The Impact of the Designation of Global Systemically Important Banks on Their Business Model*

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To the best of our knowledge, this paper is among the first to provide empirical evidence on how the recent international regulation designed for global systemically important banks (G-SIBs) drove changes in these institutions' activity. Our econometric approach quantifies the impact of the designation of G-SIBs on their activity, controlling for both structural differences and industry trends. We find that G-SIBs have reduced the expansion of their balance sheet, which further improved their leverage ratio. A downward pressure is noticed on their return on equity, but no adverse consequences are observed on lending. We find no effect on G-SIBs' funding cost advantage, which suggests that "too-big-to-fail" distortions still persist.

JEL Codes: G01, G21, G28, G32.

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1. Introduction

At the Pittsburgh Summit in 2009, G-20 leaders called on international regulators to propose solutions to the "too-big-to-fail" (TBTF) problem (Financial Stability Board 2010). Whereas this category of banks had already been identified in 1984[1] and the adverse incentives related to their status had largely been analyzed by academics (Flannery and Sorescu 1996; Freixas, Rochet, and Parigi 2004; Brandao-Marques, Correa, and Sapriza 2013; Gropp, Gruendl, and Guettler 2013), no concrete measure had been taken until the crisis had burst in order to end the TBTF distortions. The 2008 financial crisis clearly revealed that size is only one determinant of systemic risk; the complexity of a bank's business model, its interconnections with other financial entities, and internationally driven activities are other key dimensions of systemic risk.

Thus, the quantification of banks' systemic footprint and the identification of "the financial institutions whose distress or disorderly failure could cause significant disruption to the wider financial system and to the economic activity" (Financial Stability Board 2011) became a priority for international regulators and a key element of the post-Lehman reform agenda. Several measures of the systemic footprint of large banks have been developed in the academic literature, mainly based on market data, and they are still subject to ongoing discussions and refinements: the marginal expected shortfall and the systemic expected shortfall of Acharya et al. (2017), the SRISK of Acharya, Engle, and Richardson (2012) and Engle, Jondeau, and Rockinger (2015), and the CoVaR of Adrian and Brunnermeier (2016).[2] In parallel, using mainly accounting and prudential information, international regulators developed specific frameworks to make large financial institutions more resilient and to bring an end to the "too-big-to-fail" paradigm (Financial Stability Board 2010, 2013a).

[1] In 1984, the U.S. federal government made the decision to intervene in order to avoid the failure of any of the nation's 11 largest banks. This led to the identification of a new category of banks, whose disorderly failure, due to their size, could cause significant disruption in the functioning of financial markets and the economy as a whole.

[2] Benoit et al. (2017) provides a comparative analysis of these systemic risk indicators.

To that end, the concept of a "global systemically important bank" (G-SIB) has been introduced to characterize banks to be submitted to more stringent regulatory, supervisory, and resolution regimes. The publication of the first list of G-SIBs by the Financial Stability Board (FSB) occurred in November 2011. This approach further facilitated a focused implementation of additional capital requirements (additional capital buffers, higher loss-absorbency requirements imposed under the total loss-absorbing capacity, or TLAC, framework), macroprudential measures, and additional recovery and resolution regulation (FSB 2013a, 2014a, 2015a, 2016a). The rollout of the framework has taken place progressively and will continue in the coming years.[3]

In this context, this paper seeks to evaluate whether the regulatory reforms for systemic banks have contributed to the G-20 objectives to strengthen the resilience of financial institutions and enhance global financial stability. More precisely, we will evaluate whether and how much banks designated as G-SIBs have experienced changes in line with the intended objectives, and if some unintended consequences also occurred.

Research efforts have been driven so far to investigate the effects of G-SIB regulation, but usually from a different point of view: the impact of G-SIB designation on banks' debt implicit public guarantees and the efficiency of resolution regimes and practices (Schich and Toader 2017), or the shifts in stock market evaluations driven by the recent regulatory frameworks imposed on G-SIBs (Moenninghoff, Ongena, and Wieandt 2015), or the calibration of optimal capital requirements (Passmore and von Hafften 2017). Birn, Dietsch, and Durant (2017) investigate with a nonlinear optimization model how Basel III capital and liquidity requirements combine and result in a changing balance sheet.[4] They suggest that G-SIBs, contrary to their peers, have decreased total balance sheet and simultaneously increased more than other banks the share of highly liquid instruments required to fulfill the liquidity coverage ratio (LCR). To the

[3]Additional prudential requirements were phased in from January 1, 2016 to January 1, 2019. TLAC requirements have to be fulfilled by 2022.

[4]The empirical part of this study is based on bank-level data from the Basel Committee on Banking Supervision's (BCBS's) quantitative impact studies for 156 banks between 2011 and 2014.

best of our knowledge, almost no empirical analysis on the structural changes in G-SIBs' business models has been published so far,[5] thus our paper intends to fill this gap in the literature.

In this study, we empirically assess whether the post-crisis regulations specifically applied to G-SIBs, starting with their first designation by the FSB in 2011, have driven changes in their business models, broadly speaking. We first investigate whether the size and structure of the balance sheet has evolved in response to the new regulatory reforms, and we focus on the effects on the traditional activity of lending. Then, we evaluate changes in the risk-taking behavior and the cost of funding, to ultimately assess regulatory driven variations in overall profitability. In order to deal with such questions, we use granular balance sheet and income statement data from a sample of 97 large banks over a 12-year period between 2005 and 2016. Using this database, we apply an econometric approach inspired by the "difference-in-difference" methodology. We show that some key objectives of the BCBS have been achieved, namely we identify a major reduction of the balance sheet expansion of G-SIBs and a return to the mean in terms of financial leverage. However, it appears that the funding advantage derived by G-SIBs from the implicit public guarantees persists, which indicates that the "too-big-to-fail" status has not totally been put to an end.

The remaining of this paper proceeds as follows. Section 2 presents an overview of the post-crisis reforms dedicated to G-SIBs. In sections 3 and 4 we describe the data set and the methodology that allows us to analyze empirically our topic of interest. In section 5, we present the econometric results focusing on different aspects of banks' business model (balance sheet patterns, risk-taking, cost of funding, and profitability). Section 6 elaborates on the robustness of these results and section 7 concludes.

2. Overview of Post-Crisis Reforms for G-SIBs

The G-20 post-crisis agenda dealt with the systemic and moral hazard risks associated with systemically important financial

[5]See BCBS (2019) for a recent analysis of the trends of the indicators used in the BCBS methodology.

institutions (SIFIs)[6] with the aim to build a more resilient financial system. Almost 10 years after the G-20 leaders called on the FSB to propose possible measures to address the too-big-to-fail distortions generated by SIFIs, the need for concrete evidence on the contribution of the G-20 reforms in building a more resilient financial system is mandatory for the legitimacy and the credibility of FSB's post-crisis reform agenda.

Following the G-20 mandate given to the FSB in 2009, the concept of a G-SIB has been introduced to characterize the banks to be subject to new additional regulations. In November 2011, the BCBS published a methodology designed to identify these systemically important institutions focusing on five main features: size, interconnectedness, substitutability, global activity, and complexity (FSB 2011; BCBS 2011). Based on a score analysis, a first list of 29 G-SIBs (17 from Europe, 8 from the United States, and 4 from Asia) was published by the FSB in November 2011. Ever since, this list is updated and published annually each November on the FSB website.[7] This identification methodology went through several changes since its creation, particularly in November 2012 when it was revised to allocate G-SIBs into five *"buckets"* of ascending levels of systemic importance (FSB 2013a, 2014a, 2015a).[8] The latest version of the BCBS methodology was disclosed in July 2013 (BCBS 2013a).[9] Appendix B provides a broad description of this methodology developed by the BCBS for the identification of G-SIBs.

The designation of G-SIBs and their allocation into buckets were primarily conceived to enforce gradual additional capital requirements. Initially, only risk-based capital buffers were required, staging from 1 percent to 3.5 percent. More recently, in 2017, a corresponding additional buffer for the leverage ratio requirement of G-SIBs

[6] FSB (2011).

[7] http://www.fsb.org/work-of-the-fsb/policy-development/systematically-important-financial-institutions-sifis/global-systemically-important-financial-institutions-g-sifis/. For annual updates used for this paper, please see FSB (2012, 2013b, 2014b, 2015b, and 2016b).

[8] Benoit, Hurlin, and Pérignon (2019) question the adequacy of the current BCBS's methodology. They propose a correction of the score methodology and an alternative list of systemically important institutions to be further used to set capital surcharges or alternative tax on systemic risk.

[9] Available online at https://www.bis.org/publ/bcbs255.htm.

was also introduced. However, such additional capital buffers are only one aspect of the direct consequences of being designated as a G-SIB. Indeed, G-SIBs are also subject to a minimum TLAC requirement ensuring that in case of resolution the bank holds enough instruments to absorb losses and to be recapitalized without public funds intervention (cf. FSB 2014a). Other consequences of the G-SIB designation also have to be taken into account: for instance, cross-border supervisory colleges are put in place for almost all G-SIBs in order to enhance international supervisory cooperation, and G-SIBs are subject to further resolution planning expectations from authorities. G-SIBs are also requested to take part into additional reporting and statistical data collections, such as the FSB Datagaps initiative that imposes a weekly submission of their main exposures and a monthly submission of their top financing sources. Finally, the annual publication of the list of G-SIBs by the FSB is supposed to draw investors' attention on this particular set of banks, so a specific "market discipline" is supposed to affect them. Hence, for the remainder of this paper, it is crucial to have in mind that what we call *the impact of the G-SIB designation* actually covers this complete set of consequences that applies to G-SIBs, and not only the sole capital buffer.

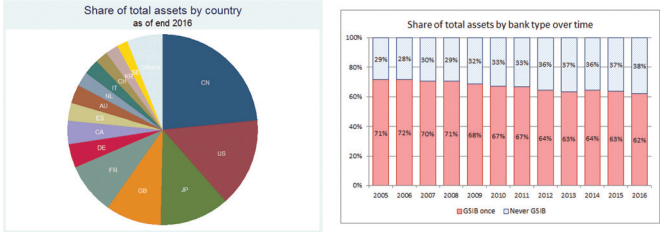
The constraints resulting from being a G-SIB were staged through time, with a leeway for G-SIBs to anticipate or delay the change in balance sheet until the effective implementation date. Additionally, the phasing-in of Basel III may have affected G-SIBs differently from other banks due to their structure of activity.[10] It is thus not possible to precisely define a clear cutoff date where the G-SIB constraint would apply.

3. Data Set Description

We exploit balance sheet and income statement data for 97 large banks from 22 countries over the period from 2005 to 2016 (12 years). We focus on a sample of large banks with total assets exceeding 200

[10]For example, Birn, Dietsch, and Durant (2017) demonstrate that G-SIBs have suffered more than other banks from the treatment of derivatives and short-term loans that was made more stringent for the net stable funding ratio (NSFR).

Figure 1. Shares of Total Assets by National Banking System (left) and by Type of Bank (right)



billion euros[11] as of end-2016, at the highest level of consolidation (subsidiaries are excluded). A detailed list of banks considered in the study is provided in appendix A. The distribution of national banking systems into the aggregated total assets is shown in the left panel of figure 1 (for color versions of the figures, see http://www.ijcb.org). The right panel of figure 1 shows that the share of total assets held by banks that have been designated as G-SIB at least once by the FSB between 2011 and 2016[12] is decreasing over time within our sample.

For each bank, we collected a set of variables at yearly frequency[13] using the S&P Global Market Intelligence database.[14] Table 1 provides a description of the variables that we use as successive dependent variables in the regressions.[15]

[11]This cutoff is inspired by the €200 billion threshold in terms of Basel III leverage ratio exposure which is used by the BCBS to identify its sample. There are usually around 75 banks in this BCBS sample. The difference with our sample of 97 banks mostly comes from the different measures used (total assets versus leverage exposure) for several banks whose size is close to the €200 billion threshold. We chose total assets, as the leverage ratio exposure measure was not fully available over the period.

[12]They are listed in appendix A.

[13]Most series were not available at higher frequency (half-yearly or quarterly) for many banks. Moving to such higher frequency would therefore drastically reduce the number of banks in the sample.

[14]This was previously known as the "SNL Financial" database.

[15]Note that in order to avoid potential disturbance of our results by extreme outliers, some variables are winsorized at the 1st and 99th percentiles. This means that, for a given variable, any value larger than the 99th percentile will actually be capped at this level. Similarly, any value lower than the 1st percentile will be raised up to this level. Also note that, in order to ensure the stationarity of our series, which is required from an econometric technical perspective, all variables are expressed either as scaled by an aggregate (e.g., total assets), as ratios, or as growth rates.

Table 1. List of Dependent Variables

Variable Code	Variable Description	Obs.	Mean	Std. Dev.	Min.	Max.
Balance Sheet and Prudential Ratios						
TA gr	Total Assets (TA) Growth Rate	1,023	8.94%	13.34%	−21.01%	65.03%
TA/GDP	Total Assets over GDP	1,083	38.28%	41.61%	1.07%	206.96%
T1 gr	Tier 1 Capital (T1) Growth Rate	886	13.94%	21.75%	−25.4%	119.75%
T1/TA	Tier 1 Capital over Total Assets ("Leverage Ratio")	990	5.09%	1.81%	1.23%	10.22%
T1/RWA	Tier 1 Capital over RWA (Solvency Ratio)	972	11.72%	4.51%	4.9%	37.87%
CASH CB/TA	Cash and Balances with Central Banks over TA	681	5.97%	5.19%	0.11%	22.12%
CUST LOANS/TA	Net Customer Loans over TA	681	51.61%	14.95%	2.11%	82.05%
SUB DEBT/TL	Total Subordinated Debt over Total Liabilities	679	1.84%	1.13%	0%	6%
Profitability, Risk-Taking, and Yield Ratios						
NET PROF/OP INC	Net Profit over Op. Inc.	663	23.99%	44.36%	−513.49%	424.54%
ROA	Return on Average Assets	1,037	0.66%	0.53%	−0.87%	2.24%
ROE	Return on Average Equity	1,017	10.5%	9.08%	−24.6%	30.33%
NPL/LOANS	Share of NPL over Total Loans	1,003	2.73%	2.96%	0%	15.94%
RWA Density	Total RWA over Total Assets	1,000	47.4%	17.88%	6.77%	87.9%
LOAN YIELD	Total Loans Yield	686	5.22%	3.15%	0.58%	18.5%
DEP COST	Total Deposits Interest Cost	686	2%	1.66%	0.05%	8.4%
NIM	Net Interest Margin	686	2.16%	1.33%	0.09%	6.76%

In a first set of dependent variables, we focus on some key indicators of balance sheet and prudential ratios. Our first variables of interest are the yearly growth rates of total assets and tier 1 capital, as well as the size of banks relative to their national economy measured by gross domestic product (GDP). We also include two capital adequacy ratios: a nonweighted ratio dividing tier 1 capital (T1) by total assets (TA), which is a proxy of the leverage ratio (hereafter referred to as "leverage ratio"[16]) and a weighted solvency ratio dividing T1 capital by total risk-weighted assets (RWA). Finally, we have three indicators for the composition of the balance sheet: the share of cash (and balances with central banks) within total assets, the share of loans to nonfinancial customers within total assets, and the share of subordinated debt within total liabilities.

In a second set of dependent variables, we focus on profitability measures, risk-taking indicators, and yield rates. We include in this set of variables the ratio of net profit over the operating income, the return on assets (ROA), and the return on equity (ROE). In order to capture the risk-taking behavior of banks, we use the RWA density (i.e., total RWA over total assets), which corresponds to the average risk weight of the balance sheet, and we also compute the nonperforming loans (NPL) ratio as a measure of asset quality. We also investigate the loan yield, the average cost of deposits, and the net interest margin.

Table 2 displays some summary statistics for these dependent variables and details the means for G-SIBs and non–G-SIBs over the two periods (2005–11 and 2012–16). Figures 2 and 3 illustrate the evolution over time of the average of these variables of interest for G-SIBs versus non–G-SIBs. These figures and table 2 provide preliminary indications about some general trends that will further be confirmed econometrically in section 5. For instance, we notice a drastic reduction of the growth rate of total assets and of the return on equity for G-SIBs, compared with non–G-SIBs, during the second period. They also highlight a structurally lower leverage ratio for G-SIBs, but the gap compared with non–G-SIBs tended to shrink over time.

[16]It differs from the regulatory definition of the Basel III leverage ratio, which was not fully available over the period.

Table 2. Means by Subgroup and Subperiod

Variables	All Banks			G-SIB (At Least Once)		Never G-SIB			
	Mean 2005–11 (A)	Mean 2012–16 (B)	T-test (B) − (A) t-stat	Mean 2005–11 (C)	Mean 2012–16 (D)	Mean 2005–11 (E)	Mean 2012–16 (F)	T-test (E) − (C) t-stat	T-test (F) − (D) t-stat
Balance Sheet and Prudential Ratios									
TA gr	11.8%	5.71%	−7.489***	10.32%	0.48%	12.62%	8.49%	1.78**	7.977***
	Obs = 542	*Obs = 481*		*Obs = 193*	*Obs = 167*	*Obs = 349*	*Obs = 314*		
TA/GDP	38.97%	37.43%	−0.607	58.14%	52.07%	28.27%	29.62%	−8.258***	−6.574***
	Obs = 600	*Obs = 483*		*Obs = 215*	*Obs = 168*	*Obs = 385*	*Obs = 315*		
T1 gr	17.87%	9.59%	−5.761***	14.98%	5.68%	19.54%	11.48%	1.86**	3.646***
	Obs = 465	*Obs = 421*		*Obs = 170*	*Obs = 137*	*Obs = 295*	*Obs = 284*		
T1/TA	4.72%	5.56%	7.393***	4.33%	5.31%	4.94%	5.68%	3.851***	2.097**
	Obs = 556	*Obs = 434*		*Obs = 201*	*Obs = 143*	*Obs = 355*	*Obs = 291*		
T1/RWA	10.15%	13.74%	13.356***	10.15%	14.1%	10.15%	13.55%	−0.018	−1.159
	Obs = 548	*Obs = 424*		*Obs = 201*	*Obs = 143*	*Obs = 347*	*Obs = 281*		
CASH	5.4%	6.6%	4.687***	4.2%	7.33%	6.08%	6.2%	3.092***	−2.13**
CB/TA	*Obs = 356*	*Obs = 325*		*Obs = 129*	*Obs = 116*	*Obs = 227*	*Obs = 209*		
LOANS	51.84%	51.37%	−0.417	43.6%	43.4%	56.52%	55.79%	8.209***	8.233***
CUST/TA	*Obs = 356*	*Obs = 325*		*Obs = 129*	*Obs = 116*	*Obs = 227*	*Obs = 209*		
SUB	1.94%	1.73%	−6.059***	1.93%	1.73%	1.94%	1.73%	0.044	0.007
DEBT/TL	*Obs = 372*	*Obs = 307*		*Obs = 142*	*Obs = 116*	*Obs = 230*	*Obs = 191*		

(*continued*)

Table 2. (Continued)

Variables	All Banks			G-SIB (At Least Once)		Never G-SIB			
	Mean 2005–11 (A)	**Mean 2012–16 (B)**	**T-test (B) − (A) t-stat**	**Mean 2005–11 (C)**	**Mean 2012–16 (D)**	**Mean 2005–11 (E)**	**Mean 2012–16 (F)**	**T-test (E) − (C) t-stat**	**T-test (F) − (D) t-stat**
Profitability, Risk-Taking, and Yield Ratios									
NET PROF/ OP INC	21.09% *Obs = 367*	27.59% *Obs = 296*	2.178**	17.07% *Obs = 134*	24.72% *Obs = 94*	23.4% *Obs = 233*	28.93% *Obs = 202*	1.17	0.932
ROA	0.69% *Obs = 556*	0.63% *Obs = 481*	−1.635	0.59% *Obs = 202*	0.46% *Obs = 167*	0.74% *Obs = 354*	0.72% *Obs = 314*	3.201***	5.588***
ROE	11.52% *Obs = 536*	9.37% *Obs = 481*	−3.8***	9.9% *Obs = 189*	6.08% *Obs = 167*	12.4% *Obs = 347*	11.12% *Obs = 314*	2.816***	6.948***
RWA Density	49.09% *Obs = 551*	45.33% *Obs = 449*	−3.326***	44.07% *Obs = 201*	41.45% *Obs = 159*	51.97% *Obs = 350*	47.45% *Obs = 290*	5.237***	3.38***
NPL/LOANS	2.65% *Obs = 540*	2.83% *Obs = 463*	0.941	3.25% *Obs = 199*	3.12% *Obs = 161*	2.3% *Obs = 341*	2.67% *Obs = 302*	−3.922***	−1.431***
LOAN YIELD	5.57% *Obs = 362*	4.83% *Obs = 324*	−3.316***	4.7% *Obs = 113*	3.5% *Obs = 93*	5.96% *Obs = 249*	5.36% *Obs = 231*	4.036***	4.534***
DEP COST	2.25% *Obs = 362*	1.72% *Obs = 324*	−5.812***	1.76% *Obs = 113*	0.92% *Obs = 93*	2.47% *Obs = 249*	2.04% *Obs = 231*	4.065***	5.538***
NIM	2.25% *Obs = 362*	2.05% *Obs = 324*	−2.381***	1.88% *Obs = 113*	1.51% *Obs = 93*	2.42% *Obs = 249*	2.26% *Obs = 231*	3.674***	4.749***

Note: Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Figure 2. Evolution of the Average Balance Sheet and Prudential Ratios for G-SIBs (red/lighter bars) versus Non–G-SIBs (blue/darker bars)

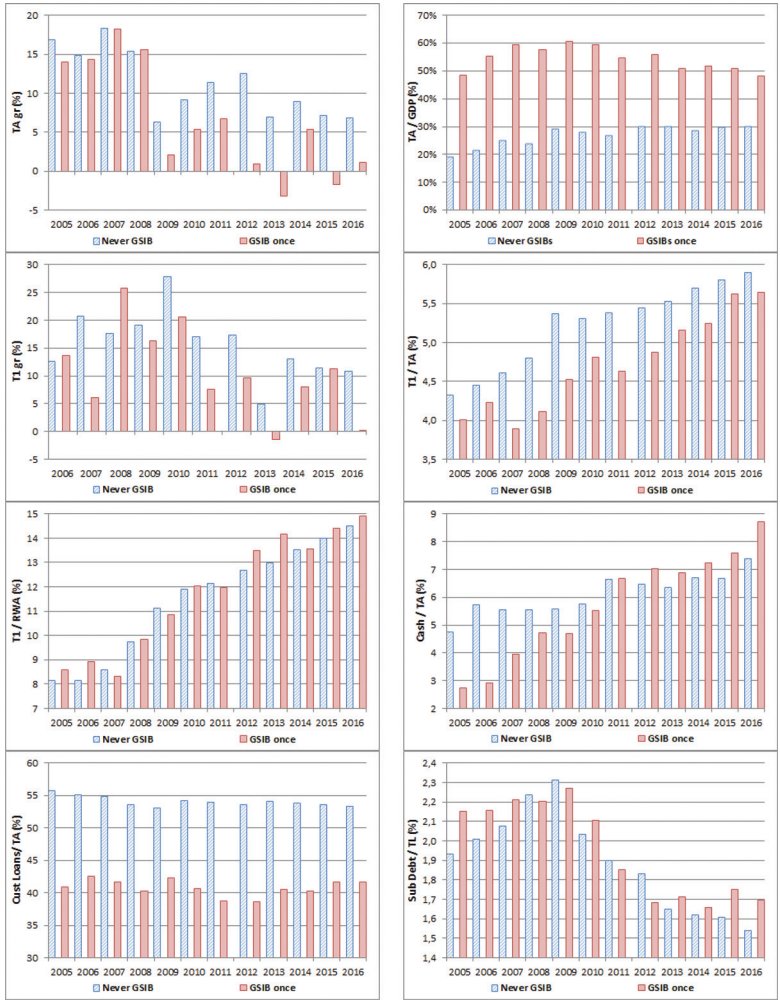
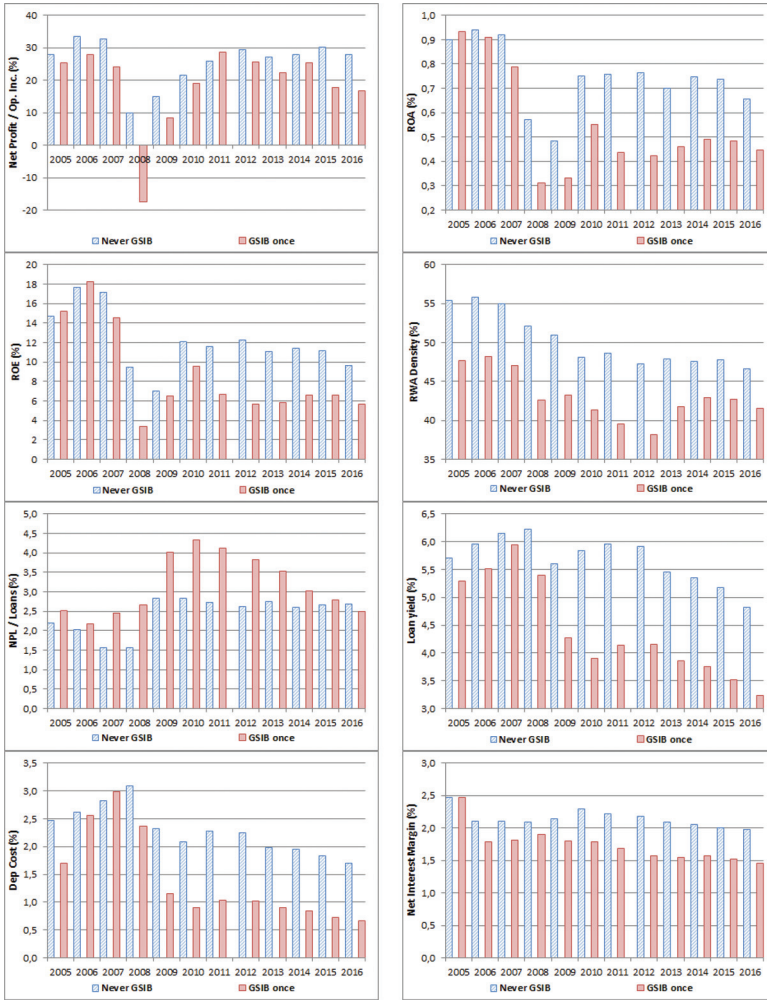


Figure 3. Evolution of the Average Profitability, Risk-Taking, and Yield Ratios for G-SIBs (red/lighter bars) versus Non–G-SIBs (blue/darker bars)



4. Econometric Methodology

4.1 Specification

This paper seeks to evaluate the changes that affected G-SIBs following the announcement and/or implementation of the prudential

rules dedicated to this specific category of banks. With such objective in mind, we rely on an approach inspired by the difference-in-difference methodology.[17] In a standard difference-in-difference model, the group of G-SIBs would correspond to the *treated* group while the group of other banks (here "non–G-SIBs") would constitute the *control* group. We compare the post-crisis reform-driven evolutions of business models' characteristics for these two groups of banks.

As the list of G-SIBs is relatively stable (with only a few entries and exits each year, if any),[18] we will consider as a G-SIB every bank that has been designated at least once by the FSB between 2011 and 2016. Hence we construct the $GSIB_{i,k}$ binary variable that takes value 1 for all periods t if the G-SIB i located in country k appeared on the FSB list at least once between 2011 and 2016, and 0 otherwise. Regarding the time dimension, even if it is not possible to precisely define a clear cutoff date where the G-SIB constraint would apply (due to the phased-in approach of the regulation, as discussed in section 2), we should recall that the first list of banks designated as G-SIBs was disclosed by the FSB in November 2011. Hence, we construct a binary variable $Post2011_t$ that equals 1 if $t > 2011$ and 0 otherwise. Note that, contrary to "event studies" papers, we do not rely on this precise cutoff date, as we do not claim that G-SIBs reforms had an effect on a very precise and short timing, but instead had a gradual effect over time. Section 6 provides some robustness checks testing alternative definitions of the $GSIB_{i,k}$ and $Post2011_t$ variables. Contrary to "placebo tests" usually performed in event studies, the fact that results remain stable for alternative cutoff date shows that the "arbitrary" decisions made for these two binary variables here are not driving the results.

In addition to these two main explanatory variables, a set of bank-specific time-varying control variables and some country-specific time-varying factors are considered. At the end, we select a given dependent variable Y (among those listed in table 1) for all

[17]We use a similar approach to the one developed by Grill, Lang, and Smith (2018), Hills et al. (2017), and especially Schich and Toader (2017), applied to different regulatory contexts.

[18]These rare changes of the list of G-SIBs might be used for other analyses, such as case studies, but this is not the purpose of this paper and this is left for future research.

banks i, incorporated in country k at time t, and we regress it on the two binary variables described above, $GSIB_{i,k}$ and $Post2011_t$, and on the cross-variable *interaction term* of these two variables: $(GSIB_{i,k} \times Post2011_t)$, as well as on control variables. We estimate the following model[19]:

$$Y_{i,k,t} = \alpha + \beta GSIB_{i,k} + \gamma Post2011_t + \delta(GSIB_{i,k} \times Post2011_t) + \varphi B_{i,k,t} + \chi C_{k,t} + PTH_t + u_{i,k,t}, \quad (1)$$

with $B_{i,k,t}$ being the set of bank-specific control variables, $C_{k,t}$ the set of country-specific macroeconomic control variables, PTH_t a conditional time-dummy variable capturing potential violations of the "parallel trend hypothesis,"[20] and $u_{i,k,t}$ being an error term. Since we cannot be sure that observations are iid among banks, standard errors will be clustered at individual level in all our regressions.

The set of country-specific macroeconomic control variables $C_{k,t}$, described in table 3, will be included in all following regressions to take into account potential structural discrepancies between economies in terms of growth, wealth, unemployment, inflation, public debt, aggregate credit growth, and sovereign yield. These variables can also capture specific conditions of the macroeconomic environment in some countries, such as the sovereign debt crisis in Europe.[21] The annual growth rate of exchange rate against the euro is also included since our data set in entirely denominated in euros, for consistency reasons. The set of bank-specific control variables $B_{i,k,t}$ included in the regressions can vary from one dependent variable to another and will be described below each regression table in the next section.

The econometric identification strategy described in equation (1) allows us to assess the impact of the G-SIB designation on their

[19] Section 6 also provides some robustness checks of this model, testing alternative specifications.

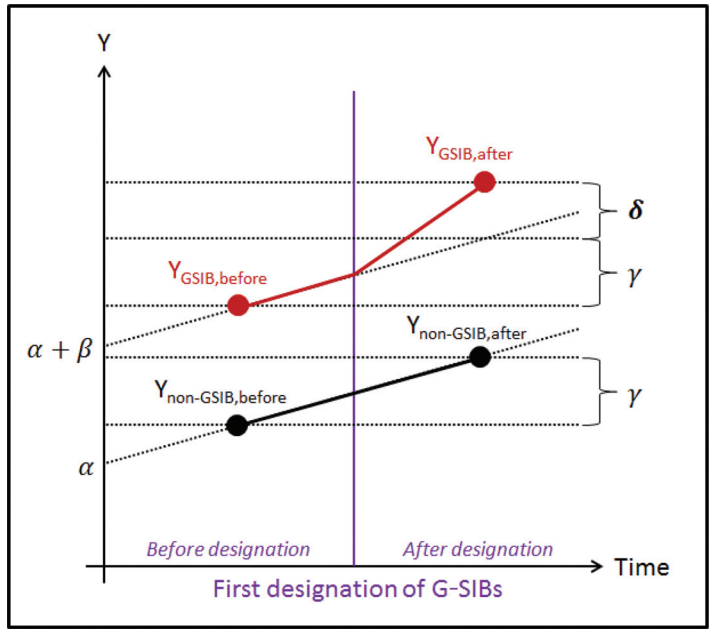
[20] See the explanation below in section 4.2.

[21] As an additional robustness check, we also include the 10-year government CDS spreads in order to capture the impact of the sovereign debt crisis that affected some countries. These results are presented in column "Gov. CDS Spread" of table 8.

Table 3. Set of Country-Specific Macroeconomic Control Variables $C_{k,t}$

Variable Code	Variable Description	Obs.	Mean	Std. Dev.	Min.	Max.
GDP gr	Real GDP Growth (%)	1,164	3.03%	3.72%	−7.93%	15.24%
GDPperCap	GDP per Capita (USD/Year)	1,164	35,943	19,160	714	102,723
UR	Unemployment Rate (%)	1,164	6.12%	3.18%	1.9%	26.09%
INPL	Inflation (%)	1,164	2.13%	1.96%	−1.35%	15.52%
PUBD/GDP	Public Debt/GDP (%)	1,164	67.17%	48.30%	4.95%	222.23%
DOMCRED gr	Domestic Credit Growth (%)	1,164	7.97%	8.23%	−15.07%	40.63%
SOVYIELD	10-Year Sovereign Debt Yield (%)	1,164	3.38%	2.47%	−0.14%	16.49%
FXRATE gr	Annual Growth Rate of Exchange Rate against Euro (%)	1,164	−0.60%	9.53%	−25.27%	59.6%

Figure 4. Illustration of the Econometric Methodology in the Univariate Case



structural patterns. It is applied successively to each of our dependent variables listed in table 1. Within this framework, our main parameter of interest will be δ, the coefficient of the interaction term. It captures the causal impact of the designation by the FSB on the Y variable for G-SIBs, controlling for both the effect of structural differences between G-SIBs and non–G-SIBs (captured by the coefficient β of the binary variable $GSIB_{i,k}$), and the time structural changes, or "industry trends" (captured by the coefficient γ of the variable $Post2011_t$). The graphic illustration in figure 4 gives a visual illustration of this approach in a simple univariate case.

However, it is recognized that this econometric identification has some limitations. The model is able to take into account general evolutions of the environment, both macroeconomic conditions and implementation of new regulations affecting the whole banking system. This is the purpose of using two subgroups and two subperiods that should be affected in a similar way by these general evolutions,

while only G-SIBs are affected by the designation. On the other hand, it will not be able to disentangle the effects of each individual consequence of the designation of a bank as a G-SIB by the FSB. As described in section 2, such designation entails several regulatory implications, such as capital buffers and TLAC requirements. Therefore, one should keep in mind that the estimator δ captures the *overall* effect of all diverse consequences posterior to the G-SIB designation, and not the impact of the sole additional capital requirement.

4.2 Parallel Trend Hypothesis

In an "ideal world" where the difference-in-difference methodology would purely apply, we should use as a control group the exact same set of treated banks, the *only* difference being that banks in the control group would not have been designated as G-SIBs. Such configuration is obviously impossible in the real world. Indeed, non–G-SIB are from the beginning smaller or less systemic than G-SIBs. Furthermore, some non–G-SIBs may also be subject to additional requirements, especially when they are designated as domestic systemically important banks (D-SIBs), even if this framework decided at the jurisdiction level is usually more recent and less homogeneous than the one of G-SIBs.

Thus, as a *second-best* option in this paper, we use all other large international banks not designated as G-SIBs as a kind of control group to capture the "industry trends" (i.e., the γ coefficient). The underlying assumption in this methodology is that both groups of banks (G-SIBs and non–G-SIBs) follow parallel trends before the designation, and that they would have continue to do so if the designation would not have occurred.[22] If the latter is clearly not testable, at least we can empirically check the former.

We can graphically assess on figures 2 and 3 whether the averaged characteristics of the two subgroups tended to evolve similarly before

[22]We also checked the parallel trends across different geographical regions (Europe, North America, China, and the rest of the world). We find no major differences in the evolutions of these variables for these four regions before 2011. However, the level of some indicators can differ for China. Therefore, we run an additional robustness check in section 6 (table 8) excluding Chinese banks from the sample. Results remain broadly unchanged.

the first designation of G-SIBs in November 2011. In order to assess more formally this "parallel trend hypothesis" (PTH) we perform a test, in line with what Danisewicz, Reinhardt, and Sowerbutts (2017) proposed. For each year preceding the first designation of G-SIBs we compute the annual growth rate of the dependent variables and then compare these growth rates between the two subgroups. Applying mean-difference t-tests, we determine whether these variables show significantly different annual evolutions between G-SIBs and non–G-SIBs. That is to say, if we notice a difference in the growth rates of G-SIBs versus non–G-SIBs, even at 10 percent significance level, then the parallel trend hypothesis will be deemed not fully met for this particular year. Table 4 summarizes the results of these tests of the parallel trend hypothesis for all our dependent variables listed in table 1.

Looking at the overall result of table 4, we see that the PTH seems met for most of the variables over the years between 2006 and 2011. The few violations of the PTH mostly tend to appear in years 2007, 2008, and 2009, which might be related to a different impact of the crisis on the two subgroups. When such violation of the PTH appears for a given year for a dependent variable, then we will include the time-dummy variable PTH_t in the regression. It will take value 1 for all i if the parallel trend hypothesis seems violated at time t for the dependent variable $Y_{i,k,t}$, even at a 10 percent significance level, and value 0 otherwise. Hence, it will try to capture the underlying source of divergence between the two subgroups that occurred during that particular year. When the PTH_t variable is introduced, it will be indicated at the bottom of each regression table in section 5.

4.3 Propensity Score Matching

In order to reduce heterogeneity between the G-SIB and non–G-SIB subgroups, an alternative approach can be used to construct the control group. We tested a propensity score matching (PSM) methodology and followed Stuart (2010). First, using a logit model, we computed the propensity scores of all banks (i.e., the probability of being designated as a G-SIB, given some covariates), using balance sheet, income statement, and profitability characteristics as

Table 4. Test of the Parallel Trend Hypothesis

Variable	2006			2007			2008		
	ΔGR	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**
TA gr	2.80	0.43		16.0	0.22		−1.3	0.27	
TA/GDP	0.02	0.37		0.00	0.98		0.09	0.09	*
T1 gr				−13.0	0.19		−3.6	0.63	
T1/TA	0.01	0.75		−0.1	0.01	**	−0.0	0.54	
T1/RWA	0.02	0.58		−0.1	0.00	***	0.13	0.00	***
CASH CB/TA	−0.0	0.79		0.44	0.20		−0.2	0.34	
LOANS CUST/TA	0.02	0.23		−0.0	0.81		−0.0	0.15	
SUB DEBT/TL	−0.0	0.35		−0.0	0.40		−0.2	0.28	
	2009			**2010**			**2011**		
Variable	**ΔGR**	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**
TA gr	−1.1	0.61		1.31	0.45		0.68	0.03	
TA/GDP	−0.0	0.94		0.01	0.37		0.00	0.91	
T1 gr	2.57	0.02	**	1.36	0.61		−0.3	0.33	
T1/TA	0.06	0.26		0.03	0.31		−0.0	0.06	*
T1/RWA	−0.0	0.41		0.03	0.17		−0.0	0.50	
CASH CB/TA	0.64	0.07	*	0.07	0.57		−0.9	0.06	*
LOANS CUST/TA	0.10	0.00	***	−0.0	0.22		−0.0	0.18	
SUB DEBT/TL	0.21	0.00	***	0.02	0.72		0.00	0.95	

(*continued*)

Table 4. (Continued)

Variable	2006			2007			2008		
	ΔGR	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**
NET PROF/OP INC	−0.1	0.22		0.03	0.85		3.80	0.21	
ROA	2.88	0.32		0.22	0.47		0.30	0.56	
ROE	3.78	0.29		−0.0	0.66		0.14	0.79	
RWA Density	−0.0	0.74		0.01	0.57		−0.2	0.14	
NPL/LOANS	0.08	0.31		0.04	0.84		0.12	0.58	
LOAN YIELD	0.08	0.03	**	−0.0	0.36		−0.1	0.07	*
DEP COST	0.15	0.19		−0.0	0.88		−0.2	0.00	***
NIM	0.04	0.52		0.04	0.59		0.16	0.17	
Variable	**2009**			**2010**			**2011**		
	ΔGR	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**	**ΔGR**	**p-val.**	**Sig.**
NET PROF/OP INC	−2.9	0.28		−3.6	0.23		1.10	0.11	
ROA	−2.0	0.37		−1.1	0.00	***	0.22	0.71	
ROE	−1.8	0.35		−1.0	0.00	***	0.24	0.65	
RWA Density	0.07	0.00	***	−0.0	0.46		−0.0	0.09	*
NPL/LOANS	−0.0	0.78		0.64	0.27		0.03	0.43	
LOAN YIELD	−0.0	0.81		−0.0	0.09	*	−0.0	0.36	
DEP COST	−0.2	0.00	***	−0.0	0.18		−0.1	0.21	
NIM	0.07	0.24		−0.0	0.27		−0.0	0.07	*

Notes: ΔGR indicates the difference between the year-on-year growth rates of the two subgroups of banks (G-SIBs and non–G-SIBs). We also report the p-value of the mean-difference t-test between these two growth rates. When we notice a significant difference, even at the 10 percent significance level, then the parallel trend hypothesis will be deemed not fully met for this particular year. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

explanatory variables. Then, each G-SIB was matched to the non–G-SIB with the closest propensity score (without replacement). All remaining non–G-SIBs were simply ignored. Finally, we rerun our regressions using this alternative control group. Results are displayed in table 8, column "PS Matching." Since they are very similar to our main approach described in the two previous subsections, both in terms of significance and magnitude, we decided to retain as the main methodology our initial strategy and consider the PSM as a robustness check analysis since it is based on a smaller sample.

5. Assessing Changes in Banks' Business Model

This section presents the regression results regarding the different aspects of the banks' business models. We first focus on some key balance sheet and prudential ratios (including balance sheet growth and structure, as well as capital adequacy). Then we turn to an analysis of profitability, risk-taking behavior, and yields.

5.1 Balance Sheet and Prudential Ratios

5.1.1 Growth of the Balance Sheet

Looking at the regression results in table 5, we notice a very significant negative sign for the interaction variable (δ coefficient) for the growth rate of total assets. It decreases by 5.8 percentage points (pp) on average for G-SIBs starting with 2012, everything else equal.

Result 1. *Everything else equal, G-SIBs have strongly curbed the expansion of their balance sheet since their first designation by the FSB.*

Note that, as shown in table 2, growth rates of total assets remain—at least slightly—positive on average for the two types of banks over the two subperiods. However, this relative slowdown of the expansion of G-SIBs' balance sheet, which we can attribute to the designation, is strongly consistent with the steady decline over time of the share of assets held by G-SIBs versus non–G-SIBs illustrated in the right panel of figure 1. When total asset is scaled by GDP, we also find strong evidence of the relative decrease of the weight of G-SIBs into their national economies.

Table 5. Balance Sheet and Prudential Ratios: Regression Results

	Dependent Variable							
	TA gr	**TA/GDP**	**T1 gr**	**T1/TA**	**T1/RWA**	**CASH CB/TA**	**LOANS CUST/TA**	**SUB DEBT/TA**
(β) GSIB	0.177	37.981**	0.100	−0.907**	−0.748	−0.300	−4.475	0.294
	(1.605)	(16.107)	(1.780)	(0.375)	(0.922)	(0.844)	(4.137)	(0.347)
(γ) Post2011	−1.651**	2.301	−3.730**	0.509***	1.974***	2.312***	3.555***	−0.234
	(0.834)	(1.499)	(1.737)	(0.107)	(0.451)	(0.804)	(1.160)	(0.157)
(δ) GSIB	**−5.763*****	**−14.704****	**−2.512**	**0.589*****	**−0.133**	**2.340*****	**−1.120**	**0.301***
× Post2011	(1.392)	(7.234)	(2.039)	(0.200)	(0.569)	(0.809)	(1.545)	(0.169)
Size	0.019		−0.418	0.337**	−0.675*	0.232	−5.499***	−0.221*
	(0.636)		(0.765)	(0.167)	(0.350)	(0.387)	(1.070)	(0.115)
LOANS/TA			−0.074**	0.004	−0.058**			
			(0.029)	(0.008)	(0.025)			
DEP/TL			0.006	0.013*	0.013			
			(0.034)	(0.007)	(0.018)			
ROA			4.794***	0.459***	0.282			
			(1.579)	(0.117)	(0.224)			
Intercept	5.428	6.287	34.671**	−2.008	26.618***	2.900	151.677***	6.951***
	(12.297)	(5.752)	(16.821)	(3.407)	(6.627)	(7.983)	(21.167)	(2.148)
Obs.	1,023	1,083	883	946	930	681	681	679
Adj.-R^2	0.333	0.023	0.266	0.227	0.383	0.547	0.103	0.122
Macro Control Var.	YES	YES	YES	YES	YES	YES	YES	YES
PTH Dummy = 1 for Nonparallel Trends in Year(s)		2008	2009	2007 2011	2007 2008	2009 2011	2009	2009
Bank-Specific Control Variables included for Some Variables of This Set								
Size: Balance Sheet Size (Log of Total Assets) LOANS/TA: Loans to Total Assets DEP/TL: Deposits to Total Liabilities ROA: Return on Assets								

Notes: Figures are in percentage points. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard deviations are in parentheses.

This result 1 is then fairly consistent with the design of the BCBS's methodology used to identify G-SIBs, as it tends to indicate that G-SIBs try to reduce their systemic footprints by actively reducing the expansion of their balance sheet, as the size indicator is of paramount importance in the identification of G-SIBs performed by the BCBS (cf. appendix B for more details). It is then not surprising that this indicator seems strategically managed in order to avoid, or at least minimize, the additional regulatory constraints that follow the designation of a bank as a G-SIB. Note that conversely some banks might also be tempted to increase their systemic footprint so as to be designated as G-SIB and benefit from an increased implicit bailout guarantee. However, such behavior would tend to bias our δ estimate toward zero, hence it does not contradict result 1.

We also tested whether such downward pressure was noticed for other indicators used in the BCBS's methodology. Out of the 12 indicators used by the BCBS in its G-SIB identification methodology, we could replicate 6 of them with enough accuracy using the S&P Global Market Intelligence database. Apart from the growth rate of total assets, although we find a negative coefficient for most of them, the strategic reduction of the systemic footprint does not appear significant for the other systemic indicators of the BCBS methodology, as they can be proxied from public data.[23]

5.1.2 Prudential Ratios

Our focus is now drawn toward solvency patterns.[24] Both structural and time differences can be noticed. We find a significant structural gap in terms of leverage ratio (T1/TA) between G-SIBs and non–G-SIBs (coefficient β). This implies that G-SIBs are generally more leveraged than non–G-SIBs, with a leverage ratio 0.91 percentage point lower than the one of non–G-SIBs, everything else equal. Such

[23]This complete analysis of the proxy indicators used in the BCBS's methodology can be obtained from the authors upon request.

[24]For the growth rate of tier 1 capital, and for the two capital adequacy ratios (leverage ratio and tier 1 solvency ratio), we include as bank-specific control variables two ratios describing the level of retail activities in banks' balance sheets: the share of loans within total assets and the share of deposits within total liabilities. We also include the return on average asset to take into account differences in assets profitability, which is likely to impact banks' ability to raise capital.

structural gap between G-SIBs and non–G-SIBs does not appear significant for the risk-weighted capital ratio (T1/RWA). For these two capital ratios, the coefficient γ is positive and strongly significant, so all banks display higher solvency levels in the second period. This is consistent with the adoption of the Basel III regulatory framework that imposed all banks to boost their solvency ratios.

The main interest variable, $GSIB \times Post2011$, brings additional interesting evidence, although counterintuitive at a first view: the coefficient δ is significant only for the leverage ratio and not for the risk-weighted solvency ratio. Since the designation of a bank as a G-SIB automatically results in an additional capital buffer on top of the minimum risk-weighted solvency requirements, one may have expected a positive and significant coefficient here. In fact, such mechanical explanation does not take into account the general race for higher solvency ratios. Many banks, either G-SIBs or not, have increased their solvency ratio more than requested by the Basel III standards, as a response to market and supervisory pressure (such as "pillar 2" additional requirements, for instance). Such general hoarding of new capital is reflected in our results by the coefficient δ which is not significant for the growth rate of tier 1 capital (T1 gr): G-SIBs did not increase their tier 1 more than their peers following their designation. This may also come from the fact that some banks among the non–G-SIBs might be subject to equivalent additional capital requirements, such as a D-SIB buffer.[25] These two elements could partly explain why the G-SIB designation has no significant effect on the G-SIBs' risk-weighted capital adequacy ratio in our results.

On the contrary, we notice a significant and substantial effect on the leverage ratio, which shows an additional increase by 0.59 pp for G-SIBs on top of the general improvement of 0.51 pp that affected all banks in the second period. As G-SIBs used to be more leveraged than other banks before 2011, this further improvement of the leverage ratio helped them bridge this leverage gap, at least partly. It is noticeable that such an evolution occurred years before the discussion about a possibly higher leverage ratio requirement for G-SIBs began.

[25]If they are listed as "domestic systemically important banks" by their national supervisory authority; please see BCBS (2012).

Result 2. *The G-SIBs designation seems to have triggered an additional increase of the leverage ratio for the subgroup of G-SIBs since 2012, tending to bridge the structural leverage gap noticed between G-SIBs and non–G-SIBs. Surprisingly, the designation does not seem to have an impact on the levels of the risk-weighted capital ratio in the second period.*

5.1.3 Balance Sheet Structure

Beyond the pressure to raise capital, the G-SIB reform agenda might also lead banking institutions to modify their balance sheet. In order to reach the new capital requirements, an alternative to capital increase would be to change the composition of the balance sheet or to improve the quality of asset portfolio. One can also expect that banks will be incentivised to increase the share of stable loss-absorbing liabilities. To assess the evolutions of banks' balance sheets, we use a detailed breakdown of both assets and liabilities.[26] All variables of this breakdown of banks' balance sheet have been tested to provide an in-depth assessment of potential structural changes attributable to the G-SIB designation. For the sake of simplicity and brevity, only results with the most important policy implications are reported in this paper. However, results for all other variables for both asset and liability structure are gathered into a supplementary document available upon request to the authors.

With respect to asset portfolio, two main changes have to be highlighted. First, we find a significant positive impact (+2.3 pp) of the G-SIB reform agenda on cash and central bank holdings for the subsample of G-SIBs compared with other banks. This result

[26]Over the full database that comprises a maximum of 1,164 observations (97 banks time 12 years), we get 681 observations for assets structure and 679 observations for liabilities. On average, total assets can be broken down into cash and balances with central banks (6.0 percent of assets over the full panel), loans to banks (6.9 percent), loans to nonfinancial customers (51.6 percent), trading account (7.2 percent), available for sales securities (7.6 percent), held to maturity securities (2.9 percent), derivatives (6.6 percent), other financial assets (1.2 percent), intangible assets (0.7 percent), and other assets (9.3 percent). Total liabilities can be split into deposits from banks (11.6 percent of liabilities over the full sample), customer deposits (53.1 percent), subordinated debt (1.8 percent), senior debt obligations (17.5 percent), derivatives (7.0 percent), other financial liabilities (2.1 percent), and other liabilities (6.9 percent).

brings empirical proof of the efforts made by G-SIBs to catch up with a higher share of liquid assets of good quality from a relatively lower level recorded over the period 2005–11. This effect is likely to have been partially driven by expansive monetary policies around the world (quantitative easing programs and low interest rates) and the implementation of a new liquidity framework within the post-crisis reform agenda. Indeed, cash and balances with central banks are high-quality liquid assets taken for 100 percent as a buffer in the context of the liquidity coverage ratio (LCR). Even though the LCR is not a G-SIB-specific regulation, the fact that G-SIBs tended to lag behind in terms of cash holdings put a stronger pressure on these institutions.[27] Moreover, as one can see in figure 2, G-SIBs started to increase the share of cash since the crisis; this can easily be explained through market pressure to increase the holdings of high-quality liquid assets (the so-called flight to liquidity and quality). Still, taking into account the crisis effect in the regressions, using a set of macroeconomic control variables, we find that the G-SIB designation pushed further this reallocation of assets toward larger cash holdings.

Secondly, the share of loans to nonfinancial customers in the balance sheet was not affected by the overall regulatory framework designated for G-SIBs. It appears that over the second period all banks have raised their holdings of loans on average (as indicated by the coefficient γ of +3.6 pp). The estimated coefficient δ of the interaction variable is negative although not statistically significant. Such finding is in line with Admati and Hellwig (2014) sustaining that, according to the Modigliani-Miller view, higher capital requirements should have a limited impact on the bank's lending policy. It therefore provides empirical evidence against some industry's concerns that higher regulatory requirements would lead to a drop in credit supply.

Result 3. *Everything else equal, the most important change in broad asset structure driven by the G-SIB designation has been a 2.3 pp increase in the share of cash and central bank reserves that tended to*

[27] Our findings are in line with the conclusions of Birn, Dietsch, and Durant (2017) highlighting that between 2011 and 2014, G-SIBs effectively increased liquid assets more than other banks.

affect the structural gap in the share of cash recorded before 2011 compared with non–G-SIBs. Beyond that, the rest of the balance sheet does not seem to have been affected by the G-SIB designation, especially the ability of G-SIBs to provide loans and finance the real economy remained unchanged.

Turning now to the analysis of the structure of liabilities, the estimated coefficients δ suggest that the G-SIB designation and its regulatory consequences did not drive major shifts in the liabilities composition of G-SIBs, except a slightly significant increase of the share of subordinated debt (+0.3 pp after 2011 compared with non–G-SIBs). This finding may be linked to the introduction of the TLAC requirement, as some of the underlying debt instruments can be eligible to fulfill the required loss-absorbing capacity of the bank.

Result 4. *Everything else equal, apart from a small increase of subordinated debt, the G-SIB designation does not seem to have changed the liability structure of G-SIBs' balance sheet.*

5.2 Profitability, Risk-Taking, and Yield Ratios

We now focus on other aspects of banks' business model and analyze measures of profitability, risk-taking behavior, and yields. The challenges posed by new regulations and the macroeconomic environment are likely to affect the results of financial institutions. Banks designated as G-SIBs since 2011 are subject to more stringent regulatory requirements, which is generally considered costly by regulated banks (Institute of International Finance 2010). At the opposite, several empirical studies highlight that an improvement of the quality of capital reduces banks' risk-taking and leaves profitability unchanged in the long run (King 2010; Kashyap, Stein, and Hanson 2010). The aim of the analysis in this subsection is to examine the extent to which the regulatory driven changes have affected the risk-taking behavior, the cost of funding, and ultimately the profitability of banks designated as G-SIBs since 2011.

5.2.1 Profitability

Our investigation on the income statement composition provided clear evidence of the existence of a major structural difference in

the revenue mix of the two groups: G-SIBs report a much lower income generated by interest-bearing activities compared with other banks (non–G-SIBs) while the revenues from trading securities are considerably higher for the former subgroup. With regard to time variations, net gains on securities have increased for all banks during the second subperiod to the detriment of net interest revenues, which is consistent with the macroeconomic conditions characterized by low interest rates and the flattening of the yield curve. On the other hand, the model fails to find evidence that the designation of G-SIBs has significantly affected whatsoever their income statement composition, and especially their net profit.

Result 5. *The FSB designation of G-SIBs seems not to have had any statistically significant impact on their net profit (scaled by operating income).*

We observe from descriptive statistics (see table 2 and figure 3) that G-SIBs and non–G-SIBs have rather comparable profitability levels in terms of net profit, ROA, and ROE at the beginning of the study period, i.e., 2005–07. Then G-SIBs tend to be more heavily affected during the 2008–09 crisis. Finally, in the aftermath of the crisis, profitability is recovering for all banks relative to the crisis level, but G-SIBs' profitability remains at a lower level compared with their peers.

The results of the regressions fail to confirm the existence of a structural difference (β coefficient) between the two subgroups of banks over the full period (2005–16), all things being equal. The second subperiod (2012–16) is characterized by a significantly higher profitability than the first one (i.e., 2005–11), which is rather consistent given the fact that the first subperiod includes the financial crisis. Such overall improvement of profitability can be seen for the three profitability indicators. As a consequence, the net profit (scaled by operating income) appears 21.6 pp larger in the second subperiod for the complete set of banks (γ coefficient).

Our empirical results in table 6 suggest that becoming a G-SIB had a significant negative impact on the ROE (–3.1 pp), which more than offset the upward profitability trend (+1.9 pp) noticed over the period for the whole sample of institutions. Econometrically, we do not find any impact of the designation on the return on assets

Table 6. Profitability, Risk-Taking, and Yield: Regression Results

	Dependent Variable							
	NET PROF/ OP INC	**ROA**	**ROE**	**RWA Density**	**NPL/ LOANS**	**LOAN YIELD**	**DEP COST**	**NIM**
(β) GSIB	24.457	−0.024	1.782	−3.784	0.737	−0.899*	−0.418**	−0.529*
	(15.034)	(0.093)	(1.566)	(3.615)	(0.692)	(0.497)	(0.193)	(0.295)
(γ) Post2011	21.553***	0.157***	1.853**	−2.714**	0.154	−0.087	−0.122	−0.064
	(8.073)	(0.042)	(0.790)	(1.256)	(0.242)	(0.110)	(0.120)	(0.082)
(δ) GSIB	**−4.610**	**−0.074**	**−3.064*** **	**4.609*** **	**−0.675***	**0.096**	**0.086**	**−0.051**
× Post2011	(7.309)	(0.053)	(1.056)	(1.432)	(0.348)	(0.134)	(0.138)	(0.087)
Size	−12.531*	0.046	−0.246	3.011***	−0.612**	−0.179	0.044	−0.072
	(7.580)	(0.037)	(0.652)	(1.152)	(0.290)	(0.114)	(0.081)	(0.067)
LOANS/TA	0.291	0.001	0.039	0.294***	−0.009	−0.017*	0.005	0.001
	(0.215)	(0.002)	(0.032)	(0.083)	(0.014)	(0.009)	(0.004)	(0.006)
DEP/TL	−0.155	0.004***	0.065*	0.001	−0.017	−0.014**	−0.020***	0.005
	(0.289)	(0.001)	(0.036)	(0.059)	(0.013)	(0.007)	(0.004)	(0.004)
RWA Density	−0.013							
	(0.207)							
Intercept	223.261	−0.872	2.801	−4.787	13.600***	10.289***	1.491	3.277**
	(150.737)	(0.741)	(13.333)	(22.710)	(5.254)	(2.278)	(1.783)	(1.374)
Obs.	637	1,026	1,007	994	998	686	686	686
Adj.-R^2	0.100	0.404	0.364	0.364	0.204	0.676	0.729	0.317
Macro Control Var.	YES	YES	YES	YES	YES	YES	YES	YES
PGH Dummy = 1 for Nonparallel Trends in Year(s)		2010	2010	2009 2011		2006 2008 2010	2008 2009	2011
Bank-Specific Control Variables included for Some Variables of This Set								
Size: Balance Sheet Size (Log of Total Assets) LOANS/TA: Loans to Total Assets DEP/TL: Deposits to Total Liabilities RWA Density: Total RWA over Total Assets								

Notes: Figures are in percentage points. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard deviations are in parentheses.

of G-SIBs, as the fall in their ROA is triggered by the crisis and not the designation. Therefore, taking the ROA as exogenous, and everything else equal, we interpret the negative impact of the designation on the return on equity (ROE) as a "mechanical" effect of the general improvement of G-SIBs' leverage ratio (LR), as it can easily be seen looking at the accounting equation (2) below.

$$ROE = \frac{R}{TE} = \frac{R}{TA} \times \frac{TA}{TE}$$
$$= ROA \times \frac{1}{LR} \qquad \Rightarrow \qquad ROA \times \frac{1}{\nearrow LR} = \overset{\searrow}{ROE} \qquad (2)$$

Result 6. *There is no empirical evidence of any G-SIB specificity in the level and change in the profitability of assets (ROA). On the contrary, G-SIBs' return on equity (ROE) appears negatively affected through a deleveraging effect induced by the G-SIB regulation.*

5.2.2 Risk-Taking Behavior

One can notice a sizable relative increase of the RWA density for G-SIBs in the second subperiod (+4.6 pp) while non–G-SIBs record a slight reduction of their RWA density. This situation could be interpreted as a willingness from banks to pursue riskier activities, and the moral hazard behavior springs to mind, but it may not be the main reason. Birn, Dietsch, and Durant (2017) tend to underline that off-balance-sheet (OBS) activity increased only for G-SIBs starting in 2011.[28] Such increase of OBS items would then translate into an increase of RWAs but not of total assets (by construction), which would ultimately result in an increase of the RWA density of G-SIBs. Meanwhile, such off-balance-sheet activities (for example, guarantees and undrawn credit lines) are not riskier than balance sheet activities, if correctly measured.

Secondly, the increase in the amount of RWAs for G-SIBs could be partly explained by the implementation of Basel III standards for all banks through the period, combined with G-SIBs' higher

[28]This is an *indirect* observation based on the difference between the total leverage exposure measure, which comprises OBS items, and total assets, which does not.

exposure to market activities and particularly to counterparty credit risk and market risk. Indeed, the revision of market risk framework (under Basel 2.5 and Basel III) drove important increases in risk-weighted assets measures (counterparty risk capital charges, higher asset value correlation parameter for exposures to certain financial institutions, higher risk weights for securitized assets or derivatives).[29] Hence, this change of weights would have affected differently the two groups of banks and would have also triggered an increase of the average risk weight of G-SIBs' balance sheet, irrespective of any change in activity.

Finally, we cannot fully exclude the remaining explanation that some G-SIBs might have started to gradually shift their assets toward more heavily weighted (i.e., riskier) assets. However, if such voluntary risk-shifting is occurring for some banks in search for higher returns, it has not yet materialized in the intended improved profitability of G-SIBs' assets, neither in an increase of nonperforming loans (NPL). On the contrary, the share of NPL even seems to have been slightly reduced for G-SIBs following the designation.

Whatever the explanation for the underlying phenomenon of the increased RWA density of G-SIBs, this fact also brings insights for why we do not notice any significant impact of the designation on G-SIBs' risk-based solvency ratio (see section 5.1). In addition to the global race toward solvency ratios higher than minimum requirements for all banks, the higher increase of RWA density for G-SIBs also played a role, as it caught up their effort to increase tier 1, as shown in equation (3) below.

$$\frac{T1}{RWA} = \frac{T1}{TA} \times \frac{TA}{RWA}$$

$$= LR \times \frac{1}{RWA\,dens} \Rightarrow \overset{\nearrow}{LR} \times \frac{1}{\overset{\nearrow}{RWA}\,dens} = \left(\frac{\overrightarrow{T1}}{RWA}\right) \quad (3)$$

[29]See BCBS (2013b), which shows that group 1 banks' RWA increased in the aggregate by approximately 16.1 percent after applying the Basel 2.5 and Basel III frameworks.

Result 7. *The G-SIB regulation seems to have triggered an increase of their RWA density, but this does not seem to reflect a shift in the risk-taking behavior of these banks.*

5.2.3 Yields

The question that can be raised further in the analysis concerns the extent to which banks subject to higher regulatory requirements responded to the reduction in ROE. Using equation (1), we analyze the effects of G-SIB reform agenda on the cost of funding (especially for deposits), the yield of loans, and interest margins.

Over the available sample for the complete 2005–16 period (686 observations), the average yield on loans equals 5.2 percent while the average cost of deposits is 2.0 percent and the global net interest margin is 2.2 percent. The results of regressions, and particularly the estimated coefficient β, suggest that G-SIBs, compared with their peers, benefit from a structural lower cost of deposits in the range of 0.4 pp. Such funding advantage can be related to both the existence of implicit public support (cf. Schich and Toader 2017) and the greater diversification of G-SIBs (in terms of activity and geographic locations) that could lower their idiosyncratic risk in the view of investors.

Our findings suggest that, for G-SIBs, this lower cost of liabilities is transmitted to loans pricing to the extent that their average loan yield is structurally 0.9 pp lower than for non–G-SIBs. Furthermore, these structural features are stable over time for all banks, G-SIBs or not. The lack of significance for the coefficient γ of the "Post2011" time-dummy variable can be explained by the introduction of macroeconomic control variables, and particularly the 10-year sovereign debt yield that captures the impact of the evolution of the general interest rates environment. As for the interaction variable, we do not find any direct and significant impact of the G-SIB designation on these dependent variables.

Result 8. *The G-SIB designation did not have any impact on loans yields, cost of deposits, nor net interest margin. This lack of significant impact suggests that stricter regulation had no unintended effects so far on banks' and customers' funding cost. However, since the cost of funding appears to be structurally lower for G-SIBs, the*

absence of impact of the G-SIB regulation on this variable also corroborates the fact that the designation of G-SIBs did not put an end to the implicit public support.

6. Robustness Checks

6.1 Alternative Subperiods

In section 4, we described that we chose to split our panel into the two subperiods 2005–11 and 2012–16, so we included the $Post2011_t$ time-dummy variable in the regressions. As explained above, this cutoff date between 2011 and 2012 seems the more "natural," since the first list of G-SIBs was published in November 2011. However, on the one hand, someone could argue that a longer time is needed for real effects of this designation to materialize in the balance sheet/income statement of G-SIBs. This would lead to postponement of the cutoff date, for instance considering that the second subperiod only started in 2013 or 2014, instead of 2012. On the other hand, one could say that most effects may have been anticipated, either by banks themselves, or by the market.[30] This would argue for setting an earlier cutoff date—for instance, in 2011 or 2010. Therefore, we reran all the regressions displayed in section 5, each time using an alternative starting date of the second subperiod, ranging from 2010 to 2014, with 2012 being the baseline starting date used in all previous sections of the paper.

Table 7 shows the coefficient δ of the interaction variable for all dependent variables listed in table 1 and discussed in section 5 and for all alternative starting dates of the second subperiod between 2010 and 2014. As one can notice in this table, coefficients generally remain of the same magnitude, as well as their significance level. This indicates that the choice we made to consider 2012 as the start of the second subperiod—although still "arbitrary"—is not driving the results, and that similar conclusions would have been drawn if we had decided to set an earlier or later cutoff date.

[30] As mentioned by Moenninghoff, Ongena, and Wieandt (2015), the *Financial Times* published two lists of systemic banks in 2009 and 2010, before the first official publication of the FSB list in November 2011.

Table 7. Alternative Subperiods and Definition of G-SIB Subsample

	Second Subperiod Starting in:					G-SIB Binary Variable Used		
δ Coefficient for Dependent Variable:	**2010**	**2011**	**2012**	**2013**	**2014**	**G-SIB Once**	**G-SIB 2011**	**G-SIB Always**
TA gr	-5.079^{***}	-5.532^{***}	-5.763^{***}	-3.401^{**}	-2.154^{*}	-5.763^{***}	-6.31^{***}	-5.434^{***}
	(1.65)	(1.385)	(1.392)	(1.325)	(1.306)	(1.392)	(1.497)	(1.653)
TA/GDP	-14.374^{*}	-14.687^{*}	-14.704^{**}	-14.849^{**}	-13.837^{**}	-14.704^{**}	-17.472^{**}	-13.46
	(8.544)	(7.9)	(7.234)	(6.737)	(6.081)	(7.234)	(8.38)	(8.693)
T1/TA	0.45^{**}	0.483^{**}	0.589^{***}	0.65^{***}	0.646^{***}	0.589^{***}	0.541^{**}	0.49^{**}
	(0.215)	(0.204)	(0.2)	(0.199)	(0.191)	(0.2)	(0.213)	(0.222)
T1/RWA	-0.332	-0.203	-0.133	-0.426	-0.63	-0.133	0.103	-0.248
	(0.505)	(0.523)	(0.569)	(0.601)	(0.626)	(0.569)	(0.584)	(0.542)
T1 gr	-4.99	-4.641^{**}	-2.512	-1.514	-0.828	-2.512	-3.211	-2.024
	(3.079)	(2.332)	(2.039)	(1.721)	(1.78)	(2.039)	(2.057)	(2.023)
CASH CB/TA	2.7^{***}	2.518^{***}	2.34^{***}	2.249^{***}	2.196^{***}	2.34^{***}	2.319^{***}	2.266^{***}
	(1.028)	(0.905)	(0.809)	(0.732)	(0.702)	(0.809)	(0.803)	(0.833)
CUST LOANS/TA	-1.659	-1.592	-1.12	-0.244	-0.181	-1.12	-1.099	-0.327
	(2.031)	(1.746)	(1.545)	(1.365)	(1.295)	(1.545)	(1.538)	(1.605)
SUB DEBT/TL	0.33^{*}	0.324^{*}	0.301^{*}	0.323^{**}	0.271^{*}	0.301^{*}	0.281	0.35^{*}
	(0.177)	(0.178)	(0.169)	(0.161)	(0.158)	(0.169)	(0.178)	(0.18)
NET PROF/OP INC	6.064	1.798	-4.61	-6.663	-9.781^{*}	-4.61	0.333	-7.774
	(10.907)	(11.4)	(7.309)	(5.449)	(5.822)	(7.309)	(10.098)	(9.043)
ROA	-0.063	-0.101^{*}	-0.074	-0.031	-0.039	-0.074	-0.092^{*}	-0.08
	(0.065)	(0.061)	(0.053)	(0.054)	(0.052)	(0.053)	(0.05)	(0.05)
ROE	-2.302^{*}	-3.284^{***}	-3.064^{***}	-2.052^{**}	-1.841^{**}	-3.064^{***}	-3.084^{***}	-2.306^{**}
	(1.399)	(1.268)	(1.056)	(0.971)	(0.92)	(1.056)	(1.079)	(1.072)
NPL/LOANS	-0.393	-0.553	-0.675^{*}	-0.743^{**}	-0.699^{**}	-0.675^{*}	-0.509	-0.071
	(0.379)	(0.341)	(0.348)	(0.343)	(0.31)	(0.348)	(0.367)	(0.372)
RWA Density	4.108^{**}	3.914^{***}	4.609^{***}	5.429^{***}	5.608^{***}	4.609^{***}	3.468^{**}	3.733^{**}
	(1.619)	(1.514)	(1.432)	(1.409)	(1.408)	(1.432)	(1.598)	(1.616)
LOAN YIELD	-0.145	-0.039	0.096	0.31^{**}	0.337^{**}	0.096	0.015	0.051
	(0.156)	(0.13)	(0.134)	(0.158)	(0.165)	(0.134)	(0.154)	(0.159)
DEP COST	-0.018	0.012	0.086	0.225	0.198	0.086	-0.002	0.002
	(0.138)	(0.134)	(0.138)	(0.142)	(0.126)	(0.138)	(0.139)	(0.14)
NIM	-0.056	-0.058	-0.051	0.003	0.045	-0.051	-0.083	-0.064
	(0.111)	(0.1)	(0.087)	(0.082)	(0.082)	(0.087)	(0.095)	(0.099)

Note: Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard deviations are in parentheses.

6.2 Alternative Definition of "G-SIB" Subsample

Similarly, section 4 explains that the $GSIB_{i,k}$ dummy variable indicates all banks that have been identified as G-SIB at least once by the FSB between 2011 and 2016. In table 7, this baseline definition of the G-SIB subsample is referred to as "G-SIB Once." Alternative definition of this "G-SIB" subsample could have been used instead. Therefore, we reran all regressions presented in section 5 using two alternative G-SIB binary variables. With the first alternative we simply focus on the initial list of G-SIBs published by the FSB in November 2011 and simply ignore the few changes of this list that intervened in the following years. We refer to this first alternative dummy variable as "G-SIB 2011" in the regression table 7. The second alternative consists in restraining the binary variable to banks that have constantly been listed as G-SIBs between 2011 and 2016, and therefore use a stable list of permanent G-SIBs. We refer to this second alternative dummy variable as "G-SIB Always" in table 7.[31] We notice that most results remain the same whatever definition for the G-SIB subsample is used.

6.3 Taking into Account the Financial Crisis

The baseline equation (1) used in the paper includes a set of macroeconomic control variables, notably the unemployment rate and the GDP growth that should—at least partially—capture the effect of a macroeconomic downturn. However, in order to specifically isolate the impact of the 2008–09 financial crisis, on top of the macroeconomic control variables, we can add a "crisis" time-specific dummy variable taking value 1 only for years 2008 and 2009, like in equation (4) below. The results of this specification are available in column "Crisis Dummy" of table 8 and do not show major differences compared with the baseline results.

[31]The "G-SIB Always" variable identifies 26 banks. "G-SIB 2011" adds the following three banks compared with "G-SIB Always": Lloyds Banking Group, Commerzbank, and Dexia. "G-SIB Once" adds the following five banks compared with "G-SIB 2011": Industrial and Commercial Bank of China, China Construction Bank Corporation, Agricultural Bank of China Limited, BBVA, and Standard Chartered.

Table 8. Alternative Econometric Specifications

δ Coefficient for Dependent Variable:	Specification											
	Baseline	Crisis Dummy	Buffer Rates	First Bucket	Country FE	Country FE * 2	Regional FE	Without China	Gov. CDS Spread	Europe	No State Support (EU)	PS Matching
	Eq. (1)	Eq. (4)	Eq. (5)	Eq. (1)	Eq. (6)	Eq. (7)	Eq. (6)	Eq. (1)	Eq. (1)	Eq. (1)	Eq. (1)	Eq. (1)
TA gr	−5.763***	−5.818***	−2.783***	−5.49***	−5.963***	−4.701***	−5.818***	−6.828***	−6.664***	−5.577***	−4.999**	−5.134***
	(1.392)	(1.386)	(0.9)	(1.543)	(1.514	(1.472)	(1.386)	(1.595)	(1.64)	(1.998)	(2.327)	(1.507)
TA/GDP	−14.704**	−14.791**	−6.603	−15.115	−13.152**	−9.623**	−14.791**	−16.994**	−7.662*	−20.788*	−18.835	−13.471*
	(7.234)	(7.162)	(4.108)	(9.803)	(6.699)	(4.189)	(7.162)	(8.37)	(4.323)	(11.12)	(13.046)	(6.932)
T1/TA	0.589***	0.592***	0.415***	0.369	0.642***	0.399**	0.592***	0.491***	0.414**	0.362*	0.446*	6.408**
	(0.2)	(0.199)	(0.124)	(0.226)	(0.197)	(0.171)	(0.199)	(0.181)	(0.189)	(0.213)	(0.243)	(0.201)
T1/RWA	−0.133	−0.187	−0.247	−0.081	0.018	−0.378	−0.187	−0.263	−0.695	−1.71**	−1.947**	0.697
	(0.569)	(0.573)	(0.292)	(0.662)	(0.631)	(0.532)	(0.573)	(0.595)	(0.029)	(0.739)	(0.867)	(0.517)
T1 gr	−2.512	−2.819	−0.847	−2.386	0.275	−1.435	−2.819	−4.989***	−2.746	−0.948	−1.197	−2.036
	(2.039)	(2.108)	(1.033)	(2.337)	(1.913)	(1.991)	(2.108)	(1.852)	(2.278)	(3.118)	(3.253)	(2.211)
CASH CB/TA	2.34***	2.24***	1.218**	2.501***	2.422***	2.094***	2.24***	2.587***	2.268***	2.474**	2.444*	2.048***
	(0.809)	(0.806)	(0.494)	(0.864)	(0.763)	(0.655)	(0.806)	(0.895)	(0.864)	(1.261)	(1.484)	(0.649)
CUST LOANS/TA	−1.12	−1.091	−0.396	−1.441	−1.257	−0.903	−1.091	−2.742*	−0.584	−3.404*	−2.617	0.685
	(1.545)	(1.53)	(0.969)	(1.631)	(1.473)	(1.424)	(1.53)	(1.555)	(1.572)	(2.064)	(2.43)	(1.488)
SUB DEBT/TL	0.301*	0.298*	0.185*	0.261	0.183	0.157	0.298*	0.191	0.151	0.206	0.104	−0.009
	(0.169)	(0.169)	(0.105)	(0.178)	(0.205)	(0.169)	(0.169)	(0.192)	(0.158)	(0.213)	(0.237)	(0.208)
NET PROF/OP INC	−4.61	−2.099	−11.315*	−0.829	−0.606	−2.993	−2.099	−8.96	−8.759	−10.248	−0.443	−4.155
	(7.309)	(7.28)	(6.345)	(8.536)	(8.622)	(8.359)	(7.28)	(8.915)	(7.123)	(9.529)	(8.663)	(5.702)
ROA	−0.074	−0.052	−0.054*	−0.052	−0.093	−0.039	−0.052	−0.151***	−0.04	−0.207***	−0.165**	−0.107*
	(0.053)	(0.049)	(0.03)	(0.061)	(0.064)	(0.057)	(0.049)	(0.052)	(0.056)	(0.064)	(0.065)	(0.06)
ROE	−3.064***	−2.714***	−1.706***	−2.366**	−3.109***	−2.365**	−2.714***	−4.435***	−2.845**	−5.543***	−4.233***	−3.23***
	(1.056)	(1.001)	(0.654)	(1.157)	(1.157)	(1.076)	(1.001)	(1.153)	(1.133)	(1.466)	(1.554)	(1.17)
NPL/LOANS	−0.675*	−0.676*	−0.062	−0.835**	−0.384	−0.716*	−0.676*	−0.395	−0.671*	−1.791**	−1.092	−0.677
	(0.348)	(0.352)	(0.197)	(0.417)	(0.432)	(0.412)	(0.352)	(0.394)	(0.399)	(0.751)	(0.722)	(0.432)
RWA Density	4.609***	4.816***	3.443***	3.457**	3.809**	3.246**	4.816***	4.494***	4.156***	8.382***	8.877***	2.937**
	(1.432)	(1.415)	(0.876)	(1.549)	(1.512)	(1.302)	(1.415)	(1.469)	(1.515)	(2.147)	(2.521)	(1.332)
LOAN YIELD	0.096	0.057	−0.017	0.136	−0.1	−0.051	0.057	0.17	0.154	0.381	0.499	0.079
	(0.134)	(0.129)	(0.091)	(0.146)	(0.18)	(0.145)	(0.129)	(0.146)	(0.133)	(0.27)	(0.308)	(0.151)
DEP COST	0.086	0.086	−0.015	0.129	−0.134	0.074	0.086	0.134	0.069	−0.026	−0.019	0.26
	(0.138)	(0.138)	(0.103)	(0.141)	(0.167)	(0.123)	(0.138)	(0.148)	(0.129)	(0.3)	(0.366)	(0.171)
NIM	−0.051	−0.067	−0.02	−0.072	−0.052	−0.095	−0.067	−0.08	−0.02	0.158	0.413***	−0.88
	(0.087)	(0.088)	(0.058)	(0.095)	(0.089)	(0.086)	(0.088)	(0.089)	(0.093)	(0.115)	(0.154)	(0.103)

Notes: Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard deviations are in parentheses.

$$Y_{i,k,t} = \alpha + \beta GSIB_{i,k} + \gamma Post2011_t + \delta(GSIB_{i,k} \times Post2011_t) + \varphi B_{i,k,t} + \chi C_{k,t} + \lambda Crisis_t + PTH_t + u_{i,k,t} \quad (4)$$

6.4 Including G-SIB Buffers

In this paper we use a binary variable to distinguish G-SIBs from non–G-SIBs. Such approach is justified in order to apply the difference-in-difference methodology and to get directly interpretable magnitude of the coefficients. However such a choice neglects the fact that there are several G-SIB "buckets" (groups). Therefore, as a robustness check, we replace the dummy variable $GSIB_{i,k}$ in the interaction term with the level of G-SIB buffer applied to each bank. This gives us an alternative econometric specification to equation (1).

$$Y_{i,k,t} = \alpha + \beta GSIB_{i,k} + \gamma Post2011_t + \delta(Buffer_{i,k,t} \times Post2011_t) + \varphi B_{i,k,t} + \chi C_{k,t} + PTH_t + u_{i,k,t} \quad (5)$$

This alternative specification hence takes into account the various levels of the G-SIB buffers (from 1 percent to 2.5 percent). Overall results are displayed in the "Buffer Rates" column of table 8. If the sign and significance level of coefficients can still be interpreted as in equation (1), on the other hand the magnitude of coefficients are no longer comparable to the one estimated using equation (1). As one can notice, the main findings of the paper are still valid using this specification.

Furthermore, one could expect that being identified as a G-SIB in the first bucket (i.e., with the smallest systemic footprint) may not have the same consequences as being listed in the higher G-SIB buckets. Then, as a robustness check, we exclude the largest G-SIBs in order to focus only on G-SIBs in the first bucket (i.e., with systemic scores between 130 and 230 bp in the 2016 FSB's designation). Results are presented in the "First Bucket" column of table 8. Once again, the main findings of the paper are confirmed, though the effect on the leverage ratio disappears, as it seems mostly driven by the largest G-SIBs.

6.5 Geographic Dimensions

The baseline regression (1) of the paper includes a set of eight country-specific macroeconomic control variables that evolve over time. More simply, we could have used some country fixed effects (FE), as in equation (6) below, to capture time-invariant country-specific characteristics. Results of this alternative specification are shown in the "Country FE" column of table 8.

$$Y_{i,k,t} = \alpha + \beta GSIB_{i,k} + \gamma Post2011_t + \delta(GSIB_{i,k} \times Post2011_t) + \varphi B_{i,k,t} + \chi FE_k + PTH_t + u_{i,k,t} \quad (6)$$

On top of that, we can take into account that the 2008–09 financial crisis may have affected differently all countries represented in the panel, these country fixed effects may be differentiated between the pre- and post-crisis periods as in equation (7) below. These alternative results are displayed in the "Country FE * 2" column of table 8.

$$Y_{i,k,t} = \alpha + \beta GSIB_{i,k} + \gamma Post2011_t + \delta(GSIB_{i,k} \times Post2011_t) + \varphi B_{i,k,t} + \chi_1 FE_{k,(2005-2007)} + \chi_2 FE_{k,(2008-2016)} + PTH_t + u_{i,k,t} \quad (7)$$

Using equation (6), we can also use fixed effects by region, instead of by country, in order to take into account potential differences among regulatory frameworks in the United States, Europe, Asia, and the rest of the world. These results are shown in the "Regional FE" column of table 8.

Finally, we also rerun equation (1) excluding banks from China, as it is the largest country in the data set in terms of total assets as of end-2016. Results are presented in the "Without China" column of table 8. Once again, looking at these alternative specifications, we can broadly draw the same conclusions as those exposed in section 5.

6.6 The Influence of the State

The final alternative robustness check analysis will complement the set of macroeconomic country-specific control variables with market

data (retrieved from the Bloomberg database): we include the year-end spread level of the 10-year maturity sovereign CDS. Such additional variable will better capture the situation of countries that had to face a sovereign debt crisis, which could have had some repercussions on its national banking system. The results of this robustness check are shown in the "Gov. CDS Spread" column of table 8.

States can also influence banks through public support interventions, especially following the financial crisis. An alternative explanation for the reduction in asset growth observed in the paper could be that some banks received public financial assistance during the crisis and were subsequently forced to reduce their activity. In order to rule out this alternative hypothesis, we rerun our regressions, focusing only on European banks, excluding banks that received public assistance, as listed by the European Commission.[32] These two alternative specifications are shown in the "Europe" and "No State Support (EU)" columns of table 8, and, as one can notice, the δ coefficient for the growth rate of assets remains highly significant and of the same order of magnitude as in the baseline. Hence we can claim that this effect is not particularly driven by state supports.

7. Concluding Remarks

This empirical analysis of 97 banks over 12 years is designed to identify the changes in G-SIBs' business model characteristics after their first designation by the FSB in 2011, controlling for the changes also experienced by other banks (industry trends). First, it allows to identify initial structural differences between G-SIBs and other banks. In that respect, we show that G-SIBs are structurally more leveraged. We also find empirical evidence that G-SIBs benefit from a lower cost of deposits that is likely to indicate lower perceived idiosyncratic risk due to higher diversification and implicit public support.

Secondly, we also identify some changes that affected G-SIBs after their first designation by the FSB in 2011. Using our econometric identification methodology based on a difference-in-difference approach, we identify some key effects of the designation on G-SIBs'

[32]European Commission (2018).

activity. Using these quantitative results, this paper provides a first assessment of the effectiveness of the G-SIBs reforms undertaken after the 2008 crisis and determines whether the highlighted changes are in line with the objectives of the international regulators.

In terms of policy implications, this paper shows that some intended objectives have been achieved: the expansion of the balance sheet of G-SIBs has been drastically slowed down by the regulation. The financial leverage of the G-SIBs, structurally greater than that of the other banks before the designation, has also been reduced. Such increase of G-SIBs' capital base has strengthened their resilience, which has improved further global financial stability and social welfare. However, this "deleveraging" of the G-SIBs led to another logical consequence, although not specifically sought by the regulation: the reduction of their return on equity, due to a mechanical accounting effect.

Moreover, we show in this paper that potential negative unintended consequences of these regulations, which were pointed out either by theoretical considerations or by the fears expressed by the industry, actually did not materialize. Indeed, for the time being, we have not measured any reduction in the supply of loans to the economy, or excessive risk-taking by banks in search for higher yields, that could be attributed to these regulations.

On the other hand, as the structural funding advantage derived by G-SIBs from the implicit public guarantees appears to persist in the data, it seems that the objective of ending the status of "too big to fail" is yet to be achieved.

Appendix A. Banks included in the Panel

Table A.1. List of Banks Included in the Panel

N	Institution Name	Country	Total Assets (€bn)	Identified as G-SIB by the FSB					
				At Least Once	In 2011	In 2012	In 2013	In 2014	In 2015	In 2016
1	Dexia SA	BE	213	1	1	0	0	0	0	0
2	UBS Group AG	CH	872	1	1	1	1	1	1	1
3	Credit Suisse Group AG	CH	765	1	1	1	1	1	1	1
4	Industrial and Comm. Bank of China	CN	3,293	1	0	0	1	1	1	1
5	China Construction Bank Corp.	CN	2,860	1	0	0	0	0	1	1
6	Agricutural Bank of China Limited	CN	2,670	1	0	0	0	1	1	1
7	Bank of China Limited	CN	2,476	1	1	1	1	1	1	1
8	Deutsche Bank AG	DE	1,591	1	1	1	1	1	1	1
9	Commerzbank AG	DE	480	1	1	0	0	0	0	0
10	Banco Santander, SA	ES	1,339	1	1	1	1	1	1	1
11	Banco Bilbao Vizcaya Argentaria, SA	ES	732	1	0	1	1	1	0	0
12	BNP Paribus SA	FR	2,077	1	1	1	1	1	1	1
13	Credit Agricole Group	FR	1,723	1	1	1	1	1	1	1
14	Societe Generale SA	FR	1,382	1	1	1	1	1	1	1
15	Groupe BPCE	FR	1,235	1	1	1	1	1	1	1
16	HSBC Holdings Plc	GB	2,252	1	1	1	1	1	1	1
17	Barclays Plc	GB	1,421	1	1	1	1	1	1	1
18	Lloyds Banking Group Plc	GB	958	1	1	0	0	0	0	0
19	Royal Bank of Scotland Group Plc	GB	935	1	1	1	1	1	1	1
20	Standard Chartered Plc	GB	613	1	0	1	1	1	1	1
21	Morgan Stanley and Co. International	GB	401	1	1	1	1	1	1	1
22	UniCredit SpA	IT	860	1	1	1	1	1	1	1
23	Mitsubishi UFJ Financial Group, Inc.	JP	2,330	1	1	1	1	1	1	1
24	Mizuho Financial Group, Inc.	JP	1,511	1	1	1	1	1	1	1
25	Sumitomo Mitsui Financial Group	JP	1,457	1	1	1	1	1	1	1
26	ING Groep N.V.	NL	845	1	1	1	1	1	1	1
27	Nordea Bank AB (publ)	SE	616	1	1	1	1	1	1	1
28	JPMorgan Chase and Co.	US	2,362	1	1	1	1	1	1	1
29	Bank of America Corporation	US	2,074	1	1	1	1	1	1	1
30	Wells Fargo and Company	US	1,830	1	1	1	1	1	1	1
31	Citigroup Inc.	US	1,699	1	1	1	1	1	1	1
32	Goldman Sachs Group, Inc.	US	816	1	1	1	1	1	1	1
33	Bank of New York Mellon Corporation	US	316	1	1	1	1	1	1	1
34	State Street Corporation	US	230	1	1	1	1	1	1	1
Total for G-SIBs			47,236	34	29	28	29	30	30	30

(*continued*)

Table A.1. (Continued)

N	Institution Name	Country	Total Assets (€bn)	Identified as G-SIB by the FSB					
				At Least Once	In 2011	In 2012	In 2013	In 2014	In 2015	In 2016
35	Commonwealth Bank of Australia	AU	626	0	0	0	0	0	0	0
36	Australia and NZ Banking Group	AU	623	0	0	0	0	0	0	0
37	Westpac Banking Corporation	AU	571	0	0	0	0	0	0	0
38	National Australia Bank Limited	AU	529	0	0	0	0	0	0	0
39	KBC Group NV	BE	275	0	0	0	0	0	0	0
40	Banco do Brasil S.A.	BR	404	0	0	0	0	0	0	0
41	Itau Unibanco Holding S.A.	BR	394	0	0	0	0	0	0	0
42	Caixa Economica Federal	BR	369	0	0	0	0	0	0	0
43	Banco Bradesco S.A.	BR	347	0	0	0	0	0	0	0
44	Royal Bank of Canada	CA	805	0	0	0	0	0	0	0
45	Toronto-Dominion Bank	CA	803	0	0	0	0	0	0	0
46	Bank of Nova Scotia	CA	611	0	0	0	0	0	0	0
47	Bank of Montreal	CA	469	0	0	0	0	0	0	0
48	Canadian Imperial Bank of Commerce	CA	342	0	0	0	0	0	0	0
49	Bank of Communications Co., Ltd.	CN	1,147	0	0	0	0	0	0	0
50	Industrial Bank Co., Ltd.	CN	830	0	0	0	0	0	0	0
51	China Merchants Bank Co., Ltd.	CN	811	0	0	0	0	0	0	0
52	China Minsheng Banking Corp., Ltd.	CN	804	0	0	0	0	0	0	0
53	Shanghai Pudong Development Bank	CN	799	0	0	0	0	0	0	0
54	China Everbright Bank Company	CN	549	0	0	0	0	0	0	0
55	Ping An Bank Co., Ltd.	CN	403	0	0	0	0	0	0	0
56	Hua Xia Bank Co., Limited	CN	321	0	0	0	0	0	0	0
57	Bank of Beijing Co., Ltd.	CN	289	0	0	0	0	0	0	0
58	China Guangfa Bank Co., Ltd.	CN	279	0	0	0	0	0	0	0
59	Bank of Shanghai Co., Ltd.	CN	240	0	0	0	0	0	0	0
60	DZ BANK AG	DE	509	0	0	0	0	0	0	0
61	Landesbank Baden-Wurttemberg	DE	244	0	0	0	0	0	0	0
62	Bayerische Landesbank	DE	212	0	0	0	0	0	0	0
63	Danske Bank A/S	DK	469	0	0	0	0	0	0	0
64	Banco de Sabadell, SA	ES	213	0	0	0	0	0	0	0
65	La Banque Postale, SA	FR	230	0	0	0	0	0	0	0
66	Nomura International Plc	GB	336	0	0	0	0	0	0	0
67	Nationwide Building Society	GB	262	0	0	0	0	0	0	0
68	State Bank of India	IN	408	0	0	0	0	0	0	0
69	Intesa Sanpaolo SpA	IT	725	0	0	0	0	0	0	0
70	Cassa depositi e prestiti SpA	IT	410	0	0	0	0	0	0	0

(*continued*)

Table A.1. (Continued)

N	Institution Name	Country	Total Assets (€bn)	Identified as G-SIB by the FSB					
				At Least Once	In 2011	In 2012	In 2013	In 2014	In 2015	In 2016
71	Japan Post Bank Co., Ltd.	JP	1,617	0	0	0	0	0	0	0
72	Norinchukin Bank	JP	790	0	0	0	0	0	0	0
73	Sumitomo Mitsui Trust Holdings, Inc.	JP	455	0	0	0	0	0	0	0
74	Resona Holdings, Inc.	JP	384	0	0	0	0	0	0	0
75	Shinkin Central Bank	JP	274	0	0	0	0	0	0	0
76	Japan Housing Finance Agency	JP	214	0	0	0	0	0	0	0
77	Shinhan Financial Group Co., Ltd.	KR	312	0	0	0	0	0	0	0
78	KB Financial Group Inc.	KR	296	0	0	0	0	0	0	0
79	NongHyup Financial Group Inc.	KR	289	0	0	0	0	0	0	0
80	Hana Financial Group Inc.	KR	274	0	0	0	0	0	0	0
81	Woori Bank	KR	245	0	0	0	0	0	0	0
82	Korea Development Bank	KR	215	0	0	0	0	0	0	0
83	Cooperatieve Rabobank U.A.	NL	663	0	0	0	0	0	0	0
84	ABN AMRO Group NV	NL	394	0	0	0	0	0	0	0
85	DNB ASA	NO	292	0	0	0	0	0	0	0
86	PAO Sberbank of Russia	RU	394	0	0	0	0	0	0	0
87	Svenska Handelsbanken AB (publ.)	SE	274	0	0	0	0	0	0	0
88	Skandinaviska Enskilda Banken	SE	274	0	0	0	0	0	0	0
89	Swedbank AB (publ.)	SE	225	0	0	0	0	0	0	0
90	DBS Group Holdings Limited	SG	316	0	0	0	0	0	0	0
91	Oversea-Chinese Banking Corp.	SG	269	0	0	0	0	0	0	0
92	United Overseas Bank Limited	SG	223	0	0	0	0	0	0	0
93	Cathay Financial Holding Co., Ltd.	TW	239	0	0	0	0	0	0	0
94	Federal Home Loan Banks	US	1,002	0	0	0	0	0	0	0
95	U.S. Bancorp	US	423	0	0	0	0	0	0	0
96	PNC Financial Services Group, Inc.	US	347	0	0	0	0	0	0	0
97	Capital One Financial Corporation	US	339	0	0	0	0	0	0	0
Total for Non–G-SIBs			28,696	0	0	0	0	0	0	0

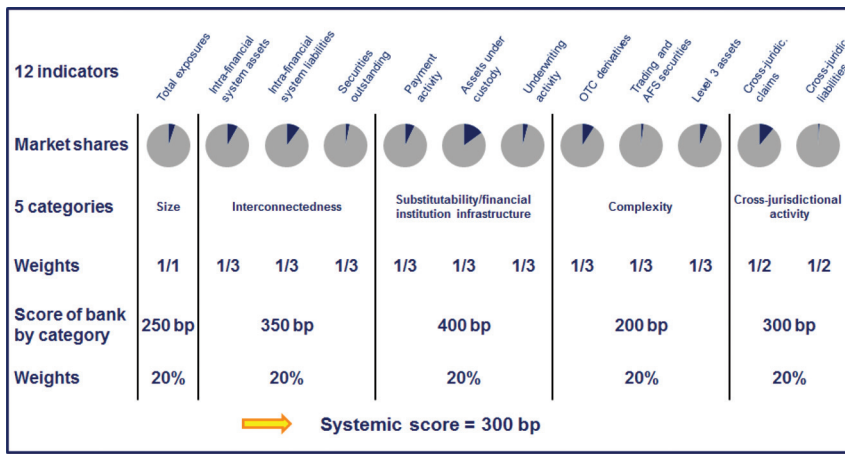
Note: Banks are ranked by (i) G-SIBs versus non–G-SIBs, (ii) country, and (iii) decreasing total assets as of end-2016.

Appendix B. Description of the Methodology Used by the BCBS to Identify G-SIBs

According to the BCBS methodology, banks' systemic footprint is assessed using a set of 12 indicators grouped into five categories. For each indicator, a "market share" is computed at bank level (i.e., the value of the indicator for bank i is divided by the sum of this indicator's values for all banks in the sample used by the BCBS). Within each of the five categories, the "market shares" of the underlying indicators are then equally weighted to compute a score in basis points. Finally, these five categories' subscores are averaged (20 percent each) to get the final systemic score. Figure B.1 provides an illustration of this methodology.

Once the systemic score is computed, banks are ordered and allocated into buckets according to their systemic score value. Only banks with systemic scores above 130 basis points are labeled as G-SIBs. For these banks, the allocation into buckets is made as follows. If its systemic score is between 130 and 230 basis points, the bank will be allocated to the first bucket and face an additional CET1 capital requirement (or "buffer") of 1 percent of its total risk-weighted assets. Next, buckets are then imposing more and more stringent buffers: 1.5 percent for banks with systemic scores between 230 and 330 bp, 2 percent between 330 and 430 bp, and 2.5 percent between 430 and 530 bp. Currently, the fifth and last bucket would

Figure B.1. Illustration of Current BCBS Methodology to Identify G-SIBs



trigger a 3.5 percent buffer if the systemic score were to reach the 530 bp threshold. For the time being, this last bucket is only "dissuasive" and has never been applied to any G-SIB.

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