In order to estimate the size of the bond market, I obtain data on the aggregate size of the bond market for non-financial firms, *BondMarket*, from the Bank for International Settlements (BIS). The control of the bond market in country c during year *t* is computed below.

$$BondControl_{c,t} = \frac{BondMarket_{c,t}}{BondMarket_{c,t} + TotalBankLoans_{c,t}}$$

The variable *BondControl* should capture the substitutability of bank loans with the bond market. I expect the relationship between firm leverage and the size of the bond market to be negative, which means that countries that have greater access to the bond market should take on less bank loans. The variable *BondControl* is also skewed to the right. The average value of *BondControl* is about 0.12, though the median is only 0.04. The skewness comes from the fact that a number of countries in the sample have more developed bond markets, while many of the emerging market countries in the sample do not. Furthermore, I control for the level of information sharing in an economy, which may alleviate financing constraints, foster credit market expansion, and act as a substitute for creditor rights (Jappelli and Pagano, 2002; Padilla and Pagano, 2002; Djankov, McLiesh, and Schleifer, 2007; and Brown, Jappelli, Pagano, 2009).

Information sharing measures the degree of efficient contracting between borrowers and lenders and is an indication of how much banks know about borrowers. It has also been shown that if banks exchange information about borrowers, this can influence borrower behavior by motivating them to exert more effort into projects (Padilla and Pagano, 2000 and Vercammen, 1995) and pay back loans (Klein, 1992). The proxy for information sharing is from the World Bank. The variable Depth measures the depth of information sharing for a country during a given year. It is an index taking on a value between 1 and 6, where higher values indicate the availability of more credit information from either a public registry or a private bureau. The variable depth is available annually for all years in the sample, and the six components of the index Depth are discussed in detail in Appendix A.4.

Information sharing may act as a reward or punishment for borrowers. The spreading of knowledge regarding something like consistent payments may serve as a positive signal, while numerous delinquencies may make it more difficult for the firm to obtain future credit. Information sharing has been shown to be an important determinant of credit availability by a number of theory (Padilla and Pagano, 1997; Padilla and Pagano, 2000; Pagano and Jappelli, 1993; Boyd and Hakenes, 2013) and empirical papers (Jappelli and Pagano, 2002; Djankov, McLiesh, Shleifer, 2007; Laeven, Levine, Michalopoulos, 2015; Brown, Jappelli and Pagano, 2009).

A number of papers also suggest that it’s not just the rules that are in place but the way that they are enforced that determines their implications (Bae and Goyal; 2009 and

Bhattacharya and Daouk; 2002, 2005), which means it is necessary to control for the degree of enforcement within each country. Later, socialist countries are dropped entirely in robustness checks, since their enforcement is most questionable, which will be discussed in Section 7 of this paper. From the World Governance Indicators (compiled by Kaufmann, Kray, and Mastruzzi, 2008), at the country-year level, variables to control for control for control of corruption (*Corruption*), government effectiveness (*Effectiveness*), quality of regulation (Regulation), and rule of law (Law), and political stability (*Stability*) to capture government stability, are included. These variables designed to control for the degree of law enforcement that is in place and are explained in detail in Appendix A.4.

I also control for economic development by controlling for log Real GDP Per Capita (*LogGDP*) to capture the size of the economy, inflation (*Inflation*) , and create dummy variables for French (*French*), German (*German*), Scandinavian (*Scan*), and Socialist (*Socialist*) legal origin. Further details regarding country-level controls can be found in Appendix A.4. Panel B of Table 2 shows all of the country-level variables discussed in this section. There are ninety-six country-year observations present in the final sample, and each macro variable is winsorized at the 1% level and lagged by one year in analysis.

5 Firm Leverage Regression Results

5.1 Firm Leverage Ordinary Least Squares Results

The first step in the analysis is to use an ordinary least squares approach in order to examine the overall effect that creditor rights have on firm leverage. The main dependent variable is firm leverage, which is the ratio of firm-level total liabilities in loans and long-term debt to total assets. The key independent variables of interest are the interest rate and creditor rights measures. Both firm-level controls and macro-level controls are included in the regressions. The construction of each variable is contained within Section 4, and the ordinary least squares regression takes the form:

$$\begin{aligned} FirmLeverage_{f,c,t} &= \alpha_1 + \beta_1' IRCorp_{f,c,t} + \beta_2' CreditorRightsMeasure_{c,2003} + \\ &\quad \beta_3' FirmControls_{f,c,t-1} + \beta_4' CountryControls_{c,t-1} + \varepsilon_{f,c,t} \end{aligned} \quad (1)$$

I analyze the aggregate creditor rights index as proposed by La Porta, Lopez-de-Silanes, and Shleifer (1998) and Djankov, McLeish, and Shleifer (2007), as well as the individual components. I also include industry-year fixed effects, and robust standard errors are clustered at the country-level year level. By clustering the errors at the country-year, firms are not restricted to be independent within country-years. However, observations are required to be independent across country-years.

Unfortunately, I am unable to include country-level or firm-level fixed effects because the creditor rights measures are from 2003, which is the most recent year of the data provided by Djankov, McLeish, and Shleifer (2007), while the earliest year of firm-level data I analyze is 2006. As previously discussed, creditor rights are very constant over time and are likely to accurately estimate the degree of investor protection during the sample period. If creditor rights negatively affect borrowing, this would indicate that $\beta_2' < 0$, though $\beta_2' > 0$ would indicate a positive relationship between leverage and borrowing. The results of the firm-level ordinary least squares results for the full sample are presented in Table 3.

The regression results show that the firm-level interest rate, *IRCorp*, is negative and significant, indicating that firms borrow more when interest rates are lower, and the magnitude is consistent across each of the four components of the creditor rights index. As shown by regression 1, the aggregate index, *Crights*, is associated with an increase in firm leverage. Only two of the individual creditor rights index components appear significant in the regressions. All else equal, this means that for two similar firm, operating in two economies where the creditor rights index differs by one unit, the firm in the environment with higher creditor rights will have a leverage ratio that is .0260 higher than the other. For the average firm in the sample, with a leverage ratio of .296, a similar firm in an environment with one unit more of investor protection would have a leverage ratio of .296+.0260 = .322, which is an increase in leverage of approximately 8.78%. When there is no automatic stay of assets (*NoAutostay*) present that increase firm-level leverage by 0.044. For the average firm in the sample, this is associated with a 14.8% increase in leverage, while if the secured creditor is paid first (*Secured*), this leads to an increase in firm leverage by about 25% for the average firm. The magnitude of these coefficients indicate that when these specific elements of the creditor rights index are present, it is much easier for firms to obtain credit, as evidenced by increased leverage. The significance and magnitude of the creditor rights coefficients indicate that the effects are economically large and meaningful.

When creditors have to approve reorganization (*Reorg*) or have the ability to remove management (*Manages*), there is no significant effect on firm leverage. The positive and significant effect on leverage from the creditor rights index is in line with the findings of Brown, Jappelli, and Pagano (2009) and Giannetti (2003) but contradict those of Acharya, Amihud, and Litov (2011) and Acharya and Subramanian (2009). The coefficients on firm-level and macro controls exhibit the expected signs that are consistent with the established finance literature, which are discussed below.

The firm-level controls show that

1. Firm size, *LogFAssets*, is positive and significant, indicating that larger firms may be slightly more levered than small firms, though the magnitude on this coefficient is extremely small. Firm size has generally found to be negatively correlated with leverage in previous studies, with the exception of Rajan and Zingales (1995) and Giannetti (2003) who find some evidence of a positive relationship in certain countries within their studies.
2. Sales growth, *Growth*, is not shown to be a significant predictor of firm leverage.
3. Profitability, *ROA*, always appears negatively correlated with firm leverage, which is consistent with the existing finance literature, suggesting that firms would rather finance with internal funds rather than debt (Harris and Raviv, 1991; Rajan and Zingales, 1995 and Boot, Aivazian, Demirğuç-Kunt, and Maksimovic, 2001).
4. Tangible assets, *TanAssets*, is positive and significant, as the literature suggests (Titman and Wessels, 1988; Rajan and Zingales, 1995 and Giannetti, 2003). Tangible assets represent the amount of collateral a firm can offer. When firms can offer more

as collateral, creditors are more willing to supply them with debt. Borrowers may also demand more loans as a result.

5. The proxy for firm reputation, *Age*, appears negative and significant, yet the magnitude is very small. Diamond (1991) suggests that firm reputation will affect firm financing decisions once the firm matures and gains access to the bond market, though the paper suggests a nonlinear relationship.

The country-level controls indicate:

1. The proxy for substitutability of the bond market, *BondControl*, is negative and significant, indicating that for countries where the bond market is larger, firms are less levered.
2. Depth of information sharing, Depth, is shown to be positively associated with firm leverage, which is consistent with the literature suggesting information sharing alleviates financing constraints (Jappelli and Pagano, 2002; Padilla and Pagano, 2002; Djankov, McLiesh, and Schleifer, 2007; and Brown, Jappelli, Pagano, 2009).
3. Economic development, *LogGDP*, when significant is negative and has a very small magnitude, though it is only negative at the 10% significance level when examining the aggregate creditor rights measure in regression 1.
4. The variable *Inflation* does not enter the regressions significantly
5. Rule enforcement, including *Corruption*, *Effectiveness*, *Regulation*, and *Law*, do not appear to influence leverage very much. In some regression specifications, they are significant and are positively associated with firm leverage, indicating firms borrow more when enforcement is greater.

6. Political Stability, *Stability*, is shown to be positively associated with firm leverage for regressions 1 and 3, indicating that firms borrow more when they are in environments that are more politically stable. However, the opposite effect is true in regression 4 at the 10% significance level.

5.2 Further Leverage Analysis

Next, I analyze the way creditor rights affect the leverage of specific cross-sections of firms. When creditor rights are higher, creditors may be more likely to extend credit to to firms that could not easily acquire it. Specifically, I test whether or not firms with low levels of assets or firms that can post less collateral are able to obtain more loans.

First, I focus on firms that have a high percentage of tangible assets that could be used as collateral. I examine if these firms are able to obtain more loans in higher creditor rights environments by focusing on the interaction between the creditor rights measure and asset tangibility. By examining this interaction term, I am able to include country fixed effects, allowing me to control for any unobservable country-level characteristics that are unchanged within my sample period. The regression framework is outlined in equation 2:

$$\begin{aligned} Leverage_{f,c,t} &= \alpha_2 + \beta_5^{'} CreditorRightsMeasure_{c,2003} \times Tangibility_{f,c,t-1} \\ & \quad \beta_6^{'} FirmControls_{f,c,t-1} + \omega_{f,c,t} \end{aligned} \tag{2}$$

All of the firm-level controls from Table 3 are included within the regressions, including asset tangibility. Beyond controlling for the effect that asset tangibility has on leverage, the interaction term between asset tangibility and creditor rights indicates any additional effects that creditor rights have on firm leverage through asset tangibility. Because the asset tangibility variable represents the percentage of total firm assets that are considered tangible, if firms that cannot pledge as much collateral are able to obtain more loans, this would indicate that $\beta_5{}'$ <0 . Alternatively, if it is found that $\beta_5{}'$ <0, this could also mean that firms with more tangible assets are reducing leverage as a risk reduction technique. In Section 6, I will examine an alternate risk-taking measures and see if these results are consistent with a risk-reduction story. The results are presented in Panel A of Table 4. Only the coefficients on the interaction terms between creditor rights and asset tangibility are reported for the sake of space, though the other controls are quantitatively similar to the OLS results presented in Table 3.

Table 4 indicates that firms with more tangible assets reduce leverage when the aggregate creditor rights index is higher, and this finding is driven by the components associated with restrictions on reorganization or management removal. The average firm in the sample has an asset tangibility of 0.253 and a leverage ratio of 0.293. Table 4 indicates that when the aggregate creditor rights index increases by one unit, the average firm in the sample has a decrease in leverage of 0.0811 × 0.253 = 0.0203, which is approximately a 7% drop in leverage. The interaction terms between tangibility and either no automatic stay on assets or secured creditor paid first do not significantly impact leverage.

Next, I analyze whether small firms are able to obtain more loans when creditor rights are higher or if larger firms are capable of additional borrowing. I examine the interaction between the creditor rights variable and log lagged assets. I control for all firm-level variables presented in Table 3, including log lagged assets. The regression framework is presented in equation 3:

$$
\begin{aligned}
Leverage_{f,c,t} &= \alpha_3 + \beta_7^{'} CreditorRightsMeasure_{c,2003} \times LogFAssets_{f,c,t-1} \\
&\quad \beta_8^{'} FirmControls_{f,c,t-1} + \gamma_{f,c,t} \qquad (3)
\end{aligned}
$$

Table 4 Panel B shows the results of Equation 3 for each creditor rights variable. The average firm in the sample has log assets of 13.948 and leverage of 0.296. Table 5 Panel B indicates that the when the aggregate creditor rights index, restrictions on reorganization, or management removal components of the creditor rights index interact with firm size, this has a positive effect on firm leverage. For the aggregate creditor rights index, this means that all else equal, for two equally sized firms existing in economies where the creditor rights index differs by one unit, this is associated with a difference in leverage of 0.0057, suggesting that on average, larger firms are able to obtain more credit in debtor friendly economies. For the average firm in the sample, with log assets of 13.948, that is a difference of 13.948 × 0.0057 = 0.0795. Interestingly, the coefficient on the interaction between *Secured* and *LogFAssets* is negative and significant, indicating that smaller firms borrow more when the secured creditor is paid first. This suggests that secured creditors are more likely to give small firms credit, if they have priority over employees or government workers. The interaction term between size and no automatic stay of assets does not have a significant effect on firm leverage.

6 Firm Investment Policy

6.1 Firm Investment

If higher creditor rights lead to greater borrowing, as evidenced by increased leverage, the next question to consider is how firms are utilizing the additional capital that they acquire. I first test whether higher creditor rights leads to increased firm investment.

Most investment literature defines investment as capital expenditures, mergers and acquisitions, and research and development. However, due to the nature of the Amadeus Database, it is difficult to distinguish between these types of investment, and the majority of firms in the sample do not report research and development expenditure, either because they do not have this type of expenditure or because the country accounting standards do not require it. As in Asker, Farre-Mensa, and Ljungqvist (2015), the variable Investment is defined as the annual increase in gross fixed assets divided by total assets at the beginning of the year. Also, as discussed in Section 4.2, a number of firms in the final sample do not report incremental depreciation.

As a result, a group of firm-year observations are lost, resulting in a reduced sample, though the country composition has not changed. Both capital expenditure and mergers and acquisitions activities will lead to increases in the variable Investment , though increases in research and development is not contained within this variable due to the limitations of the Amadeus database. In order to test the second hypothesis, that creditor rights are associated with greater firm investment, the following regression presented in Equation 4 is examined:

$$Investment_{f,c,t} = \alpha_4 + \beta_9' CreditorRightsMeasure_{c,2003} + \beta_{10}' FirmControls_{f,c,t-1} + +\beta_{11}' CountryControls_{c,t-1} + \delta_{f,c,t} \quad (4)$$

Within this investment framework, the variable of interest for hypothesis 2 is β_9'. If firms are taking the additional capital that they borrow and investing it, I expect $\beta_9' > 0$. I control for a variety of lagged firm-level controls that have been established by the finance literature as important determinants for investment. These firm-level and country-level controls are similar to those utilized in the leverage regressions, but lagged leverage is added as a control.

Leverage has shown to be an important determinant for investment because firms with lower leverage can more easily engage in investment opportunity improvement. I also control for greater investment opportunity sets as proxied by sales growth (*Growth*). Firms that are more profitable (*ROA*), larger (*LogFAssets*), have more tangible assets (*TanAssets*), or are more reputable (*Age*) are more likely to have fewer financing constraints, which should positively affect firm investment. Firms that have lower costs of obtaining credit, as estimated by *IRCorp*, are also more likely to be able to take advantage of investment opportunities. At the country-level, I control for the level of information sharing (*Depth*) , which is believed to help alleviate financial constraints, economic development (*LogGDP*), inflation (*Inflation*) enforcement (*Corruption, Effectiveness*, *Regulation*, *Law*), as well as political stability (*Stability*), substitutability of the bond market (*BondControl*) and legal origin. The results are presented in Table 5.

I find that *Secured* is the only component of the creditor rights that impacts firm investment, though the significance is only at the 10% level. The leverage analysis had indicated that Secured was the most important determinant of firm borrowing, and Table

5 provides evidence that at least some of this money is invested in tangible assets. In Section 5, it was shown that firms with lower levels of asset tangibility had greater leverage when creditors could approve restrictions on reorganization or remove firm management, which drove the significance of the creditor rights index.

Equation 5 tests whether the interaction between creditor rights and asset tangibility significantly impacts firm investment. If this interaction significantly impacts firm leverage, it could be possible that part of the additional capital acquired is being used to grow the firm's business.

$$\begin{aligned} Investment_{f,c,t} &= \alpha_5 + \beta_{12}^{'} CreditorRightsMeasure_{c,2003} \times TanAssets_{f,c,t-1} \\ &\quad \beta_{13}^{'} FirmControls_{f,c,t-1} + \eta_{f,c,t} \end{aligned} \tag{5}$$

Section 5 also indicates that the interaction effect between creditor rights and firm size is positive if restrictions on reorganization, the ability to remove management, or the aggregate index is examined. However, if the secured creditor is paid first, the interaction effect with creditor rights is negative, indicating that smaller firms are more levered. Equation 6 examines whether the interaction between creditor rights and firm size to determine if the firms that obtain more credit are investing in tangible assets.

$$\begin{aligned} Investment_{f,c,t} &= \alpha_6 + \beta_{14}^{'} CreditorRightsMeasure_{c,2003} \times LogFAssets_{f,c,t-1} \\ &\quad \beta_{15}^{'} FirmControls_{f,c,t-1} + \xi_{f,c,t} \end{aligned} \tag{6}$$

The regression results of Equations 5 and 6 are presented in Table 6, and robust stand errors are clustered at the country-year level. Firm-level controls are quantitatively similar to those in Table 5 but are not reported for the sake of space.

Table 6 Panel A suggests that the interaction between tangible assets and any of the creditor rights measures does not significantly impact firm investment decisions. Even if firms with low levels of asset tangibility are able to acquire more credit, they do not have increased investment in tangible assets. Interestingly, Table 6 Panel B indicates that the interaction term between asset tangibility and whether the secured creditor is paid first is the only element of the creditor rights index that negatively impacts firm investment.

Table 4 Panel B indicated that small firms were able to borrow more when secured creditors are paid first, and Table 7 Panel B indicates that smaller firms invest more when this element is present. These two results suggest that when the secured creditor is paid first, smaller firms are able to borrow more, and some of this money is invested in tangible assets.

6.2 Creditor Rights and Firm Risk

This study next examines the types of projects that firms are engaging in by examining overall firm cash-flow risk. There are two conflicting hypothesis regarding the way that creditor protection impacts these two variables. Acharya, Amihud, and Litov (2011) suggest that when creditor rights are high, firms fear inefficient liquidation and engage in projects to decrease their overall firm risk, even if these projects are unprofitable. Jensen and Meckling (1976) suggest that when equity holders have smaller claims in bankruptcy, they take on projects that have higher variances and lower mean returns, which translates to more risk and less profitability overall.

The measure of firm risk is defined as the standard deviation of $ROA_{f,c,t-1}$, $ROA_{f,c,t}$, and$ROA_{f,c,t+1}$, though the results are robust to using the previous three years of return on assets as well. A small number of firms in the sample do not have the data from 2005 necessary to compute the measure of firm risk necessary for 2006, which is the first year of the study. As a result, the sample for this analysis is slightly reduced, though this reduction should not affect the results, as the firms without data available come from a variety of different countries.

First, I analyze the overall relationship between creditor rights and firm risk. I use industry-year fixed effects, and robust standard errors are clustered at the country level. The framework presented in equation 7 is used to gain an overall impression of the way investor protection impacts firm cash-flow risk.

$$\begin{aligned} Risk_{f,c,t} &= \alpha_7 + \beta_{16}' CreditorRightsMeasure_{c,2003} + \\ & \quad \beta_{17}' FirmControls_{f,c,t-1} + \beta_{18}' CountryControls_{c,t-1} + \tau_{f,c,t} \end{aligned} \tag{7}$$

If creditor rights leads to higher firm risk, as in Jensen and Meckling (1976), it can be expected that $\beta_{16}{}' > 0$. The agency conflict mentioned in Jensen and Meckling (1976) is most closely related to the component of the creditor rights index that indicates whether or not secured creditors are paid first (*Secured*), since in some countries, employees can actually rank higher than secured creditors.

Many of the firms in the sample are small private firms that are owned and operated by the same small group of individuals. If a firm goes bankrupt in an environment where the secured creditor is paid first, the employees (or government) retain a smaller percentage of the firm, which is directly related to the agency conflict presented in Jensen and Meckling (1976). If employees are paid first out of liquidation claims, the owners are able to retain a greater portion of the firm and the downside losses of the equity holders are less substantial. All else equal, it is more likely for equity holders to want to continue firm operations, while secured creditors may be more eager to collect their claims.

The firm-level and country-level controls are identical to those used for the investment regressions. I control for ROA because risk, as measured by the volatility of ROA, could potentially stem from poor management ability, opposed to risk-taking choices, as mentioned by Faccio, Marchica, and Mura (2011). I also expect to see negative relationships between firm risk-taking and firm leverage (*Leverage*), as more debt results in greater equity risk. I also expect negative coefficients on size (*LogFAssets*), and reputation proxied by age (*Age*) , and tangibility (*TanAssets*) . I also control for firm-level interest rate (*IRCorp*) and investment opportunity (Growth). The country-level controls include (*LogGDP*), the size of the bond market (*BondMarket*), enforcement (*Corruption*, *Effectiveness*, *Regulation*, and *Law*), political stability (Stability), and legal origin. Full sample are presented in Table 7.

The results presented in Table 7 show that the only element of the creditor rights index that has an impact on corporate risk-taking is whether the secured creditor is paid first. When the secured creditor is paid first, corporate cash-flow risk increases, and this finding is what drives the positive sign on the aggregate index. This finding suggests that overall, firms respond to investor protection by risk-shifting. The control coefficients all have the predicted signs. Size, leverage, asset tangibility, and growth opportunities all negatively impact firm risk, while the interest rate has a positive effect. Firm age and profitability are not significantly related to firm cash-flow risk.

The agency conflicts between debt and equity holders are most severe for two particular groups of firms that will be examined separately. Creditors may be more likely to liquidate a firm when they control a large proportion of the firm, such as when the firm is highly levered, or when they can retrieve a large amount of claims, such as when the firm has a large proportion of tangible assets. If firms do fear inefficient asset liquidation, it can be expected that firms that are highly levered or have high levels of asset tangibility to reduce risk-taking when creditor rights are greater. However, it could also be the case that increased creditor rights cause equity holders to even take more risks, since they have more to lose when creditor rights are stronger. The former supports Acharya, Amihud, and Litov (2011), while the latter is consistent Jensen and Meckling (1976).

I test the risk-reducing hypothesis more closely by examining the cross-sectional variation within the sample. In order to test the risk-reducing hypothesis, I focus on a group of firms that is most likely to fear inefficient liquidation. As discussed in Section 5.2, firms that are primarily invested in tangible assets that can easily be sold that operate in economies with high levels of investor protection are most likely to fear inefficient liquidation. Creditors may be more likely to liquidate a firm if they can retrieve a large portion of their claim by selling assets or if they have more control over the bankruptcy and liquidation process. As a result, these firms may ex ante reduce risk-taking initiatives.

In equation 8, I directly test the risk-reduction hypothesis of Acharya, Amihud, and Litov (2011). I expect that firms with high levels of tangibility fear inefficient liquidation in environments where creditor rights are strong, indicating β_{19}'<0.

$$\begin{aligned} Risk_{f,c,t} &= \alpha_9 + \beta_{19}' CreditorRightsMeasure_{c,2003} \times Tangibility_{f,c,t-1} \\ & \beta_{20}' FirmControls_{f,c,t-1} + \upsilon_{f,c,t} \end{aligned} \tag{8}$$

The firm-level cash-flow controls for Table 8 Panel A are quantitatively similar to those reported in Table 7, including the negative relationship with asset tangibility, but are unreported. Table 8 Panel A shows that the interaction between the aggregate creditor rights index and tangibility is negative and significant, indicating that when creditor rights are higher, firms with greater levels of asset tangibility do reduce risk. The aggregate creditor rights index is driven by whether the secured creditor is paid first and if there is no automatic stay of assets present.

The leverage results presented in Table 4 Panel A show that the interaction between creditor rights and asset tangibility impacts leverage negatively only when restrictions on reorganization and management removal are examined. If firms with high levels of tangible assets in high creditor rights environments were using leverage as a risk-reduction technique, I would these same interaction terms to negatively enter the regressions in Table 8 Panel A. I find that the direction of the overall interactions is significant, but the creditor rights index components have different effects.

By examining Table 4 Panel A and Table 8 Panel A together, the empirical results in Table 4 Panel A suggest that firms with lower asset tangibility are able to acquire more loans when restrictions on reorganization or management removal is present, not that larger firms are reducing leverage as a risk-reducing technique, since the two components mentioned do not significantly suggest reductions in cash-flow risk. Only examining the aggregate creditor rights index would have suggested that reduced leverage was consistent with a risk-reduction story in both tables, yet that is not the case when I examine the individual components that drive the index.

Next, I empirically test if creditor rights influence firm risk-taking in a manner that is consistent with the risk-shifting literature. I focus on firms where the agency conflict between debt and equity holders is already severe. When firms are highly levered, debt holders hold large firm claims, but equity holders manage the firm and may have incentives to take additional risk, as suggested by the risk-shifting literature.

Equation 9 tests whether creditor rights amplify the agency conflict between debt and equity holders. I examine whether firms with high leverage values that exist in economies with high creditor rights are more likely to pursue risky projects, as indicated by β_{21}'>0.. The results are presented in Table 8 Panel A.

$$\begin{aligned} Risk_{f,c,t} &= \alpha_9 + \beta_{21}^{'} CreditorRightsMeasure_{c,2003} \times FLeverage_{f,c,t-1} \\ & \beta_{22}^{'} FirmControls_{f,c,t-1} + \nu_{f,c,t} \end{aligned} \tag{9}$$

The firm-level cash-flow risk controls, including a negative sign on firm leverage, are quantitatively similar to those in Table 7 but are unreported. Table 8 Panel B indicates that firms that are already highly levered take on additional risks when any element of the creditor rights index is higher. Adler (1982) suggests that firms that are approaching bankruptcy respond to higher creditor rights by increasing risk, which is consistent with the story told by Jensen and Meckling (1976).

It is possible that the firm chooses leverage and risk together. To alleviate some of this endogeneity problem, I examine lagged leverage, though this doesn't perfectly solve the problem of the two variables being jointly determined. However, high leverage is a strong indication of financial distress, which is why it is examined in Equation 9. Table 8 Panel B shows that the interaction effect between each creditor rights and firm leverage positively impacts cash-flow risk. This is consistent with the idea that creditor rights make the agency conflict between debt and equity holders more pronounced.

6.3 Creditor Rights and Firm Profitability

Acharya, Amihud, and Litov (2011) find that when creditor rights are high, firms engage in diversifying acquisitions, even if they are unprofitable, as evidenced by announcement returns. Jensen and Meckling (1976) suggest that as the agency conflict between debt and equity holders gets more severe, firms engage in riskier projects with lower overall mean returns. Both hypotheses suggest that creditor rights should negatively impact firm profitability. I use the following regression framework to understand the overall relationship between creditor rights and firm profitability, and the regression analysis below is are presented in Table 9.

$$\begin{aligned} ROA_{f,c,t} \quad = \quad & \alpha_{10} + \beta_{23}^{'} CreditorRightsMeasure_{c,2003} + \\ & \beta_{24}^{'} FirmControls_{f,c,t-1} + \beta_{25}^{'} CountryControls_{c,t-1} + \psi_{f,c,t} \qquad (10) \end{aligned}$$

Industry-year fixed effects are included, and robust standard errors are clustered at the country level. The firm-level and country-level controls are identical to those used in Tables 5 and 7. Table 10 shows that each of the creditor rights measures, except Reorg, is associated with a decrease in firm profitability. I find that the interest rate, asset tangibility, and leverage are positively related to firm profitability, while growth opportunities and reputation have a negative impact. When no automatic stay of assets is in place, this is associated with the most dramatic decrease in profitability.

Table 7 indicated that when the secured creditor was paid first, this leads to an increase in risk, while Table 9 shows that this element of the index is associated with a small decrease in profitability. Though, no automatic stay of assets and management removal did not have significant effects on firm risk-taking in Table 8, they do significantly reduce firm profitability.

Next, I examine the effect creditor rights have on firms that either have high liquidation values or are highly levered. Again, I am able to use country and year fixed effects, and robust standard errors are clustered by country year. I control for tangibility, leverage, and all firm characteristics from Table 9.

In Table 4 Panel A, I found that the interaction between asset tangibility and the creditor rights index, restrictions on reorganization, or management removal all negatively impacted firm leverage. That is, firms with lower asset tangibility were able to acquire more loans when these creditor rights existed in the economy. In equation 11, I attempt to understand whether or not the result of this additional credit lead to those firms being more profitable. The results of equation 11 are presented in Table 10 Panel A.

$$\begin{aligned} ROA_{f,c,t} \quad &= \quad \alpha_{11} + \beta_{26}' CreditorRightsMeasure_{c,2003} \times Tangibility_{f,c,t-1} \\ &\beta_{27}' FirmControls_{f,c,t-1} + \theta_{f,c,t} \end{aligned} \qquad (11)$$

The controls in Table 10 Panel A are quantitatively similar those presented in Table 9, including the positive sign on tangible assets, but are unreported. Table 10 Panel A indicates that even after controlling for asset tangibility, the interaction between tangibility and creditor rights significantly impacts firm profitability when the aggregate index, restrictions on reorganization, or management removal are examined. These are the same interaction terms that were shown to impact leverage in Table 4 Panel A.

Examining Table 4 Panel A and Table 10 Panel A together indicates that not only are firms with lower tangibility are able to borrow more when these two components of the creditor rights index are present, and that these projects lead to higher overall profitability overall. The interaction effects between asset tangibility and either no automatic stay of assets or whether the secured creditor is paid first do not impact firm leverage or profitability.

In Table 8 Panel A it was shown that firms who have high levels of asset tangibility reduce risk when no automatic stay of assets is present or the secured creditor is paid first. Table 10 Panel A shows that the interaction between asset tangibility and either of the elements that was shown the reduce risk-taking (NoAutostay or Secured) does not lead to lower profitability. Thus, firms with high levels of tangible assets may be reducing overall firm risk when these elements are present, but they are not necessarily taking on unprofitable projects in order to reduce risk. However, firms with higher levels of tangible assets do realize lower profits when any of the other creditor rights elements are present.

Next, I examine whether highly levered firms that exist in investor-friendly environments realize greater levels of profitability by examining Equation 12. Again, the firm-level controls are quantitatively similar to those presented in Table 9 but are unreported.

$$\begin{aligned} ROA_{f,c,t} &= \alpha_{12} + \beta_{28}^{'} CreditorRightsMeasure_{c,2003} \times FLeverage_{f,c,t-1} \\ & \quad \beta_{29}^{'} FirmControls_{f,c,t-1} + \vartheta_{f,c,t} \end{aligned} \qquad (12)$$

Table 8 Panel B indicated that firms that are highly levered increase firm risk when creditor rights are higher. This finding is significant for all elements of the creditor rights index, which is in line with Jensen and Meckling (1976) and Adler (1982). Table 10

Panel B presents evidence that creditor rights emphasize the agency conflict between debt and equity holders.

Table 8 Panel B and Table 10 Panel B suggest that the all interactions between firm leverage and each element of the creditor rights index leads to more cash-flow risk and lower returns for firms that are approaching bankruptcy, which is consistent with the risk-shifting literature.

7. Instrumental Variable Analysis

In this next section, I further analyze the impact creditor rights have on firm leverage by using an instrumental variable framework. When examining the determinants of firm leverage, the firm-level interest rate is included as a control variable, since the amount that firms pay for debt is an important determinant of leverage. The debt quantities and interest rates examined are equilibrium quantities, which are functions of both supply and demand forces.

Examining the relationship between borrowing and the cost of debt is prone to the problems pertaining to simultaneous equations, and the OLS coefficient estimates for the interest rate will be biased. Furthermore, OLS estimates on all controls correlated with the endogenous variable will also be biased. However, the other firm-level and country-level controls that are not correlated with the interest rate are all consistently estimated.

Creditor rights are also not equilibrium quantities and were imposed at the time of legal origin. However, they are an important determinant of the firm-level interest rates. When creditor rights are higher, there is some evidence that banks charge lower interest rates (Qian and Strahan, 2007), suggesting that the correlation between creditor rights and the firm interest are is non-zero. However, it is also possible that creditors lend to a riskier pool of investors and raise interest rates in response to the increased risk. Thus, it could be the case that interest rates increase. If creditor rights affect interest rates, borrowers may also adjust their leverage decisions in response to these changes in interest rates.

For example, if higher investor protection leads to lower interest rates being charged, firms may respond to lower interest rates by taking on additional debt. The OLS coefficients on creditor rights will not capture any effect on lending that indirectly arise from changes in interest rates. If the creditor rights element does not influence interest rates, then the creditor rights OLS coefficients should indicate the full effects of creditor rights on firm leverage. In order to understand the complete impact that creditor rights have on firm leverage, it is necessary to use an instrumental variable approach and correct the bias of the OLS estimates.

7.1 Instrument Identification and Motivation

In order to construct an instrumental variable framework, it is necessary to first identify an instrument will exogenously shift the supply curve, allowing me to trace out a demand curve. This instrument must be relevant, exogenous, and only affect firm demand for loans through its effect on the firm-level interest rate. The instrument examined is the level of bank concentration. There are two conflicting hypotheses regarding the way concentration impacts loan rates.

The “efficient structure hypothesis” suggests that concentration within the banking industry is due to more efficient banks taking over less efficient ones (Demsetz, 1973; Peltzman, 1977). Diamond (1984) and Boyd and Prescott (1986) suggest that scale economies may drive banking to a monopolistic structure and that concentration is a result of scale economies. As a result, loan rates charged and deposit rates paid would be more competitive, resulting from the efficiency gains being passed to the consumers. This argument assumes firm-specific efficiencies as exogenous and ultimately, these firm-specific efficiencies are what lead to higher levels of concentration. This means that markets that exhibit higher than average concentrations are due to the fact that the most efficient firms have the highest market shares, not chance or a random event.

An alternative theory, commonly referred to as the “structure performance hypothesis,” suggests that when there is more concentration within the banking industry, banks will collude and use their market power to extract rents, which can be interpreted as higher loan rates charged on business loans. The existing finance literature has examined the idea that concentrated banking industries have been able to extract rents through paying lower rates on their deposits. A number of theory papers have formalized this hypothesis, and several empirical papers using U.S. data have confirmed it (Berger and Hannan, 1989; Hannan, 1991; Edwards, 1964; Heggestad and Mingo, 1976). Demirğuç-Kunt, Laeven, and Levine (2004) examine banking concentration in 72 countries between 1995-1999 and find evidence that when controlling for bank-specific factors, concentration is positively linked to bank net interest margins. However, this link breaks down when controlling for certain regulatory restrictions.

Within the regression framework, in order for banking concentration to be a valid instrument, it must be both relevant and satisfy the exclusion criteria. To be considered relevant, the instrument must be meaningfully correlated with the firm interest rate, though it is not important whether this correlation is positive or negative. There is a plethora of both theoretical and empirical literature suggesting that banking concentration influences loan rates, either positively or negatively. Empirically, I expect that concentration will be negatively related to firm-level interest rates, if the efficient structure hypothesis holds true, but a positive relationship provides evidence in favor of the structure performance hypothesis.

The instrument must also satisfy the exclusion criteria, meaning that it only affects firm demand for loans through its effect on the interest rate and not any additional unobserved variables within the error term. In order for the exclusion criteria to hold, it must be shown that the instrument is meaningfully related to firm demand exclusively through its impact on the firm-level interest rate. This means that when a firm is deciding on the amount it wants to borrow, it does not directly consider the concentration of the banking industry when making its decisions.

The banking industry concentration may influence credit conditions beyond the links through interest rates, but this would affect the supply-side of the loan market. That is, the banking industry concentration may influence the way banks supply loans by being a factor in credit rationing or interest rates charged. Except for the effect on interest rate, any influence on credit conditions should affect the way banks supply loans, opposed to the amount that banks demand.

In order to measure the degree of competition within the banking industry, I use data from the Bankscope Database by Bureau Van Dijk. Bankscope contains balance sheet data for almost all public and private banks in 183 countries, including all of those contained within the Amadeus database. I represent the degree of concentration within the banking sector of a country by calculating the fraction of assets held by the three largest banks in a country (BankFrac3) . This measures ranges from 0 to 1, where higher values indicate greater market share is held by the three largest banks, indicative of greater concentration within the banking industry, and it is computed yearly for each country.

In robustness checks, the fraction of assets held by the largest five banks in a country (BankFrac5) and fraction of assets held by the largest three commercial banks within a given country (*ComBankFrac3*) are also examined. These alternative measures of concentration are utilized by Demirğuç-Kunt, Laeven, and Levine (2004) in their cross-country study. Alternatively, I calculate a Herfindahl-Hirschman Index (BankHHI) for a given country-year by taking the squares of the bank-level loans over the sum of the total loans. The results from each instrumental variable are quantitatively similar, and the robustness checks will be discussed in detail in Section 8.

The results I report in this section utilize the fraction of assets held by the three largest banks in a country (BankFrac3) as an instrument. Staiger and Stock (1997) propose a test for the strength of an instrument under the null hypothesis that the coefficients for the instruments in the first stage are zero. They suggest that a first stage F-test statistic of 10 is necessary to assume that the maximum bias in IV estimators to be less than 10%, which is the case for each one of the first stage regressions presented in this analysis.

Panel A in Table 11 shows the first-stage regression results, which show strong evidence in support for the efficient structure hypothesis, indicating a negative relationship between the modified herfindahl index and the firm-level interest rate.

One criticism of using the measure of concentration is that country boundaries may not represent the market for the country's market. Utilizing country lines as a boundary for the country's banking market may be problematic because it ignores the possibility that firms are obtaining credit from banks outside of country lines, especially when banks across country lines may actually be geographically closer to the borrower. Unfortunately, the measure of concentration used in this study cannot account for this possibility.

A second concern is that it could also be believed that bank concentration varies monotonically with country size. Table 2 shows the bank concentration measures for the year 2006 for each country, and it is evident that there is not a monotonic relationship between country size and concentration. The three countries with the largest banking concentrations include Finland, Switzerland, and the Netherlands, while the three least concentrated countries are France, Austria, and Poland. In robustness checks, alternative measures of bank concentration and competition are both discussed and reported in section eight.

7.2 Firm Leverage Two Stage Least Squares Regression Results

In order to identify the effect creditor rights have on firm borrowing, it is necessary to be creative with an econometric framework. The OLS leverage regressions that were presented in Table 3 produce inconsistent coefficient estimates on the interest rate and creditor rights due to the endogeneity problems of the firm-level interest rate. In order to control for this endogeneity, I pursue an instrumental variable framework that first identifies the relationship an exogenous change in interest rate has on firm loan demand.

For an instrument that satisfies the relevance and exclusion criteria, the instrumental variable result should produce consistent coefficient estimates for all regressors, including creditor rights. If creditor rights negatively affect firm borrowing, I would expect the coefficients on the creditor rights measures to be negative in the second stage. However, it could also be the case that they increase loan demand.

Panel B of Table 11 shows the second stage results. The second stage results indicate that the firm-level and country-level controls are quantitatively similar to those that were obtained by the OLS regressions with the exception of firm size, which switches sign. The negative relationship between size and leverage is consistent with the bulk of the existing finance literature. The other key controls maintain their significance and the expected signs. The magnitude on *IRCorp* becomes more negative in the second stage regressions. When interest rates decrease, it is not surprising that firms respond to cheaper credit by borrowing more. The instrumental variable results correct for the simultaneous equations problem that exists within the OLS framework.

Next, I examine the effect creditor rights have on firm leverage. For the regression examining the aggregate index, this means that when interest rates drop 1%, the average firm in the sample, having a leverage of .292, increases its leverage to approximately .310 (.292 + .01 × -1.6973). This is equivalent to the firm increasing its leverage by about 6%, which is a much greater increase than the OLS results show.

Consider two identical firms that operate in two different economies that have varying levels of investor protection. All else equal, the firm that is present in the economy where creditor consent for reorganization (Reorg) is present will have a leverage ratio that is higher by approximately .13. If the secured creditor is paid first in one economy but not the other, that firm in the more debtor friendly economy will have higher leverage of approximately .09 on average, indicating that it is easier for these firms to obtain more loans. However, no automatic stay of assets (*NoAutostay*) and management removal (*Manages*) are not associated with increased leverage.

In previous OLS regressions presented in Table 3, *NoAutostay* was positively related to firm leverage, but after correcting for the simultaneous equations problem, it is not found to significantly impact leverage in the second stage regressions.

Acharya, Amihud, and Litov, (2011) suggests that borrowers may become less levered as a response to increased creditor rights because they fear the creditors inefficiently using their power. This hypothesis is not supported by the OLS or instrumental variable results in this study, but it is also necessary to address the differences in study samples. Acharya, Amihud, and Litov (2011) examine publicly traded firms across the world. Public firms, by being able to access the equity market or international bond markets, can access more substitute types of financing and may respond to the local creditor rights environment differently than private firms.
Both Table 3 and Table 11 suggest that firms are more highly levered when creditor rights are higher. This finding is consistent with Brown, Jappelli, and Pagano (2009),

who find that the aggregate creditor rights index is positively related to leverage in their study of small businesses in emerging market economies. These results suggest that as investors are better protected, it is easier for firms, on average, to obtain more loans.

The positive relationship between creditor rights and firm borrowing is very robust and has proven to be persistent through a variety of robustness checks. The positive relationship between the creditor rights index and firm borrowing is not just driven by size, as it is robust to examining cross-sections differences in size.

In subsequent robustness checks, socialist countries were removed, since there is a question of enforcement ability in these countries. I also remove additional NACE codes where government intervention may be more severe, as Claessens and Klapper (2005) suggest. Furthermore, I drop each single country and rerun the regression to make sure that no single country was biasing the results. Selected robustness checks are discussed in further detail in Section 8.

8. Robustness Checks

The first set of robustness checks conducted define banking concentration differently. First, I measure the fraction of bank assets held by the largest three commercial banks in a country, *ComFrac3*. The results of this robustness test are presented Panels A and B of Table 12.

The first stage regression results still indicate that more banking concentration is associated with a decrease in firm-level interest rates. In the second stage regressions, restrictions on reorganization, no automatic stay of assets, and secured creditor paid first all positively affect firm leverage, though management removal does not. These results are quantitatively similar to those presented in Table 11 and only exhibit minor differences in magnitude, except for *NoAutostay* which is significant at the 10% level.

Instead of examining banking concentration, I examine competition within the banking industry on the basis of loans. To measure the degree of competition within the banking industry, I calculate a bank herfindahl index, which is defined as the squares of the bank-level loans over the sum of the total loans. These results are presented in Panels A and B of Table 13.

The elements of the creditor rights index that are positively associated with leverage are restrictions on reorganization and whether the secured creditor is paid first. The magnitudes of the coefficients are also quantitatively similar to the other results from those obtained in Tables 11 and 12 analyzing the other two proposed instruments. The results are also quantitatively similar when the herfindahl index is calculated utilizing bank assets, though these results are not reported. I further test the robustness of these results by analyzing the fraction of assets held by the largest five banks and largest five commercial banks. The results of the instrumental variable regressions always indicate that the creditor rights measures are positively associated with firm leverage.

I also examine public and private firms separately and find that whether the secured creditor is paid first always positively impacts leverage, but restrictions on reorganizations has not effect on public firm leverage. Furthermore, I run regression tests by examining different size cross-sections. The positive effect on the secured creditor measure and loans demanded is present when examining each quartile of firms based on size. I find that the significance on restrictions on reorganization goes away once I examine the largest 10% of firms. This is consistent for what I find for public firms, which are among the largest firms in the sample.

I also remove socialist countries and rerun the analysis and find that all demand regressions are quantitatively similar. I also complete the analysis dropping each country one at a time. This alleviates concerns that a single country is driving the results. Furthermore, Bureau Van Dijk is not provided with information for small Swiss firms, so the sample composition for Switzerland is different. I find that whether the secured creditor is paid first is still a positive and significant determinant of firm demand. Occasionally, *NoAutostay* enters the leverage regressions significantly, though this is only at the 10% level.

I also notice that there are a number of firms in the sample that are considerably larger or smaller than the rest, resulting in highly right skewed variables. I redo the analysis with leveraged winsorized at the 10% level, and the results are quantitatively similar. I am also concerned that a number of firms within the sample have extremely high firm-level interest rates, which may suggest that there are substantial differences in the way liabilities are recorded in different countries. I truncate the firm-level interest rate at 0.5 and redo the analysis again and find quantitatively similar results.

The last robustness check pertains to the concern that some countries in the sample have significantly more observations than other countries. For example, Italy has 423,155 firms in the sample, while Hungary only has 7,635. I consider each Hungarian firm to have the weight of approximately 55 Italian firms in this regression framework. The results for the full sample are reported in Table 13 Panel C and Panel D. Yet again, the element of the creditor rights index indicating whether secured creditors are paid first is shown to be a significant determinant of firm leverage.

9. Conclusion

This paper examines the way creditor rights affect borrower financing and investment decision-making. By examining a sample of over 1.5 million firms in Europe between 2006-2011, I find that creditor rights play a strong role in firm financing and investment decisions outside of bankruptcy. I also examine the components of the creditor rights aggregately and individually in order to understand which components affect borrower decision-making. There is strong evidence suggesting that the different components of the creditor rights index impact borrower leverage and investment decisions in varying ways.

The heterogeneity in the Amadeus data set allows me to understand the way creditor rights impact different types of firms. I find that firms with low levels of tangible assets are able to acquire more loans, though this does not lead to an increase in investment in tangible assets for these firms. However, small firm are able to obtain more loans when the secured creditor is paid first, and there is evidence that some of this money is invested in tangible assets.

I am also able to test two competing, yet related, hypotheses relating the way creditor rights impact firm risk-taking and profitability. I find evidence for both predictions in the cross-sectional analysis and that stronger creditor rights amplify the agency conflicts between debt and equity holders. Consistent with Acharya, Amihud, and Litov (2011), I find that firms with high liquidation values that operate in economies with high levels of investor protection do reduce risk and realize lower profitability. This suggests that these firms are willing to take unprofitable projects in order to reduce cash-flow risk in order to decrease the probability of being inefficiently liquidated. However, firms that are approaching distress, as evidenced by high leverage, do pursue projects that increase risk and lead to decreased profitability, which is consistent with the risk-shifting literature.

Furthermore, this paper suggests that the most important element of the creditor rights index is whether or not the secured creditor is paid first. This element is a determinant of leverage as well as all aspects of investment policy. When the secured creditor is paid first, small firms are able to obtain more loans, which leads to greater investment. Furthermore, this element leads to increased cash-flow risk in the full sample analysis, which may be seen as correlated with future growth. Overall, when the secured creditor is paid first, this seems to benefit firms that may have otherwise had difficulty obtaining credit. This may be an important policy implication for countries that are considering reforming their bankruptcy codes.

Chapter 1 Tables

Table 1: Amadeus Firm Composition

Country	Total Firms	Public	Private	Origin	Crights	Reorg	NoAutostay	Secured	Manages	BankFrac3
Austria	3,007	50	2,957	German	3	1	1	1	0	0.278
Belgium	11,645	97	11,548	French	2	0	0	1	1	0.427
Bulgaria	10,306	123	10,183	German	2	0	0	1	1	0.294
Switzerland	526	173	353	German	1	0	0	1	0	0.610
Czech Republic	34,588	5	34,583	German	3	0	1	1	1	0.461
Germany	33,531	583	32,948	German	3	0	1	1	1	0.303
Spain	390,354	135	390,219	Scandinavian	2	0	1	0	1	0.316
Finland	41,700	95	41,605	Scandinavian	1	0	0	1	0	0.651
France	451,019	703	450,316	French	0	0	0	0	0	0.235
Greece	13,987	173	13,814	French	1	1	0	0	0	0.342
Hungary	7,635	22	7,613	German	1	1	0	0	0	0.412
Italy	423,155	226	422,929	French	2	1	0	0	1	0.344
Netherlands	595	43	552	French	3	0	1	1	1	0.572
Norway	51,548	92	51,456	Scandinavian	2	1	0	1	0	0.374
Poland	22,241	172	22,069	German	1	0	0	0	1	0.287
Portugal	119,224	41	119,183	French	1	0	0	1	0	0.367
Slovenia	3,387	9	3,378	German	3	0	1	1	1	0.491
Slovak Republic	3,402	13	3,389	German	2	0	1	1	0	0.529
Ukraine	2,911	63	2,848	Socialist	2	1	1	0	0	0.331
Total	1,624,761	2,818	1,621,943							

Table 1 shows the number of firms in the Amadeus database that are examined for the study. Amadeus contains data for both public and private firms and is very unbalanced. The majority of the sample firms for each country are privately held firms. Data for these firms are available from 2006-2011. This table also shows the legal origins of each country as well as the existence of each creditor rights component in 2003. The creditor rights index, components, and legal origin variables are taken from Djankov, McLiesh, and Schleifer (2007). The final column shows the fraction of assets held by the three largest banks in a country as calculated using data from Bankscope.

Table 2: Amadeus Descriptive Statistics

Panel A: Firm-Level Variables

Variable	mean	sd	p25	p50	p75	N
FirmLeverage	0.296	0.245	0.092	0.234	0.451	4,656,320
IRCorp	0.101	0.136	0.032	0.054	0.102	4,656,320
FAssets (US $)	5,022,075	11,800,000	368,178	1,001,052	3,254,212	4,656,320
FDebt (US $)	1,433,335	3,721,895	50,547	196,798	793,836	4,656,320
LogFAssets (US $)	13.948	1.649	12.789	13.786	14.965	4,656,320
Growth	0.037	0.356	-0.111	0.025	0.169	4,656,320
TanAssets	0.253	0.253	0.050	0.164	0.384	4,656,320
Age	15.492	12.837	7.000	12.000	20.000	4,656,320
Investment	0.047	0.110	0.000	0.019	0.066	3,205,084
Risk	0.075	0.120	0.019	0.042	0.086	4,432,775
ROA	0.100	0.128	0.035	0.084	0.156	4,656,320

Panel B: Country-Year Variables

Variable	mean	sd	p25	p50	p75	N
BondControl	0.116	0.193	0.014	0.038	0.108	96
Inflation	0.031	0.023	0.014	0.026	0.040	96
Depth	4.625	1.069	4.000	5.000	5.000	96
LogGDP	9.444	0.943	8.931	9.647	10.159	96
Corruption	0.905	0.944	0.260	0.995	1.700	96
Stability	0.719	0.507	0.510	0.810	1.070	96
Effectiveness	1.038	0.748	0.630	1.000	1.665	96
Regulation	1.068	0.551	0.840	1.140	1.440	96
Law	1.007	0.765	0.600	1.025	1.735	96
BankFrac3	0.410	0.118	0.320	0.379	0.481	96

Panel C: Country-Level Variables

Variable	mean	sd	p25	p50	p75	N
Crights	1.850	0.875	1	2	2.5	20
Reorg	0.300	0.470	0	0	1	20
NoAutostay	0.350	0.489	0	0	1	20
Secured	0.650	0.489	0	1	1	20
Manages	0.550	0.510	0	1	1	20
French	0.350	0.489	0	0	1	20
German	0.450	0.510	0	0	1	20
Scandinavian	0.100	0.308	0	0	0	20

Table 2 shows the summary statistics for the firms in the final sample. Panel A shows the firm-level variables. All variables in Panel A are calculated using the Amadeus Database. Panel B shows summary statistics for annual country variables. Data for these variables come from the Bank for International Settlements, the World Bank, Bankscope, and Kauffman, Kray, and Mastruzzi (2008). Panel C shows country-level variables from the year 2003 taken from Djankov, McLiesh, and Schleifer (2007).

Table 3: Amadeus Leverage OLS Results

Dependent Variable: Firm Leverage					
	(1)	(2)	(3)	(4)	(5)
Crights	0.0260***				
Reorg		0.0471			
NoAutostay			0.0440**		
Secured				0.0729***	
Manages					-0.0017
IRCorp	-0.6255***	-0.6245***	-0.6229***	-0.6262***	-0.6235***
LogFAssets	0.0035**	0.0036**	0.0039**	0.0034**	0.0038**
Growth	0.0032	0.003	0.0032	0.0031	0.003
ROA	-0.1523***	-0.1561***	-0.1530***	-0.1543***	-0.1561***
TanAssets	0.1794***	0.1819***	0.1803***	0.1803***	0.1820***
Age	-0.0024***	-0.0024***	-0.0024***	-0.0024***	-0.0024***
LogGDP	-0.0271*	-0.0565	-0.0048	0.0192	-0.0137
Inflation	0.2647	0.0073	0.3657	0.3873	0.2106
BondControl	-0.2511***	-0.3264***	-0.2352***	-0.2338***	-0.2673***
Depth	0.0529***	0.0748***	0.0664***	0.0490***	0.0793***
Corruption	0.0326	0.0233	0.0297	0.0074	0.0047
Stability	0.0329**	0.0156	0.0471**	-0.0247*	0.017
Effectiveness	0.0111	-0.0003	0.0128	-0.0299	-0.0119
Regulation	0.0265	0.0791*	0.0134	0.0930***	0.0529
Law	-0.0074	0.0237	-0.0385	-0.0125	0.0192
French	-0.1305*	-0.2690***	-0.1874**	-0.1551**	-0.2740***
German	-0.2461***	-0.3652***	-0.2968***	-0.2399***	-0.3662***
Scandinavian	-0.1293*	-0.2435***	-0.1504*	-0.1435*	-0.2180**
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320
R-sq	0.237	0.235	0.236	0.238	0.235

Table 3 presents the ordinary least squares results for the determinants of firm leverage using 4,656,320 firm-year observations in 20 countries. The dependent variable is firm leverage, which is calculated as the sum of non-current liabilities in long-term debt and current liabilities in loans scaled by total assets. The sample period is from 2006-2011 and covers 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 4: Further Leverage Analysis

	Panel A: Tangibility Interactions Dependent Variable: Firm Leverage				
Crights×TanAssets	-0.0811***				
Reorg×TanAssets		-0.1580***			
NoAutostay×TanAssets			0.0467		
Secured×TanAssets				-0.0544	
Manages×TanAssets					-0.0896**
Controls from Table 3	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320
	Panel B: Size Interactions Dependent Variable: Firm Leverage				
Crights×LogFAssets	0.0057***				
Reorg×LogFAssets		0.0096***			
NoAutostay×LogFAssets			0.0041		
Secured×LogFAssets				-0.0073**	
Manages×LogFAssets					0.0138***
Controls from Table 3	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320

Table 4 presents the ordinary least squares results for the determinants of firm leverage using 4,656,320 firm-year observations in 20 countries. The dependent variable is firm leverage, which is calculated as the sum of non-current liabilities in long-term debt and current liabilities in loans scaled by total assets. All regressions control for firm-level interest rate, size, growth opportunities, profitability, tangible assets, and age. Country and year year fixed effects are also included. For the sake of space, only the key variables of interest, which are the interaction between creditor rights and the firm characteristic, are reported. The sample period is from 2006-2011, and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 5: Amadeus Investment Results

Dependent Variable: Firm Investment					
	(1)	(2)	(3)	(4)	(5)
Crights	0.0045				
Reorg		0.0058			
NoAutostay			0.0109		
Secured				0.0149*	
Manages					-0.0036
IRCorp	-0.0580***	-0.0577***	-0.0575***	-0.0585***	-0.0575***
LogFAssets	-0.0044***	-0.0044***	-0.0044***	-0.0045***	-0.0044***
TanAssets	0.1326***	0.1330***	0.1327***	0.1326***	0.1331***
Growth	0.0094***	0.0094***	0.0094***	0.0094***	0.0094***
ROA	0.0830***	0.0824***	0.0830***	0.0829***	0.0823***
Leverage	-0.0443***	-0.0443***	-0.0443***	-0.0444***	-0.0443***
Age	-0.0002*	-0.0002*	-0.0002*	-0.0002*	-0.0002*
LogGDP	0.0118	0.0091	0.0162**	0.0214**	0.0154*
Inflation	0.6819*	0.6204	0.7279*	0.6550*	0.6356*
BondControl	-0.0099	-0.0212	-0.0063	-0.0014	-0.0160
Depth	0.0264	0.0234	0.0266	0.0255	0.0212
Corruption	-0.0057	-0.0023	-0.0040	-0.0077	-0.0011
Stability	0.0252***	0.0220**	0.0300***	0.0133	0.0202**
Effectiveness	-0.0106	-0.0141	-0.0086	-0.0182	-0.0168
Regulation	0.0170	0.0259	0.0120	0.0268	0.0261
Law	-0.0291	-0.0237	-0.0372	-0.0348	-0.0266
French	0.0788*	0.0522	0.0741	0.0803*	0.0453
German	0.0757	0.0546	0.0704	0.0845*	0.0506
Scandinavian	0.0434	0.0239	0.0435	0.0460	0.0224
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	3,205,084	3,205,084	3,205,084	3,205,084	3,205,084
R-sq	0.163	0.163	0.163	0.164	0.163

Table 5 presents the ordinary least squares results for the determinants of firm investment using 3,205,084 firm-year observations in 20 countries. The dependent variable is firm investment, which is defined as annual increase in gross fixed assets scaled by total assets in the beginning of the year. The sample period is from 2006-2011 and covers 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 6: Further Investment Analysis

Panel A:Tangibility Interactions
Dependent Variable: Firm Investment

	(1)	(2)	(3)	(4)	(5)
Crights×TanAssets	-0.0247				
Reorg×TanAssets		-0.0211			
NoAutostay×TanAssets			-0.0254		
Secured×TanAssets				0.0158	
Manages×TanAssets					-0.0437
Controls from Table 6	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	3,205,084	3,205,084	3,205,084	3,205,084	3,205,084

Panel B: Size Interactions
Dependent Variable: Private Firm Investment

	(6)	(7)	(8)	(9)	(10)
Crights×LogFAssets	-0.0012				
Reorg×LogFAssets		0.0006			
NoAutostay×LogFAssets			-0.0024		
Secured×LogFAssets				-0.0037***	
Manages×LogFAssets					-0.0011
Controls from Table 6	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	3,205,084	3,205,084	3,205,084	3,205,084	3,205,084

Table 6 presents the ordinary least squares results for the determinants of firm investment using 3,205,084 firm-year observations in 20 countries. The dependent variable is firm investment, which is defined as annual increase in gross fixed assets scaled by total assets in the beginning of the year. All regressions control for firm-level interest rate, size, growth opportunities, profitability, leverage, tangible assets, and age. Country and year year fixed effects are also included. For the sake of space, only the key variables of interest, which are the interaction between creditor rights and the firm characteristic, are reported. The sample period is from 2006-2011 and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 7: Amadeus Risk Results

	Dependent Variable: Firm Cash-Flow Risk				
	(1)	(2)	(3)	(4)	(5)
Crights	0.0041***				
Reorg		0.0044			
NoAutostay			0.0021		
Secured				0.0122***	
Manages					0.0041
IRCorp	0.0428***	0.0431***	0.0432***	0.0425***	0.0430***
LogFAssets	-0.0151***	-0.0151***	-0.0151***	-0.0152***	-0.0151***
TanAssets	-0.0300***	-0.0297***	-0.0297***	-0.0298***	-0.0298***
Growth	-0.0028***	-0.0028***	-0.0028***	-0.0028***	-0.0028***
ROA	0.0042	0.0036	0.0037	0.0038	0.0038
Leverage	-0.0300***	-0.0297***	-0.0297***	-0.0298***	-0.0298***
Age	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
LogGDP	0.0112***	0.0092**	0.0137***	0.0188***	0.0122***
Inflation	0.3021***	0.2729***	0.3008***	0.3313***	0.2947***
BondControl	-0.0046	-0.0125	-0.0054	-0.0011	-0.0041
Depth	0.0048*	0.0085***	0.0083***	0.0041**	0.0079***
Corruption	0.0048	0.0019	0.0014	0.0010	0.0006
Stability	-0.0063***	-0.0088***	-0.0073**	-0.0158***	-0.0064**
Effectiveness	0.0116**	0.0090	0.0092	0.0047	0.0094
Regulation	-0.0140**	-0.0068	-0.0115	-0.0028	-0.0149*
Law	0.0082	0.0131*	0.0099	0.0073	0.0153*
French	-0.0729***	-0.0957***	-0.0915***	-0.0761***	-0.0876***
German	-0.0387**	-0.0584***	-0.0546***	-0.0375***	-0.0521***
Scandinavian	-0.0602***	-0.0774***	-0.0713***	-0.0625***	-0.0682***
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	4,432,775	4,432,775	4,432,775	4,432,775	4,432,775
R-sq	0.077	0.077	0.077	0.077	0.077

Table 7 presents the ordinary least squares results for the determinants of firm cash-flow risk using 4,432,775 firm-year observations. The dependent variable is firm risk, which is defined as the standard deviation of earnings before depreciation and taxes normalized by total assets for the year before, year of analysis, and year after analysis. The sample period is from 2006-2011 and covers 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 8: Further Risk Analysis

Panel A: Tangibility Interactions
Dependent Variable: Firm Cash-Flow Risk

	(1)	(2)	(3)	(4)	(5)
Crights×TanAssets	-0.0114***				
Reorg×TanAssets		-0.0027			
NoAutostay×TanAssets			-0.0148***		
Secured×TanAssets				-0.0229***	
Manages×TanAssets					-0.0050
Controls from Table 8	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,432,775	4,432,775	4,432,775	4,432,775	4,432,775

Panel B: Leverage Interactions
Dependent Variable: Firm Cash-Flow Risk

	(6)	(7)	(8)	(9)	(10)
Crights×Leverage	0.0178***				
Reorg×Leverage		0.0332***			
NoAutostay×Leverage			0.0182***		
Secured×Leverage				0.0358***	
Manages×Leverage					0.0275***
Controls from Table 8	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,432,775	4,432,775	4,432,775	4,432,775	4,432,775

Table 8 presents the ordinary least squares results for the determinants of firm cash-flow risk for 4,432,775 firm-year observations. The dependent variable is firm risk, which is defined as the standard deviation of earnings before depreciation and taxes normalized by total assets for the year before, year of analysis, and year after analysis. All regressions control for firm-level interest rate, size, growth opportunities, profitability, leverage, tangible assets, and age. Country and year year fixed effects are also included. For the sake of space, only the key variables of interest, creditor rights measures and the firm-level interest rate, are reported. The sample period is from 2006-2011, and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 9: Amadeus Profitability Results

Dependent Variable: Firm Profitability (ROA)					
	(1)	(2)	(3)	(4)	(5)
Crights	-0.0093***				
Reorg		0.0104			
NoAutostay			-0.0267***		
Secured				-0.0073**	
Manages					-0.0179***
IRCorp	0.0412***	0.0401***	0.0401***	0.0407***	0.0409***
LogFAssets	0.0001	-0.0000	-0.0000	0.0001	0.0001
TanAssets	0.0161***	0.0152***	0.0162***	0.0154***	0.0160***
Growth	-0.0045**	-0.0044**	-0.0045**	-0.0044**	-0.0044**
Leverage	0.0314***	0.0310***	0.0315***	0.0312***	0.0310***
Age	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
LogGDP	0.0192***	0.0053	0.0089***	0.0112***	0.0195***
Inflation	-0.0388	-0.0657	-0.1117	-0.0407	-0.0222
BondControl	-0.0321***	-0.0405**	-0.0451***	-0.0307***	-0.0391***
Depth	-0.0047**	-0.0150***	-0.0063***	-0.0112***	-0.0100***
Corruption	0.0112**	0.0253***	0.0060	0.0209***	0.0200***
Stability	0.0047*	0.0095***	-0.0076**	0.0144***	0.0000
Effectiveness	0.0105	0.0209**	0.0036	0.0204**	0.0125
Regulation	0.0174**	0.0143	0.0318***	0.0037	0.0315***
Law	-0.0352***	-0.0442***	-0.0092	-0.0416***	-0.0569***
French	-0.0576***	-0.0063	-0.0587***	-0.0179	-0.0413**
German	-0.0087	0.0342	-0.0081	0.0225	0.0092
Scandinavian	-0.0543***	-0.0289	-0.0639***	-0.0295	-0.0498***
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	4,282,176	4,282,176	4,282,176	4,282,176	4,282,176
R-sq	0.335	0.334	0.335	0.334	0.334

Table 9 presents the ordinary least squares results for the determinants of firm profitability using 4,282,176 firm-year observations. The dependent variable is firm profitability, which is defined as earnings before depreciation and taxes normalized by total assets. The sample period is from 2006-2011 and covers 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 10: Further Profitability Analysis

Panel A: Tangibility Interactions Dependent Variable: Firm Profitability (ROA)					
	(1)	(2)	(3)	(4)	(5)
Crights×TanAssets	-0.0143***				
Reorg×TanAssets		-0.0207***			
NoAutostay×TanAssets			-0.0031		
Secured×TanAssets				0.0034	
Manages×TanAssets					-0.0226***
Controls from Table 10	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,282,176	4,282,176	4,282,176	4,282,176	4,282,176
Panel B: Leverage Interactions Dependent Variable: Firm Profitability (ROA)					
	(6)	(7)	(8)	(9)	(10)
Crights×Leverage	-0.0377***				
Reorg×Leverage		-0.0607***			
NoAutostay×Leverage			-0.0447***		
Secured×Leverage				-0.0629***	
Manages×Leverage					-0.0655***
Controls from Table 10	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	4,282,176	4,282,176	4,282,176	4,282,176	4,282,176

Table 10 presents the ordinary least squares results for the determinants of firm profitability for 4,282,176 firm-year observations. The dependent variable is firm profitability, which is defined as EBITDA scaled by total assets. All regressions control for firm-level interest rate, size, growth opportunities, profitability, leverage, tangible assets, and age. Country and year year fixed effects are also included. For the sake of space, only the key variables of interest, creditor rights measures and the firm-level interest rate, are reported. The sample period is from 2006-2011, and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 11: Amadeus Instrumental Variable Results

Panel A: First Stage Results
Dependent Variable: Firm-Level Interest Rate

BankFrac3	-0.398***	-0.302***	-0.337***	-0.426***	-0.321***

Panel B: Second Stage Results
Dependent Variable: Firm Leverage

Crights	0.0360***				
Reorg		0.1333***			
NoAutostay			0.0298		
Secured				0.0908***	
Manages					0.0295
IRCorp	-1.6973***	-2.1966***	-1.9844***	-1.5323***	-2.0793***
LogFAssets	-0.0041***	-0.0074***	-0.0055***	-0.0031**	-0.0062***
Growth	0.0035	0.0028	0.0031	0.0036	0.003
ROA	-0.1517***	-0.1580***	-0.1553***	-0.1543***	-0.1560***
TanAssets	0.1241***	0.1026***	0.1119***	0.1339***	0.1072***
Age	-0.0018***	-0.0018***	-0.0018***	-0.0019***	-0.0018***
LogGDP	0.0012	-0.0864**	0.0338*	0.0559***	0.0222
Inflation	0.138	-0.5862	0.1264	0.3076	0.0223
BondControl	0.0443	-0.0118	0.1233*	0.0188	0.1487*
Depth	0.0554***	0.0847***	0.0860***	0.0526***	0.0890***
Corruption	-0.0196	-0.0349	-0.0583	-0.0452	-0.0783**
Stability	0.0468***	0.0235	0.0481**	-0.0284***	0.0454*
Effectiveness	-0.0975***	-0.1516***	-0.1438***	-0.1336***	-0.1604***
Regulation	-0.1392***	-0.0977**	-0.1729***	-0.0291	-0.1984***
Law	0.2031***	0.3533***	0.2611***	0.1666***	0.3390***
French	-0.2876***	-0.5692***	-0.4791***	-0.3075***	-0.4972***
German	-0.3532***	-0.5868***	-0.5098***	-0.3398***	-0.5285***
Scandinavian	-0.1354**	-0.3470***	-0.2181**	-0.1614***	-0.2219**
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320

Table 11 presents the instrumental variable regression results for the determinants of firm leverage using 4,656,320 firm-year observations in 20 countries. Panel A shows the first stage results where the dependent variable is firm-level interest rate. The instrument BankFrac3 represents the percentage of bank assets held by the three largest banks using the Bankscope Database. The controls in Panel A are identical to those shown in Panel B but are not reported. Panel B shows the second stage results for the determinants of firm leverage. The dependent variable is firm leverage, which is calculated as the sum of non-current liabilities in long-term debt and current liabilities in loans scaled by total assets. The sample period is from 2006-2011, and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at 1%, 5%, and 10%.

Table 12: Amadeus Leverage Robustness Checks

Panel A: Leverage Analysis Using ComFrac3 as Instrument Stage 1: Firm Interest Rate as Dependent Variable					
ComFrac3	-0.377***	-0.357***	-0.360***	-0.384***	-0.349***
Panel B: Second Stage Results Dependent Variable: Firm Leverage					
Crights	0.0367***				
Reorg		0.118***			
NoAutostay			0.0309*		
Secured				0.0940***	
Controls from Table 4	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320

Table 12 presents the instrumental variable regression results for the determinants of firm leverage using 4,656,320 firm-year observations. Panel A shows the first stage results where the dependent variable is firm-level interest rate. The instrument ComFrac3 represents the percentage of bank assets held by the three largest commercial banks using the Bankscope Database. All regressions control for firm-level interest rate, size, growth opportunities, profitability, tangible assets, age, real per capita GDP, inflation, bond market, depth of information sharing, control of corruption, political stability, government effectiveness, regulation, rule of law, and legal origin, but they are not reported for the sake of space. Panel B shows the second stage results for the determinants of firm leverage. The dependent variable is firm leverage, which is calculated as the sum of non-current liabilities in long-term debt and current liabilities in loans scaled by total assets. The instrument used is ComFrac3. The sample period is from 2006-2011, and the data spans 20 countries. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 13: Further Amadeus Leverage Robustness Checks

Panel A: Leverage Analysis Using BankHHI as Instrument Stage 1: Firm Interest Rate as Dependent Variable					
bankHHI	-1.010***	-0.542**	-0.652**	-1.010***	-0.703***
Panel B: Second Stage Results Dependent Variable: Firm Leverage					
Crights	0.0347***				
Reorg		0.160*			
NoAutostay			0.0271		
Secured				0.0874***	
Manages					0.0337
Controls from Table 4	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes
N	4,656,320	4,656,320	4,656,320	4,656,320	4,656,320
Panel C: Weighted Regressions for Full Sample Stage 1: Firm Internet Rate as Dependent Variable					
BankFrac3	-0.1908***	-0.1777***	-0.1752***	-0.2542***	-0.1810***
Panel D: Second Stage Results Dependent Variable: Firm Leverage					
Crights	0.0281***				
Reorg		0.0431			
NoAutostay			-0.0034		
Secured				0.1033***	
Manages					0.0135
Controls from Table 4	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes

Table 13 presents the instrumental variable regression results for the determinants of firm leverage using 4,656,320 firm-year observations. Panel A shows the first stage results where the dependent variable is firm-level interest rate. The instrument bankHHI represents the herfindahl index of the banks within a given country as calculated on the basis of loans. The data are obtained from the Bankscope Database. All regressions control for firm-level interest rate, size, growth opportunities, profitability, tangible assets, age, real per capita GDP, inflation, bond market, depth of information sharing, control of corruption, political stability, government effectiveness, regulation, rule of law, and legal origin, but they are not reported. Panel B shows the second stage results for the determinants of firm leverage, which is calculated as the sum of non-current liabilities in long-term debt and current liabilities in loans scaled by total assets. The instrument used is bankHHI. Panel C shows full sample results where observations are given appropriate weight so that no country is represented equally in the sample. Robust standard errors are clustered at the country-year level. All variables are defined in Appendix A. The designation ***, **, and * indicate significance at 1%, 5%, and 10%.

Chapter 2

The Social Costs and Benefits of Too-Big-To-Fail Bank: A "Bounding" Exercise

Written by John H. Boyd and Amanda R. Heitz[4]

Chapter 2 Summary

While the policy of Too-Big-To-Fail has received wide attention in the literature, there is little agreement regarding economies of scale for financial firms. We take the stand that systemic risk increases when the larger players in the financial sector have a larger share of output. Calculations indicate that the cost to the macro-economy due to increased systemic risk is always much larger than the potential benefit due to scale economies. When distributional and intergenerational issues are considered, the potential benefits to economies of scale are unlikely to ever exceed the potential costs due to increased risk of a banking crisis.

[4] Special Thanks to Brendan Boyd for Programming assistance. We thank Ravi Jagannathan and Ross Levine for helpful comments on an earlier draft; also seminar participants at the University of Bonn, the European Central Bank, the Deutsche Bundesbank, the Chicago Federal Reserve Bank, the Cleveland Federal Reserve Bank, and the Finance Department at the University of Minnesota - Philip Bond, Murray Frank, Jeremy Graveline, Hendrik Hakenes, Joseph Haubrich, Cornelia Holthausen, David Humphrey, Manfred Kremer, Filippo Occhino, and Andrew Winton. Any remaining errors are of course our responsibility, not theirs.

Introduction: Banks, Economies of Scale, and Externalities

It is essential that definitions be precise. By bank we intend a very broad definition, not limited to commercial banks. We mean, essentially, all privately owned U.S. financial intermediary firms that borrow and lend. Besides commercial banks, this would include investment banks, thrift institutions, Fannie and Freddie and, for that matter, hybrid affiliates like GE Capital. We do not mean to include life or casualty insurers or securities markets.

By "*economies of scale*," we have a very conventional definition in mind: production efficiencies that are achieved as a firm grows in size. In particular, we are studying production efficiencies of the very largest banks - so called ``economies of super-scale''. Technically, such economies are properties of the production technology. It is our essential that they be kept logically separate and distinct from any ``externalities'' associated with TBTF banks. There are negative externalities associated with the failure of such firms, and there is a large literature on this topic. Specifically, TBTF firms, if they fail, may have negative effects on the macroeconomy. That is the *raison d'etre* of the TBTF policy. Both concepts, economies of super-scale and externalities, are fundamental to the cost-benefit analysis that follows. The costs that we calibrate are those associated with the failure of a TBTF bank(s). The benefits that we calibrate are those associated scale.

1. Introduction: Statement of a Problem

Many argue that the market's *ex-ante* belief in a public policy of too-big-to-fail (TBTF) caused the excessive risk that produced the recent banking crisis. It is further believed that the government's ex-post actualization of that TBTF policy produced a series of massive government bailouts (Boyd and Jagannathan (2009), Johnson (2010), Volcker (cited in Casey (2010)). Some of these same individuals have argued that the TBTF banks are inherently costly to society and should be broken into smaller independent pieces. Boyd, Kwak and Jagannathan (2009) provide empirical evidence that the twenty largest banking firms took extraordinary risks in the 2000s and suffered extraordinary losses beginning around 2007. Importantly, the rest of the banking industry did not experience losses to nearly the same extent, and only after the crisis had severely damaged the real economy, did small and medium sized banks begin to report serious problems. Arguably, problems at small and medium-sized banks were an effect of the banking crisis, not a cause.

An Estimation Problem: A counter-argument to the above is that very large banks exhibit economies of scale, and if they are broken into pieces, efficiency gains will be lost. It is widely believed, however, that scale economies in banking are extremely difficult to estimate. There is a large literature on this topic, and the only general point of agreement is that very small banks (less than a few hundred million in assets) are generally not efficient. One problem for the empirics is that, for this industry, output is difficult to measure. Theory tells us that commercial banks provide three broad classes of economic functions: payments services, inter-temporal risk management in the sense of Diamond and Dybvig (1983), and delegated monitoring in the sense of Diamond (1984) or Boyd and Prescott (1986). The first function is susceptible to measurement using proxy variables such as cash provided and checking account balances/transactions. However, the second two economic functions change the nature of the macroeconomic equilibrium (see studies cited above) and are almost impossible to measure. Various authors have taken different approaches to this problem, but none of this empirical literature can claim to be derived from the theory.

The policy of TBTF complicates the estimation problem further. This policy provides an obvious advantage to very large banks; they have de-facto insurance of all their liabilities. Other banks do not. This advantage looks like a funding cost efficiency and affects Tobin's Q and related measures in the same manner. Unfortunately, the correlation between size and TBTF coverage is believed to be close to one hundred percent. TBTF is not any kind of a scale economy - it is just favorable treatment of a few banks by the government.

Recently, it has been argued that reliable estimates of scale economies for very large banks cannot be obtained in the current environment with a rapidly changing technology and industrial structure. As DeYoung (2010) points out, there are two main problems in using traditional statistical techniques on modern banking data. First, the distribution of bank size is severely skewed.[5] Second, the largest banks differ from smaller banks in kind, not just size. Small and big banks operate differently and make money in different ways.[6]

---

[5] Econometric tools provide the most accurate estimates for average companies, but they become less precise for firms that are substantially larger or smaller. The three largest banks, holding more than $2 trillion in assets, are almost ten times as large as the thirteenth largest bank.

[6] The literature on economies of super scale is mixed at best. Some studies using panel data across countries have found evidence of diseconomies of scale in very large banks (De Nicolo, 2000). Moreover, there is evidence that although large banks are better diversified than smaller banks, they offset this advantage by increasing risk in other ways, especially through the use of financial leverage (Boyd and Runkle, 1993)

A Policy Dilemma. If these arguments are correct, then the policy-maker cannot ascertain whether the social cost of these large institutions exceeds the social benefit or vice-versa. However, the policy-maker must make decisions in real time, and to ignore the issue is a decision in itself. This is especially significant at the present time, since the recent bailout greatly increased concentration in the US banking industry (Wheelock and Wilson, 2011). We believe we have found a new and different way to investigate this issue.

Some readers may not be familiar with our ``bounding" approach, and it is essential that they understand one particularly nice aspect of it. We are not obliged to produce the best possible estimates of either costs or benefits. Instead, we seek to produce benefits estimates that, as the reader will agree, are extremely generous. Similar, we try to produce cost estimates that are extremely conservative on all counts. Numerous assumptions are made with this intent and will be described as we proceed. If the reader agrees that our estimates are substantially biased in both ways, our job is essentially done–for we still find that the social costs of TBTF substantially exceed the social benefits.

In this study, we place ``bounds"[7] on the social costs and benefits of TBTF banks. We estimate the social cost of the recent banking crisis assuming (initially) that the crisis was strictly caused by the TBTF banks. We use assumptions that are consistently biased so as to produce the lowest conceivable crisis cost estimates. Next, we estimate the economies of scale benefits of TBTF banks and make similarly Herculean assumptions

[7] It should be clear from above that we do not mean bounds in the mathematical sense. What we essentially mean is ``unreasonably biased in a systematic manner."

about economies of scale so as to obtain the largest imaginable social benefits estimates. Then, we compare costs and benefits using a methodology due to Boyd, Kwak and Smith (2005, hereafter BKS). Their method converts both costs and benefits into a comparable metric: the present value-added to (or lost from) real per-capita GDP at a base date.

As we will see in the next section, the costs are assumed to cover a relatively short time period, while the benefits are assumed to go to infinity. Therefore, we must employ a social discount factor to compare the two. There is an old and ongoing debate on how this is to be done, and therefore, we employ several methods.

Findings. We find that even under these extreme assumptions, the social costs of TBTF banks substantially exceed the benefits. Mostly, this is because the estimated crisis cost, even though intentionally biased downward, is very large. Our median crisis cost estimate is $14.83 trillion in 2007 dollars. The estimates include output losses extending a number of years into the future. Such large cost estimates may not be so surprising given some estimates already available in the literature (Rogoff *et al.* (2004)).

Now, it could be that TBTF was only one of several factors leading to the crisis. Therefore, we make probability calculations showing how large the role of TBTF banks would have needed to be such that the costs and benefits were equated. Our results show that if the policy of TBTF increases crisis probabilities by even a modest percentage, then the cost of the policy exceeds the benefit.

3. Estimating the Social Cost of the Banking Crisis

To estimate the costs associated with the TBTF banks, we estimate the real per capita output losses associated with the recent banking crisis. These real cost estimates include output lost during the crisis as well as output lost during the time it takes the economy to recover to its pre-crisis trend level of output. Using the methodology of BKS, we assume that had the banking crisis not occurred, output would have continued to grow at the long-run trend real growth rate of the economy. We use two methods to estimate the long-run trend in output. The first estimate is simple - a 25-year arithmetic average of historical US growth rates in real per-capita GDP over the period 1983-2007. That rate is 2.27%.

The second trend estimator employs the maximum likelihood estimator proposed by Easterly *et al.* (1993). With this method, the trend estimate depends on the United States' growth rate and the world growth rate. If we define g_t as the estimated growth rate in real per capita GDP for the United States in period *t*, w_t as the world growth rate in period *i*, $\overline{g_t}$ as the historical average growth rate as of year *t*, and n as the number of years used to compute the historical average, then the Easterly *et al.* (1993) estimate yields a growth rate estimate of 2.16% from the years 1983-2007. This trend rate of real GDP growth is defined as[8]:

$$g_t = \left[n \times \frac{var(w_t)}{var(\bar{g}_t) + n \cdot var(w_t)} \times \bar{g}_t\right] + \left[n \times \frac{var(\bar{g}_t)}{var(\bar{g}_t) + n \cdot var(w_t)}\right] \times w_t \qquad (13)$$

[8] The estimate obtained using the method of Easterly *et al* (1993) provides a trend rate of 2.16%, which is lower than the average rate of 2.27%. This consequently leads to smaller estimated output losses resulting from the banking crisis when the Easterly *et al* (1993) method is used.

We then use these two trend estimates to obtain the hypothetical real per capita GDP per capita values for 2007 and after - economic performance that might have been obtained had the crisis not occurred.[9]

We also need to know the economy's actual output path. We use reported US real per-capita GDP figures for 2007-2013. To be conservative in estimating the crisis cost, we assume that the crisis ends in 2013, so for the years 2014 and after, we assume real per-capita GDP has risen to the pre-crisis trend. Thus, the trend GDP line and the actual GDP lines come together in 2014, forcing the loss estimates to be zero from that date onward. The result of this procedure is shown in Figure 1. Our estimate of the social loss is the discounted integral of the area between the two lines in Figure 1.

Assuming that the banking crisis is over rather quickly in 2014 and there are no further economic losses after that date is a conservative assumption that massively reduces our crisis cost estimates.[10]

---

[9] This method is explained in detail in Easterly *et al* (1983). Footnote 15 describes that the maximum likelihood is derived by solving a signal extraction problem. A Dickey-Fuller test on the maximum likelihood estimator alleviates concerns that the process is non-stationary or has a unit root, indicating a test statistic of -3.023 (p-value of 0.0328). The Phillips-Perron test for unit root produced a test statistic of -2.890 and a p-value of 0.0466. The stationary process further biases our cost estimates down. If the process was non-stationary, then this would indicate that the actual level of Real Per Capita GDP may never approach pre-crisis levels, essentially making the cost estimates even larger.

[10] It's necessary to distinguish between crisis end date and business cycle end date. Within the context of this paper, we associate crisis costs with the length of time that Real Per Capita is determined to be below pre-crisis trend levels. NBER, however, declared that the business cycle ended in 2009. This is different than our definition of a crisis end date because by looking at the Real Per Capita GDP numbers in 2009, it can be seen that they are still significantly below trend. The business cycle may have ended, but the real output losses continued.

By contrast, BKS find that only four out of twenty-three countries in their sample of historical banking crises re-attain their pre-crisis trend level of output within seventeen years after a crisis onset. Pappell and Prodan (2011) find that in developed countries, the return to the potential GDP path following recessions associated with financial crises takes an average of nine years. As will be seen in a moment, we obtain cost estimates of about 45% of base year (2007) GDP. This may be contrasted with BKS who find an average lower bound cost estimate of 63% of base year GDP and an upper bound of 302%.

Cost Computation. First, we compute the actual and trend rates for each crisis year. Next, we assume that each annual loss continues to grow by the growth rate in each period. Then, all annual losses are discounted back to 2007 and expressed as a percentage of 2007 real per capita GDP. Essentially, we integrate the difference between the actual real per capita GDP and the trend values but allow these costs to grow at the growth rate, g. A similar procedure will be employed later for the benefits stream. Define c_t as the annual crisis cost in year *t*. The present value of the total crisis cost is:

$$C = \sum_{t=1}^{6} \frac{c_t(1+g)^{6-t}}{(1+o)^t} \quad (14)$$

where o is a social discount rate to be discussed in the following section.

As shown in Table 1, when a simple average historical growth is used for the historical growth trend, this estimate ranges between 22.55% and 27.25% of 2007 real per-capital GDP. When trend growth is estimated with the Easterly *et al* (1993) method, cost estimates range between 46.84% and 52.55% of 2007 real per capita GDP.

To conclude this section, we note another source of conservatism in our crisis cost estimates. We are assuming that all economic costs are represented by lost real output in the United States and *assign no weight to economic problems elsewhere in the world*. We know that the US banking crisis did have economic consequences and caused real output losses around the world. However, estimating these costs is almost impossible, and we cannot derive a credible way to disentangle the magnitude to which these losses impacted or compounded the US crisis costs. Presumably, crisis losses around the world were large. However, if TBTF banks exacerbated these costs, which in turn increased the US crisis cost, then this chain of reasoning still leaves US TBTF banks at the root of US losses.

4. The Social Discount Rate

In conducting a cost-benefit analysis, it is necessary to reduce both costs and benefits to a single date in order to compare them. For risky projects, a higher social discount rate is typically used in order to reflect the riskiness of the project. We believe that both the social costs and benefits of TBTF banks are inherently risky and thus, a risky social discount factor seems appropriate. The future benefits to TBTF banks depend on technology advances and on the industrial organization of the banking industry, both difficult to predict. The future costs of financial crises depend on a myriad of things that are also extremely hard to predict. To be abundantly conservative, however, we use three different estimates of the social discount rate. The definition and estimation of these rates is discussed in Appendix A.1.

We note that the risk-free social discount rate of 3.63% is designed for extremely safe public projects. This discount rate is not realistic, considering, as we have pointed out, that both costs and benefits are difficult to predict. However, the results are reported in order to indicate a minimum discount rate in order for the reader to examine the upper obtainable bound for benefits and lowest cost number. By computing a riskless social discount rate, which is designed to reflect a level of risk less than TBTF costs and benefits, this allows the reader to see the most conservative cost to benefit ratios. A more detailed discussion of this is included within Appendix A.1.

5. Estimating the Benefits of Economies of Scale in TBTF Banks

Hughes, Mester and Moon (2001) have obtained some of the largest banking scale economy estimates in the literature, and we shall first use their benefits estimates in our calculations[11]. Mester (2010) has recently argued that these scale economies currently remain intact and would be lost if the largest banks were broken up. The literature on scale economies in banking, including my own studies, suggests that imposing a strict size limit would have unintended consequences and work against market forces. (*op. cit*., page 10). Hughes, Mester, and Moon (*op. cit.*) and that when managers are allowed to make value maximizing decisions and rank projects based on both their profitability and risk, scale economies increase with bank size, suggesting that even mega-mergers are

[11] Several other studies have found economies of scale in large banks including Hughes, Lang, Mester, and Moon (1996), Berger and Mester (1997), Hughes and Mester (1998), Hughes, Lang, Mester, and Moon (2000), Bossone and Lee (2004), Feng and Serletis (2010), Wheelock and Wilson (2012), Hughes and Mester (2013).

exploiting scale economies.[12] Their measure of scale economies is the inverse cost elasticity of output.

For their full sample, the mean measure of scale economies for the banking industry is 1.145, while the largest banks with assets of more than $50 billion have scale economies of 1.25. This implies that TBTF banks are on average (1.25-1.145)/1.145 = 9.2% more efficient than the overall industry.[13]

We define the returns-to-scale parameter as l. For our first benefits calculations, we assume that the largest banks obtain economies of scale that, *ceteris paribus*, increase their contribution to national output by l = 9.2%. This value added is being produced under the current banking arrangement and would, by assumption, be lost if the TBTF banks were broken up. Thus, the benefit we estimate is effectively a counter-factual: an estimate of existing economic benefits that could be lost.

Wheelock and Wilson (2012) obtain economies of super-scale estimates that appear to be even larger than those obtained by Hughes *et. al.*, (*op. cit.*). We next assume their economy of scale results in our calculations. However, they do not provide a breakdown that allows us to compare TBTF banks (roughly the largest 20) with the rest of the banking industry. What they do provide is an estimate of the economies of scale advantage of the largest four banks *vis-a-vis*, the costs that would obtain if the largest

[12] An important innovation of this study is that it identifies and measures scale economies not just in terms of operating costs but also in terms of risk management. The authors argue that to ignore scale economies in risk management results in a serious miss-specification.

[13] Recall that this study was published in 2002 and employs data earlier than that. Thus, at this time banks with assets exceeding $50 billion were clearly TBTF. Their sample includes 15 banks in this size category which were the largest banks in the United States at that time.

four were broken into eight equal sized banks. This cost advantage estimate is 16%, and that is what we shall employ in what follows (Wheelock and Wilson, *op. cit*. p. 18).[14]

We have intentionally chosen these two studies from a substantial literature because they have the largest estimates of economies of super-scale. The reader should note that there is an on-going debate as to whether economies of super-scale in banking even exist. Other studies, such as DeNicolo (2000), and as much evidence of scale diseconomies as of scale economies. The De Nicolo study employs an international panel dataset giving it an international dimension (and statistical power) that is absent in most of this literature.

5.1. Numerical Implementation: National Income Added

We next calculate the percentage of total real per capita GDP provided by TBTF banks, s, from the National Income Value-Added Accounts.[15] First, we obtain the data for the sector called Federal Reserve Banks, Credit Intermediation, and Related Activities and employ an average of this sector's percentage value-added to national output over the twenty-year period between 1988 and 2007. We obtain s = 3.63%.

This number is vastly overstated for our purposes since it includes all of the banks in this entire sector including the Federal Reserve Banks. Our next goal is to determine the fraction of this sector, f that represents only the TBTF banks. The Federal Reserve releases quarterly data on domestically chartered insured commercial banks that have

[14] Note that their estimated cost advantage must be considerably larger when the top four banks are compared with the overall industry.

[15] http://www.census.gov/eos/www/naics/

consolidated assets of $300 million or more.[16] The largest 25 banks have about $5,855 million in assets, the largest 100 banks have $7,214 trillion in assets, while the total domestic financial assets $68,301 trillion in assets.[17] Thus the largest 25 banks represent approximately 8.57% of the sector, while the largest 100 banks are approximately 10.56%.[18] In the proceeding analysis, we attribute the scale economies to either the fraction of financial assets, *f*, that are held by the largest 25 or 100 banks.

The annual social benefit attributable to economies of scale in TBTF banks now is $G_t \cdot f \cdot s \cdot l$,, where G_t is real per capita GDP in year *t.* G_t is growing, and we need to take that into account in our estimates. Our empirical proxies for real output growth will be the two trend growth rate estimators presented in the last section. To realize real growth, the TBTF banks, like all firms, must retain earnings so they can invest in real capital. The fraction of their earnings that is retained, *r*, is not available for consumption in the current year and must be subtracted from current benefits. For empirical purposes, we obtained the average retention ratio of commercial banks, defined as the difference in the average net income after taxes and average dividends declared over the period 1990-2007 divided by average net income after taxes for all US commercial banks over the period 1990-2007. We obtained r = .3226.

In the base year, the annual social benefits of TBTF are $G_t \cdot f \cdot s \cdot l$, and it is assumed that these benefits are growing and continue indefinitely into the future. Therefore, accounting for retention, we have:

---

[16] http://www.federalreserve.gov/Releases/Lbr/20071231/default.htm

[17] https://research.stlouisfed.org/fred2/series/FBTFASQ027S

[18] We thank David Humphrey for the suggestion of appropriately attributing TBTF bene_ts to just TBTF
banks, opposed to the entire banking sector

$$V = \frac{s \cdot l \cdot f \cdot (1 - r)}{o - g} \tag{15}$$

where *V* is the period zero value of the entire future stream of economies of scale additions to real economic output going out to infinity, expressed as a percent of period 0 real per capita GDP.

From Table 2, we can see that when we employ the 25-year arithmetic average growth rate of 2.27% and the Moon *et. al.* (*op. cit.*) scale estimates are employed, the discounted value of TBTF benefits ranges between 0.53% and 1.80% of base year per-capita output for the Top 100 banks, while the largest 25 banks realize benefits between 0.43% and 1.46%. When the larger Wheelock and Wilson scale estimates are employed, the benefit calculations are larger and range between 0.75% and 2.54% for the largest 25 banks. The largest 100 banks exhibit scale economies between 0.92% and 3.12% of 2007 real per capita GDP. Table 16 shows that when 2.16% is used as the growth rate, consistent with the method proposed by Easterly *et. al.*, the results are very similar. When scale economies are attributed to the largest 100 banks, estimates range from 0.52% to 2.89% of base year real per capita output, while the estimates pertaining to the largest 25 banks range from 0.42% to 2.34% of base year per-capita output.

6. Comparing Costs and Benefits

We can now compare cost and benefits estimates. Table 17a shows the cost and benefits estimates obtained when the 25-year average is used to approximate trend growth in real, per capita GDP. The cost benefit ratio ranges from a high of 46.28 to a low of 10.75, depending on the measure of scale economies used as well as the number of banks that are assumed to receive these scale economies. Table 17b shows the cost and benefit estimates obtained when the method from Easterly *et. al.* (1993) is used to approximate trend growth in real per capita GDP. These cost benefit ratio ranges from a high of 56.63 to a low of 10.66. In all of the cases in Tables 17a and 17b, including the most extreme, the estimated cost of TBTF exceeds the estimated benefit by a wide margin.

7. The Payback Period

Tables 5 and 6 use a different metric for comparing costs and benefits one that is not so dependent on the choice of the social discount rate *o*. This is the payback period, a commonly used analytical tool in accounting. In this application, the payback period measures how many good, non-crisis years it would take to make up for the social cost of a single crisis. TBTF benefits are not discounted in these calculations, but the 6 years of crisis costs must be reduced to a single cost number. To do that, we go back to the original cost estimates shown in Figure 1 and define c t as the annual crisis cost in year t. In computing the payback period, the crisis cost number is defined as:

$$\sum_{t=1}^{6} c_t(1+g)^{6-t} \tag{16}$$

We express this cost as a percentage of 2007 real GDP per capita. This is symmetric with our treatment of the TBTF benefit stream, which is also assumed to grow at the rate *g*. To estimate the payback period benefits, we use the expression:

$$\sum_{t=0}^{t} l \cdot s \cdot f \cdot (1-r) \cdot (1+g)^{6-t} \tag{17}$$

The actual solution procedure is to solve for the integer value of *t* above that renders expressions 16 and 17 approximately equal.

When the 25-year average growth rate is used to estimate trend real per capita growth (Table 5), these payback period estimates vary between 45 and 62 years. When the Easterly *et al.* (*op. cit*) method is used to estimate trend real per capita growth (Table 6), they vary between 43 years and 61 years. Therefore, the shortest payback period, under the most extreme assumptions, is 43 years.

Crisis Arrival Rates Under TBTF: Actual Experience. Laeven and Valencia (2008) document 124 systemic banking crises in 161 countries over a 37 year period. The average country is present in their sample for 34.5 years. This means there are 161*34.5 country-year points (total data points) and 124 systemic crises documented. Therefore, the average world crisis-arrival rate in recent years has been 124 / (161 × 34.5) = 0.0223 or a crisis arrival approximately every 45 years. It is important to note that virtually all modern systemic banking crises have involved some form of TBTF policy. Thus, the estimates of Laeven and Valencia (2008) give us a modern estimate of crisis frequencies in the presence of TBTF.

We can now compare the payback period to the average actual crisis arrival rate based on recent international experience. The shortest payback period in Tables 18 and 19 is 43 years. The median payback period is 53 years, which is approximately 1.17 times the average world time between crises.

8. What if TBTF is One Among Several Causes of Banking Crises? Some Probability Calculations

Even without TBTF banks, banking systems can exhibit crises as is demonstrated by centuries of monetary history. In this section, we allow for that possibility in a simple model in which crises can occur with or without TBTF.

In what follows, there are two regimes: *i* TBTF banks are present and *ii* TBTF banks are not present. Banking crises can occur in either regime. In the TBTF regime, TBTF banks are assumed to provide social benefits in all years including crises. We assume that the annual social benet of TBTF banks' scale economies, as a percent of real per-capita GDP, is at the mid-point of our previous estimates. We start with the formula $s \cdot l \cdot f \cdot (1-r)$. The midpoint of the scale estimates previously examined (16% and 9.2%) is 12.6%. The midpoint of the fraction of assets held by TBTF banks is the midpoint of the largest 25 banks (8.57%) and largest 100 banks (10.565%), which is 9.565%. The sector size and retention ratio are unchanged. This leaves with a median benefit of .000296.

The structure of the two regimes is depicted in Figure 2. In the no-TBTF regime, the social benefits of economies of scale are never obtained. In both regimes, when a crisis occurs, we assume the same social cost of a banking crisis that was estimated earlier. We further assume that when a crisis occurs, it lasts six years (as in the previous analysis the crisis was assumed to last from 2008 - 2013). A crisis realization is assumed to produce a cost at the midpoint of our previous crisis cost estimates in Tables 18 and 19, which is .30067 This represents the cost of the crisis in terms of lost real GDP per capita over six years, *C*. We treat a crisis as a single event and including all six years of costs appropriately discounted. That's because once the economy enters a crisis state, it remains there for six years. Then, by assumption, the economy always returns to a non-crisis state. With this structure, there is no randomness in leaving a crisis state; the single random variable is the probability of going from a non-crisis to crisis state.

In this analysis it is assumed that TBTF (weakly) increases the probability of a crisis. If this were not assumed, the TBTF regime would always dominate the no-TBTF regime by construction. The TBTF regime would exhibit weakly lower expected crisis costs and would also have positive returns in non-crisis states. The No-TBTF regime would never have positive returns in non-crisis states. Thus, there could be no trade-off.[19] This is not assuming a result because, if the assumption is contradicted by the parameters. That will become obvious.

With this structure, one can directly compute expected welfare by calculating the ex-ante expected cost/benefit in any year. Given the simple probability structure, this will be the same at all times. In the TBTF regime, the expected social return is $p_i \cdot C + (1 - p_i) \cdot f \cdot s \cdot l \cdot (1-r)$, where p_i is the probability of a crisis arrival in the TBTF regime. In the No-TBTF regime, the expected welfare next year is $p_n \cdot C$, where p_n is the probability of crisis in this regime.

The results are shown in Table 20, where it is assumed that the crisis arrival rate in the TBTF regime is once every 25, 35, 45, 55, or 65 years as shown in row 1. We

---

[19] We are assuming, therefore, that the policy of TBTF *ceteris paribus* increases the probability of a crisis by at least some amount. This is hardly a strong assumption, since there is an enormous literature on this topic. Virtually, all of the literature finds that the policy of TBTF increases risk. Here, we mention just a few examples in this literature. One is the seminal theoretical work on moral hazard in banking written by our colleagues (Karaken and Wallace, 1978). Another example is the empirical study by Houston, Lin, Lin and Ma (2010), which finds that banks classified as TBTF engage in significantly more risk taking than other banks (p. 22 - 23).

center the computations on one crisis every 45 years, since this was indicated by the results of Laeven and Valencia (2008). The second row shows the total crisis loss at the point where the TBTF and No-TBTF regimes break even, which corresponds to the crisis frequency under TBTF. The third row shows the break-even probability - that is, the value of p_n which would give the two policies the same expected return. If we assume that a crisis occurs once every 45 years, this break-even value is 2.12%. Finally, the last row in Table 20 shows the object (p_i - p_n)/ p_i . This represents the percentage difference in crisis probabilities associated with the break-even point. The interpretation is straightforward. For the case of a crisis occurring once every 45 years, we can interpret column 4 as meaning, if the presence of TBTF increases the probability of a crisis by more the 4.34%, then TBTF is not good policy and is dominated by No-TBTF. A more detailed version of Table 20 is explained in Appendix A.2.

We have some values of crisis arrival occurring more frequently than the Laeven and Valencia (2008) benchmark case and some values occurring less frequently. What these cases show is that the lower the probability of a crisis under TBTF, the larger the percentage increase at the break-even point. This should be intuitive; the longer the average elapsed time between crises, the more years TBTF benefits have to accumulate. However, even when crises only arrive once every sixty five years on average (see Table 7 Column 6) the break-even occurs at p_n = 1.45%. Even in this case, if the presence of TBTF increases the probability of a crisis by more than 6.31%, it is not good policy.

Table 20 and Appendix A.2 are both centered about a crisis every 45 years, since this is what Laeven and Valencia (2008) find. If the reader believes that crisis occur more or less frequently, then more emphasis can be placed on the other columns in Table 20.

However, all Table 20 columns suggest that the presence of TBTF only needs to increase the probability of a crisis by a small percentage in order to be more of a detriment to society than a benefit.

8.1 A Robustness Check 1: "Perhaps a Banking Crisis Would Have Occurred in 2007 Even if There Were No TBTF Banks"

This is a comment we have gotten frequently from readers and discussants. If it is true, our cost estimates may be biased upward by the assumption (adopted from BKS) that absent a banking crisis, the economy would have continued to grow at its long term trend rate. But, maybe not. Maybe there would have been a recession in 2007 anyway. Our methodology is supposed to deal with this problem indirectly because the estimated growth rate, *g*, is a long run trend rate that is intended to average across business cycle frequencies. However, we can deal with the criticism directly, by forcing a recession into our counter-factual growth rate assumptions.

In this robustness check, we assume that a representative post-World War II crisis would have occurred in 2007 even in the absence of TBTF banks. To determine the length of the hypothetical crisis, we examined all recessions occurring after World War II as declared by the National Bureau of Economic Research with the exception of the recession starting in 2007. The NBER declared eleven recessions between 1945 and 2001 and these recessions had an average length of about ten months. For these recession periods, we obtained quarterly data on real per capita GDP growth and found that real per capita GDP grew by 0.35% on average. Thus, our summary of a representative Post-WWI recession is .35% growth for 10 months or .0035(12/10) = 0.0042% annually. We assume that such a recession occurred in calendar 2007, and in 2008, the economy reverted to its normal long run trend growth. Therefore, we simply assume that the growth rate for 2007 is 0.0042% and subsequent growth rates are consistent with either the arithmetic mean or method proposed by Easterly *et. al.* (1993).

The cost to benefit ratios assuming the hypothetical crisis costs are shown in Tables 21a and 21b. Not surprisingly, the cost to benefit ratios are smallest when the Wheelock and Wilson scale economies are attributed to the largest 100 banks, smallest social discount rate, and Easterly Trend estimate are all utilized. The opposite extremes lead to the highest cost to benefit ratios. Tables 21a and 21b indicate that the cost to benefit ratios range between 4.24 and 28.78. Tables 17a and 17b had ratios ranging between 8.65 and 57.03 for the same implemented assumptions. The difference between the two groups of tables is due to the fact that the growth rate for 2007 for the calculations within Tables 21a and 21b is 0.0042%, while Tables 17a and 17b use the same trend estimate (either 2.27% or 2.16%) for all years from 2007-2013.

8.2 A Robustness Check 2: Other Potential Benefits Due to TBTF, Magnitude

Many have commented regarding the potential biases regarding our benefits. As stated in the introduction, the benefits that the first section of the paper have in mind are strictly scale benefits that resolve from a production function. However, many have argued that there could be other benefits that are due to TBTF banks, such as technological advances, better diversification, or increased growth before the crisis.[20] This section of the paper is designed to answer determine how big TBTF benefits, from scale economies or otherwise, would need to be in order to overturn the findings within the paper.

For the first exercise within this section, we begin with our most conservative cost-benefit ratio from Table 21b Panel B, which is 4.24. This panel assumes the largest scale benefit estimates along with the assumption that a crisis would have already occurred even without the presence of TBTF banks, affecting the growth rate in 2007. Under these conservative circumstances, in order for the costs to equate to the benefits, the additional benefit component would have to be 12.23% - 2.89% = 9.34% of 2007 Real Per Capita GDP, which is more than three times the benefits estimate of 2.89% that applies to that scenario. We argue that this dramatic benefit increase seems too large to be realistic.

In an additional robustness check, we back out the percentage of benefits associated with TBTF banks that would be needed in order to offset the costs. We set the cost estimates from Table 1, *C*, equal to the benefits formula from Formula 3. However, because we are considering all benefits of TBTF banks, not just scale economies, we replace the *l* in Equation 15 with a *b*, which now represents TBTF benefits of any kind.

$$C = \frac{s \cdot b \cdot (1 - r)}{o - g} \tag{18}$$

[20] Baxamusa and Boyd (2013) even find that large banks are more likely to fail than small banks

In Table 22, we examine the benefits from Table 1 that vary with the fraction of banks examined, *f*, displayed in Columns 3 and 4 and growth rates, *g*, show in Panels A and B. Since the sector size, *s*, and retention ratio, *r*, are both fixed, we can back out the corresponding benefits level, *b* that is necessary to equate costs to benefits. Rearranging Equation 6 allows us to solve for *b*.

$$b = \frac{C \cdot (o - g)}{f \cdot s \cdot (1 - r)} \tag{19}$$

In equation 19, *b* represents the entire benefit that would need to come from TBTF banks from any conceivable source including but not limited to technological advances, scale economies, additional diversification, etc. The smallest benefits estimate is 138% of 2007 Real Per Capita GDP, which is unreasonably large. Given relative magnitudes of costs and benefits, we argue that there is no way that unmeasured benefits could be that large.

9. Conclusion

Our work needs to be further tested and we encourage others to consider the bounding methodology as an alternative to econometric techniques. The policy-maker needs to make decisions and cannot wait while economists experiment with new empirical methods or search for new data. Our main point is that the costs of TBTF seem to substantially exceed the benefits. This suggests that the link between TBTF banks and financial crises needs to be broken. One way to achieve that is to break the largest banks into smaller pieces as argued by Boyd and Jagannathan (2009). However, there are other policies that could be effective. If economies of super-scale are actually as large as some believe and go on without limit, an attractive policy would be to turn the TBTF banks into something like regulated public utilities. This would require regulating their rates of return on capital and managerial compensation as is done by state public utility commissions. A third alternative is to require them to hold very high capital ratios - as high as 20 or 30 percent. It has recently been argued by Hellwig et. al. (2010) that such capital requirements are only costly because of policy interventions in the form of tax deductibility of interest expense and the policy of TBTF.

Chapter 2 Figures

Figure 1

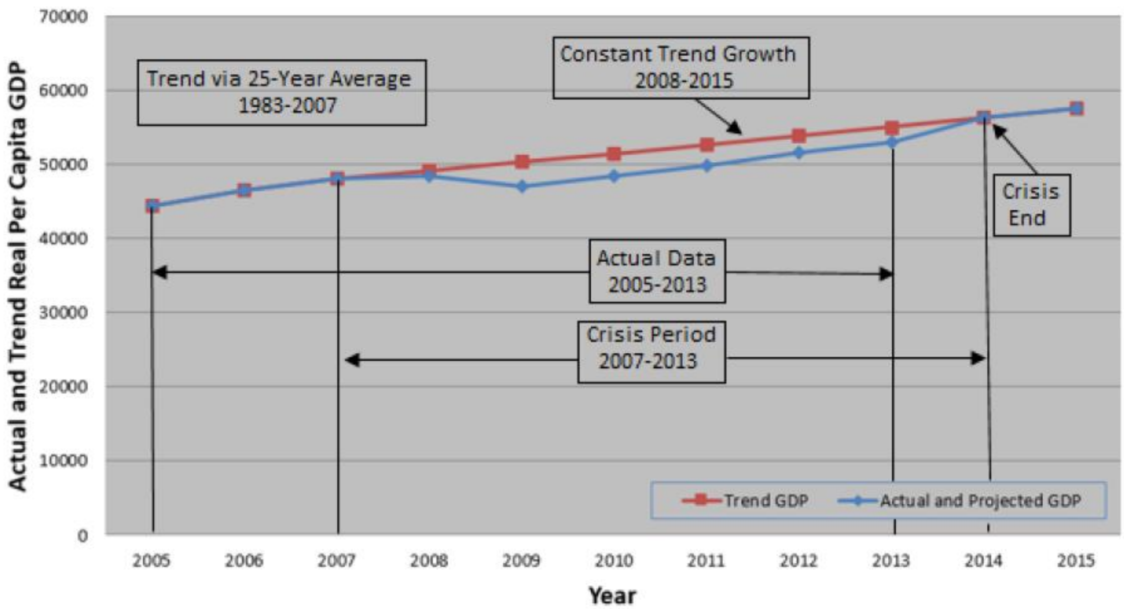
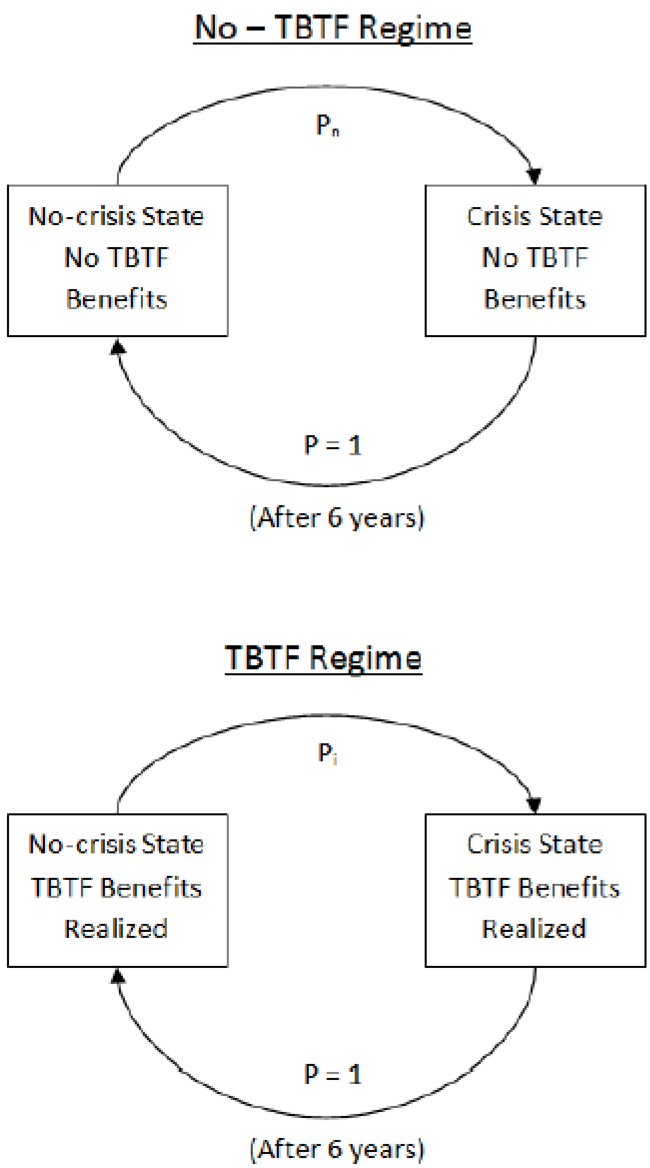


Figure 2


No – TBTF Regime
P_n
No-crisis State
No TBTF
Benefits
Crisis State
No TBTF
Benefits
P = 1
(After 6 years)
TBTF Regime
P_i
No-crisis State
TBTF Benefits
Realized
Crisis State
TBTF Benefits
Realized
P = 1
(After 6 years)

TBTF Tables

Table 14
Estimated Economic Losses Due to the Banking Crisis

Social Discount Rate (o)	Loss as a Percentage of 2007 Real GDP per capita (C)
Panel A: Trend Predicted Using 25-Year Average Rate of 2.27%	
6.77%	24.57%
5.25%	25.81%
3.60%	27.25%
Panel B: Trend Predicted Using Easterly *et.al*. Method Rate of 2.16%	
6.77%	22.55%
5.25%	23.67%
3.60%	24.97%

Table 14 compares the estimated losses employing varying GDP growth rate and trend assumptions. Column 1 shows the social discount rates used. Column 2 shows the loss values as a percentage of 2007 real per capita GDP for each of the corresponding social discount rates in Column 1. Panel A estimates the losses based on trend calculations, which are the average growth rate of real per capita GDP of 2.27% over the period 1983-2007. Panel B estimates losses based on trend calculations of 2.16% with the method proposed by Easterly *et.al* (1993) over the period from 1983-2007.

Table 15
Estimated Social Value-added of TBTF Banks
Estimated Social Value-added of TBTF Banks Resulting from Economies of Scale
Growth Rate Calculated using 25-year average 2.27%

Social	Benefit as a Percentage of 2007 Real Per Capita GDP (V)	
Discount Rate (o)	Top 25 Banks	Top 100 Banks
Panel A: Moon et. al. Measure of Scale Economies 9.2%		
6.77%	0.43%	0.53%
5.25%	0.65%	0.80%
3.6%	1.46%	1.80%
Panel B: Wheelock & Wilson Measure of Scale Economies 16%		
6.77%	0.75%	0.92%
5.25%	1.13%	1.39%
3.60%	2.54%	3.12%

Table 15 shows the benefits of Too Big to Fail Banks (TBTF) where the growth rate of real per capita GDP is calculated using the arithmetic average of the previous growth rates, 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the benefits as a percentage of 2007 real per capita GDP where 2007 is assumed to be the year of crisis onset and scale economies are attributed to the largest 25 banks as classified by asset size, while Column 3 shows estimates attributing scale economies to the largest 100 banks. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012)

Table 16

Estimated Social Value-added of TBTF Banks

Estimated Social Value-added of TBTF Banks Resulting from Economies of Scale

Growth Rate Calculated using Easterly Method for Trend Growth 2.16%

Social Discount Rate (o)	Benefit as a Percentage of 2007 Real Per Capita GDP (V) Top 25 Banks	Top 100 Banks
Panel A: Moon et. al. Measure of Scale Economies 9.2%		
6.77%	0.42%	0.52%
5.25%	0.63%	0.77%
3.6%	1.35%	1.66%
Panel B: Wheelock & Wilson Measure of Scale Economies 16%		
6.77%	0.73%	0.90%
5.25%	1.09%	1.34%
3.60%	2.34%	2.89%

Table 16 shows the benefits of Too Big to Fail Banks (TBTF) where the growth rate of real per capita GDP is calculated using the method proposed by Easterly et:al (1993) over the period 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the benefits as a percentage of 2007 real per capita GDP where 2007 is assumed to be the year of crisis onset and scale economies are attributed to the largest 25 banks as classified by asset size, while Column 3 shows estimates attributing scale economies to the largest 100 banks. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012)

Table 17a

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP Calculated Using 25-Year Average Method for Trend Growth 2.27%

Social		Benefit Estimate (V)		Cost Benefit Ratio	
Discount Rate (o)	Cost Estimates (C)	Top 25 Banks (f)	Top 100 Banks (f)	Top 25 Banks (f)	Top 100 Banks (f)
Panel A: Moon *et.al*. Measure of Scale Economies 9.2%					
6.77%	24.57%	0.43%	0.53%	57.03	46.28
5.25%	25.81%	0.65%	0.80%	39.67	32.19
3.60%	27.25%	1.46%	1.80%	18.70	15.17
Panel B: Wheelock & Wilson Measure of Scale Economies 16%					
6.77%	24.57%	0.75%	0.92%	32.79	28.61
5.25%	25.81%	1.13%	1.39%	22.81	18.51
3.60%	27.25%	2.54%	3.12%	10.75	8.72

Table 17a shows the Summary of Costs and Benefits as a percentage of 2007 Real Per Capita GDP where the growth rate is calculated using the 25-year arithmetic average from 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the cost estimates as a percentage of 2007 real per capita GDP. Column 3 shows the benefits estimate as a percentage of 2007 real per capita GDP when scale economies are attributed to the largest 25 banks as classified by asset size, while Column 4 shows the estimates when attributing scale economies to the largest 100 banks. Column 5 shows the cost to benefit ratio for the largest 25 banks, which is the ratio of Column 2 to Column 3. Column 6 shows the cost to benefit ratio for the largest 100 banks, which is the ratio of Column 2 to Column 4. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012).

Table 17b

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP Growth Rate Calculated using Easterly Method for Trend Growth 2.16%

Social		Benefit Estimate (V)		Cost Benefit Ratio	
Discount Rate (o)	Cost Estimates (C)	Top 25 Banks (f)	Top 100 Banks (f)	Top 25 Banks (f)	Top 100 Banks (f)
Panel A: Moon *et.al.* Measure of Scale Economies 9.2%					
6.77%	22.55%	0.42%	0.52%	53.63	43.52
5.25%	23.67%	0.63%	0.77%	37.72	30.61
3.60%	24.97%	1.35%	1.66%	18.55	15.05
Panel B: Wheelock & Wilson Measure of Scale Economies 16%					
6.77%	22.55%	0.73%	0.90%	30.84	25.03
5.25%	23.67%	1.09%	1.34%	21.69	17.60
3.60%	24.97%	2.34%	2.89%	10.66	8.65

Table 17b shows the Summary of Costs and Benefits as a percentage of 2007 Real Per Capita GDP where the growth rate is calculated using the method proposed by Easterly et. al (1993) over the period 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the cost estimates as a percentage of 2007 real per capita GDP. Column 3 shows the benefits estimate as a percentage of 2007 real per capita GDP when scale economies are attributed to the largest 25 banks as classified by asset size, while Column 4 shows the estimates when attributing scale economies to the largest 100 banks. Column 5 shows the cost to benefit ratio for the largest 25 banks, which is the ratio of Column 2 to Column 3. Column 6 shows the cost to benefit ratio for the largest 100 banks, which is the ratio of Column 2 to Column 4. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012).

Table 18
Payback Period
Calculated Using 25-Year Averages for Trend Growth 2.27%

Growth Rate (g)	Cost Estimates	Top 25 Banks	Top 100 Banks
Panel A: Moon *et.al*. Measure of Scale Economies 9.2%			
2.27%	31.29%	62	62
Panel B: Wheelock & Wilson Measure of Scale Economies 16%			
2.27%	31.29%	45	45

Table 18 shows the Payback Period where the growth rate is calculated using the 25-year arithmetic average from the years 1983-2007. Column 1 shows the growth rate of the 25-year arithmetic average. Column 2 shows the loss estimates from 2007-2014. Column 3 shows the estimated payback period when scale economies are attributed to the largest 25 banks, as classified by asset size. Column 4 shows the estimated payback period when scale economies are attributed to the largest 25 banks, as classified by asset size. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012). Please note that the payback period is the first integer year where benefits exceed costs. This is a form of rounding which explains why they two estimates above are the same.

Table 19

Payback Period

Calculated Using Easterly *et.al*. Method for Trend Growth 2.16%

Growth Rate (g)	Cost Estimates	Top 25 Banks	Top 100 Banks
Panel A: Moon *et.al*. Measure of Scale Economies 9.2%			
2.27%	28.84%	61	61
Panel B: Wheelock & Wilson Measure of Scale Economies 16%			
2.27%	28.84%	43	43

Table 19 shows the Payback Period where the growth rate is calculated using the method proposed by Easterly *et.al*. (1993) over the period 1983-2007. Column 1 shows the growth rate of the 25-year arithmetic average. Column 2 shows the loss estimates from 2007-2014. Column 3 shows the estimated payback period when scale economies are attributed to the largest 25 banks, as classified by asset size. Column 4 shows the estimated payback period when scale economies are attributed to the largest 25 banks, as classified by asset size. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012). Please note that the payback period is the first integer year where benefits exceed costs. This is a form of rounding which explains why they two estimates above are the same.

Table 20

Present Discounted Value Under Different Regimes

Crisis Frequency Under TBTF, P_i	25	35	45	55	65
Total Crisis Loss at Break Even Point	-1.06%	-0.71%	-0.52%	-0.40%	-0.31%
Break Even Probability, P_n	3.91%	2.76%	2.12%	1.72%	1.44%
Difference as a Percentage of TBTF Crisis Probability	2.37%	3.35%	4.34%	5.32%	6.31%

Table 20 shows the Present Discounted Value Under Different Regimes. Row 1 shows the Crisis Frequency under the regime where TBTF banks are present, p_i. Row 2 shows the Total Crisis Loss for both regimes when evaluated at the Break even Probability, p_n. Row 3 shows the value of this breakeven probability, P_n, for each frequency, and Row 4 shows $(p_i$ - $p_n)/p_i$, which is the percentage difference in crisis probabilities associated with the breakeven point.

Table 21a

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP

Assuming an Average Banking Crisis

Calculated Using 25-Year Averages for Trend Growth 2.27%

Social		Benefit Estimate (V)		Cost Benefit Ratio	
Discount Rate (o)	Cost Estimates (C)	Top 25 Banks (f)	Top 100 Banks (f)	Top 25 Banks (f)	Top 100 Banks (f)
Panel A: Moon *et.al*. Measure of Scale Economies 9.2%					
6.77%	12.40%	0.43%	0.53%	28.78	23.36
5.25%	13.04%	0.65%	0.80%	20.05	16.27
3.60%	13.79%	1.46%	1.80%	9.46	7.68
Panel B: Wheelock & Wilson Measure of Scale Economies 16%					
6.77%	12.40%	0.75%	0.92%	16.55	13.43
5.25%	13.04%	1.13%	1.39%	11.53	9.35
3.60%	13.71%	2.54%	3.12%	5.44	4.41

Table 21a shows the Cost to Benefit Ratios assuming there would have been an average banking crisis in 2007. Thus, the growth rate in 2007 is assumed to be 0.0042%, while the growth rates from 2008 forward are calculated using the 25-year arithmetic average from 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the cost estimates as a percentage of 2007 real per capita GDP. Column 3 shows the benefits estimate as a percentage of 2007 real per capita GDP when scale economies are attributed to the largest 25 banks as classified by asset size, while Column 4 shows the estimates when attributing scale economies to the largest 100 banks. Column 5 shows the cost to benefit ratio for the largest 25 banks, which is the ratio of Column 2 to Column 3. Column 6 shows the cost to benefit ratio for the largest 100 banks, which is the ratio of Column 2 to Column 4. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012).

Table 21b

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP

Assuming an Average Banking Crisis

Calculated Using Easterly *et.al*. Method for Trend Growth 2.16%

Social		Benefit Estimate (V)		Cost Benefit Ratio	
Discount Rate (o)	Cost Estimates (C)	Top 25 Banks (f)	Top 100 Banks (f)	Top 25 Banks (f)	Top 100 Banks (f)
Panel A: Moon *et.al*. Measure of Scale Economies 9.2%					
6.77%	11.04%	0.42%	0.52%	26.26	21.30
5.25%	11.59%	0.63%	0.77%	18.47	13.90
3.60%	12.23%	1.35%	1.66%	9.08	7.37
Panel B: Wheelock & Wilson Measure of Scale Economies 16%					
6.77%	11.04%	0.73%	0.90%	15.09	12.25
5.25%	11.59%	1.09%	1.34%	10.62	8.62
3.60%	12.23%	2.34%	2.89%	5.22	4.24

Table 21b shows the Cost to Benefit Ratios assuming there would have been an average banking crisis in 2007. Thus, the growth rate in 2007 is assumed to be 0.0042%, while the growth rates from 2008 forward are calculated using the method proposed by Easterly *et.al* (1993) over the period 1983-2007. Column 1 shows the varying social discount rates. Column 2 shows the cost estimates as a percentage of 2007 real per capita GDP. Column 3 shows the benefits estimate as a percentage of 2007 real per capita GDP when scale economies are attributed to the largest 25 banks as classified by asset size, while Column 4 shows the estimates when attributing scale economies to the largest 100 banks. Column 5 shows the cost to benefit ratio for the largest 25 banks, which is the ratio of Column 2 to Column 3. Column 6 shows the cost to benefit ratio for the largest 100 banks, which is the ratio of Column 2 to Column 4. Panel A estimates Too Big to Fail (TBTF) benefits based on scale economies obtained by Hughes, Mester, Moon (2001), and Panel B estimates TBTF benefits based on scale economies obtained by Wheelock and Wilson (2012).

Table 22

Benefits Estimate Necessary to Equate Crisis Costs

Social Discount Rate (o)	Loss as a Percentage of 2007 Real Per Capita GDP (C)	Benefits Metric Top 25 Banks (f)	Benefits Metric Top 100 Banks (f)
Panel A: Trend Predicted Using 25-Year Average Rate of 2.27%			
6.77%	11.04%	0.42%	0.52%
5.25%	11.59%	0.63%	0.77%
3.60%	12.23%	1.35%	1.66%
Panel A: Trend Predicted Using Easterly *et.al* Method Rate of 2.16%			
6.77%	11.04%	0.73%	0.90%
5.25%	11.59%	1.09%	1.34%
3.60%	12.23%	2.34%	2.89%

Table 22 shows how large benefits from TBTF banks need to be in order to overcome the crisis cost computations. Column 1 shows the social discount rates used. Column 2 shows the loss values as a percentage of 2007 real per capita GDP for each of the corresponding social discount rates in Column 1. Columns 3 and 4 indicate the necessary benefits that must come from TBTF banks in order to equalize the costs presented in Column 2. Column 3 shows how large the TBTF benefits must be if the largest 25 banks, as classified by asset size, are considered too-big-to-fail, while Column 4 assumes that the largest 100 banks are considered too-big-to-fail. Panel A estimates the losses based on trend calculations, which are the average growth rate of real per capita GDP of 2.27% over the period 1983-2007. Panel B estimates losses based on trend calculations of 2.16% with the method proposed by Easterly *et.al* (1993) over the period from 1983-2007.

References

D. Acemoglu and F. Zilibotti. Was Prometheus Unbound By Chance? Risk, Diversification, and Growth. *Journal of Political Economy*, 105(4):709-751, 1997.

V.V. Acharya, Y. Amihud, and L. Litov. Creditor Rights and Corporate Risk-Taking. *Journal of Financial Economics*, 102(1):150-166, 2011.

V. V. Acharya and K. V. Subramanian. Bankruptcy Codes and Innovation. *Review of Financial Studies*, 22(12):4949-4988, 2009.

V. V. Acharya, R. K. Sundaram, and K. John. Cross-Country Variations in Capital Structures: The Role of Bankruptcy Codes. *Journal of Financial Intermediation*, 20(1):25-54, 2011.

B. Adler. Bankruptcy and Risk Allocation. *Cornell Law Review*, 77(3):439-489, 1992.

P. Aghion and P. Bolton. An Incomplete Contracts Approach to Financial Contracting. *The Review of Economic Studies*, 59(3):473-494, 1992.

F. Allen and D. Gale. Financial Markets, Intermediaries, and Intertemporal Smoothing. *Journal of Political Economy*, 105(3):523-546, 1997.

K. Arrow. Economic Welfare and the Allocation of Resources for Invention. *Review of Economic Studies*, 29:155-173, 1962.

K.J. Arrow, WR Cline, KG Maler, M. Munasinghe, R. Squitieri, and JE Stiglitz. Intertemporal Equity, Discounting, and Economic Efficiency. Cambridge, UK, New York and Melbourne: Cambridge University Press, 1996.

J. Asker, J. Farre-Mensa, and A. Ljungqvist. Corporate Investment and Stock Market Listing: A Puzzle? *Review of Financial Studies*, 28(2):342-390, 2015.

K. Bae and V. K. Goyal. Creditor Rights, Enforcement, and Bank Loans. *The Journal of Finance*, 64(2):823-860, 2009.

J.R. Barth, G. Caprio, and R. Levine. *Guardians of Finance: Making Them Work for Us*. MIT Press, 2006.

J.R. Barth, G. Caprio, and R. Levine. *Rethinking Bank Regulation: Till Angels Govern*. Cambridge University Press, 2008.

M.H. Baxamusa and J.H. Boyd. Too Many Banks to Fail? Theory and Evidence. *The Economists' Voice*, 10(1):7-13, 2013.

A.N. Berger and G.F. Udell. The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle. *Journal of Banking and Finance*, 22(6):613-673, 1998.

A.N. Berger and G.F. Udell. Small Business Credit Availability and Relationship Lending: *The Importance of Bank Organisational Structure. Economic Journal*, 112(477):32-53, 2002.

A.N. Berger and T.H. Hannan. The Price-Concentration Relationship in Banking. *The Review of Economics and Statistics*, 71(2):291-299, 1989.

A.N. Berger and L.J. Mester. Efficiency and Productivity Change in the US Commercial Banking Industry: A Comparison of the 1980s and 1990s. *Working Papers*, 1997.

U. Bhattacharya and H. Daouk. The World Price of Insider Trading. *The Journal of Finance*, 57(1):75-108, 2002.

U. Bhattacharya and H. Daouk. When No Law is Better than a Good Law. *Review of Finance*, 13(4):577-627, 2009.

N. Bloom, S. Bond, and J. Van Reenen. Uncertainty and Investment Dynamics. *The Review of Economic Studies*, 74(2):391-415, 2007.

A.E. Boardman, D.H. Greenberg, A.R. Vining, and D.L. Weimer. *Cost-Benefit Analysis: Concepts and Practice*. Prentice Hall, 4th edition, 2006.

L. Booth, V. Aivazian, A. Demirguc-Kunt, and V. Maksimovic. Capital Structures in Developing Countries. *The Journal of Finance,* 56(1):87-130, 2001.

B. Bossone and J.K. Lee. In Finance, Size Matters: The "Systemic Scale Economies" Hypothesis. *IMF Staff Papers*, pages 19-46, 2004.

J.H. Boyd and R. Jagannathan. Avoiding the Next Crisis. *The Economists' Voice*, 6(7), 2009.

J.H. Boyd, R. Jagannathan, and S. Kwak. What Caused the Current Financial Mess and What Can We Do About It? *Working Paper*, 2009.

J.H. Boyd, S. Kwak, and B. Smith. The Real Output Losses Associated with Modern Banking Crises. *Journal of Money, Credit and Banking*, 37(6):977-999, 2005.

J.H. Boyd and E.C. Prescott. Financial Intermediary-Coalitions. *Journal of Economic Theory*, 38(2):211-232, 1986.

J.H. Boyd and D.E. Runkle. Size and Performance of Banking Firms: Testing the Predictions of Theory. *Journal of Monetary Economics*, 31(1):47-67, 1993.

R.J. Brent. Applied Cost-Benefit Analysis. Edward Elgar Publishing, 2006.

M. Brown, T. Jappelli, and M. Pagano. Information Sharing and Credit: Firm-level Evidence from Transition Countries. *Journal of Financial Intermediation*, 18(2):151-172, 2009.

M. Casey. 'Volcker: Fed Must Retain Bank Supervisor Role'. *Wall Street Journal*, January 2010.

G. De Nicolo and Board of Governors of the Federal Reserve System (US). *Size, Charter Value and Risk in Banking: An International Perspective*, volume 689. Board of Governors of the Federal Reserve System, 2000.

S. Claessens and K. Tzioumis. Ownership and Financing Structures of Listed and Large Non-listed Corporations. *Corporate Governance: An International Review*, 14(4):266-276, 2006.

A. Demirgüç-Kunt, L. Laeven, and R. Levine. Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation. *Journal of Money, Credit and Banking*, 36(3):593-622, 2004.

H. Demsetz. Industry Structure, Market Rivalry, and Public Policy. *Journal of Law and Economics*, 16(1):1-9, 1973.

M. A. Desai, C.F. Foley, and J.R. Hines. Domestic Effects of the Foreign Activities of US Multinationals. *American Economic Journal: Economic Policy*, 1(1):181-203, 2009.

S. Djankov, C. McLiesh, and A. Shleifer. Private Credit in 129 Countries. *Journal of Financial Economics*, 84(2):299-329, 2007.

R. DeYoung. Scale Economies Are a Distraction. *The Region, Federal Reserve Bank of Minneapolis*, 2010.

R. DeYoung and G. Torna. Nontraditional Banking Activities and Bank Failures during the Financial Crisis. *Journal of Financial Intermediation*, 2013.

D.W. Diamond. Financial Intermediation and Delegated Monitoring. *The Review of Economic Studies*, 51(3):393, 1984.

D.W. Diamond and P.H. Dybvig. Bank Runs, Deposit Insurance, and Liquidity. *The Journal of Political Economy*, 91:401-419, 1983.

W. Easterly, M. Kremer, L. Pritchett, and L.H. Summers. Good Policy or Good Luck? *Journal of Monetary Economics*, 32(3):459-483, 1993.

Franklin R Edwards. Concentration in Banking and Its Effect on Business Loan Rates. *The Review of Economics and Statistics*, 46(1):294-300, 1964.

M. Faccio, M. Marchica, and R. Mura. Large Shareholder Diversification and Corporate Risk-Taking. *Review of Financial Studies*, 24(11):3601-3641, 2011.

R. Feldman. Size and Regulatory Reform in Finance: Important but Difficult Questions. *The Region, Federal Reserve Bank of Minneapolis*, 2010.

M. Giannetti. Do Better Institutions Mitigate Agency Problems? Evidence from Corporate Finance Choices. *Journal of Financial and Quantitative Analysis*, 38(1):185-212, 2003.

R. Gropp, C. Gründl, and A. Güttler. *The Impact of Public Guarantees on Bank Risk Taking: Evidence from a Natural Experiment*. European Central Bank, 2010.

T.H. Hannan. Bank Commercial Loan Markets and the Role of Market Structure: Evidence from Surveys of Commercial Lending. *Journal of Banking and Finance*, 15(1):133-149, 1991.

Curtis Hanson. *Too Big To Fail*. HBO, 2011.

M. Harris and A. Raviv. The Theory of Capital Structure. *The Journal of Finance*, 46(1):297-355, 1991.

O. Hart and J. Moore. A Theory of Debt Based on the Inalienability of Human Capital. *The Quarterly Journal of Economics*, 109(4):841-879, 1994.

O. Hart and J. Moore. Default and Renegotiation: A Dynamic Model of Debt. *Quarterly Journal of Economics*, 113(1):1-41, 1998.

A. A. Heggestad and J. J. Mingo. Prices, Nonprices, and Concentration in Commercial Banking. *Journal of Money, Credit and Banking*, 8(1):107-117, 1976.

M. Hellwig. *Capital Regulation after the Crisis: Business as Usual?* Max Planck Institute for Research on Collective Goods, 2010

J.F. Houston, C. Lin, P. Lin, and Y. Ma. Creditor Rights, Information Sharing, and Bank Risk Taking. *Journal of Financial Economics*, 96(3):485-512, 2010.

J.P. Hughes, W. Lang, L.J. Mester, and C.G. Moon. Efficient Banking under Interstate Branching. *Journal of Money, Credit and Banking*, 28(4):1045-1071, 1996.

J.P. Hughes, W. Lang, L.J. Mester, and C.G. Moon. Recovering Risky Technologies Using the Almost Ideal Demand System: an Application to US Banking. *Journal of Financial Services Research*, 18(1):5-27, 2000.

J.P. Hughes and L. Mester. Who Said Large Banks Don't Experience Scale Economies? Evidence from a Risk-Return-Driven Cost Function. *Journal of Financial Intermediation*, 22(4):559-585, 2013.

J.P. Hughes and L.J. Mester. Bank Capitalization and Cost: Evidence of Scale Economies in Risk Management and Signaling. *Review of Economics and Statistics*, 80(2):314-325, 1998.

J.P. Hughes and L.J. Mester. Efficiency in Banking: Theory, Practice, and Evidence. In A.N. Berger, P. Molyneux, and J. Wilson, editors, *The Oxford Handbook of Banking*. Oxford University Press, 2010.

J.P. Hughes, L.J. Mester, and C.G. Moon. Are Scale Economies in Banking Elusive or Illusive? Evidence Obtained by Incorporating Capital Structure and Risk-Taking into Models of Bank Production. *Journal of Banking and Finance*, 25(12):216-2208, 2001.

T. Jappelli and M. Pagano. Information Sharing, Lending and Defaults: Cross-Country Evidence. *Journal of Banking and Finance*, 26(10):2017-2045, 2002.

S. Jayaraman and A. Thakor. The Effect of Creditor Rights on Bank Monitoring, Capital Structure, and Risk-Taking. *Working Paper*, 2013.

M.C. Jensen and W.H. Meckling. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, 3(4):305-360, 1976.

K. John, L. Litov, and B. Yeung. Corporate Governance and Risk-Taking. *The Journal of Finance*, 63(4):1679_1728, 2008.

S. Johnson and J. Kwak. *13 Bankers: The Wall Street Takeover and the Next Financial Meltdown*. Vintage, 2011.

J.H. Karaken and N. Wallace. Deposit Insurance and Bank Regulation: A Partial Equilibrium Exposition. *Journal of Business*, 51(3):413-438, 1978.

D. Kaufmann, A. Kraay, and M. Mastruzzi. Governance Matters VI: Aggregate and Individual Governance Indicators 1996-2007. World Bank Policy Research. *Working Paper*, 46-54, 2008.

B.T. Kelly, H. Lustig, and S. Van Nieuwerburgh. Too-Systemic-To-Fail: What Option Markets Imply About Sector-wide Government Guarantees. Technical report, National Bureau of Economic Research, 2011.

D. Klein. Promise keeping in the great society: A Model of Credit Information Sharing. *Economics and Politics*, 4(2):117-136, 1992.

L. Laeven and F. Valencia. Systemic Banking Crises: A New Database. International Monetary Fund, 2008.

R. La Porta, F. Lopez-de Silanes, A. Shleifer, and R. W. Vishny. Law and Finance. *Journal of Political Economy*, 106(6):1113-1155, 1998.

L. Laeven, R. Levine, and S. Michalopoulos. Financial Innovation and Endogenous Growth. *Journal of Financial Intermediation*, 24(1):1-24, 2015.

K. Lehn and A. Poulsen. Free Cash Flow and Stockholder Gains in Going Private Transactions. *The Journal of Finance*, 44(3):771-787, 1989.

R. Levine. Finance and Growth: Theory and Evidence. Handbook of Economic Growth, 1:865-934, 2005.

L. Mester. Scale Economies in Banking and Financial Regulatory Reform. *The Region, Federal Reserve Bank of Minneapolis*, 2010.

M.A. Moore, A.E. Boardman, A.R. Vining, D.L. Weimer, and D.H. Greenberg. "Just Give Me a
Number!" Practical Values for the Social Discount Rate. *Journal of Policy Analysis and Management*, 23(4):789-812, 2004.

G. Morgenson and J. Rosner. *Reckless Endangerment: How Outsized Ambition, Greed, and Corruption Led to Economic Armageddon*. Times Books, 2011.

S. C. Myers. Determinants of Corporate Borrowing. *Journal of Financial Economics*, 5(2):147-175, 1977.

G. Nini, D.C. Smith, and A. Sufi. Creditor Control Rights and Firm Investment Policy. *Journal of Financial Economics*, 92(3):400-420, 2009.

G. Nini, D.C. Smith, and A. Sufi. Creditor Control Rights, Corporate Governance, and Firm Value. *Review of Financial Studies*, 25(6):1713-1761, 2012.

A.J. Padilla and M. Pagano. Endogenous Communication Among Lenders and Entrepreneurial Incentives. *Review of Financial Studies*, 10(1):205-236, 1997.

A.J. Padilla and M. Pagano. Sharing Default Information as a Borrower Discipline Device. *European Economic Review*, 44(10):1951-1980, 2000.

M. Pagano and T. Jappelli. Information Sharing in Credit Markets. *The Journal of Finance*, 48(5):1693-1718, 1993.

D.H. Papell and R. Prodan. The Statistical Behavior of GDP after Financial Crises and Severe Recessions. *The B.E. Journal of Macroeconomics*, 12(3):1-29, 2012.

S. Peltzman. The Gains and Losses from Industrial Concentration. *Journal of Law and Economics*, pages 229-263, 1977.

J. Qian and P. E. Strahan. How Laws and Institutions Shape Financial Contracts: The Case of Bank Loans. The Journal of Finance, 62(6):2803-2834, 2007.

R. G. Rajan and L. Zingales. What Do We Know About Capital Structure? Some Evidence from International data. *The Journal of Finance*, 50(5):1421-1460, 1995.

F.P. Ramsey. A Mathematical Theory of Saving. *The Economic Journal*, 38(152):543_559, 1928.

K.S. Rogoff, A.M. Husain, A. Mody, R. Brooks, and N. Oomes. *Evolution and Performance of Exchange Rate Regimes*. International Monetary Fund, 2004.

D. Staiger and J.H. Stock. Instrumental Variables Regression with Weak Instruments. *Econometrica*, 65(3):557-586, 1997.

H. Shin and R. M. Stulz. Are Internal Capital Markets Efficient? *Quarterly Journal of Economics*, 113(2):531-552, 1998.

J. E. Stiglitz and A. Weiss. Credit Rationing in Markets with Imperfect Information. The *American Economic Review*, 71(3):393-410, 1981.

A. Taskm. 'Reckless Endangerment': Morgenson, Rosner Name Names - Point Finger at Fannie Mae'. *Yahoo! Finance - Business Finance, Stock Market, Quotes*, May 2011. May 27.

R. M. Townsend. Optimal Contracts and Competitive Markets with Costly State Verification. *Journal of Economic Theory*, 21(2):265-293, 1979.

J. A .Vercammen. Credit Bureau Policy and Sustainable Reputation Effects in Credit Markets. *Economica*, 62(248):461-478, 1995.

D. Wheelock and P. Wilson. Do Large Banks have Lower Costs? New Estimates of Returns to Scale for US Banks. *Journal of Money, Credit, and Banking*, 44(1):171-199, 2012.

T. M. Whited. External Finance Constraints and the Intertemporal Pattern of Intermittent Investment. *Journal of Financial Economics*, 81(3):467-502, 2006.

T. M. Whited and G. Wu. Financial Constraints Risk. *Review of Financial Studies*, 19(2):531-559, 2006.

Appendix

A.1 Estimating a Social Discount Rate

To estimate a risky social discount rate, we use the methodology of Boardman (2001). We average the real pretax rate of return on Moody's AAA long-term corporate bonds over the period 1947-2007 and get an estimate of 6.77%. Our second estimate of 5.25% is taken from BKS.[21]

In order for the benefits formula shown in Formula 15 to hold, it's necessary to make certain that the social discount rate, o, is larger than the growth rate, g. The appropriate social discount rate should reflect the riskiness of the project being examined, which are the costs and benefits of TBTF banks. There are risks associated with almost every project or investment, even risk-free treasury notes. In order to construct a lower bound for the social discount rate, we focus on a method that is designed for extremely safe public projects.

Our third estimate uses the optimal growth model proposed by Ramsey (1928) and reviewed in Moore *et. al*. (2004). We do not believe that this discount rate is appropriate, since both costs and benefits associated with TBTF are inherently risky. However, it's necessary to determine the lowest feasible option for the social discount rate in order to examine the robustness of our conclusions, since the lower the social discount rate, the higher the benefits estimate. Thus, this leads to a lower cost to benefit ratio. For Formula

[21] This is computed as the average real rate of return of equity for the twenty-three countries in their sample. We do not update these estimates because that would include the crisis years and result in an unreasonably low estimated cost of equity.

15 to hold, it's also necessary for the social discount rate to be larger than the growth rate, which is what we find.

To obtain this estimate, we estimate the absolute value of the rate at which the marginal value of consumption decreases as per capita consumption increases *e*, a utility discount rate *d*, which measures the rate society discounts the utility of future per capita consumption, and the growth rate of per capita consumption, *g*. The social discount rate, *o*, is then defined

$$o = d + g \cdot e \tag{20}$$

We regress the natural logarithm of real per capita aggregate consumption on time over the period 1947-2007 and use the slope coefficient to obtain our estimate of *g*.[22]

Based on the previous literature by Brent (2006) and Arrow *et al.* (1995), we use *e* = 1. Arrow suggests a figure of around 1 percent for *d*. Thus, with estimates of *g* = 3.6%, *e* = 1, and *d* = 1 we obtain the estimate of the (gross) social discount factor o by substituting into equation 20.

$$o = d + g \cdot e = 1.0 + 0.36 \times 1 = 1.036 \tag{21}$$

[22] Data come from http://www.bea.gov/.

A.2 Probabilistic Calculations Explained

In this section, we expand the discussion of the probabilistic calculations from Section VI. The results are shown in Table B.1, where it is assumed that the crisis arrival rate in the TBTF regime is once every 25, 35, 45, 55, or 65 years. Panel A in Table B.1 shows results when crisis occur once every 45 years or p_i = .0222 - as reported by Laeven and Valencia (2008). What is allowed to vary in the panel is the crisis probability under the No-TBTF regime. For example, in column 1 it is assumed that pn = .005 and we can see the net benefits under both regimes. Clearly, No-TBTF is better with these probabilities since - 0.15% > -0.64%. Columns 3, 4, and 5 makes the same calculation allowing for successively higher values of p_n. As would be expected, the advantage of No-TBTF declines as pn rises. In the fourth row, last column in Panel A Table B.1, we have the break even probability - that is, the value of p n which would give the two policies the same expected return. This is 2.12%. Finally, the last row and column in each panel of Table B.1 shows the object (p_i - p_n) / p_i . This represents the percentage difference in crisis probabilities associated with the breakeven point. The other panels in Table B.1 are similar to Panel A, except that in each panel we change p_i, the probability of crisis arrival under TBTF.

Panels B, C, D, and E show the various losses and break-even points as crisis occur less frequently. The lower the probability of a crisis under TBTF, the larger the percentage increase at the breakeven point. This means that the longer the average elapsed time between crises, the more years TBTF benefits have to accumulate. Panel B shows the same types of calculations when crisis occur more frequently than the data suggest. If we assume that a crisis occurs every 25 years, opposed to every 45 years as Laeven and Valencia (2008) suggest, then we see that if the presence of TBTF increases the probability of a crisis by more than only 2.37%, then it is not a good policy. If we assume crisis occurrence is very infrequent, occurring once every 65 years, then Panel E indicates that TBTF only needs to increase the probability of a crisis by 6.31% in order for it to be detrimental to the economy

Table B.1
Present Discounted Value Under Different Regimes Elaboration

Panel A: Assume Crisis Occurs Every 45 Years ($p_i = 0.0222$)				
Assumed Probability Under no-TBTF Regime (p_n)	$p_n = 0.005$	$p_n = 0.01$	$p_n = 0.013$	$p_n = 0.0173$
TBTF Regime Crisis Cost	-0.64%	-0.64%	-0.64%	-0.64%
no-TBTF Regime Crisis Cost	-0.15%	-0.30%	-0.39%	-0.52%
Break Even Probability, p_n				**2.12%**
Difference as a Percentage of TBTF Crisis Probability				**4.34%**
Panel B: Assume Crisis Occurs Every 25 Years ($p_i = .04$)				
Assumed Probability Under no-TBTF Regime (p_n)	$p_n = 0.020$	$p_n = 0.025$	$p_n = 0.030$	$p_n = 0.0351$
TBTF Regime Crisis Cost	-1.17%	-1.17%	-1.17%	-1.17%
no-TBTF Regime Crisis Cost	-0.60%	-0.75%	-0.90%	-1.06%
Break Even Probability, p_n				**3.91%**
Difference as a Percentage of TBTF Crisis Probability				**2.37%**
Panel C: Assume Crisis Occurs Every 35 Years ($p_i = 0.02857$)				
Assumed Probability Under no-TBTF Regime (p_n)	$p_n = 0.010$	$p_n = 0.015$	$p_n = 0.020$	$p_n = 0.0237$
TBTF Regime Crisis Cost	-0.83%	-0.83%	-0.83%	-0.83%
no-TBTF Regime Crisis Cost	-0.30%	-0.45%	-0.60%	-0.71%
Break Even Probability, p_n				**2.76%**
Difference as a Percentage of TBTF Crisis Probability				**3.35%**
Panel D: Assume Crisis Occurs Every 55 Years ($p_i = 0.018182$)				
Assumed Probability Under no-TBTF Regime (p_n)	$p_n = 0.005$	$p_n = 0.0075$	$p_n = 0.010$	$p_n = 0.0132$
TBTF Regime Crisis Cost	-0.52%	-0.52%	-0.52%	-0.52%
no-TBTF Regime Crisis Cost	-0.15%	-0.23%	-0.30%	-0.40%
Break Even Probability, p_n				**1.72%**
Difference as a Percentage of TBTF Crisis Probability				**5.32%**
Panel E: Assume Crisis Occurs Every 65 Years ($p_i = 0.015385$)				
Assumed Probability Under no-TBTF Regime (p_n)	$p_n = 0.003$	$p_n = 0.005$	$p_n = 0.007$	$p_n = 0.0095$
TBTF Regime Crisis Cost	-0.43%	-0.43%	-0.43%	-0.43%
no-TBTF Regime Crisis Cost	-0.09%	-0.15%	-0.21%	-0.31%
Break Even Probability, p_n				**1.44%**
Difference as a Percentage of TBTF Crisis Probability				**6.31%**

Table B.1 shows the Present Discounted Value Under Different Regimes. Row 1 shows the Crisis Frequency under the regime where TBTF banks are present, Pi. Row 2 shows the Total Crisis Loss for both regimes when evaluated at the Break even Probability, p_n. Row 3 shows the value of this breakeven probability, p_n, for each frequency, and Row 4 shows $(p_i - p_n)/p_i$, which is the percentage difference in crisis probabilities associated with the breakeven point. Panel A assumes that Crisis occur every 45 years, as Laeven and Valencia (2008) have documented. Within each panel, crisis probability under no-TBTF regime is allowed to vary, which is shown in columns 2-5. Columns 3-5 make the same calculations for successively higher values of p_n. Column 5 contains all calculations for the breakeven probability. Panels B, C, D, and E perform the same calculations assuming crises occur every 25, 35, 55, and 65 years respectively.

A.3 Realistic Crisis Cost Assumptions

In this section, we briefly drop the bounding approach and employ realistic crisis cost estimates for eighteen countries studied by BKS. We continue to assume the TBTF scale benefits that we have just presented. The idea is to see how much of a difference it makes to drop one important biasing assumption and substitute realistic estimates.

We assume those parameter values that tend to most inflate TBTF benefits. We use the lowest discount rate, o = .036 and the highest economies of scale parameter l = 0.16 attributed to the largest 100 banks. We also use the average growth rate, since it is larger and associated with larger benefits estimates. This amounts to us using the largest benefit estimates from the paper, which are 3.12%. In essence, this part amounts to a half-bounding exercise costs estimates are realistic and benefits are intentionally overstated.

Table C.1 shows the eighteen countries from BKS, their crisis dates, and the estimated cost of their crises as a present discounted percentage of base year real GDP.[23] In Table C.1, the crisis cost estimates vary enormously - from 24.7% in the case of France to 232.5% in the case of Korea.[24]

Table C.2 Column 3 shows the cost to benefit ratios for the eighteen countries with the parameter assumptions discussed above. These are highly variable. One country, France,

[23] There are four crisis countries that BKS do not report because their estimated crisis costs are zero or negative. However, as is clear from BKS (footnote 5), the bias from this omission will be very small. These cost estimates come from Table 4, column 2 of BKS and do not include the estimated losses for four countries that never converge to the original growth path. Thus, we are not employing the upper bound estimates from BKS.

[24] The crisis in France involved the failure of just one large bank, Credit Lyonaise. The sample mean (median) crisis cost is large at 116% (106.9%)

has positive net benefits due to TBTF. However, the mean (median) cost benefit ratio is 37.17 (34.26), suggesting an extremely unfavorable trade-off for TBTF. Column 4 shows the payback period calculations for these eighteen countries estimated with the same parameters. Recalling that the historical average crisis arrival rate from Laeven and Valencia (2008) is 45 years, there are only two countries with shorter estimated payback periods - France and Zimbabwe. The mean (median) payback period in Table C.2 is 87.1 (89) years, almost double the estimated arrival rate from Laeven and Valencia (2008). In sum, both the cost-benefit and payback calculations indicate that TBTF appears to be an undesirable policy.

Table C.1
Crisis Costs From Boyd, Kwak, and Smith (2005) Sample

Country Name	Total Crisis Cost Expressed as a Percentage of Year Zero GDP	Crisis Dates
Australia	62.4%	89-92
Columbia	109.0%	82-87
Denmark	49.5%	87-92
Spain	143.3%	77-85
Finland	182.9%	91-94
France	24.7%	94-95
Greece	86.7%	91-95
Hong Kong	140.0%	82-86
Italy	96.2%	90-95
Jamaica	104.8%	94-?
Jordan	207.9%	89-90
Japan	140.4%	90-?
Korea	232.5%	97-?
Norway	111.3%	87-93
New Zealand	66.7%	87-90
Peru	194.1%	83-90
Sweden	100.8%	91
Zimbabwe	34.4%	95-98
Mean	116.0%	
Median	106.9%	

Table C.1 shows the crisis costs of the sample from Boyd, Kwak, and Smith (2005). Column 1 shows the country name, and Column 2 shows the total crisis cost for that country expressed as a percentage of GDP of the last pre-crisis year. Column 3 shows the crisis dates in years. A question mark indicates that the crisis was not officially over at the time BKS were writing.

Table C.2
Payback Period From Boyd, Kwak, and Smith (2005) Sample

Country Name	Total Crisis Cost Expressed as a Percentage of Year Zero GDP	Cost Benefit Ratio	Payback Period
Australia	62.4%	2.28	68
Columbia	109.0%	3.99	90
Denmark	49.5%	1.81	60
Spain	143.3%	5.25	101
Finland	182.9%	6.69	11
France	24.7%	0.90	39
Greece	86.7%	3.17	80
Hong Kong	140.0%	5.12	100
Italy	96.2%	3.52	85
Jamaica	104.8%	3.84	88
Jordan	207.9%	7.61	116
Japan	140.4%	5.14	100
Korea	232.5%	8.51	121
Norway	111.3%	4.07	90
New Zealand	66.7%	2.44	71
Peru	194.1%	7.10	113
Sweden	100.8%	3.69	86
Zimbabwe	34.4%	1.26	48
Mean	116.0%	4.25	87.1
Median	106.9%	3.91	89.0

Table C.2 shows the payback period in years of the sample from Boyd, Kwak, and Smith (2005). Column 1 shows the country name, and Column 2 shows the total crisis cost for that country expressed as a percentage of GDP of the first pre-crisis year. Column 3 shows the cost benefit ratio, which is defined as the crisis cost divided by 3.12period is the first integer year where benefits exceed costs.

A.4 Notation

b	All benefits from TBTF banks
BankFrac3	Fraction of total assets within a given country held by the largest three banks.
BondControl total	Size of the bond market divided by the sum of the bond market and bank loans winsorized at 1% in each tail
BondMarket	Size of the bond market for non-financial firms (in US dollars)
c	The present discounted value of social output losses due to the banking crisis, in 2007 dollars
Corruption	This indicator measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Higher values indicate more control over corruption.
Crights	An index aggregating the four components of the creditor rights as originally proposed by La Porta et al. (1998) and extended by Djankov, McLiesh, and Schleifer (2007). This index ranges from zero to four where higher values indicate greater levels of investor protection. The four components of the creditor rights index are the variables Restrictions;NoAutostay;Secured;and Manages: The value of 2003 from Djankov, McLiesh, and Schleifer (2007) is used in this study.
c_t	Annual crisis cost in year *t*

d	The utility discount rate, which measures the rate society discounts the utility of its future per capita consumption
Depth	An index that measures the information sharing within an economy. A value of one is added to the index when each of the following characteristics is present. The index ranges from 0 to 6, where where higher values indicates greater information sharing. There are six components of this index. 1) Both positive information and negative information are distributed 2) Data on both firms and individual borrowers are distributed. 3) Data from retailers, trade creditors, or utilities, as well as from financial institutions are distributed 4) More than two years of historical data are distributed. 5) Data are collected on all loans of value 1% of income per capita. 6) Laws provide for borrowers rights to inspect their own data. A value of one is added to the index if each component is present in either a public registry or a private bureau.
e	The absolute value of the rate at which the martginal value o that consumption decreases as per capita consumption increases
EBITDA	Earnings before depreciation and taxes
Effectiveness	This variable indicates the quality of public services, the quality of the civil service, and the degree of its independence from political pressures, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Higher values mean higher quality of public and civil service.
FAssets	Total firm assets. The data are winsorized at 1% in each tail and reported in U.S. dollars.

FirmLeverage	Ratio of firm loans to firm assets truncated at 1 and winsorized at 1% in each tail
FDebt	Sum of on-current liabilities in long-term debt and current liabilities in loans (in US dollars) winsorized at 1% in each tail
g	The growth rate of per capita consumption
g_t	Estimated growth rate in real per capita GDP for the United States in period *t*
G_t	Real per capita GDP in year *i*
$\overline{g_t}$	Historical average growth rate as for year *t*
Growth	Log increase in sales winsorized at 1% in each tail
Inflation	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used, and the data are winsorized at 1% in each tail
Investment	Change in net fixed assets and incremental depreciation scaled by total assets winsorized at 1% in each tail
IRCorp	The ratio of interest paid to current liabilities in loans and non-current liabilities: long-term debt truncated at 1 and winsorized at 1% in each tail

l Efficiency advantage of TBTF banks relative to the banking industry

Law Rule of law measures the extent to which agents abide by and have confidence in the rules of society. In particular, this measure captures the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence. Higher values indicate stronger law and order.

LegalOrigin Dummy variables for English (Eng), German (German), French (Fren); Scandinavian (Scandinavian), or Socialist (Socialist) legal origin

LogFAssets Log total assets (in US dollars) winsorized at 1% in each tail

LogGDP Log real GDP per capital (in US dollars)

Manages One component of the creditor rights index that takes the value of one if during the reorganization of a business, an offcial is appointed by the court, or by the creditors, takes responsibility for operating the business. The firm management does not retain administration of its property pending the resolution of reorganization. This variable also takes a value of one, if the firm does not keep the administration of its property pending the resolution of the reorganization process. Otherwise, this variable is zero.

NACE Two digit European industry code

NoAutostay One component of the creditor rights index that equals one if the reorganization process does not impose an automatic stay on assets of the firm upon filing the reorganization petition and creditors are

	able to seize their collateral after the reorganization petition is approved. This variable is zero otherwise.
o	The social discount rate
p	Probability of a crisis arrival
p_i	Transition probability of going from the no crisis to crisis state in TBTF regime
p_n	Transition probability of going from the no crisis to crisis state in No-TBTF regime
Regulation	This variable represents the ability of the government to formulate and implement sound policies and regulations that permit and promote market competition and private-sector development. Higher values mean higher quality of regulation
Restrictions	This component of the creditor rights index has a value of 1 if the reorganization procedure imposes restrictions such as creditor's consent or minimum dividend for a debtor to be able to file for reorganization. If a country does not have such a restriction, this component takes a value of zero.
Risk	Standard deviation of ROA for the year before, during, and after analysis, winsorized at 1% in each tail
ROA	EBITDA/Total Assets winsorized at 5% in each tail
s	Share of total real per capita GDP that is produced by TBTF banks (Estimate from Flow-of-Funds data, s = 3.63%)

Secured	One component of the creditor rights index that takes a value of one if secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm, opposed to other creditors such as employees or government. If non-secured creditors such as the government or employees are given priority, this component takes a value of zero.
Stability	This indicator measures the perceptions of the likelihood that the government will be overthrown or destabilized or overthrown by violent or unconstitutional methods, including violence or terrorism. Higher values mean more stable environments.
TanAssets	Fixed assets scaled by total assets winsorized at 1% in each tail
TotalBankLoans	Total bank loans in a country (in US dollars). This variable is estimated by summing all individual bank loans in a given country-year from Bankscope.
V	Discounted 2007 value of the net social benefit of TBTF banks (in terms of their contribution to real per capita GDP)
w_t	World growth rate in period *t*