



Are Banks in Europe Too Big to Fail or Too Big to Save?

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Dissertation written under the supervision of Lei Zhao

Dissertation submitted in partial fulfilment of requirements for the MSc in Finance, at Universidade Católica Portuguesa and for the MSc in Management, at ESCP Europe Paris, January 6, 2021.

Abstract

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The financial crisis of 2007-2009 raised concerns regarding countries' abilities to rescue their largest banks should a new crisis emerge. By focusing on European Union banks from 2001 through 2019, this dissertation investigates the impact of both absolute and systemic bank size on a bank's valuation and CDS spreads. We find that a bank's market-to-book ratio is negatively related to its natural logarithm of total assets and liabilities-to-GDP ratio. We further established that CDS spreads seemingly increase in a dynamic market response to changes in bank's absolute size. These results suggest that large banks can increase their value by downsizing or splitting up. Our findings also show that in the aftermath of the financial crisis, most banks in our sample reduced their systemic size. This decrease may indicate that while banks in the European Union were certain of a too big to fail status with the inference that governments would rescue them if necessary, this certainty mostly vanished post 2009. The events that followed the crisis revealed to several banks that they were in fact, too big to save, leading many to adapt to this new reality by downsizing.

Keywords: *financial crisis, too big to fail, too big to save, bank size, systemic risk, bank valuation*

Resumo

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A crise financeira de 2007-2009 revelou dúvidas quanto às capacidades dos países para salvar os seus maiores bancos no caso de surgimento de uma nova crise. Ao centrar-se nos bancos da União Europeia, no período entre 2001 a 2019, esta dissertação investiga o impacto, tanto da dimensão absoluta, como sistémica, dos bancos, na sua avaliação e nos spreads dos CDS. Constatamos que o rácio entre o valor de mercado e o valor contabilístico dos capitais próprios de um banco está negativamente relacionado com o seu logaritmo natural do total de ativos e o rácio de passivos em relação ao PIB. Estabelecemos ainda que os spreads de CDS parecem aumentar em resposta dinâmica do mercado às mudanças na dimensão absoluta de um banco. Estes resultados sugerem que os grandes bancos podem aumentar o seu valor reduzindo a sua dimensão ou por cisão. Os nossos resultados também mostram que, no rescaldo da crise financeira, a maioria dos bancos da nossa amostra reduziu a sua dimensão sistémica. Esta redução pode indicar que, embora os bancos na União Europeia estivessem convictos de deterem um estatuto demasiado grande para perderem, com a inerente consequência de que os governos sempre os resgatariam se necessário, esta certeza desapareceu na sua maioria após 2009. Os acontecimentos que se seguiram à crise revelaram a vários bancos que eram, afinal, demasiado grandes para poderem ser salvos, levando muitos a adaptarem-se a esta nova realidade através de reduções de dimensão.

Palavras chave: *crise financeira, demasiado grande para perder, demasiado grande para ser salvo, dimensão dos bancos, risco sistémico, avaliação da banca*

Acknowledgments

This Dissertation submitted in partial fulfilment of requirements for the MSc in Finance, at Universidade Católica Portuguesa and for the MSc in Management, at ESCP Europe Paris was only possible due to the support of important people that I need to publicly nominate for their encouragement throughout this journey.

Firstly, I would like to thank my dissertation supervisor, Professor Lei Zhao, from the ESCP Europe Paris, for his help in carrying out this dissertation and finding all the resources necessary for me to execute it.

Secondly, I would also like to thank Professor José Faias, from the Universidade Católica Portuguesa, for his constant availability, patience, and advice throughout the execution of this paper.

Thirdly, I would like to thank Henry Gonzalez, from the ESCP Europe Paris, for taking the time to give me access and helping me navigate the Bloomberg's platform, as without his help, I would not be able to retrieve some of the data necessary to complete my Thesis.

Finally, I would like to especially thank my parents, my brother and all my friends for their unconditional love and support without which this project would have been more difficult to endure.

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1. Introduction

In the light of the recent financial crisis, the issue of too big to fail (TBTF) has gained prominence once more, as governments across Europe and North America stepped in and rescued major financial institutions through the use of public funds. In situations where banks are deemed TBTF, governments often intervene to address the consequences of financial crises and avoid possible catastrophic ripple effects across their economies. The failure of a single large bank within a country can lead to the collapse of other banks due to the considerable contemporary interconnectedness among financial institutions involved in financial market trading activities, providing underlying liquidity within their country's economy with their liabilities. Therefore, although sovereign authorities do not have any legally binding obligation to back the debts of major financial institutions in case of default, banks and their investors nevertheless expect such support¹. In the years leading to the financial crisis of 2007-2009, this implicit public guarantee allowed major financial institutions to benefit from lower borrowing costs, which in turn, led them to engage in risk taking activities while increasing their leverage, all of which contributed to systemic risk and financial fragility. In practice, financial institutions perceived these explicit and implicit government benefits as an incentive to engage in moral hazard.

By the end of 2008, many individual banks and banking systems possessed liabilities exceeding half of their respective country's Gross Domestic Product (GDP). Several governments thus found themselves unable to rescue their largest banks. Iceland, serves as a good illustration of this situation, as their banking system's liabilities had risen to approximately 9 times the country's GDP by the end of 2007, leaving the nation on the verge of bankruptcy. The Icelandic government had no choice but to let their three major financial institutions (Kauþthing, Glitnir, and Landsbankinn) collapse. This suggests that many banks, committed to their goal of reaching TBTF status, may instead end up becoming too big to save (TBTS), surpassing the size which maximizes the implicit public guarantee. This development demonstrates that large banks can alternatively face reduced rescuing outlooks, as governments lack the ability to bail them out due to a need to first protect their own solvency. Our work in this dissertation thereby aims to establish whether, in the aftermath of the recent financial crisis,

¹ For instance, in Sorkin's 2010 book on the Too Big to Fail topic, he states that in the US until the financial crisis, "many Wall Street bankers believed government would ultimately come to their rescue".

both banks and their investors continue to believe that governments would be capable and willing of rescuing their largest banks if a new crisis were to emerge.

The financial crisis of 2008 led to a severe deterioration of the banking and public systems of many countries. In Europe alone, crisis-related losses incurred by European banks between 2007 and 2010 amounted to approximately €1 trillion². Within the European Union (EU) specifically, crisis-related losses amounted to 8% of GDP³, which further contracted by 6%⁴ in 2009 due to the economic recession that followed. Concerns began to mount regarding countries' abilities to save their major financial institutions, should a new financial crisis take place. Such doubts can indicate that bank creditors of the largest banks cannot be fully certain of the TBTF status of banks and its implicit guarantee of rescue in case of default. As such, one could expect that in the face of new uncertainties regarding TBTF status, banks would face pressure to deleverage and downsize as a means of reducing the risk to both themselves, and their country's financial safety net.

This dissertation thus seeks to determine if in the aftermath of the most recent financial crisis, banks in the European Union sought to reduce their size due to TBTF concerns, or whether they kept trying to grow so as to benefit from TBTF status. For our analytical purposes, I will rely on data from 2001 through 2019 for bank valuations of over 27 countries⁵, along with the Credit Default Swap (CDS) spreads of banks from over 14 countries⁶. This will be followed by a further analysis and comparison of banks' behavior and relevant market prospects across the years.

This topic has become particularly relevant nowadays, as prospects of a new debt crisis rise due to contemporary global circumstances, alongside very low and even negative interest rates. Even despite an unprecedented pace of global debt accumulation since 2016, the trade group Institute of International Finance claims that the coronavirus crisis has pushed global debt levels to a further new high, increasing it by \$15 trillion within 2020 alone. Global debt is also expected to reach over \$277 trillion by the end of 2020, leading to a ratio of global debt to GDP of approximately 365%. Moreover, S&P have suggested that the second wave of this pandemic implies an inherently negative outlook for European banks (S&P Global, 2020), as well as a

² Data retrieved from the IMF.

³ Data retrieved from the IMF.

⁴ Data retrieved from Eurostat.

⁵ There was no market value data available for Latvia, hence its exclusion from our analysis. Moreover, for Bulgaria and Romania the data available starts in 2005, while for Slovenia the data retrieved starts in 2007.

⁶ CDS spread data was only available for 14 out of the 28 EU countries. These include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and United Kingdom.

growing risk of a new sovereign bank “doom loop”⁷. In fact, Eurozone banks have bought €210 billion worth of bonds in European countries where they operate (Martin, 2020), and public debt has increased by \$1.5 trillion (Amaro, 2020) since the start of this health crisis. Such a negative spiral conjures concerns and memories of the period leading to the 2007 to 2009 period of economic instability. The question therefore remains: have banks continued to increase in size while engaging in further risk-taking activities, or have they downsized in order to avoid another systemic crisis?

We will demonstrate in our work evidence suggesting that following the financial crisis, banks and the market itself came to realize the reality of the systemic size trap and its consequent TBTS conundrum. Thus, not only did we find that most banks in our sample began to reduce their systemic size (measured by a bank’s liabilities-to-GDP ratio), but also that overall countries’ ratios of banking system liabilities-to-GDP decreased by half between 2009 and 2019. More specifically, from 2009 through 2019, the proportions of banks presenting liabilities exceeding their country’s total GDP decreased from 4.5% to 1.6%. All these findings are consistent with a TBTS effect. Additionally, our results indicate that a bank’s valuation is negatively related to its absolute (measured by the natural logarithm of total assets) and systemic size, further supporting the existence and effect of the TBTS concept. These findings are shown to be robust throughout several tests relating to the role of dynamics in a bank’s valuation and to the definition of the bank systemic size variable. Although most of our regression models concerning bank’s CDS spreads returned non-significant relations, there was one relevant exception that was consistent with a TBTS effect – CDS spreads seemingly increase in a dynamic market response to changes in a bank’s absolute size.

In our analysis we also found that although a bank’s valuation is reduced by its systemic size, this impact seems to be less steep for risky and highly leveraged banks. This result can perhaps serve as evidence for an opposing TBTF effect, as it possibly indicates some market actors remain confident that governments are willing and able to bail out these systemically larger banks.

This dissertation is divided into different sections. Section 2 summarizes previous literature specifically addressing the TBTF concept, while section 3 discusses the data and variables used within our analysis. Section 4 outlines our empirical work and the results we have obtained, and finally section 5 concludes the dissertation while offering suggestions and possible avenues of research for future studies.

⁷ A negative spiral that can occur when banks hold a large portion of sovereign debt and governments with weak public finances are then forced to bail out these banks.

2. Literature review

The study of the effect of TBTF status on wealth creation for bank shareholders has been home to a body of literature well before the advent of this contemporary health crisis, as exemplified in O'Hara & Shaw's 1990 paper. Through the use of an event study methodology, they analyzed the impact the announcement of the US Comptroller of the Currency in 1984 had by stating that the largest banks deemed TBTF would receive total deposit insurance. They indicate that it led to positive wealth effects for those large banks (increased bank equity values), while negative effects were accrued to smaller banks. Moreover, there were also other works within the literature which examined the relationship between a bank's funding cost and its level of risk. Besides the risk-sensitivity pricing that is expected to be reflected on spreads, these studies focus on the role that implicit government support has on this relationship for larger banks. The works of Flannery & Sorescu (1996) and Sironi (2003), studied yield spreads on subordinated debt in the US and Europe respectively and for different time periods, with both studies reaching a similar conclusion. They found that yield spreads were less risk-sensitive to bank-specific risks during those timeframes in which the perception of implicit government guarantees increased due to stated legislation, and became more risk-sensitive during periods of a perceived reduction in the application of TBTF policies⁸.

The literature has only developed further since the recent financial crisis, with new studies attempting to better understand how markets react to the perception of a bank's TBTF status, and consequently the way investors price these banks' funding costs. Acharya, Anginer, & Warburton (2013) found that bondholders of the largest banks in the US, between the period of 1990 and 2011, have an expectation that the government will protect them from losses, leading to less accurate risk pricing. More specifically, this paper reveals a positive risk-to-spread relationship for small and medium size institutions. This relationship, however, is not present for the largest financial institutions, although the latter may be as risky or riskier than their smaller counterparties. These results stand even after the passage of the Dodd-Frank Act (2010). Their paper concludes by estimating the implicit subsidy given by the government to large financial institutions on an average of \$30 billion per year⁹, which rose to above \$100 billion

⁸ For instance, in the US, the formalization of a TBTF policy by the Comptroller of the Currency in 1984 increased this perception, which led yield spreads to be less risk sensitive to bank-specific risks. Almost a decade later, in 1991, the Federal Deposit Insurance Corporation Improvement Act reversed this legislation, which decreased such positive perception as regulators reduced the protection given to large banks by a country's safety net.

⁹ Acharya, Anginer, & Warburton (2013) achieve this annual dollar amount by multiplying the reduction in funding costs by the average total uninsured liabilities (in millions of US dollars).

during the financial crisis. Santos (2014) also corroborated the hypothesis that investors believed the major financial institutions in the US to be TBTF from 1985 through 2009. Some papers demonstrate this through evidence of government subsidies in bond spreads. Santos, however, proves that the largest banks have a relatively greater cost advantage than their smaller counterparts by analyzing the benefits accrued by banks when raising capital in the bond market. Demirguc-Kunt & Huizinga (2013) also analyses TBTF effects in a different approach, by investigating the impact of a bank's systemic size and government deficits on both bank stock prices, and CDS spreads. Hence, for an international sample of financial institutions, this paper shows that in countries with deteriorating public finances, systemically large banks could increase their book-to-market-value by downsizing (TBTS effect). Moreover, in countries with stronger finances, an increase in a bank's systemic size (measured by the bank's liabilities-to-GDP ratio) and risk, tends to lead to a lower CDS spread (TBTF status). Thus, it follows that systemically important financial institutions could increase their value by downsizing. This is particularly applicable to countries with weaker public finances as where limited ability to perform large rescues limits net subsidies to the banking sector.

Furthermore, yet another set of literature has demonstrated that banks deemed to be TBTF proceed to engage in morally hazardous behavior, increasing their risk taking activities with the expectation of government bailouts. These are particularly relevant as they provide evidence that TBTF status influences the policies of financial institutions. Some studies demonstrate this effect by looking at banks' balance-sheet data (Farhi & Tirole, 2012; Gropp, Hakenes, & Schnabel, 2011), others do so through the syndicated loans market (Gadanecz, Tsatsaronis, & Altunbas, 2012), and yet others observe banks' z-scores (Brandão-Marques, Correa, & Sapriza, 2013). Afonso, Santos, & Traina (2014) in particular, study this issue by looking specifically at banks classified by rating agencies as likely to receive sovereign support, and use several measures for bank risk. This paper differentiated itself from previous ones in the way it measured the likelihood of a bank receiving sovereign support, calculating this likelihood by using Fitch's support rating floors (SRFs), which became available from March 2007 onward. Their study concludes that a greater likelihood of government support does lead to an increase in a bank's risk taking. Nevertheless, this conclusion is far from unanimous as there are other sets of literature which conclude that banks reduce their risk taking activities in the presence of sovereign support (Gropp & Vesala, 2004; Kacperczyk & Schnabl, 2011).

Finally, Barth & Wihlborg more recent 2016 study on the TBTF and TBTS dilemma after

the financial crisis, sought to analyze the largest worldwide banks¹⁰ from 1984 to 2015. The different dimensions of TBTF in their paper are identified, as well as the link between a bank's systemic risk and its complexity. In fact, their study suggests that absolute and relative size are not the only contributors to the TBTF status, high complexity plays an important role, as it is found to be associated with relatively high bank risk and systemic risk. Barth & Wihlborg further evaluate several proposed reforms established after the financial crisis, stating that although several policy improvements have been made and many are still being developed, they may be insufficient as a solution to the TBTF issue. Moreover, other papers have also focused on developing key determinants of systemic risk as a means of recommending other policy requirements for banks. The work of Laeven, Ratnovski, & Tong (2016) for instance, finds that systemic risk rises with absolute bank size (measured by the natural logarithm of total assets) and is inversely related to bank capital. Additionally, Varotto & Zhao (2018) observe that while firm size can lead to systemic risk, smaller banks can still pose considerable systemic threats. Hence, it proposes standardized systemic risk measures, which allow key non-size risk factors to be brought into view. For instance, factors such as interconnectedness and default risk, could be valuable contributors to the existing traditional risk indicators in Basel III for the recognition of systemically important banks.

3. Data

This section describes the data used to conduct the analysis for this study.

3.1 Bank and country variables

In this dissertation, I use bank data from the EU over the 2001-2019 period, and specifically a sample of 471 unique banks across 27 countries. This sample only includes publicly listed banks for two main reasons. Firstly, because the majority of the largest banks tend to be publicly traded, and secondly, to ensure consistent data quality while facilitating cross-country comparison. Moreover, we excluded any bank characterized as multi-lateral governmental banks or specialized government credit institutions¹¹.

¹⁰ For that purpose it considered a sample of the 100 biggest publicly traded banks in the world by their total assets.

¹¹ We excluded these banks from our analysis since they are expected to follow stricter policies, as they respond to the government itself, limiting their freedom to engage in more risk taking activities. Moreover, these banks have a considerable governmental influence and thus are the ones who most likely will be bailed out in case of default. Finally, these banks were also excluded because their primary target is usually not profit generation, like other non-governmental banks.

In this study, I analyze two dependent variables in order to garner the impact of a bank's size, both absolute and relative, on them. The first is a proxy for a bank's market valuation. We calculated a market-to-book ratio by dividing the market value of the bank's common equity by the book value of common equity. Note that the market value of a bank's common equity was retrieved from Datastream, while the book value of common equity was from Compustat Global. This *Market-to-book* variable is intended to reflect the benefits or costs of systemic bank size for that bank's shareholders. If a bank is considered TBTF, then its bank valuation should be high, reflecting benefits for its shareholders. Conversely, if it is considered TBTS, then its bank valuation should be lower. The *Market-to-book* variable has a mean of 1.202 in the overall sample, with only 10% of the values being higher than 2.415, as shown in Table 1.

Table 1: Summary statistics on bank and country variables

Variable	Obs	Mean	Std. Dev.	Min	P10	P90	Max
Market-to-book	5 756	1.202	2.602	0	0	2.415	88.038
CDS spreads	459	0.018	0.026	0.001	0.002	0.04	0.18
Assets	5 891	8.473	3.142	0.087	4.086	12.437	14.969
Liabilities	5 958	0.126	0.304	0	0	0.389	3.383
Sum liabilities	5 958	1.903	1.071	0	0.521	3.211	5.297
Other liabilities	5 958	1.776	1.057	0	0.442	2.995	4.968
Liabilities sq	5 958	0.108	0.539	0	0	0.152	11.443
Big 0.1	5 958	0.231	0.421	0	0	1	1
Big 0.25	5 958	0.139	0.346	0	0	1	1
Big 0.5	5 958	0.079	0.27	0	0	0	1
Big 1	5 958	0.026	0.159	0	0	0	1
Bank asset risk	4 755	0.187	3.078	0	0	0.153	177.449
Leverage	5 941	0.886	0.948	0.001	0.648	0.966	38.059
Leverage other banks	5 922	0.936	0.032	0.114	0.890	0.967	1.027
Fee income	5 300	0.615	0.881	0	0	1.388	9.906
Pre-tax profits	5 941	-0.012	0.408	-16.319	-0.015	0.035	3.092
GDP per capita	5 958	30.298	12.872	4.558	10.606	44.327	103.132
Real GDP growth	5 958	1.741	2.577	-14.814	-0.714	4.179	25.163
Deposit market share	5 953	0.084	0.169	0	0	0.284	1

This table contains summary statistics for all variables. Market-to-book stands for the market value of common equity divided by the book value of common equity. CDS spreads is the annual average of daily credit default spreads for 5-year contracts. Assets is a natural logarithm of total assets in constant 2010 euros. Liabilities is total bank liabilities divided by GDP. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Other liabilities is the sum of total liabilities of other banks in a country divided by GDP. Liabilities sq is the square ratio of total bank liabilities to GDP. Big 0.1, Big 0.25, Big 0.5, and Big 1 are dummy variables that equal 1 if the liabilities to GDP ratio is greater than or equal to 0.1, 0.25, 0.5, and 1 respectively, while otherwise they equal 0. Bank asset risk is the annualized standard deviation of weekly dividend-inclusive bank stock returns times the ratio of the market value of common equity to the book value of assets. Leverage is total liabilities divided by total assets. Leverage other banks is the weighted average of total assets of total liabilities, divided by the assets of other banks in a country. Fee income is the share of non-interest income in total operating income. Pre-tax profits represents pre-tax profits divided by total assets. GDP per capita is constituted by GDP per capita in constant 2010 euros. Real GDP growth is the GDP growth rate in real terms in percentage. Deposit market share stands for the deposits of a bank divided by total deposits in the national banking system.

The second dependent variable in this dissertation is a bank's CDS spread. Credit Default Swaps are credit derivative contracts which allow investors to offset their credit risk with a counterpart. Within this context, a CDS's buyer has to make payments – the CDS spread – to the seller until the maturity date of the contract, while the CDS's seller has the obligation to compensate the buyer by purchasing defined bank liabilities at par in case the debt issuer experiences a bank credit event, as stated in the CDS contract. The CDS spread thus provides us with a direct market indicator of expected credit losses on bank liabilities. In order to compute this variable we rely upon Bloomberg's CDS data to construct a bank's yearly CDS spread as the average of daily CDS spreads, on the condition that there are, at least, 100 daily CDS spreads. Although generally, many CDS contracts are traded for any large bank differing in the duration of the contract and in the designation of the deliverable bank liabilities, we undertook to specifically consider 5-year CDS contracts, following on the steps of Jorion & Zhang (2007) and Demirguc-Kunt & Huizinga (2013). These type of contracts are the most frequently traded and the most liquid, leading to our decision to focus on them.

Although CDS spreads and bond yield spreads both measure equivalent credit risk, I chose to use the first as they diverge in certain aspects which allow CDS spreads to better reflect available information on future credit losses. When considering the terms of macro factors for instance, the majority of CDS spread is due to default risk, while bond yield spreads also include a liquidity component (Longstaff, Mithal, & Neis, 2005). As for specific credit factors, CDS spreads are usually able to anticipate debt downgrades (Finnerty, Miller, & Chen, 2013; Norden & Weber, 2004), tend to reflect insider information (Acharya & Johnson, 2007) while CDS markets also serve as the primary source of price discovery (Blanco, Brennan, & Marsh, 2005; Lee, Naranjo, & Velioglu, 2018; Norden & Weber, 2009). More specifically, Knaup & Wagner (2012) demonstrate that the correlation between bank stock returns and an index of corporate CDS spreads serves as a good indicator of overall bank asset risk exposure during the financial crisis of 2007-2008.

In the empirical work, we have CDS spreads from 2001 to 2019 across 14 countries, with CDS spreads available for 39 banks in 2010 and 2013, as seen in Table 2. From this Table, we can also gather that the mean CDS spread per year has been extremely low, and particularly until 2007, reaching a minimum of 0.113% in 2006. The years following 2007 saw a slight increase, reaching a peak in 2012 of 4.621%.

Table 2: Summary statistics for 5-year CDS spreads by year

Year	N	Mean	Std. Dev.	Min	Max
2001	5	.00284	.00095	.00209	.00393
2002	12	.00421	.00144	.00221	.0063
2003	17	.00299	.00204	.00155	.01047
2004	20	.00171	.00037	.00117	.00248
2005	23	.00144	.00037	.00093	.00253
2006	20	.00113	.00048	.00066	.00294
2007	26	.00347	.00265	.00146	.01213
2008	35	.01418	.01116	.00609	.06465
2009	36	.01748	.01377	.00567	.06643
2010	39	.02072	.01745	.00604	.08244
2011	34	.0383	.0378	.00855	.1443
2012	37	.04621	.04331	.01082	.18026
2013	39	.03293	.03245	.00693	.14563
2014	15	.0126	.00758	.00684	.03185
2015	15	.01328	.01045	.00561	.04071
2016	20	.02619	.03474	.00626	.1354
2017	19	.01478	.02244	.00399	.10225
2018	26	.01128	.01595	.00277	.08696
2019	21	.01068	.01781	.00287	.08678

This table presents summary statistics for 5-year CDS spreads by year between 2001 and 2019.

Our analysis further includes several bank-level and country-level variables, all of which are included in the summary statistics for Table 1¹². Starting with the independent variables, *Assets* is a proxy for a bank's absolute size with a mean of 8.473. This variable is the natural logarithm of total bank assets in millions, in constant 2010 euros. A measure of bank size can be relevant to bank shareholders and debtholders, due to its effect on economies (or diseconomies) of scale. Furthermore, a bank's absolute size, independently of its relative size to the national economy, can also influence its expected access to a country's safety net due to a possible TFTF status.

In order to evaluate a bank's systemic size, we computed the ratio of a bank's total liabilities to national GDP – resulting in our *Liabilities* variable. Total liabilities are considered instead of just insured deposits given that in practice, most if not all liabilities are typically honored in a bank rescue. This variable returned a mean of 12.6%. The *Sum liabilities* variable is the sum of total liabilities of all the banks in a country divided by the country's GDP per year. This variable serves as a proxy for a country's banking system size with a mean of 1.903. As for

¹² Note that all accounting data within this dissertation was sourced from Compustat's Global database, while country specific information was retrieved from the World Bank database (see Appendix 1 for all variable definitions and respective data sources). Moreover, most values are published in their national currencies and were converted to euros using the World Market Reuters (WMR) exchange rates.

Other liabilities, it represents the difference between the *Sum liabilities* and each individual bank's own *Liabilities*, while *Liabilities sq* simply refers to the square of the *Liabilities* variable. The latter is included to allow nonlinear relationships between bank valuation and CDS spreads with bank systemic size. Additionally, we have applied a series of dummy variables as indicators of systemic size, namely *Big 0.1*, *Big 0.25*, *Big 0.5* and *Big 1*. Considering *Big 0.1* for instance, it equals 1 if a bank's total liabilities exceed 10% of GDP and it equals zero otherwise. The other three dummy variables are constructed in the same manner. Looking at Table 1 we can see, for example, 23.1% of banks in our overall sample possess a liabilities to GDP ratio exceeding 0.1, with only 2.6% of banks having liabilities that exceed 100% of GDP.

For the purposes of measuring bank risk, we use the *Bank asset risk* variable as the annualized standard deviation of weekly bank stock returns multiplied by the ratio of the market value of common equity to the book value of total bank assets. This variable returns a mean value of 0.187.

As for bank-level control variables, I computed the *Leverage* variable as the ratio of total bank liabilities to total assets, with a mean of 0.886. Both *Leverage* and *Bank asset risk* variables enable us to determine the probability of default and expected credit losses on bank liabilities. Therefore, *Leverage* may be positively related to the CDS spread, if the evidence suggests that high leverage leads to relatively large potential losses for bank debtholders. As for the market-to-book ratio, it can be negatively or positively impacted by a high *Leverage* variable. This impact will be positive if the bank is deemed TBTF, and is thus entitled to higher implicit subsidies from the financial safety net or because of the tax deductibility of interest payments from a corporate tax base. Conversely, it could be negatively affected since higher leverage might lead to higher bankruptcy costs. Our *Leverage other banks* variable is the assets-weighted leverage ratio of other banks in a country, with a mean of 0.936. This controls for the well-being of other banks in a country, which can help understand if a "too many to fail" phenomenon¹³ is present. In these cases, leverage of other banks may negatively impact a bank's valuation and positively affect CDS spreads, as the government does not have the resources to bail out many failing banks at the same time.

Furthermore, *Fee income* variable is the share of non-interest income within the total operating income, with an overall sample mean of 61.5%. When a bank returns a high figure

¹³ According to Brown & Dinç (2011), although a government is more likely to take over or even close a bank if its capital ratio is low, such action is less likely if other banks in the country are similarly highly leveraged. Their paper suggests this could be evidence of a "too many to fail" effect, as governments are unable to rescue a significant number of distressed banks simultaneously.

for this variable, it can suggest that a big part of its income is derived from fee-generating activities such as brokering securities, offering advisory services, and trading stocks and bonds; instead of traditional banking activities. Non-interest income may play an important role in a bank's overall profitability, and particularly so during times of very low interest rates, as has been largely the case since the financial crisis, contributing positively to the market-to-book ratio. However, the *Fee income* effect on the CDS spread can be negative. Lastly, we included *Pre-tax profits* as an additional bank-level control variable, characterized as the ratio of a bank's pre-tax profit to total assets. Banks which experience higher profitability tend to have a higher market valuation.

For our purposes, macroeconomic control variables such as *GDP per capita* provides a measure of overall economic development, while the rate of *Real GDP growth* serves as a proxy for bank growth opportunities, with means of 30.298, and 1.741 respectively. If a bank has high growth opportunities, one can reasonably suspect it to receive a higher bank valuation along with a lower CDS spread, as it can be expected to increase its business and profits in the near future. In this dissertation we also included a *Deposit market share* variable, defined as a bank's market share in the national deposit market, with a mean of 8.4%. A high value for this variable is likely to increase the market-to-book ratio and decrease the CDS spreads. Comparing to other banks, the ones that have a greater portion of the total deposits in their country, have a bigger amount of cheap funding sources, which can facilitate their lending activities and thus their profit generation.

One should note that for many variables, such as *Market-to-book*, *Bank asset risk*, and *Leverage*, there are several evident outliers in the sample, as can be seen in Table 1 by comparing the 90th percentiles with the respective maximum values.

4. Empirical evidence on too big to fail versus too big to save

This section will outline the empirical work carried out for the purposes of our study. The first subsection will outline the evolution of systemically large banks across the European Union in order to identify any specific changes or trends in the aftermath of the financial crisis of 2007-2009. We further analyze the impact which bank size¹⁴ has on a bank's valuation and CDS spreads by categorizing banks as too big to fail or too big to save, before presenting our main empirical results alongside robustness checks.

¹⁴ Both in absolute and in relative terms to the national economy.

4.1 The evolution of systemically large banks across Europe

For our purposes, *Liabilities* will serve as the primary variable we will rely upon to assess systemically large banks across Europe throughout the entire period of the dataset, given its role as a proxy for systemic size, which is itself a prime indicator of systemic risk. Such systemically important banks are more likely to cause the collapse of the entire financial system if they fail.

Table 3: Systemically large banks throughout the entire data period

Bank name	Country	Year	Max Liabilities	Absolute liabilities (in billions of euros)
NORDEA BANK ABP	Finland	2011	3.383	690
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	2009	2.257	79
BNP PARIBAS FORTIS SA	Belgium	2007	2.197	733
CYPRUS POPULAR BANK PCL	Cyprus	2009	2.165	38
BANK OF CYPRUS HOLDINGS PLC	Cyprus	2010	2.155	40
ING GROEP NV	Netherlands	2007	2.116	1 273
DANSKE BANK AS	Denmark	2007	1.921	435
DEXIA SA	Belgium	2007	1.762	588
ABN-AMRO HOLDINGS NV	Netherlands	2007	1.652	994
FORTIS BANQUE LUXEMBOURG SA	Luxembourg	2001	1.627	38
ROYAL BANK OF SCOTLAND GROUP	United Kingdom	2008	1.368	2 929
DEPFA BANK PLC	Ireland	2009	1.318	211
KREDIETBANK SA LUXEMBOURG	Luxembourg	2001	1.283	30
BANCO SANTANDER SA	Spain	2017	1.196	1 337
BARCLAYS PLC	United Kingdom	2008	1.183	2 533
BANK OF IRELAND GROUP PLC	Ireland	2009	1.091	175
BNP PARIBAS	France	2009	1.085	1 977
AIB GROUP PLC	Ireland	2009	1.018	163
KBC GROUP NV	Belgium	2007	1.010	337
BANK OF VALLETTA LTD	Malta	2009	1.000	6
BANK OF GREECE	Greece	2015	0.940	163
HSBC HLDGS PLC	United Kingdom	2010	0.929	1 651
CREDIT AGRICOLE SA	France	2012	0.864	1 797
HSBC BANK MALTA PLC	Malta	2010	0.849	5
DEUTSCHE BANK AG	Germany	2007	0.816	1 982
HANSABANK	Estonia	2004	0.756	7
SKANDINAVISKA ENSKILDA BANK	Sweden	2009	0.725	215
UNICREDIT BANK AUSTRIA AG	Austria	2001	0.714	154
HELLENIC BANK	Cyprus	2018	0.703	15
ERSTE GROUP BK AG	Austria	2007	0.685	189
SVENSKA HANDELSBANKEN	Sweden	2009	0.670	198
BBVA	Spain	2015	0.660	695
LLOYDS BANKING GROUP PLC	United Kingdom	2009	0.650	1 061
ABN AMRO BANK NV	Netherlands	2009	0.642	378
UNICREDIT SPA	Italy	2007	0.611	959
SOCIETE GENERALE GROUP	France	2016	0.595	1 317
NATIONAL BANK OF GREECE	Greece	2015	0.586	101
SWEDBANK AB	Sweden	2009	0.560	166
BANCO COMERCIAL PORTUGUES SA	Portugal	2010	0.543	93
NOVA LJUBLJANSKA BANKA	Slovenia	2009	0.538	18
ANGLO IRISH BANK CORP	Ireland	2009	0.506	81

This table lists banks with liabilities in excess of half of their respective country's GDP. Max liabilities represents the maximum value of the liabilities-to-GDP ratio reached by each of the banks throughout our relevant timeframe. Absolute liabilities stands for bank liabilities in billions of euros.

Forty-one publicly listed banks in the European Union with a liabilities-to-GDP ratio exceeding 0.5 have been outlined in Table 3, showing the year they achieved their maximum level of systemic size. The years with more banks achieving their maximum *Liabilities* value were 2009 with 14 banks, and 2007 with 9 banks. This same trend is repeated if we restrict our analysis to banks presenting a liabilities-to-GDP ratio exceeding one (of a total of 20 banks, 7 were in 2009 and 6 in 2007). It thus becomes clear that the period of the most recent financial crisis corresponds to a period where banks were systemically larger, and their systemic size has been decreasing since. By 2019, the highest liabilities-to-GDP ratio was 2.1, with only 4 banks presenting a ratio exceeding one (Appendix 2).

Among these systemically large banks, Nordea, a Finnish bank, had the highest liabilities-to-GDP ratio in our sample, at 3.4 in 2011, followed by Espírito Santo in Luxembourg with a ratio of 2.3 in 2009, and BNP Paribas Fortis in Belgium with a ratio of 2.2 in 2007. Note that, the Nordea Bank in Finland, the ING in the Netherlands, and the Danske Bank in Denmark, were always among the top 6 banks in the European Union in terms of liabilities-to-GDP ratios, both throughout the financial crisis and since (Appendix 2). Table 3 also reveals that the largest banks do not necessarily correspond to those with the highest values of absolute liabilities. When considering that specific criteria, the largest banks are the Royal Bank of Scotland, and Barclays in the United Kingdom, with liabilities exceeding 2.5 trillion euros in 2008, and the Deutsche Bank in Germany with liabilities of 1.98 trillion euros in 2007.

Table 4 presents additional information on the distribution of systemically important banks per country, enabling a comparison between 2009 and 2019, and thus a cross analysis of the height of the financial crisis with its aftermath. Columns (1) and (2) of this table present information on each country's banking system size and on the largest bank's liabilities relative to GDP. Column (3) indicates the total number of publicly listed banks in 2009 and 2019, with the remaining columns displaying the number of banks that are systemically large in relation to their liabilities-to-GDP ratios, when they exceed 0.1, 0.25, 0.5, and 1, respectively.

Table 4: Systemically large banks by country in 2009 and 2019

Country	Sum liabilities		Max of liabilities		Nr of banks		N° of banks with liabilities \geq 0.1		N° of banks with liabilities \geq 0.25		N° of banks with liabilities \geq 0.5		N° of banks with liabilities \geq 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	2009	2019	2009	2019	2009	2019	2009	2019	2009	2019	2009	2019	2009	2019
Austria	2.203	1.437	0.684	0.554	12	10	6	4	3	2	2	1	0	0
Belgium	4.250	1.747	1.734	0.591	4	4	4	4	4	3	3	2	2	0
Bulgaria	0.086	0.092	0.054	0.080	3	2	0	0	0	0	0	0	0	0
Croatia	0.808	0.801	0.299	0.310	14	10	3	3	1	1	0	0	0	0
Cyprus	4.743	1.826	2.165	0.842	6	4	3	3	3	3	2	2	2	0
Czech Republic	0.207	0.201	0.175	0.168	2	2	1	1	0	0	0	0	0	0
Denmark	2.235	1.918	1.850	1.517	39	21	2	2	1	2	1	1	1	1
Estonia	0.003	0.099	0.003	0.099	1	1	0	0	0	0	0	0	0	0
Finland	3.108	2.476	2.835	2.138	5	6	2	2	1	2	1	1	1	1
France	2.965	2.539	1.085	0.830	27	20	5	5	3	3	3	3	1	0
Germany	2.706	1.163	0.635	0.353	41	29	10	4	2	1	1	0	0	0
Greece	2.194	1.764	0.463	0.568	12	6	7	5	4	5	0	1	0	0
Hungary	0.388	0.364	0.357	0.364	2	1	1	1	1	1	0	0	0	0
Ireland	4.420	0.656	1.318	0.343	5	4	5	2	5	1	4	0	3	0
Italy	1.920	1.263	0.583	0.436	31	25	4	2	3	2	1	0	0	0
Lithuania	0.293	0.044	0.131	0.044	4	1	1	0	0	0	0	0	0	0
Luxembourg	2.257	0.004	2.257	0.004	1	1	1	0	1	0	1	0	1	0
Malta	1.983	1.461	1.000	0.837	4	4	2	3	2	2	2	1	1	0
Netherlands	3.423	1.511	1.909	1.011	6	5	3	2	3	2	3	1	1	1
Poland	0.500	0.575	0.107	0.131	32	26	1	1	0	0	0	0	0	0
Portugal	1.527	0.549	0.535	0.343	7	3	3	2	3	1	1	0	0	0
Romania	0.135	0.127	0.091	0.078	3	3	0	0	0	0	0	0	0	0
Slovak Republic	0.390	0.359	0.147	0.167	5	4	2	2	0	0	0	0	0	0
Slovenia	0.853	0.409	0.538	0.254	4	3	3	1	1	1	1	0	0	0
Spain	2.346	2.367	1.030	1.112	13	9	5	5	2	3	2	2	1	1
Sweden	1.956	1.513	0.725	0.551	6	8	3	3	3	3	3	2	0	0
United Kingdom	4.890	2.727	1.059	0.892	45	36	9	8	5	4	4	1	1	0
Total					334	248	86	65	51	42	35	18	15	4

This table provides information on the size and the number of large banks for each country. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Max of liabilities represents the maximum value of any bank's liabilities divided by GDP. N° of banks with liabilities \geq 0.1 stands for the number of banks with a liabilities-to-GDP ratio exceeding 0.1, and the next columns show the number of banks with a liabilities-to-GDP ratio exceeding 0.25, 0.5, and 1, respectively.

From this table it becomes evident that the largest ratios of banking system total liabilities to GDP in 2009, were almost double those of 2019. The United Kingdom possessed the highest ratio in both years, returning 4.890 in 2009, and 2.727 in 2019. This trend is followed by the top 5 countries with the largest sum of bank liabilities to GDP in 2009 consistently returning ratios above 3, while in 2019, only the top 4 countries presented ratios above 2.

Table 4 also demonstrates that the number of banks in the EU decreased 26% between 2009 and 2019, as per our overall sample. In terms of the proportion of banks with liabilities exceeding 10% and 25% of GDP, a slight increase is evident, whereas for banks with liabilities exceeding 50% and 100% of GDP, the opposite appears to be true. For instance, the proportion of banks that had liabilities exceeding their country's GDP in 2009 was 4.5%, while in 2019 it was just 1.6%.

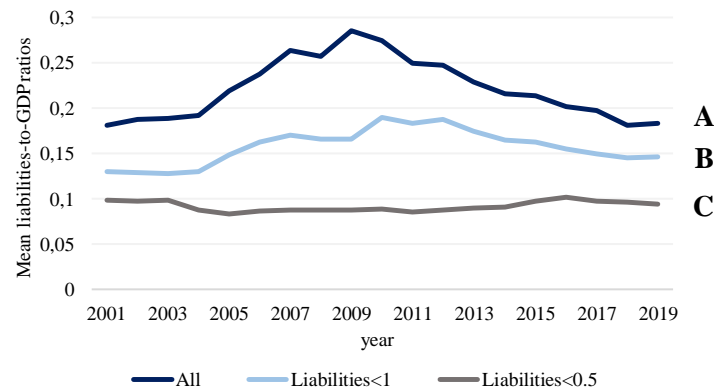
However, it is clear throughout both timeframes that some countries have highly concentrated banking systems with very large banks relative to GDP. Belgium is a prime example, with 4 publicly listed banks in both years, with two possessing liabilities exceeding the total GDP in 2009, and with two having liabilities that exceed half of the total GDP in 2019. The Netherlands is in a similar position, with 6 banks in 2009, and 5 banks in 2019, with both years also revealing one bank with liabilities exceeding the total GDP. Nevertheless, there are also other countries with highly concentrated banking systems, but with few large banks relative to GDP in 2009, which drastically decreased in size until 2019. Ireland for instance, had 5 publicly listed banks in 2009, three of which possessed liabilities exceeding the total GDP, by 2019 however, it possessed only 4 banks, with only one having liabilities exceeding 25% of GDP. A similar trend took place in Luxembourg, with both years returning just a single bank, which in 2009 had liabilities that exceeding GDP, but which by 2019, failed to exceed even 10% of the total GDP.

At the other extreme, there are also some countries with highly dispersed banking systems and very few large banks relative to GDP. The United Kingdom had 45 banks in 2009, and 36 banks in 2019, but for both years 9 and 8 of those banks, respectively, contained liabilities exceeding 10% of GDP. Denmark serves as another prime example of this reverse trend, with 39 banks in 2009, and 21 banks in 2019, with only two of these in both years, possessing liabilities that exceeded 10% of GDP.

The significant size of many countries' largest banks in 2009 demonstrates that several bank's liabilities grew faster than GDP until the financial crisis, before decreasing in its aftermath. This could suggest that until the crisis, banks were confident of their TBTF status, with the implication that governments would always be able and willing to bail them out. The events that followed revealed to several that they were in reality, TBTS, and hence began to decrease their liabilities.

For the purposes of further analysis of this phenomena, Figure 1 below exhibits the mean value of the *Liabilities* variable for each year in the 2001-2019 period for those banks present in our sample throughout this entire timeframe. Line A simply shows the mean values of the liabilities-to-GDP ratio each year, while Line B and Line C present mean values for the *Liabilities* variable for banks with liability levels below GDP, and banks with levels of liabilities below half of GDP, respectively, per year.

Figure 1: Mean liabilities-to-GDP ratios during 2001-2019



This figure presents yearly mean liabilities-to-GDP ratios for the 144 banks that existed during the entire 2001-2019 period. It provides mean ratios for the overall sample (line A), and furthermore, specifically for those banks that have liabilities-to-GDP ratios below 1 (line B), and below 0.5 (line C).

From the comparison of the three lines, it is possible to see that there are significant effects to be derived from the inclusion and exclusion of systemically larger banks. Indeed, a visual analysis of line C makes it evident that that systemically smaller banks with liabilities-to-GDP ratios below 0.5, show very little variation within our timeframe, whereas when we include systemically larger banks in our sample, variability increases. Although more prominent when we also consider banks with liabilities exceeding the total GDP, both lines A and B reveal a similar trend. The mean *Liabilities* variable experiences an increase until 2009-2010, despite a slight drop in 2008 across both lines, before a consistent decrease in the years since. Note that for line A, the mean value reached its peak in 2009 with a ratio of 0.29, while for line B, the peak was reaching in 2010 with a mean ratio of 0.19. This clear decline in average systemic size following the financial crisis, when we include the systemically larger banks in our sample, is consistent with the view that these banks were becoming too big to save.

In the final part of this subsection, Table 5 provides further insight into our analytical comparison of systemically large and small banks. For this purpose, table 5 shows two panels, one for 2009, and another for 2019, presenting the means of the set of variables separately for banks with liabilities exceeding half of GDP – the systemically larger banks – and for banks with a liabilities-to-GDP ratio below 0.5 – the systemically smaller banks.

Table 5: Systemically large and small banks during and after the financial crisis

Variables	Total		Liabilities<0.5		Liabilities≥0.5		Mean comparison test t-Statistics
	N	Mean	N	Mean	N	Mean	
Panel A: 2009							
Market-to-book	324	0.930	290	0.928	34	0.954	-0.079
CDS spreads	36	0.017	18	0.022	18	0.013	2.160
Assets	329	8.442	294	7.951	35	12.571	-8.856
Bank asset risk	265	0.116	236	0.128	29	0.016	1.116
Leverage	333	0.872	298	0.863	35	0.950	-1.931
Leverage other banks	332	0.937	298	0.936	34	0.948	-2.103
Fee income	289	0.550	256	0.536	33	0.660	-0.680
Pre-tax profits	333	0.002	298	0.002	35	-0.003	0.253
GDP per capita	334	23.928	299	23.367	35	28.712	-3.113
Real GDP growth	334	-4.093	299	-4.107	35	-3.972	-0.266
Deposit market share	334	0.081	299	0.050	35	0.348	-12.169
Liabilities	334	0.158	299	0.052	35	1.066	-27.024
Sum liabilities	334	2.434	299	2.344	35	3.205	-3.547
Other liabilities	334	2.276	299	2.292	35	2.139	0.630
Liabilities sq	334	0.165	299	0.011	35	1.482	-14.441
Big 0.1	334	0.257	299	0.171	35	1	-13.007
Big 0.25	334	0.153	299	0.054	35	1	-24.806
Big 1	334	0.045	299	0	35	0.429	-14.930
Panel B: 2019							
Market-to-book	241	0.863	224	0.879	17	0.642	0.800
CDS spreads	21	0.011	16	0.012	5	0.005	0.793
Assets	247	8.926	229	8.637	18	12.611	-5.781
Bank asset risk	222	0.061	206	0.065	16	0.010	1.140
Leverage	248	0.879	230	0.874	18	0.936	-0.515
Leverage other banks	244	0.925	226	0.925	18	0.926	-0.219
Fee income	228	0.742	210	0.744	18	0.725	0.108
Pre-tax profits	248	0.003	230	0.003	18	0.006	-0.131
GDP per capita	248	36.600	230	36.327	18	40.086	-1.051
Real GDP growth	248	1.946	230	1.948	18	1.921	0.086
Deposit market share	248	0.109	230	0.086	18	0.407	-7.165
Liabilities	248	0.121	230	0.066	18	0.828	-20.424
Sum liabilities	248	1.560	230	1.526	18	1.990	-2.384
Other liabilities	248	1.439	230	1.461	18	1.162	1.510
Liabilities sq	248	0.077	230	0.016	18	0.852	-12.198
Big 0.1	248	0.262	230	0.204	18	1	-8.338
Big 0.25	248	0.169	230	0.104	18	1	-12.380
Big 1	248	0.016	230	0	18	0.222	-8.074

This table lists variable means for all banks, while distinguishing between banks with a liabilities-to-GDP ratio below 0.5, and those with a liabilities-to-GDP ratio equal or above 0.5. The last column presents the t-statistics for the mean comparison tests of systemically large and small banks. Market-to-book stands for the market value of common equity divided by book value of common equity. CDS spreads represents the annual average of daily credit default spreads for 5-year contracts. Assets is the natural logarithm of total assets in constant 2010 euros. Bank asset risk provides us with the annualized standard deviation of weekly dividend-inclusive bank stock returns times the ratio of the market value of common equity to the book value of assets. Leverage serves as the total liabilities divided by total assets. Leverage other banks is the weighted average of total assets of total liabilities, divided by the assets of other banks in a country. Fee income is the share of non-interest income in total operating income. Pre-tax profits represents pre-tax profits divided by total assets. GDP per capita is given in constant 2010 euros. Real GDP growth returns the growth rate in real terms in percentage. Deposit market share provides us with the deposits of a bank divided by total deposits in the national banking system. Liabilities stands for total bank liabilities divided by GDP. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Other liabilities serves as the sum of total liabilities of other banks in a country divided by GDP. Liabilities sq is the square of the ratio of total bank liabilities to GDP. Big 0.1, Big 0.25, and Big 1 are dummy variables which equal 1 if the liabilities to GDP ratio is greater than or equal to 0.1, 0.25, and 1 respectively, and otherwise they equal 0.

Table 5 demonstrates that systemically important banks have significantly higher *Assets* and *Deposit market shares*. However, some other statistically significant differences between systemically large and small banks were clear during 2009. For that particular year, systemically important banks possessed higher *Leverage*, higher *Leverage other banks*, higher *GDP per capita*, but lower *CDS spreads*. This suggests that, despite possessing higher leverage, the market priced their CDS spreads lower, a possible indicator that during the period of the financial crisis, these banks were considered TBTF.

4.2 Determining market-to-book ratios and CDS spreads

4.2.1 Applied data testing for the too big to fail and too big to save concept

This subsection will provide a brief outline of the variables chosen for our TBTF testing. The independent variables in this study can have an interesting impact on a bank's valuation and CDS spreads, and further aid in understanding if a bank is considered by the market as too big to fail or too big to save.

The first variable we chose is *Assets*, because it serves as a measure of a bank's absolute size and can positively affect a bank's market-to-book ratio through economies of scale, diversification advantages, and a possible TBTF status. The latter may impact a bank's valuation, with TBTF status positively influencing expected access to a country's financial safety net, given that failure to do so could lead to catastrophic economic consequences. A TBTF status can also affect a bank's CDS spread, as the risk profile of their liabilities may undergo significant change. As stated in the work of Flannery & Sorescu (1996), a bank's absolute size (measured by the log of total assets) is negatively related to its subordinated debenture yields. Their 1996 paper provides insight into the process by which this relationship takes place, with notable suggestions that banks deemed TBTF by market participants¹⁵ either possess more diversification benefits, or their subordinated debentures trade in more liquid markets.

For our second variables, we chose both *Liabilities* and *Big*, given that they serve as a proxy for systemic size, which is itself a prime indicator of systemic risk, meaning that the state of

¹⁵ Especially during periods where TBTF policies were in place (for instance, after the announcement made by the Comptroller of the Currency in 1984).

banks which are large relative to their national economy, can have a severe impact on that same economy should they fail. Hence, systemically large banks can become TBTF, and consequently, present better bank valuations and lower CDS spreads as market participants believe these banks will always be rescued by the government in situations of financial turmoil. Conversely, a significant systemic size may also lead a bank to being rendered TBTS, should it become so large that its country does not have the resources to bail it out. In such cases, systemically large banks can present lower share prices and higher CDS spreads. Therefore, the impact of systemic size on both bank's valuation and CDS spreads is not linear, being contingent on the relative degree of TBTF versus TBTS effects.

Additionally, we chose to analyze the potential impact of the *Bank asset risk* variable in both a bank's valuation and its CDS spreads. This impact is best seen when together with the *Leverage* variable as they enable us to determine the probability of default and expected credit losses on bank liabilities. Therefore, our analysis includes an interaction term of these variables. This interaction can indicate a higher bank valuation, along with lower CDS spreads, if the banks are thought to be TBTF, since they are considered to have lower costs of access to their country's financial safety net. However, it can also correlate with a reverse effect if banks are instead considered TBTS, as these banks can expect higher bankruptcy costs.

Finally, to have a more direct test of TBTF and TBTS, we include an interaction term of bank risk, leverage, and bank systemic size in a market-to-book specification, as the relationship between bank valuation and bank asset risk may become more strongly positive if banks are systemically larger with a TBTF status. The reverse could also take place, leading to it becoming less positive should they be considered TBTS instead, particularly when compared to systemically smaller banks. I also include this interaction term in a CDS spread specification, as the relationship between CDS spreads and bank risk may be stronger for systemically larger banks if they are deemed TBTS, while appearing lower for those banks if they are deemed TBTF, especially relative to smaller banks.

4.2.2 Empirical results

Table 6 outlines results from our regression models of bank valuation, as measured by market-to-book ratios, shown in columns 1 through 6, along with CDS spreads in columns 7 through 12. The independent variables relied upon throughout these models are absolute size, bank asset risk, individual bank, and banking system size, in addition to several bank-level and

country-level control variables. Bank and yearly fixed effects were also included in all our regressions.

Table 6: Model testing market-to-book ratios and CDS spreads

	Market-to-book						CDS spreads					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Assets	-0.631*** (0.052)	-0.775*** (0.052)	-0.671*** (0.053)	-0.583*** (0.054)	-0.619*** (0.054)	-0.634*** (0.052)	0.001 (0.004)	-0.005 (0.004)	-0.002 (0.004)	-0.004 (0.005)	-0.005 (0.005)	0.002 (0.004)
Bank asset risk	-0.023 (0.292)	0.024 (0.294)	-0.029 (0.291)	-0.023 (0.291)	-0.030 (0.290)	0.161 (0.292)	0.837 (1.198)	0.638 (1.196)	0.829 (1.195)	0.348 (1.222)	0.419 (1.224)	0.214 (1.321)
Leverage	4.672*** (0.402)	5.051*** (0.404)	4.802*** (0.402)	4.625*** (0.402)	4.760*** (0.401)	4.739*** (0.400)	-0.021 (0.060)	-0.018 (0.060)	-0.013 (0.060)	-0.039 (0.060)	-0.030 (0.061)	-0.033 (0.060)
Leverage other banks	4.857*** (1.299)	2.623** (1.316)	3.818*** (1.313)	5.196*** (1.300)	4.111*** (1.312)	4.571*** (1.292)	0.170*** (0.059)	0.131** (0.065)	0.133** (0.064)	0.194*** (0.061)	0.163** (0.067)	0.178*** (0.060)
Fee income	-0.118*** (0.033)	-0.128*** (0.033)	-0.120*** (0.033)	-0.111*** (0.033)	-0.111*** (0.033)	-0.108*** (0.033)	0.003** (0.002)	0.003** (0.002)	0.003** (0.002)	0.003** (0.002)	0.003** (0.002)	0.003** (0.002)
Pre-tax profits	0.171 (0.791)	0.130 (0.796)	0.382 (0.790)	0.217 (0.790)	0.456 (0.788)	0.098 (0.787)	-1.329*** (0.118)	-1.349*** (0.119)	-1.346*** (0.119)	-1.319*** (0.118)	-1.333*** (0.119)	-1.346*** (0.119)
GDP per capita	-0.005 (0.005)	0.006 (0.006)	0.007 (0.006)	-0.007 (0.005)	0.006 (0.006)	-0.005 (0.005)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Real GDP growth	0.040*** (0.010)	0.048*** (0.010)	0.047*** (0.010)	0.037*** (0.010)	0.044*** (0.010)	0.041*** (0.010)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
Deposit market share	-6.394*** (0.651)	-7.599*** (0.629)	-5.845*** (0.659)	-5.860*** (0.666)	-5.180*** (0.677)	-6.336*** (0.647)	0.004 (0.018)	0.012 (0.020)	0.018 (0.020)	-0.002 (0.018)	0.010 (0.021)	0.002 (0.018)
Bank asset risk * Leverage	5.086*** (0.581)	4.933*** (0.585)	5.025*** (0.580)	5.100*** (0.580)	5.036*** (0.578)	4.582*** (0.583)	-1.223 (1.288)	-1.019 (1.286)	-1.227 (1.285)	-0.692 (1.315)	-0.779 (1.317)	-0.478 (1.450)
Liabilities	-1.745*** (0.252)		-1.934*** (0.254)	-3.775*** (0.612)	-4.286*** (0.618)	-2.067*** (0.255)	-0.012 (0.007)		-0.012 (0.007)	0.026 (0.021)	0.020 (0.022)	-0.008 (0.008)
Sum liabilities		0.104* (0.055)						0.002 (0.002)				
Other liabilities			0.277*** (0.058)		0.303*** (0.058)				0.003 (0.002)		0.002 (0.002)	
Liabilities sq				1.097*** (0.301)	1.262*** (0.302)					-0.015* (0.008)	-0.013 (0.008)	
Liabilities * Bank asset risk *						26.720*** (4.104)						-0.199 (0.178)
Constant	-0.937 (1.322)	1.419 (1.307)	-0.642 (1.320)	-1.477 (1.328)	-1.235 (1.325)	-0.727 (1.315)	-0.116 (0.087)	-0.025 (0.090)	-0.067 (0.092)	-0.067 (0.090)	-0.039 (0.094)	-0.117 (0.087)
Observations	4 189	4 189	4 189	4 189	4 189	4 189	380	380	380	380	380	380
R-sq	0.250	0.241	0.254	0.252	0.258	0.258	0.503	0.501	0.506	0.508	0.510	0.505

Twelve regression models are presented here, with the market-to-book ratio and CDS spreads serving as our dependent variables for columns 1 through 6 and columns 7 through 12, respectively. Market-to-book stands for the market value of common equity divided by its book value. Our CDS spreads variable represents the annual average of daily credit default spreads for 5-year contracts. The Assets variables is the natural logarithm of total assets in constant 2010 euros. Bank asset risk provides us with the annualized standard deviation of weekly dividend-inclusive bank stock returns, times the ratio of the market value of common equity to the book value of assets. Leverage represents the total liabilities divided by total assets. Leverage other banks is the weighted average of total assets of total liabilities, divided by the assets of other banks in a country. Fee income is the share of non-interest income within the total operating income. Pre-tax profits simply shows pre-tax profits divided by total assets. GDP per capita is given in constant 2010 euros. Real GDP growth returns the growth rate in real terms in percentage. Deposit market share provides us with the deposits of a bank divided by total deposits in the national banking system. Liabilities stands for total bank liabilities divided by GDP. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Other liabilities serves as the sum of total liabilities of other banks in a country divided by GDP. Liabilities sq is the square of the ratio of total bank liabilities to GDP. All regressions include bank and year fixed effects. Standard errors are in parentheses.

* Significance at 10%; ** Significance at 5%; *** Significance at 1%.

Several significant conclusions can be drawn from this table. Perhaps the first that should be addressed being that our *Asset* variable returned negative and statistically significant coefficients for all our market-to-book regression models, possibly implying diseconomies of

scale and a TBTS effect. This suggests that banks can improve their valuation should they choose to downsize or split up. As for our CDS spread regressions, none of the coefficients returned were statistically significant.

Regarding our *Bank asset risk* variable, one should remember its role as a proxy measure for a possible bank failure in situations where a bank's leverage is sufficiently high. In order to capture that effect, all our 12 regression models include an interaction term between *Bank asset risk* and *Leverage*, beyond their individual effect on the dependent variables. Individually, our *Bank asset risk* variable has virtually no statistically significant effect on both bank valuation and CDS spreads, while *Leverage* has positive and significant effects on bank valuation, along with negative but non-significant effects on CDS spreads. Our interaction term does return positive and statistically significant coefficients in the market-to-book specification. The point estimates shown for our *Leverage* variable and interaction term coefficients throughout regression models 1 to 6, suggest that leverage increases bank valuation for any level of bank asset risk within the sample. This result suggests that banks are either able to maintain access to a country's financial safety net with relative ease and are thus not expected to have high bankruptcy costs, or otherwise possess high tax deductibility of interest payments from a corporate tax base.

The *Liabilities* variable, serving as a proxy for systemic size, appears in regression model 1 of the market-to-book specification with a coefficient of -1.745, being significant at the 1% level, whereas it obtains a negative and non-significant coefficient in our analogous regression model 7, under the CDS spread specification. This result appears to suggest that systemic size tends to reduce a bank's valuation, without having much of a significant effect on expected credit losses on bank liabilities. Moreover, individual bank liabilities to-GDP ratio is replaced by the overall banking system liabilities-to-GDP ratio within models 2 and 8. Our market-to-book regression model returned a coefficient of 0.104, significant at the 10% level. This suggests that an increase in a country's banking system size, positively influences a bank's valuation possibly because market participants expect their government to be able to have enough resources to rescue it (TBTF effect). Its CDS spread equivalent in model 8 yielded non-significant coefficients.

As for our market-to-book regression model 3, we jointly included a bank's own liabilities-to-GDP ratio, alongside other banks' liabilities-to-GDP ratios, which returned coefficients of -1.934 and 0.277, respectively, both being statistically significant at the 1% level. This appears to indicate that although a bank's own systemic size has a negative effect on a bank's valuation (a possible suggestion of a TBTS effect), if all other banks in a country also present together a

high value of total liabilities relative to its country GDP, this decline is attenuated. Models 5 and 11 are distinct in that they contain the systemic variables included in models 3, 4, 9 and 10. Our market-to-book regression model 5 yielded a negative coefficient for a bank's own liabilities-to-GDP ratio, along with a positive coefficient for other bank's liabilities-to-GDP ratio, as well as for the quadratic term of a bank's own liabilities-to-GDP ratio, all significant at the 1% level, suggesting the same effects as regression model 3.

We further included an interaction term for our *Liabilities* and *Bank asset risk* variables (multiplied by the *Leverage* variable¹⁶) in models 6 and 12, as a means of obtaining further insight into the relationship, of both market-to-book ratios and CDS spreads, with systemic size. Model 6 returned a positive and statistically significant coefficient, and one can further deduce that a one standard deviation increase in the *Liabilities* variable of 0.304 would increase the market-to-book ratio of a bank, with a mean *Bank asset risk* of 0.187 and mean *Leverage* of 0.886, by 1.346¹⁷ ($= (26.720 * 0.187 * 0.886) * 0.304$). This calculation being of course relative to the valuation of a very low risk bank with nearly no bank asset risk (or leverage). Thus, the bank valuation of risky and highly leveraged banks is reduced by relatively little given the *Liabilities* variable, possibly implying that the market expects governments to support systemically large banks, an indication of a TBTF effect. In our equivalent model 12, the coefficient of this interaction term is negative, but not statistically significant. Hence, the impact of *Bank asset risk* on a bank's CDS spread does not appear to depend on a bank's systemic size.

The overall results of Table 6 appear to indicate that a bank's valuation is reduced both with its absolute and systemic size. However, this systemic size decline may be less steep for risky and highly leveraged banks. Our CDS spreads results however, do not appear to strongly reflect either absolute or systemic bank size.

The *Fee income* variable also returned a negative and statistically significant coefficient in our market-to-book model, along with a positive and significant coefficient in the concurrent CDS spread model. These results might suggest that a focus on non-traditional banking activities which are not specifically interest-generating may reduce a bank's valuation, while increasing its expected credit losses on bank liabilities.

Our *Leverage of other banks* variable however, returned instead solely positive coefficients, significant at the 1% or at the 5% levels in both our market-to-book and CDS spread models.

¹⁶ Very similar coefficient estimates were obtained in both our market-to-book and CDS spread regression models when include the interaction of *Liabilities* and *Bank asset risk* without multiplying it by bank leverage – see Appendix 3.

¹⁷ Concurrently, it could increase 51.7% of the standard deviation of the *Market-to-book* of 2.602.

These results are of particular interest, since they suggest that the “too many to fail” phenomenon discussed by Brown & Dinç (2011) may be absent from our market-to-book models, despite its possible presence within our CDS spread models. Indeed, it seemingly demonstrates that an increase in other bank’s leverage, which can cause them to become financially distressed, can positively influence a bank’s own valuation. A bank’s CDS spread can nevertheless rise alongside an increase in other bank’s leverage, possibly reflecting that a bank can expect less from a country’s financial safety net if many other distressed banks also need to be bailed out.

Our market-to-book ratio also has a negative and significant correlation to a bank’s deposit market share. This result can indicate that although banks with bigger portions of a country’s deposit market tend to rely on cheaper funding sources, they may be using this money to engage in riskier activities. Another possibility is that these banks end up possessing a vast majority of the deposit market in their country, rendering their governments unable to have the resources to bail them out if necessary, and hence, being deemed TBTS. Finally, *Real GDP growth* returned a positive and statistically significant coefficient in the market-to-book regression models, whereas it yielded negative and significant coefficients within our CDS spreads models. Such results suggest that expected bank growth opportunities lead to an increase in a bank’s valuation, while reducing expected credit losses on bank liabilities.

4.3 Robustness checks

In this subsection, the regression models of Table 6 will be subject to robustness checks on the role of dynamics in a bank’s valuation and CDS spreads, as well as the definition of the bank systemic size variable.

For our first robustness check, we consider the dynamics in a bank’s valuation and its CDS spreads, to gather insight on the temporal development and impact of both larger absolute size and systemic bank size. To capture any possible effects, we replaced our twelve regression models in Table 6 with lead market-to-book ratios in models 1 through 6, and lead CDS spreads in models 7 through 12, as shown in Table 7.

Table 7: Model testing lead market-to-book ratios and lead CDS spreads

	Market-to-book t+1						CDS spreads t+1					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Assets	-0.787*** (0.066)	-0.930*** (0.065)	-0.832*** (0.067)	-0.758*** (0.068)	-0.797*** (0.069)	-0.789*** (0.066)	0.012*** (0.004)	0.005 (0.004)	0.009** (0.005)	0.009* (0.005)	0.007 (0.005)	0.012*** (0.004)
Bank asset risk	-0.011 (0.388)	0.049 (0.389)	-0.010 (0.388)	-0.012 (0.388)	-0.012 (0.387)	0.036 (0.390)	1.330 (1.285)	0.937 (1.278)	1.276 (1.283)	1.037 (1.321)	1.079 (1.319)	0.946 (1.442)
Leverage	4.246*** (0.524)	4.666*** (0.525)	4.411*** (0.524)	4.213*** (0.524)	4.379*** (0.524)	4.267*** (0.524)	-0.022 (0.070)	-0.019 (0.070)	-0.014 (0.070)	-0.033 (0.070)	-0.022 (0.071)	-0.030 (0.071)
Leverage other banks	-5.079** (2.295)	-8.402*** (2.324)	-6.899*** (2.328)	-4.769** (2.301)	-6.607*** (2.330)	-5.157** (2.295)	0.135* (0.071)	0.081 (0.078)	0.084 (0.078)	0.147** (0.072)	0.097 (0.080)	0.138* (0.071)
Fee income	0.068* (0.040)	0.059 (0.040)	0.065 (0.040)	0.072* (0.040)	0.071* (0.040)	0.070* (0.040)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)
Pre-tax profits	3.653*** (1.061)	3.658*** (1.064)	3.870*** (1.060)	3.671*** (1.061)	3.905*** (1.059)	3.633*** (1.061)	-0.958*** (0.142)	-0.997*** (0.144)	-0.986*** (0.143)	-0.948*** (0.143)	-0.976*** (0.144)	-0.970*** (0.144)
GDP per capita	-0.032*** (0.007)	-0.021*** (0.008)	-0.019** (0.008)	-0.033*** (0.007)	-0.019** (0.008)	-0.032*** (0.007)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Real GDP growth	0.046*** (0.012)	0.054*** (0.012)	0.053*** (0.012)	0.043*** (0.012)	0.051*** (0.012)	0.046*** (0.012)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Deposit market share	-7.184*** (0.800)	-8.033*** (0.774)	-6.539*** (0.812)	-6.880*** (0.818)	-6.112*** (0.833)	-7.174*** (0.800)	-0.013 (0.020)	-0.004 (0.022)	0.004 (0.022)	-0.016 (0.020)	0.000 (0.023)	-0.013 (0.020)
Bank asset risk * Leverage	1.933*** (0.729)	1.757** (0.731)	1.856** (0.728)	1.942*** (0.729)	1.864** (0.727)	1.804** (0.736)	-1.465 (1.384)	-1.050 (1.376)	-1.419 (1.381)	-1.148 (1.423)	-1.204 (1.421)	-1.006 (1.589)
Liabilities	-1.400*** (0.308)		-1.615*** (0.311)	-2.595*** (0.746)	-3.160*** (0.754)	-1.474*** (0.313)	-0.014 (0.009)		-0.015* (0.009)	0.007 (0.023)	-0.001 (0.024)	-0.012 (0.009)
Sum liabilities		0.153** (0.066)						0.002 (0.002)				
Other liabilities			0.305*** (0.071)		0.322*** (0.071)				0.004 (0.002)		0.003 (0.002)	
Liabilities sq				0.640* (0.364)	0.820** (0.365)					-0.008 (0.008)	-0.006 (0.009)	
Liabilities * Bank asset risk * Leverage						6.413 (4.884)						-0.122 (0.206)
Constant	11.000*** (2.284)	14.260*** (2.266)	11.960*** (2.290)	10.560*** (2.297)	11.450*** (2.299)	11.060*** (2.285)	-0.204** (0.097)	-0.088 (0.102)	-0.140 (0.105)	-0.175* (0.101)	-0.125 (0.107)	-0.202** (0.097)
Observations	3 831	3 831	3 831	3 831	3 831	3 831	371	371	371	371	371	371
R-sq	0.143	0.139	0.148	0.144	0.149	0.144	0.318	0.315	0.324	0.320	0.325	0.319

Twelve regression models are presented here, with the lead market-to-book ratio and lead CDS spreads serving as our dependent variables for columns 1 through 6, and columns 7 through 12, respectively. Market-to-book stands for the market value of common equity divided by its book value. Our CDS spreads variable represents the annual average of daily credit default spreads for 5-year contracts. The Assets variables is the natural logarithm of total assets in constant 2010 euros. Bank asset risk provides us with the annualized standard deviation of weekly dividend-inclusive bank stock returns, times the ratio of the market value of common equity to the book value of assets. Leverage represents the total liabilities divided by total assets. Leverage other banks is the weighted average of total assets of total liabilities, divided by the assets of other banks in a country. Fee income is the share of non-interest income within the total operating income. Pre-tax profits simply shows pre-tax profits divided by total assets. GDP per capita is given in constant 2010 euros. Real GDP growth returns the growth rate in real terms in percentage. Deposit market share provides us with the deposits of a bank divided by total deposits in the national banking system. Liabilities stands for total bank liabilities divided by GDP. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Other liabilities serves as the sum of total liabilities of other banks in a country divided by GDP. Liabilities sq is the square of the ratio of total bank liabilities to GDP. All regressions include bank and year fixed effects. Standard errors are in parentheses.

* Significance at 10%; ** Significance at 5%; *** Significance at 1%.

In our lead market-to-book regression models, the *Assets* variable returned statistically significant negative coefficients, which may suggest that a larger absolute size not only reduces a contemporaneous bank's valuation (as seen through the coefficients in Table 6) but may carry its effects into the following year of a bank valuation. In our analogous lead CDS spreads regression models, the *Assets* variables returned positive and significant coefficients in four out of six models. Thus, although larger absolute size does not appear to affect a contemporaneous bank's CDS spread (as demonstrated by non-significant coefficients in Table 6), it appears to increase expected credit losses on bank liabilities in the following year, as evidence of a

dynamic market response to changes in a bank's absolute size. Both results are consistent with the presence of a TBTS effect.

Regarding our *Liabilities* variable, it returned negative and significant coefficients in both Table 6 and Table 7 of our market-to-book regression models. These results are also consistent with the presence of a TBTS effect, suggesting that a larger systemic size continually lowers a bank's valuation over time. However, in our lead CDS spreads regression models, the *Liabilities* variable continues to appear with overall non-statistically significant coefficients, similarly to the results obtained from the concurrent CDS spread models of Table 6.

It is of particular interest to compare the coefficients of the *Leverage of other banks* variable between Table 6 and Table 7. In the latter, both lead market-to-book and CDS spreads regression models seem to suggest that the "too many to fail" phenomenon discussed by Brown & Dinç (2011) is present. *Leverage of other banks* appears there with negative and significant coefficients in a market-to-book setting, along with positive and significant coefficients in three out of 6 models in a CDS spreads setting. Particularly when considering the market-to-book models, such results may indicate that leverage of other banks initially increase a bank's own valuation with a decline in stock price the next year. This may in turn serve as possible evidence of a dynamic market response to concerns that if several banks in a country are distressed, the government will not have enough resources to rescue all of them simultaneously. As for the CDS spread models, our results suggest that a bank should expect less from a country's financial safety net if many other distressed banks also need to be bailed out.

Furthermore, regression models 4 and 5 of Table 6 suggest that the relationship between the market-to-book ratio and bank systemic size may be non-linear, given the positive and significant coefficients of the *Liabilities sq* variable (1.097 and 1.262, respectively). Similarly, our regression model 10 also indicates a similar relationship may be present between CDS spreads and a bank's systemic size (the *Liabilities sq* variable appears with a coefficient of -0.015, significant at the 10% level). As a means of addressing these results, we replaced the *Liabilities* variable with one of the *Big* variables in Table 8, to serve as a categorical indicator of bank systemic size. This table contains four panels, with the *Liabilities* variable being replaced by one of the dummy variables *Big 0.1*, *Big 0.25*, *Big 0.5* and *Big 1*. More specifically, Panel A of Table 8 presents market-to-book and CDS spreads regression models which include the *Big 0.1* variable representing systemic size. Models 1 and 2 correspond to our regression models 6 and 12 in Table 6, while models 3 and 4 correspond to our equivalent regression models 7 and 12 of Table 6. In this same manner, Panels B-D of Table 8 include the *Big 0.25*, *Big 0.5* and *Big 1* variable, respectively.

Table 8: Model testing market-to-book ratios and CDS spreads with categorical measures of systemic size

	Market-to-book		CDS spreads	
	(1)	(2)	(3)	(4)
Panel A: Big 0.1 representing systemic size				
Bank asset risk	0.022 (0.294)	0.162 (0.294)	0.615 (1.198)	-1.128 (1.473)
Leverage	4.977*** (0.403)	5.009*** (0.401)	-0.019 (0.060)	-0.044 (0.061)
Bank asset risk * Leverage	4.966*** (0.585)	4.585*** (0.587)	-0.985 (1.288)	1.135 (1.658)
Big 0.1	0.038 (0.146)	-0.139 (0.149)	0.004 (0.004)	0.011** (0.006)
Big 0.1 * Bank asset risk * Leverage		11.320*** (2.148)		-0.319** (0.158)
N	4 189	4 189	380	380
R-sq	0.240	0.246	0.501	0.507
Panel B: Big 0.25 representing systemic size				
Bank asset risk	0.005 (0.293)	0.132 (0.293)	0.739 (1.200)	0.454 (1.291)
Leverage	4.839*** (0.403)	4.874*** (0.401)	-0.021 (0.060)	-0.028 (0.061)
Bank asset risk * Leverage	5.015*** (0.583)	4.667*** (0.585)	-1.119 (1.291)	-0.773 (1.413)
Big 0.25	-0.676*** (0.167)	-0.919*** (0.173)	-0.003 (0.004)	-0.001 (0.005)
Big 0.25 * Bank asset risk * Leverage		12.710*** (2.384)		-0.073 (0.121)
N	4 189	4 189	380	380
R-sq	0.243	0.249	0.500	0.501
Panel C: Big 0.5 representing systemic size				
Bank asset risk	0.016 (0.293)	0.052 (0.292)	0.619 (1.203)	0.507 (1.252)
Leverage	4.842*** (0.402)	4.846*** (0.401)	-0.024 (0.060)	-0.027 (0.060)
Bank asset risk * Leverage	4.978*** (0.582)	4.877*** (0.582)	-0.990 (1.294)	-0.858 (1.356)
Big 0.5	-0.804*** (0.153)	-1.030*** (0.165)	0.001 (0.003)	0.002 (0.003)
Big 0.5 * Bank asset risk * Leverage		15.100*** (4.169)		-0.044 (0.134)
Observations	4 189	4 189	380	380
R-sq	0.246	0.248	0.500	0.500
Panel D: Big 1 representing systemic size				
Bank asset risk	-0.004 (0.293)	0.004 (0.293)	0.635 (1.195)	0.692 (1.206)
Leverage	4.857*** (0.402)	4.861*** (0.401)	-0.025 (0.060)	-0.023 (0.060)
Bank asset risk * Leverage	5.031*** (0.583)	5.007*** (0.583)	-1.011 (1.285)	-1.076 (1.298)
Big 1	-1.319*** (0.256)	-1.635*** (0.310)	-0.005 (0.004)	-0.007 (0.006)
Big 1 * Bank asset risk * Leverage		20.840* (11.507)		0.119 (0.305)
Observations	4 189	4 189	380	380
R-sq	0.245	0.246	0.501	0.502

Twelve regression models are presented here, with the market-to-book ratio and CDS spreads serving as our dependent variables for columns 1 through 6 and columns 7 through 12, respectively. Market-to-book stands for the market value of common equity divided by its book value. Our CDS spreads variable represents the annual average of daily credit default spreads for 5-year contracts. The Assets variable is the natural logarithm of total assets in constant 2010 euros. Bank asset risk provides us with the annualized standard deviation of weekly dividend-inclusive bank stock returns, times the ratio of the market value of common equity to the book value of assets. Leverage represents the total liabilities divided by total assets. Big is a dummy variable that equals 1 if the ratio of bank liabilities-to-GDP exceeds a threshold set equal to 0.1 in Panel A, 0.25 in Panel B, 0.5 in Panel C, and 1 in Panel D. The Panels do not report estimated coefficients for some regressors for brevity. All regressions include bank and year fixed effects. Standard errors are in parentheses.

* Significance at 10%; ** Significance at 5%; *** Significance at 1%.

In our regression model 1 within all Panels, with the exception of Panel A, the *Big* variable returns negative and statistically significant coefficients at the 1% level. These coefficients seemingly indicate that banks with liabilities of at least 25% of GDP are large enough to possess significantly lower valuations on account of a possible TBTS effect.

The interaction of the *Big* variable with *Bank asset risk* and *Leverage*, included in regression model 2 of the four panels, returned positive and statistically significant coefficients at the 1% level in Panels A-C, maintaining significance at the 10% level in Panel D. This may suggest that banks with a liabilities-to-GDP ratio of 0.1 or more can gain from higher *Bank asset risk* and higher *Leverage*, results consistent with the presence of a TBTF effect.

In our analogous CDS spreads regression models in Panels A-D, the *Big* variable and its interaction with *Bank asset risk* and *Leverage* obtains non-significant coefficients, with the exception of Panel A. In model 4 of this particular Panel, the *Big 0.1* variable obtains a coefficient of 0.011, with its interaction returning a coefficient of -0.319, both being statistically significant at the 5% level. This seems to indicate that although the expected losses of a bank's liabilities increase when they reach at least 10% of GDP, this relation is rather muted if banks take on more risk or are more leveraged, which is also more consistent with the presence of a TBTF effect.

Overall, the results of Table 8 are consistent with those of Table 6, suggesting that a bank's valuation is reduced by its systemic size, although this decline is not as steep for risky and highly leveraged banks. Furthermore, it appears that TBTS effects are primarily applied to banks which present a liabilities-to-GDP ratio of at least 0.25.

To conclude this subsection and as a means of diving deeper into the results found in Table 8, we constructed Table 9 by replicating Table 6 while limiting the sample to those banks which present liabilities exceeding 25% of GDP.

From Table 9 we find that the *Liabilities* variable does return negative and statistically significant coefficients throughout all our market-to-book regression models. The results found in Table 8 thus appear to verify the presence of TBTS effects for banks with liabilities-to-GDP ratios of at least 0.25.

As concerns our *Assets* variable, its results further support the notion that a rise in a bank's absolute size can lead to a significantly lower bank valuation, which can possibly imply diseconomies of scale and a TBTS effect.

Table 9: Model testing market-to-book ratios and CDS spreads for banks with a liabilities-to-GDP ratio of at least 0.25

	Market-to-book						CDS spreads					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Assets	-0.573** (0.271)	-0.326* (0.196)	-0.516* (0.276)	-0.389 (0.322)	-0.376 (0.323)	-0.573** (0.271)	0.007 (0.007)	0.002 (0.006)	0.008 (0.008)	-0.006 (0.010)	-0.008 (0.010)	0.009 (0.007)
Bank asset risk	-235.7** (58.085)	-246.3*** (58.729)	-245.6*** (58.735)	-238.9*** (58.157)	-246.6*** (58.762)	-223.8*** (61.111)	-4.212 (3.013)	-4.030 (3.034)	-4.241 (3.032)	-3.861 (3.002)	-4.086 (3.006)	-6.193* (3.331)
Leverage	12.290*** (3.786)	12.360*** (3.786)	12.360*** (3.786)	12.690*** (3.805)	12.680*** (3.805)	12.660*** (3.834)	0.009 (0.079)	0.007 (0.080)	0.008 (0.080)	-0.004 (0.079)	-0.024 (0.081)	-0.015 (0.081)
Leverage other banks	7.806*** (1.210)	8.188*** (1.224)	8.062*** (1.230)	7.958*** (1.218)	8.144*** (1.235)	7.795*** (1.210)	0.129* (0.069)	0.128* (0.073)	0.131* (0.073)	0.147** (0.069)	0.184** (0.077)	0.147** (0.070)
Fee income	0.060 (0.068)	0.060 (0.068)	0.064 (0.068)	0.068 (0.068)	0.070 (0.068)	0.062 (0.068)	0.006*** (0.002)	0.007*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.007*** (0.002)
Pre-tax profits	30.600*** (6.813)	30.670*** (6.810)	30.520*** (6.812)	30.610*** (6.812)	30.540*** (6.813)	31.200*** (6.883)	-1.427*** (0.163)	-1.447*** (0.165)	-1.429*** (0.165)	-1.403*** (0.163)	-1.419*** (0.163)	-1.449*** (0.164)
GDP per capita	0.021** (0.010)	0.016 (0.010)	0.017 (0.011)	0.019* (0.010)	0.016 (0.011)	0.021** (0.010)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Real GDP growth	0.045*** (0.017)	0.044** (0.017)	0.044*** (0.017)	0.043** (0.017)	0.043** (0.017)	0.046*** (0.017)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Deposit market share	-4.675*** (0.703)	-4.913*** (0.766)	-5.055*** (0.780)	-4.578*** (0.709)	-4.915*** (0.798)	-4.644*** (0.705)	-0.000 (0.021)	-0.009 (0.024)	-0.002 (0.025)	-0.004 (0.021)	-0.021 (0.026)	-0.004 (0.022)
Bank asset risk * Leverage	276.4*** (63.839)	288.0*** (64.527)	287.2*** (64.534)	279.8*** (63.912)	288.2*** (64.561)	261.4*** (68.253)	4.134 (3.195)	3.960 (3.220)	4.167 (3.217)	3.791 (3.182)	4.063 (3.188)	6.450* (3.603)
Liabilities	-0.244* (0.399)		-0.304* (0.403)	-0.689* (0.968)	-0.461* (0.999)	-0.177* (0.414)	-0.017 (0.011)		-0.017 (0.011)	0.040 (0.033)	0.062 (0.038)	-0.013 (0.011)
Sum liabilities		-0.080 (0.097)						-0.003 (0.003)				
Other liabilities			-0.117 (0.104)		-0.098 (0.106)				-0.000 (0.004)		-0.005 (0.004)	
Liabilities sq				0.342 (0.323)	0.277 (0.331)					-0.019* (0.010)	-0.025** (0.012)	
Liabilities * Bank asset risk *						4.073 (6.509)						-0.357 (0.258)
Constant	-10.660** (4.735)	-13.550*** (4.170)	-11.280** (4.766)	-13.000** (5.225)	-13.070** (5.226)	-10.970** (4.763)	-0.184 (0.135)	-0.116 (0.129)	-0.188 (0.140)	-0.042 (0.155)	-0.039 (0.155)	-0.197 (0.135)
Observations	647	647	647	647	647	647	244	244	244	244	244	244
R-sq	0.396	0.396	0.397	0.397	0.398	0.397	0.525	0.521	0.525	0.533	0.536	0.530

Twelve regression models are presented here, with the market-to-book ratio and CDS spreads serving as our dependent variables for columns 1 through 6 and columns 7 through 12, respectively. Market-to-book stands for the market value of common equity divided by its book value. Our CDS spreads variable represents the annual average of daily credit default spreads for 5-year contracts. The Assets variables is the natural logarithm of total assets in constant 2010 euros. Bank asset risk provides us with the annualized standard deviation of weekly dividend-inclusive bank stock returns, times the ratio of the market value of common equity to the book value of assets. Leverage represents the total liabilities divided by total assets. Leverage other banks is the weighted average of total assets of total liabilities, divided by the assets of other banks in a country. Fee income is the share of non-interest income within the total operating income. Pre-tax profits simply shows pre-tax profits divided by total assets. GDP per capita is given in constant 2010 euros. Real GDP growth returns the growth rate in real terms in percentage. Deposit market share provides us with the deposits of a bank divided by total deposits in the national banking system. Liabilities stands for total bank liabilities divided by GDP. Sum liabilities is the sum of total bank liabilities in a country divided by GDP. Other liabilities serves as the sum of total liabilities of other banks in a country divided by GDP. Liabilities sq is the square of the ratio of total bank liabilities to GDP. All regressions include bank and year fixed effects. Standard errors are in parentheses.

* Significance at 10%; ** Significance at 5%; *** Significance at 1%.

Our market-to-book regression models also returned negative and statistically significant coefficients for the *Bank asset risk* variable, possibly indicating that when systemically smaller banks are excluded from our sample, a rise in bank risk leads to a decrease in its own valuation. However, when one considers the interaction term of *Bank asset risk* with the *Leverage* variable, this effect is seemingly attenuated, as the point estimates of our coefficients suggest that leverage increases bank valuation for any level of *Bank asset risk* within the sample. This result suggests that banks are either not expected to have high bankruptcy costs, or instead have high tax deductibility of interest payments from a corporate tax base. Note that when the

interaction term of *Liabilities* with *Bank asset risk* and *Leverage* is included in a market-to-book setting, resulting non-statistically significant coefficient indicate that the impact of bank risk and leverage does not appear to depend on a bank's systemic size.

5. Conclusion

This dissertation seeks to provide evidence indicating that banks in the European Union were confident of their TBTF status until the financial crisis of 2007-2009, with the implication that governments would always be both able and willing to bail them out. However, the events that followed made it apparent that a TBTS effect was also present, and they could improve their valuation by downzizing or splitting up.

Through a thorough analysis of the evolution of systemic bank size (as measured by its liabilities-to-GDP ratio) we demonstrated that banks were systemically larger until the period of the financial crisis, and became systemically smaller afterwards. There was a clear decline in average systemic size following the financial crisis, becoming particularly evident when systemically large banks (banks with liabilities exceeding half of their country's GDP) were included in our analysis, as systemically smaller banks showed relatively little variation between 2001 and 2019. This reduction in systemic size was not only seen in individual banks, but also on overall countries' banking systems, which decreased to half from 2009 to 2019. This downsizing relative to economic size could also be a consequence of the introduction of the Basel III in 2009, since this regulatory accord requires banks to maintain proper leverage and capital ratios, with the express aim of reducing systemic risk in order to avoid a new financial crisis.

Further evidence which suggests many banks have grown too large, is the negative correlation we found between a bank's valuation and both its absolute size (as measured by the natural logarithm of total bank assets) and its systemic size. These results are robust, and were further tested while taking lead market-to-book ratios into account. Additionally we reduced our sample to only banks presenting liabilities exceeding 0.25 of GDP as a robustness check. Consequently a bank's market-to-book ratio was also found to be negatively correlated to its systemic size, further contributing to the idea that some banks come under the TBTS effect. However, throughout the majority of the analysis performed here, we found that although a bank's valuation is reduced by its systemic size, this reduction can be significantly less steep

for risky and highly leveraged banks, which can perhaps serve as evidence for an opposing TBTF effect. This result suggests that at least some market actors are still confident that their country's governments will be able and willing to save these systemically larger banks.

Our regression models concerning banks' CDS spreads mostly returned non-statistically significant relations. It is possible that this lack of significance stems from a relatively small sample size, but it nevertheless remains an inconclusive avenue of questioning which future iterations of our work could develop further. An interesting and particular exception was found when we considered a bank's absolute size within a dynamic setting. Our results suggested that such a setting appeared to not affect a contemporaneous bank's CDS spread, but ended up increasing expected credit losses on bank liabilities for the following year. This result may support notions of dynamic market response to changes in a bank's absolute size, while also being consistent with a TBTS effect.

The evidence thus appears to strongly suggest that the market is now increasingly aware that banks have grown too large, and countries are no longer able to guarantee their rescue. The reduction in banks' systemic sizes observed since the last financial crisis, can be expected to at least mitigate the likelihood of the European Union's financial system falling into another severe crisis. In the overall, markets appear to have learned from the catastrophic ripple effects they felt during the period of the financial crisis, and are thus now more engaged in reducing systemic risk.

In the years to come, the conditions under study within our work and the relationships observed will only grow more relevant, and it remains to be seen whether the TBTS effect will indeed prevent the onset of another financial crisis, particularly with the emergence of coronavirus. Future iterations of our work should go further by analyzing not simply European Union countries, but with an international sample of banks. Such a study would be timely given the current financial strain affecting the global market, and potentially reducing the floor on the TBTS status. Further investigation on this matter, particularly when taking international policies installed after the financial crisis (like Basel III) into account, would undoubtedly provide yet deeper and interesting insights into the real impact of TBTF and TBTS effects.

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7. Appendices

7.1 Appendix 1: Variable definitions and data sources

Variable	Description	Sources
Market-to-book	Market value of common equity divided by book value of common equity.	Compustat Global and Datastream
CDS spreads	Annual average of daily credit default spreads for 5-year contracts.	Bloomberg
Assets	Natural logarithm of total assets in millions of constant 2010 euros.	Compustat Global
Liabilities	Total bank liabilities divided by GDP.	Compustat Global and WDI
Sum liabilities	Sum of total bank liabilities in a country divided by GDP.	Compustat Global and WDI
Other liabilities	Sum of total liabilities of other banks in a country divided by GDP.	Compustat Global and WDI
Liabilities sq	Square of ratio of total bank liabilities to GDP.	Compustat Global and WDI
Big 0.1	Dummy variable that equals one if the liabilities to GDP ratio is greater than or equal to 0.1 and zero otherwise.	Compustat Global and WDI
Big 0.25	Dummy variable that equals one if the liabilities to GDP ratio is greater than or equal to 0.25 and zero otherwise.	Compustat Global and WDI
Big 0.5	Dummy variable that equals one if the liabilities to GDP ratio is greater than or equal to 0.5 and zero otherwise.	Compustat Global and WDI
Big 1	Dummy variable that equals one if the liabilities to GDP ratio is greater than or equal to 1 and zero otherwise.	Compustat Global and WDI
Bank asset risk	Annualized standard deviation of weekly dividend-inclusive bank stock returns times the ratio of the market value of common equity to the book value of assets.	Datastream and Compustat Global
Leverage	Total liabilities divided by total assets.	Compustat Global
Leverage other banks	Weighted average by assets of liabilities divided by assets of other banks in a country.	Compustat Global
Fee income	Share of non-interest income in total operating income.	Compustat Global
Pre-tax profits	Pre-tax profits divided by total assets.	Compustat Global
GDP per capita	GDP per capita in thousands of constant 2010 euros.	WDI
Real GDP growth	GDP growth rate in real terms in percentage.	WDI
Deposit market share	Deposits of a bank divided by total deposits in the national banking system.	Compustat Global

This table contains the definitions and sources of all the variables used throughout this dissertation. The variables considered follow the work of Demirguc-Kunt & Huizinga (2013). Besides the two dependent variables considered – market-to-book ratio and CDS spreads – it includes variables of absolute bank size, bank asset risk, individual bank, and banking system size variables, in addition to several bank-level and country-level control variables.

7.2 Appendix 2: Top 6 systemically large banks from 2008 to 2019

Bank name	Country	Liabilities	Absolute liabilities (in billions of euros)
<i>Panel A: 2008</i>			
NORDEA BANK ABP	Finland	2.189	456
ING GROEP NV	Netherlands	1.876	1 303
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	1.792	73
DANSKE BANK AS	Denmark	1.784	462
DEXIA SA	Belgium	1.710	645
CYPRUS POPULAR BANK PCL	Cyprus	1.705	35
<i>Panel B: 2009</i>			
NORDEA BANK ABP	Finland	2.835	485
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	2.257	79
CYPRUS POPULAR BANK PCL	Cyprus	2.165	38
BANK OF CYPRUS HOLDINGS PLC	Cyprus	2.100	37
ING GROEP NV	Netherlands	1.909	1 123
DANSKE BANK AS	Denmark	1.850	403
<i>Panel C: 2010</i>			
NORDEA BANK ABP	Finland	3.110	556
BANK OF CYPRUS HOLDINGS PLC	Cyprus	2.155	40
CYPRUS POPULAR BANK PCL	Cyprus	2.108	39
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	2.091	80
ING GROEP NV	Netherlands	1.973	1 199
DANSKE BANK AS	Denmark	1.805	417
<i>Panel D: 2011</i>			
NORDEA BANK ABP	Finland	3.383	690
ING GROEP NV	Netherlands	1.832	1 227
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	1.749	78
DANSKE BANK AS	Denmark	1.738	443
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.715	35
CYPRUS POPULAR BANK PCL	Cyprus	1.623	33
<i>Panel E: 2012</i>			
NORDEA BANK ABP	Finland	3.241	649
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	1.808	79
DANSKE BANK AS	Denmark	1.770	449
ING GROEP NV	Netherlands	1.705	1 109
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.585	31
BANCO SANTANDER SA	Spain	1.154	1 185
<i>Panel F: 2013</i>			
NORDEA BANK ABP	Finland	2.996	601
ESPIRITO SANTO FINANCIAL GRP	Luxembourg	1.711	78
DANSKE BANK AS	Denmark	1.625	413
ING GROEP NV	Netherlands	1.583	1 027
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.562	28
BANCO SANTANDER SA	Spain	1.033	1 036
<i>Panel G: 2014</i>			
NORDEA BANK ABP	Finland	2.962	640
DANSKE BANK AS	Denmark	1.596	443
ING GROEP NV	Netherlands	1.333	934
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.281	23
BANCO SANTANDER SA	Spain	1.092	1 177
BNP PARIBAS	France	0.884	1 984
<i>Panel H: 2015</i>			
NORDEA BANK ABP	Finland	2.983	616
DANSKE BANK AS	Denmark	1.575	420
BANCO SANTANDER SA	Spain	1.180	1 242
ING GROEP NV	Netherlands	1.177	793
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.159	20
BANK OF VALLETTA LTD	Malta	0.981	9

<i>Panel I: 2016</i>			
NORDEA BANK ABP	Finland	2.709	583
DANSKE BANK AS	Denmark	1.591	446
ING GROEP NV	Netherlands	1.134	795
BANCO SANTANDER SA	Spain	1.122	1 236
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.020	19
BANK OF VALLETTA LTD	Malta	0.976	10
<i>Panel J: 2017</i>			
NORDEA BANK ABP	Finland	2.523	548
DANSKE BANK AS	Denmark	1.614	453
BANCO SANTANDER SA	Spain	1.196	1 337
ING GROEP NV	Netherlands	1.119	795
BANK OF CYPRUS HOLDINGS PLC	Cyprus	1.088	21
BANK OF VALLETTA LTD	Malta	1.000	11
<i>Panel K: 2018</i>			
NORDEA BANK ABP	Finland	2.156	519
DANSKE BANK AS	Denmark	1.476	458
BANCO SANTANDER SA	Spain	1.092	1 352
ING GROEP NV	Netherlands	1.048	835
BANK OF CYPRUS HOLDINGS PLC	Cyprus	0.906	20
BANK OF VALLETTA LTD	Malta	0.876	11
<i>Panel L: 2019</i>			
NORDEA BANK ABP	Finland	2.138	523
DANSKE BANK AS	Denmark	1.517	481
BANCO SANTANDER SA	Spain	1.112	1 412
ING GROEP NV	Netherlands	1.011	837
HSBC HLDGS PLC	United Kingdom	0.892	2 297
BANK OF CYPRUS HOLDINGS PLC	Cyprus	0.842	19

This table lists the top 6 banks with the highest ratios of liabilities-to-GDP between 2008 and 2019. Absolute liabilities stands for total bank liabilities in billions of euros. The bank names in bold – Nordea Bank in Finland, Danske Bank in Denmark and ING Groep in the Netherlands – are the ones that belong to the top 6 ranking throughout this timeframe.

7.3 Appendix 3: Model testing market-to-book ratios and CDS spreads with systemic size interaction without multiplying by leverage

	Market-to-book						CDS spreads					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Assets	-0.631*** (0.052)	-0.775*** (0.052)	-0.671*** (0.053)	-0.583*** (0.054)	-0.619*** (0.054)	-0.635*** (0.052)	0.00117 (0.004)	-0.00456 (0.004)	-0.00151 (0.004)	-0.00403 (0.005)	-0.00516 (0.005)	0.00166 (0.004)
Bank asset risk	-0.0229 (0.292)	0.0238 (0.294)	-0.0291 (0.291)	-0.0230 (0.291)	-0.0297 (0.290)	0.161 (0.292)	0.837 (1.198)	0.638 (1.196)	0.829 (1.195)	0.348 (1.222)	0.419 (1.224)	0.216 (1.318)
Leverage	4.672*** (0.402)	5.051*** (0.404)	4.802*** (0.402)	4.625*** (0.402)	4.760*** (0.401)	4.746*** (0.400)	-0.0209 (0.060)	-0.0176 (0.060)	-0.0125 (0.060)	-0.0389 (0.060)	-0.0299 (0.061)	-0.0335 (0.061)
Leverage other banks	4.857*** (1.299)	2.623** (1.316)	3.818*** (1.313)	5.196*** (1.300)	4.111*** (1.312)	4.607*** (1.292)	0.170*** (0.059)	0.131** (0.065)	0.133** (0.064)	0.194*** (0.061)	0.163** (0.067)	0.177*** (0.060)
Fee income	-0.118*** (0.033)	-0.128*** (0.033)	-0.120*** (0.033)	-0.111*** (0.033)	-0.111*** (0.033)	-0.108*** (0.033)	0.00341** (0.002)	0.00306** (0.002)	0.00324** (0.002)	0.00312** (0.002)	0.00304** (0.002)	0.00341** (0.002)
Pre-tax profits	0.171 (0.791)	0.130 (0.796)	0.382 (0.790)	0.217 (0.790)	0.456 (0.788)	0.0999 (0.787)	-1.329*** (0.118)	-1.349*** (0.119)	-1.346*** (0.119)	-1.319*** (0.118)	-1.333*** (0.119)	-1.347*** (0.119)
GDP per capita	-0.00548 (0.005)	0.00620 (0.006)	0.00697 (0.006)	-0.00712 (0.005)	0.00624 (0.006)	-0.00528 (0.005)	-0.000263 (0.000)	-0.000112 (0.000)	-0.000151 (0.000)	-0.000204 (0.000)	-0.000132 (0.000)	-0.000270 (0.000)
Real GDP growth	0.0400*** (0.010)	0.0475*** (0.010)	0.0469*** (0.010)	0.0367*** (0.010)	0.0437*** (0.010)	0.0409*** (0.010)	-0.00167*** (0.000)	-0.00157*** (0.000)	-0.00155*** (0.000)	-0.00165*** (0.000)	-0.00157*** (0.000)	-0.00165*** (0.000)
Deposit market share	-6.394*** (0.651)	-7.599*** (0.629)	-5.845*** (0.659)	-5.860*** (0.666)	-5.180*** (0.677)	-6.338*** (0.648)	0.00392 (0.018)	0.0105 (0.020)	0.0182 (0.020)	-0.00167 (0.018)	0.00960 (0.021)	0.00233 (0.018)
Bank asset risk * Leverage	5.086*** (0.581)	4.933*** (0.585)	5.025*** (0.580)	5.100*** (0.580)	5.036*** (0.578)	4.580*** (0.583)	-1.223 (1.288)	-1.019 (1.286)	-1.227 (1.285)	-0.692 (1.315)	-0.779 (1.317)	-0.479 (1.447)
Liabilities	-1.745*** (0.252)		-1.934*** (0.254)	-3.775*** (0.612)	-4.286*** (0.618)	-2.048*** (0.255)	-0.0109 (0.007)		-0.0118 (0.007)	0.0260 (0.021)	0.0195 (0.022)	-0.00839 (0.008)
Sum liabilities		0.104* (0.055)						0.00186 (0.002)				
Other liabilities			0.277*** (0.058)		0.303*** (0.058)				0.00339 (0.002)		0.00247 (0.002)	
Liabilities sq				1.097*** (0.301)	1.262*** (0.302)					-0.0149* (0.008)	-0.0125 (0.008)	
Liabilities * Bank asset risk						24.21*** (3.771)						-0.194 (0.172)
Constant	-0.937 (1.322)	1.419 (1.307)	-0.642 (1.320)	-1.477 (1.328)	-1.235 (1.325)	-0.761 (1.315)	-0.116 (0.087)	-0.0249 (0.090)	-0.0666 (0.092)	-0.0674 (0.090)	-0.0393 (0.094)	-0.117 (0.087)
Observations	4 189	4 189	4 189	4 189	4 189	4 189	380	380	380	380	380	380
R-sq	0.250	0.241	0.254	0.252	0.258	0.258	0.503	0.501	0.506	0.508	0.510	0.505

This table contains the same regressions models as Table 6, except the market-to-book regression model 6 and equivalent CDS spreads model 12. In these two regression models the interaction term is just between the Liabilities and Bank asset risk variables, without being multiplied by the Leverage variable.

Note that all the variables are constructed in the same manner as Table 6. All regressions include bank and year fixed effects. Standard errors are in parentheses.

* Significance at 10%; ** Significance at 5%; *** Significance at 1%.