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On Becoming an O-SII

("Other Systemically Important Institution")

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Abstract

How have financial markets reacted to the disclosure of the list of Other Systemically Important Institutions by the European Banking Authority? With an event study of bank stock prices, we document that the immediate reaction of the stock market is negative, suggesting that the included financial institutions are perceived to be less profitable because they are subject to tighter regulation. However, within a few days, investors change their perception in the case of both euro-zone and noneuro-zone banks, which can be attributed to their too-big-to-fail status. CDS spreads react similarly, increasing first before decreasing almost immediately thereafter. On the day of the event, abnormal returns are more negative for banks selected using supervisory judgement and for large banks. In the long run, the market reacts more positively in the case of financial institutions selected using discretionary information and those with a lower capitalization. (143 words)

Key words: Other Systemically Important Institutions, bank stock prices, CDS spreads, event study, abnormal returns

JEL classification: G21, G32, G34

1. Introduction

In October 2012, the Basel Committee on Bank Supervision (BCBS) published its framework for dealing with domestic systemically important banks. The Basel framework proposed the application of additional buffer requirements to such institutions to account for the externalities that they could exert on the domestic economy in the case of failure or distress. In this context, on April 25th, 2016, the European Banking Authority (EBA) disclosed the first official list of Other Systemically Important Institutions (O-SIIs).[1] These are financial institutions that are systemically important at the national level, a part of them being included on the list of Global Systemically Important Banks (G-SIBs). The latter are banks picked by the Financial Stability Board (FSB) in consultation with the Basel Committee on Banking Supervision from all Systemically Important Financial Institutions (SIFIs).[2]

National regulatory authorities also submitted lists of O-SIIs to the EBA, before or after the official publication of the O-SIIs by the EBA. In the end, the banks identified as O-SIIs by the national authorities were in fact on the official list disclosed by the EBA on April 25th, 2016. Although the EBA guidelines for identifying the O-SIIs were public and the investors could consult the national lists, there still was uncertainty in the market because nobody knew what the final designation list would look like and whether all the institutions deemed O-SIIs by the national authorities would be included.

The annual O-SII buffer assessment process comprises two main steps: first, identifying the O-SIIs within each jurisdiction and, second, assigning bank-specific O-SII buffer requirements to the institutions identified in the first step. The selection of the O-SIIs follows guidelines established by the EBA after consultation with the European Systemic Risk Board (ESRB) and reflects the 12 principles of the Basel Committee (BCBS, 2012) in dealing with Domestic Systemically Important Banks (D-SIBs). The objective is to identify institutions within the European Union with a significant contribution to systemic risk and negative externalities exerted at the national level.

[1] All European G-SIBs are by default O-SIIs, but not all O-SIIs are also G-SIBs. An institution being relevant at the global level from the standpoint of systemic importance and negative externalities created means it is also relevant at the national level; however, being relevant at the national level does not mean that the institution is also important at the global level.

[2] Besides financial intermediaries (banks), SIFIs include insurance companies (non-bank financial intermediaries) and other financial institutions. According to Zhou et al. (2012) SIFIs may jeopardize financial stability through counterparty, liquidity, and contagion risk.

Such a contribution can be based on size (e.g., total assets), interconnectedness with the financial system (e.g., intrafinancial system assets and liabilities), relevance to the economy (e.g., the amount of payments carried out at the national level), and/or complexity (e.g., cross-border assets and liabilities) (EBA, 2014). Whereas G-SIBs are required to hold additional capital of 1 to 2.5% Common Equity Tier 1 (CET1) to improve their loss absorption capacity (FSB, 2011), while also being subject to tighter and more effective supervision, O-SIIs must maintain a CET1 capital buffer of up to 2% of their total risk exposure.

Considering the importance of the publication of the official list for both banks and policy makers alike, first we examine whether the regulatory change regarding O-SIIs *per se* had any effect on the market, and then we assess how market participants reacted to the actual designation list. In particular, we investigate how the publication of the O-SII list impacted banks' stock returns and CDS spreads. From the shareholders' point of view, we aim to establish if the new regulatory framework had a *stigma* effect, i.e., the included financial institutions are perceived to be less profitable because they must maintain a capital buffer and are subject to tighter supervision, which is costly for the bank; *no effect*, i.e., the event does not bring any new information to the market; or a *positive* effect due to the association of O-SIIs with the too-big-to-fail (TBTF) status, which increases the probability of future bailouts in the case of collapse and may help such institutions obtain lower funding costs, thereby increasing profitability (e.g., Morgan et al., 2014; Gorton and Ordoñez, 2016). Not all the banks were required to build up additional capital buffers after the designation as O-SSI. In some jurisdictions, there is no capital requirement, whereas in others, it varies from 0.5% to 2%.

In our framework the *stigma effect* is defined as a penalization by the market of a bank after it was revealed publicly that it must comply with additional regulatory requirements. The designation as O-SII may impose such supplementary costs, like capital surcharges, or tighter supervisory requirements, thereby reducing banks' earnings prospects (Abreu and Gulamhussen, 2013; Kleinow et al., 2014; Dewenter and Riddick, 2018). Also, a special resolution regime for these banks could diminish future profits if it carries significant administrative and operational costs (Moenninghoff et al., 2015).[3]

[3] Our use of the word "stigma" should be distinguished from the so-called "discount window stigma" which is often used in the central banking literature. The latter stigma is related to reputational concerns regarding emergency lending programs, in particular when banks' identities could be formally or informally disclosed. Banks accessing the discount

From the bondholders' perspective, who seek protection via CDS, a negative reaction by the market can be linked to the fact that by being designated as an O-SII and therefore carrying an implicit classification as TBTF, a bank might take on more risk and succumb to moral hazard (Acharya and Yorulmazer, 2007; Farhi and Tirole, 2012). In contrast, by revealing the list of O-SIIs, policymakers may help reduce the information asymmetry surrounding banks and strengthen their capital buffers and compliance with specific regulatory measures. This can result in a safe effect for bondholders and can be associated with a *positive* reaction by the bond market.

Determining which effect dominates is relevant both for shareholders and for bondholders. To answer these research questions, we assess in a first stage the reaction of banks' stock prices and CDS spreads to the O-SII list announcement, employing an event study methodology. First, we study the day when the EBA published the O-SII list, i.e., April 25th, 2016. This day will be henceforth labeled as "the official event". Additionally, we examine whether there was a reaction on the days when the national regulatory authorities submitted the O-SII list to the EBA, henceforth "the national events".[4] Finally, for a comparison with other designation events, we investigate the financial markets' reaction to the publication of the G-SIBs list by BCBS and the inclusion of financial institutions in the Single Supervisory Mechanism (SSM) by the European Central Bank (ECB). In a second stage, we investigate potential determinants of the magnitude of bank stock abnormal returns, considering bank fundamentals such as risk strategies, size, ownership, and capitalization, as well as specific variables related to the capital requirements and identification of O-SIIs.

The empirical findings show that overall, the immediate reaction of the stock market is negative, i.e., there seems to be a *stigma* effect of being designated an O-SII. However, in the days surrounding the event, investors change their perception, resulting in an increase in shareholders'

window may then be penalized by the market as being financially weak, hence banks may become reluctant to access this window in the first place (Philippon and Skreta, 2012; Ennis and Weinberg, 2013; Armantier et al., 2015; Anbil, 2018).

[4] Each central bank or supervisory authority identified through a quantitative assessment or through supervisory judgement based on uniform criteria provided by the EBA the national list of O-SIIs. Subsequently, the national authorities notified the ESRB, the ECB and the EBA on these lists, which were afterwards published on the ESRB website. The first country that identified its O-SIIs was Denmark, on June 25th, 2014, whereas the National Bank of Poland and the National Bank of Bulgaria submitted these lists after the official publication of the O-SIIs by the EBA, i.e., on October 21st, 2016, in the case of Poland and December 12th, 2016, in the case of Bulgaria. In the end, the banks identified as O-SIIs by the national authorities were in fact on the official list disclosed by the EBA on April 25th, 2016. Therefore, we consider it worth investigating whether there was a reaction by investors after these "national events" on an aggregated basis, in addition to the single "official event".

wealth, consistent with a *positive* effect, and holding for both euro zone and noneuro zone banks. The results for the CDS spreads confirm the outcome obtained using stock returns: we find an increase in CDS spreads and thus a higher cost for the banks initially. However, on the first day after the event, the CDS spreads decrease. Further evidence suggests that the cumulative abnormal returns are not driven only by the events *per se*, being also related to other relevant factors such as the approach through which supervisors select banks that present systemic importance (based on qualitative and discretionary supervisory judgment or quantitative criteria), their size, capitalization and distance to default.

Our results are related to a broad literature on intervention mechanisms, regulation and market reactions. As the global financial crisis unfolded, public authorities (both national and supranational) took action with the use of different intervention measures and instruments to alleviate the consequences and negative externalities (see Goodhart, 2008; Praet and Nguyen, 2008; Panetta et al., 2009). Among the intervention schemes, the most frequently used were deposit guarantees, capital injections, and the setting up of new asset management companies, also known as “bad banks” (Hryckiewicz, 2014). The immediate objective of all these measures was to maintain financial stability, which was put at risk especially by the TBTF institutions and to restore the confidence in financial markets. However, the efficiency of these intervention policies, which used public money, is highly debated by academics. An extensive body of literature examines the impact of regulations and interventions on systemic risk (López-Espinosa et al., 2012; Londono and Tian, 2014; Berger et al., 2019; Nistor and Ongena, 2019), bank stability (Demirgüç-Kunt and Detragiache, 2011; Klomp and de Haan, 2012), bank risk-taking (Agoraki et al., 2011; Anginer et al., 2014) and liquidity risk (Brunetti et al., 2011; Aït-Sahalia et al., 2012). At first glance, these interventions should have had positive effects on banks because they provided liquidity and increased the confidence of market participants and customers. However, the empirical findings are inconclusive, either advocating or refuting the overall efficiency of the measures implemented and rescue packages that were provided to the banks. These aspects are of a primordial importance because taxpayers’ money is usually used to save banks and thus judicious actions are expected from governments to reduce the risk posed by TBTF institutions.

A series of regulatory measures have been proposed to address the issues of systemically important financial institutions. The majority of academics have agreed that imposing capital and/or liquidity surcharges based on an institution’s contribution to systemic risk to absorb future losses may be an appropriate tool to reduce negative externalities (e.g., Elliott and Litan, 2011; Ötker-Robe et al., 2011; Adrian and Brunnermeier, 2016; Acharya et al., 2017). In addition to capital surcharges, Elliott and Litan (2011) suggest limiting SIFIs' exposure to individual counterparties, requesting additional information be disclosed and limiting or eliminating certain types of proprietary trading and investment activity. Zhou et al. (2012) consider that shareholders and creditors should bear the losses (bail-in), and this action should be enforced together with other resolution tools. Ötker-Robe et al. (2011) propose an intensive supervision based on SIFIs' risk and resolution regimes at the national and global levels. However, Iwanicz-Drozdowska and Schab (2014) found that there are considerable differences among G-SIBs identified by the FSB and BCBS and that a uniform approach based on capital surcharges may not be appropriate. Furthermore, Elliott and Litan (2011) point out that charging additional capital for SIFIs may not result in less risk-taking.

Several studies have assessed the impact of regulatory changes on financial institutions using an event study methodology, including Schwert (1981) and MacKinlay (1997). The most recent papers focus on regulation of systemically important financial institutions across different regions, such as Europe (Petrella and Resti, 2013; Sahin and de Haan, 2016; Schäfer et al., 2016) and the US (Brewer and Klingenhagen, 2010; Abreu and Gulamhussen, 2013; Morgan et al., 2014; Schäfer et al., 2016). Additionally, some studies examine the market reaction of SIFIs' designation (Bongini et al., 2015; Moenninghoff et al., 2015).

Bekaert and Breckenfelder (2019) examine how investors re-allocate the holdings of O-SIIs securities following the public announcements by each national supervisor and show that following the inclusion on the O-SIIs list bank stock prices decrease relative to stock prices of non-O-SIIs. Petrella and Resti (2013) analyze 97 European banks that participated in the 2011 EBA stress test exercise. Their findings suggest no relevant impact on the market, concluding that the banks are opaque. Schäfer et al. (2016) assess the reaction of the stock returns and CDS spreads of banks from Europe and the USA to regulatory reforms after the crisis (i.e., the Dodd-Frank Act in the USA, the Vickers Report in the UK, the Restructuring Law in Germany, and TBTF Regulation in Switzerland). With a sample of the 10 largest banks in terms of market capitalization from the UK, the US, Germany, and Switzerland, the authors argue that the regulatory announcements led to a decrease in banks' stock prices and an increase in CDS spreads. Sahin and de Haan (2016) found limited market effects in terms of stock returns and CDS spreads to the ECB's

Comprehensive Assessment for 14 banks from the euro area. In contrast, Breckenfelder and Schwab (2018) document significant new information to market participants following the ECB's Comprehensive Assessment. In stressed countries bank equity prices declined and the risk spilled over to non-stressed euro area sovereigns.

For the US market, Brewer and Klingenhagen (2010) show that the largest TBTF banks experienced positive abnormal returns following the Troubled Asset Relief Program (TARP) compared with their smaller peers, whereas Abreu and Gulamhussen (2013) find no evidence of abnormal performance for the TBTF institutions following the FSB designation list. However, the analysis of Morgan et al. (2014) for the 19 largest US banks holding companies reveals the importance of stress testing, suggesting that stress tests can reduce banks' opacity. The findings of Moenninghoff et al. (2015) empirically show that government ownership influences the abnormal performance of banks. Furthermore, the analysis of Bongini et al. (2015) conducted for 70 of the world's largest banks, including G-SIBs, highlights the importance of banks' capital adequacy ratios. They provide evidence that banks with high capital adequacy ratios have positive abnormal performance, whereas their peers (i.e., banks with low capital adequacy ratios) experience negative abnormal performance.

Our work contributes to the literature in at least two ways. First, we provide estimates on the appropriateness and the necessity of disclosing financial institutions that are systemically important. To our knowledge, no other studies have assessed the reaction of banks' stock prices and CDS spreads to the O-SII list publication. Second, we contribute to the literature on O-SII determinants by investigating what can explain higher or lower cumulative abnormal returns. In our analysis, we focus on a large spectrum of (theoretically motivated) bank-specific characteristics, such as size, capitalization, distance to default, and ownership structure. The empirical specifications also include the CET1 capital buffer that some of the O-SIIs must hold and the way banks were identified as O-SIIs (i.e., using a quantitative approach or through supervisory judgement).

We find that, in the day of the event, abnormal returns are more negative for banks selected using supervisory judgement, which is based on discretionary information unknown by public, and for large banks. These are the banks that may have less leeway to mitigate the immediate negative impact of inclusion. Following the event, the market reacted more positively for financial institutions selected using supervisory judgement or for those with a lower capitalization, which present a higher probability of receiving future bailouts.

The remainder of our paper is structured as follows: In Section 2, we describe the sample, event dates, and methodology we employ; in Section 3, we discuss the empirical findings; and in Section 4, we conclude the paper.

2. Data and methodology

2.1 Sample

Our sample consists of a number of banks included in various lists on systemically important financial institutions published by supervisory authorities. First, we consider the official list of other systemically important institutions published by the European Banking Authority (April 25th, 2016). Second, an event study is carried out for the globally systemically important banks as defined by the Financial Stability Board and the Basel Committee on Banking Supervision (the list was first published on November 4th, 2011 and is renewed each year). Because the Financial Times twice leaked a list with the supposed G-SIBs before the publication of the official list, we also undertake an analysis of G-SIBs with the event day being 30 November 2009 (Financial Times). 19 out of 24 banks disclosed by the newspaper proved to be on the official list G-SIBs list when it was first published. Third, we analyze the effect of being included in the SSM list of the ECB (the list of supervised banks was first released on September 4th, 2014 and is renewed each year).

For all these lists, we select the banks with available data on stock prices and CDS spreads on Thomson Reuters Datastream and Bloomberg databases. To achieve a more representative sample and to eliminate the survivorship bias, we also pick the stocks that are currently no longer traded (appearing as "dead" on Datastream) but have prices and CDS spreads for the event day, event window, and estimation window. A detailed list of all these banks is provided in Table 1.

INSERT TABLE 1

Starting from the O-SII list published by the EBA (2016) consisting of 173 financial institutions, we can include in our initial sample only banks with data on stock prices available for the event window and an estimation period of 250 trading days. From the initial set of banks, 72 are subsidiaries of other banks or financial holdings, and 116 are not public at the time of the designation. From the list of 57 publicly traded banks, two of them are subsidiaries of Nordea from Finland and Denmark,[5] and one of them is ABN AMRO, for which we did not have enough observations to compute the expected return (it was relisted in November 2015). We arrive at a sample consisting of 54 banks for conducting the event study on the official EBA event and 64 banks for investigating market behavior for the national event date. These data represent 24 countries, 15 euro-area and 9 noneuro-area countries. The number of banks per country ranges from 1 to 8. The countries with the largest number of banks are Poland (8 banks), Spain (6 banks), and the UK (5 banks). For the official event, we do not include the banks from Poland and Bulgaria, as they do not appear on the official list disclosed by the EBA. Therefore, we have 54 for the official event, and 64 banks for the national events. Table 1 presents the sample of the O-SIIs included in our analysis and information regarding their size as of December 31st, 2015 (previous to the publication of the list). Our sample represents 65.55% of the total assets of the EU credit institutions and 92.06% of the total assets of the credit institutions within the euro area at the end of 2015. According to ECB (2016), the total assets of credit institutions in 2015 headquartered in the EU amounted €33,798 billion, whereas the total assets of credit institutions within the euro area amounted €24,067 billion. The sum of total assets for our sample of 54 banks is €22,156.11 billion as of 31 December 2015. The largest banks are those from the UK, representing 27.33% of our sample's size, whereas the weight of the total assets of the euro area O-SIIs in the sample is 62.08%.

The list of the O-SIIs used for the event study on CDS spreads is also shown in Table 1. As it includes only banks with data on CDS spreads available in Datastream and Bloomberg, for the event window and an estimation period of 250 trading days prior to it, the composition differs from the previous sample and it includes 40 banks for the official event analysis and 41 banks for the national events analysis. They represent 14 countries, and the number of banks per country ranges from 1 to 6, Germany, the UK, Spain, and Sweden being the countries represented by the largest number of banks.

[5] Nordea relocated its headquarters to Finland in 2017, but at the time of the publication of the O-SIIs list, it was considered a Swedish bank and was placed outside the euro zone.

2.2 Event dates

For an in-depth analysis and to capture all the relevant abnormal returns, we take into consideration several event dates for each list of banks. Hence, for the O-SIIs, the official date when the EBA published the list is used along with the very first time (not considering the subsequent days) the national banks of each country where the banks' headquarters are located sent the notification with the O-SIIs to the European Systemic Risk Board (the unofficial date). In this way, we can assess whether there is a difference in terms of effects between these two event dates and how the market reacted to these two announcements, which can be considered international and domestic, respectively.

For the G-SIBs, the relevant dates are the date when the FSB published the official list (November 4th, 2011) and the first date the Financial Times publication leaked the supposed list (November 30th, 2009).[6] For the banks included in the Single Supervisory Mechanism, we take as the event date the first time that a particular bank was included on the SSM list, starting with September 2014 when for the first time the sample of banks was made public. For all these subsamples, we consider as an event date the day the banks were first included in any of these lists. Our main purpose is to assess which of these events were the most significant (and brought new information in the market) in terms of abnormal returns. A timeline with all the events is represented in Figure 1.

INSERT FIGURE 1

2.3 Methodology

2.3.1 Abnormal return computation

In our analysis, to determine the impact of the designations to certain categories by specific regulatory bodies (i.e., O-SIIs, G-SIBs and SSM), we closely follow the standard event study techniques used in the literature, such as Schwert (1981), MacKinlay (1997), and Lamdin (2001).

[6] We do not analyze the second date of publication in the *Financial Times* (one year later) because it contains the same banks (24) as the first publication.

In the literature, the most used models for computing abnormal return (AR) are the market model, the Capital Asset Pricing Model (CAPM) and the Fama and French factor models. A concern related to these models is that they ignore the complexity of globalized markets in which the markets may not be perfectly integrated but rather segmented (Bekaert and Harvey, 1995; Bekaert et al., 2009). Integration is assumed when the company's stockholders hold globally diversified portfolios, whereas segmentation describes the situation in which stockholders are located in and invest mostly in the home country (Bodnar et al., 2003).

To overcome these drawbacks, we follow the approach proposed by Bekaert et al. (2009), simultaneously allowing regional and global benchmarks (i.e., a hybrid CAPM), in addition to the single global, regional or local benchmark indices used in the aforementioned models. Their model allows for exposure to global and regional factors at the same time and has the potential to capture international or regional integration. We apply their approach with small modifications in the sense that we use the global and regional indices already computed by relevant providers and do not construct them from our sample because it contains only European banks and therefore we cannot construct a global index. Brooks and Del Negro (2005) find that region effects are relevant in explaining the return variation accounted for by within-region country effects. Therefore, we use a global benchmark – the MSCI World Index - and two regional benchmarks – the Euro STOXX 50 for euro-zone banks and the STOXX Europe 600 excluding the euro zone for noneuro-zone banks, within the following equation:

$$R_{it} - r_{ft} = \alpha_i + \beta_i(R_{mt1} - r_{ft}) + \delta_i(R_{mt2} - r_{ft}) + \varepsilon_{it} (1)$$

where α_i is the intercept, $R_{it} - r_{ft}$ is the excess log-return of bank *i* at time *t*, $R_{mt1} - r_{ft}$ is the excess log-return of MSCI World index at time *t* (the global index), $R_{mt2} - r_{ft}$ is the excess log-return of either the Euro STOXX 50 or STOXX Europe 600 excluding euro-area indices (the regional indices), r_{ft} is the risk-free rate and ε_{it} is the disturbance term, which is assumed to be independent and identically distributed (*iid*) with a mean of zero and a constant variance. In an alternative specification, we use only a regional index, i.e., STOXX Europe 600, and the findings remain robust. To compute the excess return, we use as the risk-free rate[7] the European short-term

[7] In robustness checks, we employ several alternatives, including the three-month EURIBOR and the three-month national rates, the one- and three-month Treasury Bill Rate (T-Bill) alongside the returns computed for stock prices

rates. More precisely, we employ the one-month Euro Interbank Offered Rate (EURIBOR) for euro zone banks[8], whereas for noneuro zone banks, we use their national counterparts (e.g., one-month PRIBOR – Prague Interbank Offered Rate – for Czech Republic). Because the global and regional benchmarks are highly correlated, we orthogonalize the returns of Euro STOXX 50 and STOXX Europe 600 excluding the euro area with respect to the returns of MSCI World Index employing an OLS regression and using the errors in the Eq. (1) as the regional indices. The abnormal return for each bank *i* at time *t* is determined from Eq. (2) as follows:

$$AR_{it} = R_{it} - r_{ft} - [(\alpha_i + \beta_i(R_{mt1} - r_{ft}) + \delta_i(R_{mt2} - r_{ft})] \quad (2)$$

A positive value of AR implies that the actual return is greater than the predicted one (i.e., the market value of banks increases following the event; market participants consider the event to be beneficial), whereas a negative value of AR denotes a smaller normal return compared to the expected one (i.e., the market value of banks decreases following the event as market participants consider the event harmful).

In addition to the modified CAPM of Bekaert et al. (2009), we employ other methods in robustness exercises to compute the expected return, including the modified market model (with the MSCI World index, Euro STOXX 50 and STOXX 600 excluding the euro area as benchmark indices) and a simple CAPM with the MSCI World index as the market index and the one-month interbank rate as the risk-free rate. A detailed description of the variables is provided in Table 2.

INSERT TABLE 2

As a robustness check, we use the simple market model for the event study on the mid-rate CDS spreads reaction, with the following equation:

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denominated in US dollars, and the Euro Overnight Index Average (EONIA) with returns computed for stock prices denominated in EUR. The results are consistent with our benchmark specification and are not influenced by the currency denomination or by the risk-free rate.

[8] Currently, the European risk-free rates are going through a process of reform, and the EONIA/EURIBOR will be gradually replaced by the euro short-term rate (€STR) as the risk-free rate for the euro zone. The methodology of EONIA will be modified to become €STR until the end of 2021.

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt} \qquad (3)$$

where R_{jt} is the log-change of bank *j*'s CDS spread at time *t*, α_j is the constant term, β_j is the slope, R_{mt} is the market portfolio log-change at time *t* and ε_{jt} is the *iid* error term. The main market index used to compute the abnormal performance and betas for all the events is the iTraxx Europe 5 years CDS index collected from Bloomberg. We account for thin trading on a so-called "trade-to-trade" basis as suggested by Maynes and Rumsey (1993). In contrast to the "lumped" and "uniform" return procedures, this method does "not allocate the return to the days within the interval [in which trade prices are missing]. Instead, the multiperiod returns are used" (Maynes and Rumsey, 1993). Consequently, we compute returns from dated transaction prices for each bank and market index, eliminating periods in which no trading is recorded.

Next, following Brown and Warner (1985), we compute the average abnormal return (AAR)[9] across all banks from our sample:

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{it} \quad (4)$$

where *N* is the number of banks.

Further, to assess the stock reaction over a longer period of time, we sum all the abnormal returns obtained using Eq. (1) over any interval in the event window ([t_1; t_2]) around the event date to obtain the cumulative abnormal return (CAR), as in Morgan et al. (2014):

$$CAR_i\,[t_1;\ t_2] = \sum_{t=t_1}^{t_2} AR_{it} \quad (5)$$

Using the same approach as in Eq. (5) we aggregate the average abnormal returns over the interval [t_1; t_2] to obtain the cumulative average abnormal return (CAAR), as specified by MacKinlay (1997):

[9] For CDS spreads, the following notations apply: Abnormal Change (AC), Average Abnormal Change (AAC), Cumulative Abnormal Change (CAC), and Cumulative Average Abnormal Change (CAAC). In order to be consistent across notations for both stock prices and CDS spreads, we use the following notations: Abnormal Return (AR), Average Abnormal Return (AAR), Cumulative Abnormal Return (CAR), and Cumulative Average Abnormal Return (CAAR).

$$CAAR\ [t_1;\ t_2] = \sum_{t=t_1}^{t_2} AAR_t \qquad (6)$$

The global systemically important bank sample includes several banks with headquarters outside the Europe (the United States and Asia). If an event is taking place in Europe, the news will reach Asian markets only in the following day because the stock market would already be closed. Thus, we adjust this issue by setting the nonweekend events to the following day and the weekend events to the next Monday.

The event study is performed over an estimation window of 250 trading days, i.e., the window to estimate the betas being the [-260, -10] time interval, where the moment T=0 is the event date. MacKinlay (1997) points out that this window is sufficient to conduct an event study using daily data. To check the robustness of our results, we run all the specifications using an alternative estimation window of 150 trading days.

Finally, regarding the event window length, to measure abnormal performance, we consider four sets of event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. First, similar to Moenninghoff et al. (2015), we use a one-day sampling interval as the event dates are precisely defined and we attempt to mitigate the effect of confounding events and to exclude additional noise from other events. Second, following Bongini et al. (2015), we aim to account for both the possibility of news leaking before the event date through the national releases (we use [-3; 3]) and the possibility that investors will react slowly to the implications of the news (we use [1; 5]).

2.3.2 Significance tests

For more conclusive results, we test the significance of cumulative average abnormal returns using both parametric and nonparametric tests. As parametric tests, we employ *the t-test* and the *standardized residual test* of Boehmer et al. (1991). As nonparametric tests, we apply *the generalized sign test* (Cowan, 1992) and the *Corrado and Zivney rank test* (Corrado and Zivney, 1992).

The widely used *t-test* typically rejects the null hypothesis of no abnormal performance when it is true (i.e., the Type I error) at approximately the significance level of the test (Brown and Warner, 1980), but is based upon the underlying assumption that the residuals are not correlated across securities (i.e., are cross-sectional independent). To test the robustness of the results, we employ several other tests that have been developed during the last decades. Boehmer et al. (1991)

proposed *a test of standardized residuals* corrected for event-induced changes in volatility and return autocorrelation. The test is based on the standardization procedure proposed by Patell (1976), taking into account the heteroskedasticity of event-window abnormal returns. *The generalized sign test* according to Cowan (1992) has the advantage of being robust in the presence of skewed returns and is well-specified when cross-sectional abnormal returns are not symmetric. Also, Corrado and Zivney (1992) introduced *the Corrado and Zivney rank test* corrected for event-induced changes in volatility of rankings and cross-correlation due to event day clustering (Kolari and Pynnönen, 2010). This test is robust to skewed returns and better specified than the regular *t-test* when testing for one-day abnormal returns (Corrado and Zivney, 1992). For cumulative abnormal returns and cumulative average abnormal returns we apply the aggregation procedure from Cowan (1992) by cumulating daily ranks of abnormal returns within the CAR- and CAAR-period (Kolari and Pynnönen, 2011). All the tests have the null hypothesis that the cumulative average abnormal returns are equal to zero, whereas the alternative hypothesis specifies that the cumulative average abnormal returns are different from zero. A methodological description of the tests employed to assess the statistical significance of the CAARs is given in Appendix K.

2.4 Identifying the determinants of the magnitude of abnormal returns

Even though the abnormal returns are mainly influenced by the event *per se*, it is of interest to study other relevant factors that may have a significant influence over the abnormal performance of the financial institutions. For this purpose, we run a cross-sectional regression model for the O-SIIs sample using the *OLS method* and the cumulative abnormal return (CAR) as the dependent variable, similar to MacKinlay (1997). The model takes the following form:

$$CAR_{ij}\ [t1;\ t2] = \alpha + \beta_1 \times O\text{-}SII\ Characteristics_{ij} + \beta_2 \times Bank\ Characteristics_{ij} + \varepsilon_{ij} \quad (7)$$

where $CAR_{ij}\ [t1;\ t2]$ represents the cumulative abnormal return of bank *i* from country *j* during the event window, α is the constant term, $O\text{-}SII\ Characteristics_{ij}$ is a vector of bank-level specific variables related to the capital requirements and identification of O-SIIs, $Bank\ Characteristics_{ij}$ is a vector of bank-level specific controls, and ε_{ij} is the error term. The standard errors are clustered at the country level. The variables have an annual frequency and we consider their values as of

December 31st of the year before the event took place. A detailed description of them is provided in Table 2.

Because the market reaction to the publication of O-SII list is different during the event day in comparison with the subsequent days (i.e., the stigma perception versus the TBTF phenomenon), we assess the determinants of the cumulative abnormal returns considering two intervals: the event day, corresponding to the [0; 0] window, and a longer-term period following the event, corresponding to the [1; 5] window.

First, we investigate the impact of O-SIIs' attributes on the market reaction following the official release of the O-SIIs list by the EBA. One of the most important challenge for these institutions is the additional capital requirements they must hold after the designation. In some jurisdictions, there is no capital requirement, whereas in others, it varies from 0.5% to 2%. We construct a dummy variable, *Dummy buffer*, which takes the value of 1 if the value of the CET1 capital that the O-SIIs must hold is non-zero and 0 otherwise. As the rise in capital regulation affects the profitability of banks, we expect a pessimistic reaction of shareholders (i.e., a more negative AR). In addition, a positive reaction might also be expected if the new regulation transmits a safety view via the TBTF perception (i.e., a less negative AR). Next, we differentiate among institutions that were identified as O-SIIs through supervisory judgment and those that were chosen based on quantitative criteria. We use a dummy variable, *Dummy supervisory judgment*, from the EBA, which takes a value of one when the banks are selected based on qualitative criteria, such as national characteristics or individual functions, and zero when a quantitative set of indicators (based on banks' size, importance, complexity and interconnectedness) is used to choose the institutions with systemic importance at the national level. Using the qualitative procedure, the authorities may depict small institutions as being systemically relevant, which otherwise have not been designated as O-SIIs through the quantitative approach. If the criteria used to select an OSII are known by the market, then shareholders could expect which bank will be included in the list based on quantitative judgement. In case of supervisory judgment, the market could not anticipate the designation. This variable can provide us information on what the market perceives regarding the O-SIIs regulation. If the TBTF perception is prevailing, we expect good news for the banks that were not anticipated by the market to be on the O-SIIs list. If the investors feel that some banks could have escaped the burden of the new regulation based on quantitative criteria, we expect bad news. Further, we exploit the effects of taxing a bank with additional capital requirements multiple times, as some banks have been designated as O-SIIs more than once, as a BHC and as a subsidiary in other countries. We construct a dummy variable *(Dummy BHC designation)* that takes a value of 1 if two or more banks controlled by the same BHC appear in the national O-SII designation lists. In the case a bank is taxed more than once, we expect a negative reaction by shareholders, a more negative AR during the event day and a less positive CAR in the long run.

Second, we examine whether differences in terms of bank fundamentals can explain higher or lower ARs after the designation as O-SIIs. To account for heterogeneity among bank fundamentals, the following characteristics are included in our analysis: size, capitalization, distance to default, and ownership. *Size*, measured by the natural logarithm of total assets expressed in EUR is associated with the TBTF status of banks. Thus, we expect large banks to experience less negative or even positive ARs following the designation event because of an increased probability of future bailouts. *Capitalization*, defined as the percentage of equity to total assets, could also affect the abnormal returns. We expect less negative ARs for institutions with higher capitalization as they have a higher loss-absorbing capacity and suffer less from being required to hold additional levels of capital due to O-SIIs designation. Moreover, banks that are already compliant with the capital requirements of O-SIIs do not need to rise additional levels of capital. To measure the overall risk of banks, we use the *Distance to Default measure* of Duan and Wang (2012). The risk measure is a metric based on the valuation of options, and it expresses banks' distance to default in standard deviations. The institutions' equity is approached as a call option on the underlying asset. The higher the distance to default, the safer the institution is, and a positive reaction of shareholders is anticipated.

In addition, we distinguish *the ownership structure* by including a dummy variable that takes a value of 1 if the state is a shareholder, regardless of its participation, and 0 otherwise. Government-owned banks are more likely to receive public funds in the case of collapse (Faccio et al., 2016), thus we expect that the market will associate these institutions with the TBTF status that will generate positive ARs.

Finally, we include a dummy variable that takes a value of 1 if the bank received bailouts from the government and 0 otherwise. Data on financial aid received by the banking sector is provided by the European Commission and take the form of recapitalizations, impaired asset measures, guarantees or other liquidity measures. We expect lower ARs for institutions that are saved by the state as O-SII designation should reduce the government's forbearance.

3. Empirical results

3.1 Descriptive statistics

Table 3 presents the descriptive statistics for the cumulative effective (actual) returns and change (CER) and cumulative abnormal returns and change (CAR) for the short term (the event day [0; 0]) and for a longer time horizon (the [1; 5] window), including both stock returns and CDS spreads. In Panel A, the data refer to the official event, corresponding to the date when the EBA published the O-SII list. The cumulative average effective returns and cumulative average abnormal returns in the event day (which are equivalent to average effective/abnormal returns) are less negative for noneuro-zone banks than for the euro-zone ones, but there is no significant difference in the means of the two samples. In addition, larger banks have significantly (at 10%) greater average effective returns during the event day in comparison with smaller banks, a result that also holds in the case of abnormal returns.

Panel B exhibits the descriptive statistics for the national event dates, corresponding to the days when the national regulatory authorities submitted the list of domestic systemically important institutions to the EBA. Our results reveal no significant difference in means among the euro-zone and noneuro-zone banks for both the short- and long-term windows.

In terms of the difference in means between official and national events, one can note that only for the [1; 5] window is the difference in CARs significant at the 10% level.

INSERT TABLE 3

To conduct an in-depth analysis, we also computed several risk indicators across the full sample of 54 banks.[10] Figure 2 presents the mean systemic risk and individual risk across O-SIIs from 30 days before to 30 days after the official EBA event date. Panel A shows the systemic risk indicator computed using the *Marginal Expected Shortfall* methodology of Acharya et al. (2017). The index reflects the probability of a bank being undercapitalized when the whole system is undercapitalized (i.e., the market experiences its 5% worst market capitalization returns). The indicator is estimated using the DCC-GJR-GARCH framework (see Engle, 2002 and Glosten et al., 1993 for details), and the STOXX Europe 600 Financials index is used as a proxy for the

[10] For the restricted sample defined above, we found similar patterns.

system. To express the individual risk taking of banks (Panel B), we quantify the maximum possible drop in market capitalization that a bank could register for a given confidence level (95%), using the *Value at Risk* methodology as in Jorion (1997). Both systemic risk and individual risk-taking experienced an increase in the day following the official EBA release of O-SIIs list, followed by a reduction in the next five days.

INSERT FIGURE 2

3.2 Abnormal performance corresponding to the official EBA event

CAARs are useful for studying the aggregate effect of the abnormal returns over the entire sample or subsamples, which is of interest to us. Tables 4 and 5 show the cumulative average abnormal returns and cumulative average abnormal change of stock prices and CDS spreads respectively, together with the statistical tests and the associated p-values used to assess the significance for the full sample and the two subsets of euro-zone and noneuro-zone banks (only for the stock prices) over the official event date. We do not split the sample into euro zone and noneuro zone banks in the case of CDS spreads because it will result in a small number of noneuro zone banks and thus the sample may be nonrepresentative. The CAARs are presented for the four intervals for which we assess abnormal performance: [0; 0], [1; 1], [-3; 3], and [1; 5]. The [0; 0] and the [1; 1] CAARs are the average abnormal returns on the event day and one day after the event, respectively. To analyze the statistical significance of the CAARs, we employ two parametric tests, the *t-test* and the *Boehmer test*, and two nonparametric tests, the *Corrado and Zivney rank test* and the *generalized sign test*. As suggested by Campbell et al. (2010), the nonparametric tests are more powerful than the parametric ones and hence we decided to present the results considering both approaches.

INSERT TABLE 4
INSERT TABLE 5

During the official date (April 25^{th}, 2016) that the European Banking Authority disclosed the O-SII list, the financial market reacted negatively (i.e., pessimistic behavior of investors), as we find a negative sign associated with stock returns (Table 4) and a positive sign for CDS spreads (Table 5). In the event day, the negative abnormal performance of stock returns is significant according to three tests out of four, and the positive abnormal performance of CDS spreads is also significant for three tests. Across the remaining intervals, the sign of stock CAARs changes to positive, reflecting a confident reaction of investors, especially for the [-3; 3] window, during which the increase in stock returns is 3.26%. The effect does not differ between the euro-zone and noneuro-zone banks, with the same trend in both cases. However, the results differ for euro-zone and noneuro-zone banks for the [-3; 3] and [1; 5] windows, with the latter having a negative CAAR, although statistically insignificant. It follows that the positive sign for these two intervals are given by the banks with headquarters situated in euro area countries. In the case of CDS spreads, the perception of investors improves for the [-3; 3] window (i.e., a decrease in CDS spreads of 364.71 basis points). All four tests show statistical significance (p-value is less than 10%). For the interval [1; 5], the CAARs of banks' CDS spreads are positive, similar to the event day, but three tests out of four indicate that the result is not statistically significant. However, we can note a reduction in the CDS spread of 21.46 basis points in the first day following the event, although, as in the case of [1; 5] interval, only the generalized sign test shows statistical significance.

The empirical findings show that making the list public generated a *stigma* effect on the event day (market participants perceived the designation event as being harmful for the banks), and subsequently shareholders' wealth decreased. However, our results indicate that following it, an *optimistic* reaction came as the CAARs turned positive up to five postevent days, resulting in an increase in shareholder's wealth. Hence, on the event day, investors were worried about the regulatory framework and they did not anticipate it. Nevertheless, in the following days, the perceptions of investors changed, leading to an increase in abnormal returns. This might be due to the association of O-SIIs with the too-big-to-fail status, which increases the probability of future bailouts in the case of collapse and may help banks to obtain lower funding costs.

We also have to consider that some markets are more liquid than others, the level of uncertainty can be very high on those illiquid markets because of information asymmetry, and hence the reaction may be either reduced or exacerbated, the efficient market hypothesis being thus violated. It can be assumed that market participants value the institutions designated as O-SIIs and therefore as SIFIs more highly than the other institutions because the designation reduces investors' insolvency risk (Kleinow et al., 2014). Investors' reaction and conclusions derived from this type of events depend on the efficiency of the markets and whether security prices fully reflect all public available information (Fama, 1970).

3.3 Determinants of abnormal returns

To identify specific bank factors that might explain higher or lower cumulative abnormal returns, this section presents the results of the empirical model described in Section 2.4. considering O-SII attributes, as well as bank fundamentals. Table 6 provides a univariate (models (1)-(8)) and a multivariate analysis (model (9)) of banks' stock price ARs during the official EBA event day, corresponding to the window [0; 0]. The analysis starts by considering the effects of O-SIIs' characteristics in columns (1)-(3) of banks' fundamentals in columns (4)-(8) and further accounts for the benchmark model that includes all variables together in model (9).

INSERT TABLE 6

Looking first at the O-SIIs' attributes, the results show a significant impact of the dummy variable *Supervisory judgement*. The associated negative sign indicates that designating banks as O-SII through supervisory judgment significantly reduces abnormal returns (more negative ARs). This qualitative assessment accounts for the national and individual specificities of banks, which are heterogenous across countries and subjective in comparison with the alternative approach based on quantitative indicators. The more negative AR indicates that investors penalize those banks that could have escaped the rules of being designated as O-SIIs based on their size, importance, complexity or interconnectedness. Regarding the CET1 capital buffer that the O-SIIs must hold, the variable suggests less negative or even positive ARs. Thus, the newly introduced regulation is considered by shareholders beneficial because it might reduce the probability of O-SIIs failure. Though not significant, being included in the O-SIIs designation list more than once (i.e., as BHC and as subsidiary in other countries) leads to lower aggregated abnormal returns, which reflect an enhanced stigma perception of shareholders vis-à-vis banks that may be required to hold additional capital more than once.

Assessing the banks fundamentals, the results show that large banks present more negative ARs during the official regulatory announcement day. Thus, the market expects probable losses for large banks. A possible explanation is related to the tighter supervision for financial institutions with TBTF status, with the market expecting additional costs and thereby diminishing earnings prospects (Abreu and Gulamhussen, 2013; Kleinow et al., 2014). Also, the larger the bank, the greater is the market uncertainty that the additional regulatory requirements can be met. Also, we document less negative ARs for banks with a higher distance to default, that have state ownership, or that received public interventions in the form of bailouts. The less stringent reaction of investors for these institutions may be explained by the possibility of banks better diversifying their risk and obtaining lower funding costs. However, the impact is not statistically significant.

Next, we reassess in Table 7 the relationship between the O-SIIs' attributes and bank fundamentals and the cumulative abnormal returns considering the official EBA designation over a longer period following the event, corresponding to the window [1; 5]. The empirical output examining cross-sectionally the determinants of banks' stock prices presents some particularities in comparison with the short-term multivariate analysis.

INSERT TABLE 7

We observe that both the additional capital buffer that O-SIIs must fulfill in some jurisdictions and the dummy reflecting the inclusion in the O-SIIs designation list more than once are not significant. The results also depict a highly significant impact of the selection approach for these banks, which is robust. Across all models, the coefficient associated with the dummy variable *Supervisory judgement* is positive, reflecting more positive cumulative abnormal returns for banks selected through qualitative criteria. In comparison with the short-term impact, in the days following the event, investors are more enthusiastic about the benefits of TBTF status associated with banks designated as O-SIIs using optional indicators.

Among the bank fundamentals, capitalization has a significant and negative impact on cumulative abnormal returns in the days following the official regulatory announcement. Shareholders penalize the banks with a higher capitalization, as they prefer to maintain higher capital buffers than their peers, which is costly. Size is no longer significant in the long run, which means that investors associate the O-SIIs with the benefits of TBTF status regardless their size. Also, a greater distance to default reduces the positive CAR. Although not significant, the dummy associated with state ownership is negative in the long run, suggesting that shareholders penalize

O-SIIs with the government as shareholder. In turn, they react positively to banks that received public interventions.

Following the same strategy, we rerun the empirical specifications using as dependent variables the abnormal change corresponding to CDS. Appendix A provides the results for the short-term event window, whereas Appendix B does so for the long-term analysis. From the bondholders' perspective, for which we found that ARs are positive in the event date, the results show a significant impact of dummy supervisory judgement and less positive abnormal CDS change for banks selected through discretionary information (Appendix A, column (2)). A smaller size (column (3)) and a higher capitalization (column (4)) also reduce the stigma perception of bondholders. The capital buffer significantly influences the ARs. More stringent capital regulation is associated with less positive abnormal changes of CDS spread (Appendix A, column (1)). In the long-run window [1; 5], for which we found a positive and slightly significant reaction of the bondholders, only the size has a significant impact on CARs, amplifying the positive cumulative abnormal change (Appendix B, column (4)).

3.4 Further analysis - the national events

Appendix C presents the findings for the national event dates when the national regulatory bodies acknowledged the EBA regarding the O-SII identification. In this case, we deal with multiple event dates. The first national O-SIIs event of our sample took place in Denmark prior to the official EBA date (June 25th, 2014), whereas the last O-SII list publication event took place in Bulgaria after the official EBA date (December 12th, 2016). The findings are the same as in the case of the official EBA date, i.e., there is a *stigma effect*, but the effect is more pronounced when banks are designated officially as O-SIIs (with average AARs of -1.04% for the official date and three tests out of four showing statistical significance, compared to average AARs of -0.63% and only one test out of four showing statistical significance in the case of unofficial events). However, on average, there are no significant differences between the CARs of these two events, except for the [1; 5] window (Table 3, Panel C). On the longer post event time horizon, such as the [1; 5] interval, the average CARs are still negative and highly significant (three tests out of four prove that the CAAR is statistically significant). It appears that the market still perceived the events as harmful for the banks on an aggregated basis but waited for the EBA to make an official announcement, as we can note from our strongly negative and statistically significant results in Table 4. With regard to the subsamples, the national events had the same influence for the euro-zone banks as in the full sample (negative CAARs but statistical significance achieved only for the [-3; 3] and [1; 5] windows). Hence, for the [0; 0] event window, the negative and strongly relevant results for the official announcement of the EBA are mainly due to euro-zone banks, which is different for national events, where the market reacts in a more pronounced manner (as we can note from the test statistics) in the case of banks that are not part of the euro zone. However, for the [1; 5] post event interval, the positive effect for the official event on euro-zone banks still dominates the negative one on noneuro-zone banks, whereas for national events, the noneuro-zone banks have a more significant CAAR. Nevertheless, the mean CARs for euro zone and noneuro zone banks do not differ significantly on an average basis, as we can note from Table 3, Panel C.

As for the CDS spread, the results are shown in Appendix C2. The AARs are positive on the event day (although lacking statistical significance) but negative and statistically distinguishable from zero thereafter. Thus, for the subsequent CAARs windows, the cost of the default protection decreases for the banks designated as O-SII. This is true especially over the [1; 1] and [1; 5] windows (with a decrease in CDS spreads of 66.11 and 191.66 basis points, respectively), the results being strongly significant. For the event day, however, the investors waited for an official announcement, as we can note from higher AARs for the official EBA date compared to national events, and more statistically significant results, as shown in Table 5. Our results are in line with those of Bekaert and Breckenfelder (2019) who investigate the effect of inclusion of the banks on the list of other systemically important institutions by each national supervisor (i.e., national events) on the riskiness of securities issued by those banks. Their results indicate that following the inclusion on the O-SIIs list, bank stock prices decrease relative to stock prices of non-treated banks, and two quarters after the event cumulative returns reached a trough of -30%. In terms of bond prices, the authors document an increase for O-SIIs banks, consistent with a safety effect for bondholders.

3.5 Robustness checks

To assess the robustness of our findings, we rerun our analysis using different methodologies and estimation windows, which are appended to conserve space.

Appendix D presents the results corresponding to the robustness assessment where we employ as a methodology a hybrid market model. Similar to the hybrid CAPM model used for the main results, the specification allows simultaneously for a global index (the MSCI World index) and two regional indices depending on the locations of the banks (the Euro STOXX 50 index for the euro-zone banks and the STOXX 600 excluding the euro zone for the noneuro-zone banks). The results are consistent with our baseline analysis in terms of sign, for both official and national events, with small differences regarding the magnitude of the coefficients. Thus, when the EBA disclosed the domestic systemically important institutions list, we have negative and significant AARs (for the full sample) in the event day and positive CAARs thereafter. Furthermore, we find no relevant differences for the euro-zone and noneuro-zone banks, which have the same trend and sign as the full sample. This means that the event conveyed new information to the market, and this information was perceived as being harmful for the banks (a *stigma* effect). The positive and significant one-day AAR, however, shows a turnaround, i.e., an *optimistic* reaction – investors took this event (information) as positive, probably due to new information they acquired in the following days, regarding the too-big-to fail status of these banks. For the national announcements, there is an *opacity* effect in the event day and the following day, with differences in size across the full sample, the euro-zone banks, and the noneuro-zone banks. An exception is the positive evolution of AAR for the noneuro-zone banks on the [1; 1] interval, but the result is not validated by the significance tests. For the subsequent intervals, we observe a *stigma* effect for the euro-zone banks, yet validated just by the parametric tests, and a *positive* reaction of the noneuro-zone banks for the longer [1; 5] interval that is statistically significant.

We also assessed the robustness of the results computing the abnormal stock returns through a simple CAPM model for both events, the EBA date and national event date. The main market index is MSCI World index, and the risk-free rate is the one-month interbank rates. The estimates are similar to the baseline analysis for most of the intervals assessed in terms of trend and size, with the exceptions discussed in the previous paragraph (Appendix E).

Robust results are obtained for CDS spreads too. Appendix F presents the output corresponding to the robustness assessment where we employ as the market portfolio the Datastream Europe Banks 5 years CDS index for the official EBA event date. The results show that there is an increase in CDS spreads for the official event across the event day and on the longer-term interval [1; 5] and a decrease in CDS spreads for the [1; 1] and [-3; 3] windows. The AAR in the event day is highly significant (three tests out of four show statistical significance), suggesting that the financial market did not anticipate the event and attributed a *stigma* effect. The results are in line with those on stock returns. For a longer timeframe (three pre-event days, the event day, and three postevent days), the CDS cumulative average abnormal change is negative and highly significant, indicating an *optimistic* reaction.

Next, we rerun the analysis using an estimation window of 150 days. The results concerning both stock returns and CDS spreads for the full sample (Appendix G) are consistent with the baseline empirical specifications.

Finally, we re-estimate the empirical specifications from Eq. (1) for the official EBA event constructing several subsamples (Appendix H). First, we compute the cumulative average abnormal returns of banks' stock prices for a subset of large banks (with the value of total assets at the end of 2015 greater than the median of the sample) and for a subset of small banks (with the value of total assets at the end of 2015 smaller than the median of the sample). The results show that the CAARs of large banks (Panel A) follow a trend similar to the full sample, a negative evolution during the event day, followed by positive abnormal returns in the following intervals. The estimates associated with the small banks (Panel B) show similar evolutions of the CAARs, excepting the [1; 1] interval, during which the average abnormal return is still negative as in the event day. The coefficients are also smaller in comparison with the large banks sample, but the significance of the results is not validated by the empirical tests for the small bank subset. Thus, there was no reaction in the case of small O-SIIs, and therefore markets are concerned only about large institutions, regardless of previous experience with other similar events. The overall conclusion is that regulatory designation events matter in the case of large institutions, regardless of their previous status acquired from other similar events. Second, we eliminate from the initial sample the G-SIBs in Panel C. The results reveal a trend similar to the main specification from Table 4, but the significance is achieved just for the event day and [-3; 3] interval. One can note that the reaction of investors to the publication of the official list of O-SIIs is more pronounced in the case of the full sample (54 banks) than in the case of the restricted list, without G-SIBs (39 banks): AAR for the full list is -1.04% and three tests out of four show statistical significance whereas AAR for the restricted sample is only -0.96%, and three tests out of four reject the null hypothesis of AAR being indistinguishable from zero. Even when including the previous experience with G-SIBs, investors still reacted negatively, meaning that this event conveyed new information in the market. Third, we eliminate the top bank within each country (according to their size at the end of 2015). Panel D depicts significant results with a trend similar to the main findings for the first three intervals. The exception is the longer [1; 5] window, which presents a negative average abnormal return. However, its significance is statistically undistinguishable from zero.

3.6 Comparison with other events related to systemically important financial institutions

In this section, we discuss and compare the impact of specific regulatory changes on financial markets. This approach is very useful as it may help us to reveal whether there are differences in market participants' behavior when relevant events regarding the systemically important financial institutions occur, and whether the information they convey is significant. All the results concerning these events for stock returns are displayed in Appendix I.

We begin with the global systemically important banks (G-SIBs), as defined by the FSB and the BCBS. Before the publication of the official list, the Financial Times twice leaked a list with the supposed G-SIBs. 19 out of 24 banks disclosed by the newspaper proved to be on the official list (consisting of 29 G-SIBs when it was first published). Thus, we undertake an analysis of 19 G-SIBs with the event day being November 30th, 2009 (Financial Times). Additionally, we investigate the market reaction to the official designation event (November 4th, 2011) of 28 G-SIBs, excluding the French group BPCE, which is not listed. Banks from our sample included in the G-SIBs list are presented in Appendix J. The publication of the list by the Financial Times is associated with a positive AAR in the event day although not statistically significant as shown in Panel A (A1). However, for the [1; 1], [-3; 3] and [1; 5] intervals, the associated CAARs were negative and significant. Regarding the official disclosure of the G-SIBs list, the results from Panel A (A2) document that the CAARs were negative for all the windows and highly significant for the postevent intervals, which denotes a clear *stigma* effect (the banks' status as systemically important obviously worried investors).

Not surprisingly, the euro-zone banks included in the Single Supervisory Mechanism (Appendix J) registered positive abnormal returns (Appendix I, Panel B). These are highly statistically significant for the event day and the day following the event. The common supervisory framework set out by the ECB has induced a safe sentiment for investors, who deem this event as beneficial for banks due to the association with the TBTF status.

Overall, one can note a similarity between O-SIIs and G-SIBs in the event day, i.e., the official designation event, namely a *stigma effect*. Investors perceived these events as harmful for the banks. However, in the case of O-SIIs, in the postevent interval, the information they accumulated (greater transparency that these institutions must show) and the past experience with G-SIBs induced a *positive* expectation. This is not the case for G-SIBs, where the *stigma effect* continued even five days after the event. A possible explanation is that investors did not have previous experience with such an event and they needed more time to clarify what the status of globally systemic important bank means.

4. Conclusion

The literature concerning the impact of regulatory changes on systemically important financial institutions is inconclusive. In the present paper, we carried out an analysis regarding the influence of the disclosure of the list of other systemically important institutions (as an official event) and the identification of these institutions by national regulatory authorities followed by the submission of these lists to the European Banking Authority (as national multiple events). These banks correspond to the domestic systemically important institutions at the European level, implying close monitoring by the financial supervisors, and the raising of additional capital by some of them. We assessed how financial market reacted to these regulatory changes through an event study of bank stock prices and CDS spreads using a sample of these institutions. Our findings bring into focus some interesting features regarding the introduction of the O-SII regulation.

Overall, when the EBA published the O-SII list, the immediate reaction of the market on stock returns was negative, i.e., a *stigma* effect, which suggests that the included financial institutions were perceived to be less profitable because they were subject to tighter regulation. However, in the days surrounding the event, investors changed their perception, resulting in an increase in shareholders' wealth and thus in a *positive* effect, which can be attributed to the TBTF status. This effect holds for both euro zone and noneuro zone banks (based on their headquarter location). When considering the CDS spreads, we found a similar effect, that is, an increase in CDS spreads and thus a higher cost for banks (the perceived risk of default rose following the designation of the institutions as systemically relevant). However, in the first day after the event, the CDS spreads decreased. For the national events, the CAARs are negative across all windows, but slightly significantly different from zero. We can relate the results to the same *stigma effect* as in the case of official event, but investors waited for an official designation, as we saw from a more negative and strongly significant AAR on April 25th, 2016. Compared with other similar events, the findings support those relating to the G-SIBs designation for the day the FSB published the official list. However, being included in a broad supervisory framework (the Single Supervisory Mechanism of ECB) seems to have a *positive* effect due to their significant status.

Our additional evidence suggests that the cumulative abnormal returns are not only driven by the event *per se* but are also related to other relevant factors. On the event day, abnormal returns are more negative for banks selected using supervisory judgement, which is based on discretionary information unknown by the public, and for banks large in size. Following the event, the market reacted positively to financial institutions selected using supervisory judgement or those with a lower capitalization.

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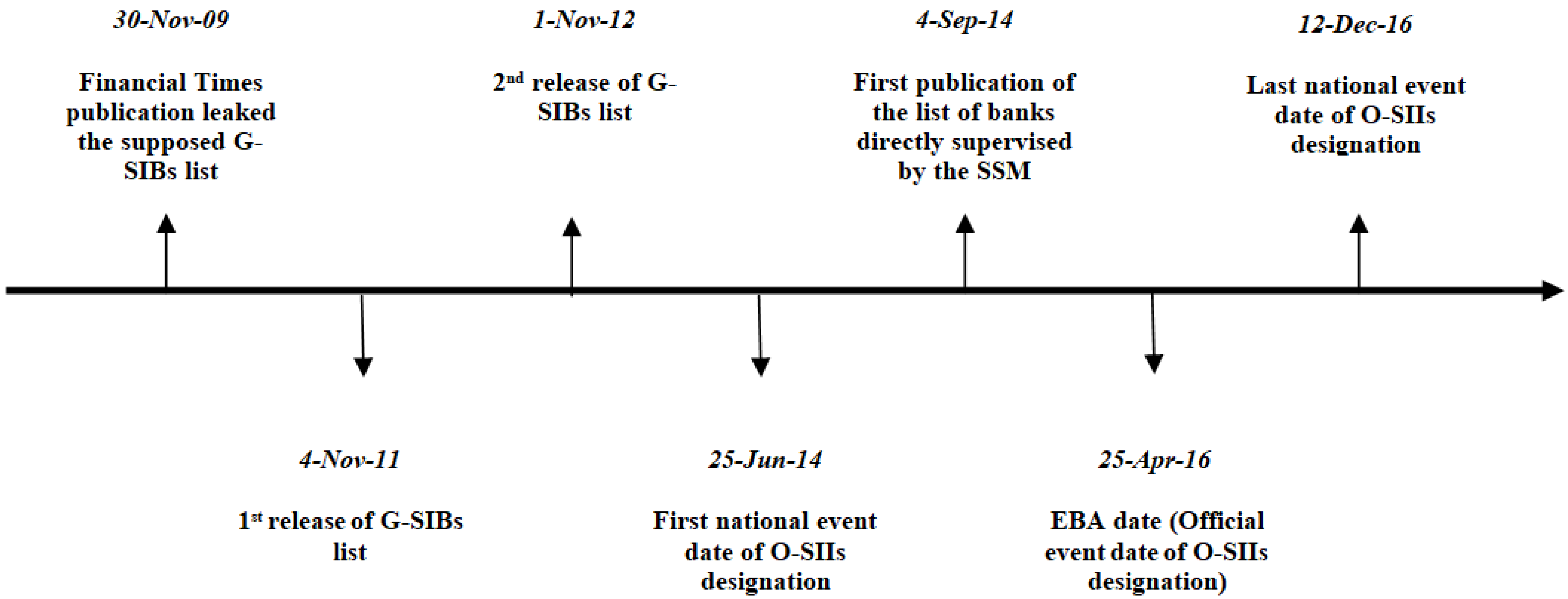
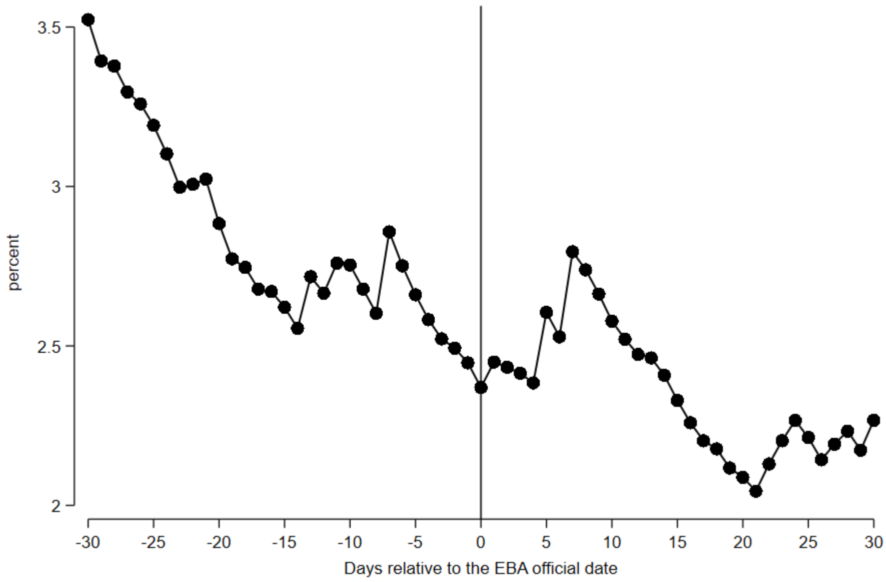
Figure 1. Timeline of O-SII and other designation events



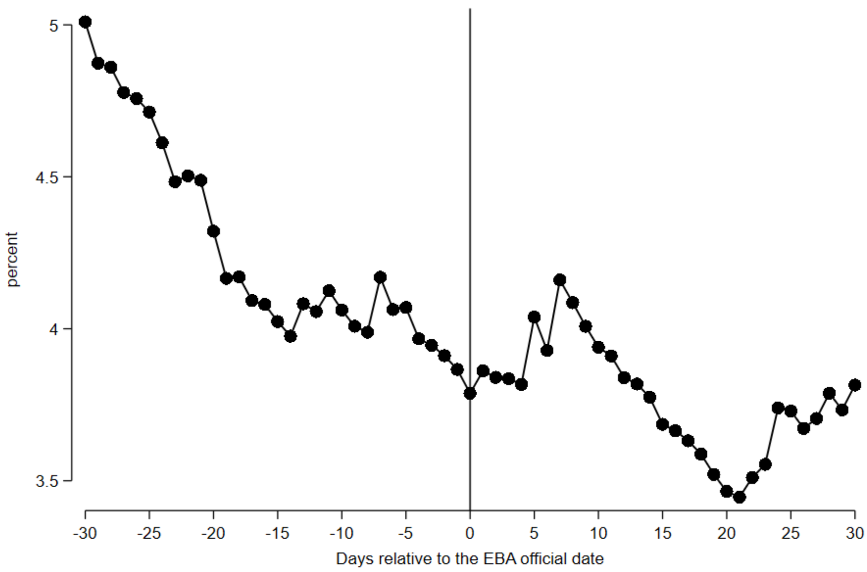
Note: This figure represents a timeline with the publication of different SIFIs lists including the official O-SII event (corresponding to the date when the EBA published the O-SII list) and national O-SII events (corresponding to the dates when the national regulatory authorities submitted the O-SII list to the EBA). The first national O-SII event of our sample took place in Denmark (June 25th, 2014), whereas the last O-SII list publication event took place in Bulgaria (December 12th, 2016).

Figure 2. Systemic risk and individual risk before and after the EBA official event date

Panel A. Systemic risk (Marginal Expected Shortfall)



Panel B. Individual risk (Value at Risk)



Note: This figure presents the mean systemic risk and individual risk across O-SIIs from 30 days before to 30 days after the EBA official event date. The risk indicators are computed across a sample of 54 banks. Panel A shows the mean systemic risk indicator computed using the Marginal Expected Shortfall methodology based on banks' stock prices and the STOXX Financial index as proxy for the system. Panel B presents the mean individual risk indicator computed using the Value at Risk methodology based on banks' stock prices.

Table 1. O-SII list and event dates for the event studies on stock returns and CDS spreads

Number	Bank	Country of origin	Total Assets as of 31 Dec. 2015 (bill. EUR)	EBA date (Official event date)	National events date (Unofficial events date)	Stock prices		CDS spreads	
						Banks subject to EBA event date	Banks subject to national events date	Banks subject to EBA event date	Banks subject to national events date
1	BAWAG P.S.K.	Austria	35.71	4/25/2016	4/19/2016			YES	YES
2	Erste Group Bank	Austria	199.43	4/25/2016	4/19/2016	YES	YES	YES	YES
3	Raiffeisen Bank International	Austria	114.16	4/25/2016	4/19/2016	YES	YES	YES	YES
4	Raiffeisen Zentralbank	Austria	138.43	4/25/2016	4/19/2016			YES	YES
5	KBC Group NV	Belgium	250.13	4/25/2016	10/26/2015	YES	YES	YES	YES
6	CB Central Cooperative Bank	Bulgaria	2.48	4/25/2016	12/12/2016		YES		
7	CB First Investment Bank	Bulgaria	4.54	4/25/2016	12/12/2016		YES		
8	HPB d.d.	Croatia	2.36	4/25/2016	2/26/2016	YES	YES		
9	Privredna banka Zagreb d.d	Croatia	10.25	4/25/2016	2/26/2016	YES	YES		
10	Zagrebačka Banka d.d.	Croatia	16.7	4/25/2016	2/26/2016	YES	YES		
11	Bank of Cyprus Plc	Cyprus	22.81	4/25/2016	12/31/2015	YES	YES		
12	Hellenic Bank Plc	Cyprus	7.34	4/25/2016	12/31/2015	YES	YES		
13	Komerční banka, a.s.	Czech Republic	32.99	4/25/2016	12/18/2015	YES	YES		
14	Danske Bank A/S	Denmark	441.31	4/25/2016	6/25/2014	YES	YES	YES	YES
15	Jyske Bank A/S	Denmark	72.84	4/25/2016	6/25/2014	YES	YES		
16	Sydbank A/S	Denmark	19.12	4/25/2016	6/25/2014	YES	YES		
17	BNP Paribas	France	1987.82	4/25/2016	11/30/2015	YES	YES	YES	YES
18	Groupe Credit Agricole	France	1526.75	4/25/2016	11/30/2015	YES	YES	YES	YES
19	Societe Generale	France	1328.46	4/25/2016	11/30/2015	YES	YES	YES	YES
20	Bayerische Landesbank	Germany	218.87	4/25/2016	7/15/2016			YES	YES
21	Commerzbank AG	Germany	529.81	4/25/2016	7/15/2016	YES	YES	YES	YES
22	Deutsche Bank AG	Germany	1621.37	4/25/2016	7/15/2016	YES	YES	YES	YES
23	Landesbank Baden-Württemberg	Germany	234.46	4/25/2016	7/15/2016			YES	YES
24	Landesbank Hessen-Thüringen Girozentrale	Germany	145,02	4/25/2016	7/15/2016			YES	YES
25	Norddeutsche Landesbank Girozentrale	Germany	181.34	4/25/2016	7/15/2016			YES	YES
26	Alpha Bank	Greece	64.9	4/25/2016	3/12/2015	YES	YES	YES	YES
27	Eurobank	Greece	68.69	4/25/2016	3/12/2015	YES	YES	YES	YES
28	National Bank of Greece	Greece	106.14	4/25/2016	3/12/2015	YES	YES	YES	YES
29	Piraeus Bank	Greece	82.45	4/25/2016	3/12/2015	YES	YES		
30	FHB Jelzálogbank Nyrt	Hungary	2.36	4/25/2016	10/29/2015	YES	YES		
31	OTP Bank Nyrt	Hungary	34.34	4/25/2016	10/29/2015	YES	YES		
32	Allied Irish Banks plc	Ireland	100.23	4/25/2016	9/11/2015	YES	YES	YES	YES
33	The Governor and Company of the Bank of Ireland	Ireland	129.51	4/25/2016	9/11/2015	YES	YES	YES	YES
34	Gruppo Monte dei Paschi di Siena	Italy	165.7	4/25/2016	12/14/2015	YES	YES	YES	YES
35	San Paolo	Italy	665.1	4/25/2016	12/14/2015	YES	YES	YES	YES
36	Unicredit Group S.p.A.	Italy	846.06	4/25/2016	12/14/2015	YES	YES	YES	YES
37	AB Šiaulių Bankas	Lithuania	1.69	4/25/2016	11/25/2015	YES	YES		

38	Bank of Valletta Group	Malta	9.82	4/25/2016	11/30/2015	YES	YES		
39	HSBC Bank Malta plc	Malta	7.22	4/25/2016	11/30/2015	YES	YES		
40	Coöperatieve Centrale Raiffeisen-Boerenleenbank	Netherlands	671.64	4/25/2016	11/26/2015			NO	YES
41	ING Bank N.V.	Netherlands	840.96	4/25/2016	11/26/2015	YES	YES	YES	YES
42	SNS Bank N.V.	Netherlands	62.69	4/25/2016	11/26/2015			YES	YES
43	DNB ASA	Norway	276.48	4/25/2016	12/5/2014	YES	YES	YES	YES
44	Bank BGZ BNP Paribas	Poland	15.04	4/25/2016	10/21/2016		YES		
45	Bank Handlowy	Poland	11.44	4/25/2016	10/21/2016		YES		
46	Bank Polska Kasa Opieki	Poland	38.9	4/25/2016	10/21/2016		YES		
47	Bank Zachodni WBK	Poland	32.09	4/25/2016	10/21/2016		YES		
48	Getin Noble Bank	Poland	16.32	4/25/2016	10/21/2016		YES		
49	ING Bank Śląski	Poland	25.22	4/25/2016	10/21/2016		YES		
50	mBank	Poland	28.54	4/25/2016	10/21/2016		YES		
51	PKO Bank Polski	Poland	61.65	4/25/2016	10/21/2016		YES		
52	Banco BPI	Portugal	40.26	4/25/2016	12/29/2015	YES	YES		
53	Banco Comercial Português	Portugal	72.32	4/25/2016	12/29/2015	YES	YES	YES	YES
54	Banca Transilvania S.A.	Romania	10.59	4/25/2016	11/27/2015	YES	YES		
55	BRD - Groupe Société Générale S.A.	Romania	11.19	4/25/2016	11/27/2015	YES	YES		
56	Tatra banka a.s.	Slovakia	11.19	4/25/2016	4/6/2015	YES	YES		
57	Všeobecná úverová banka a.s.	Slovakia	12.57	4/25/2016	4/6/2015	YES	YES		
58	Bankia	Spain	198.89	4/25/2016	1/13/2016	YES	YES		
59	BBVA	Spain	734.2	4/25/2016	1/13/2016	YES	YES	YES	YES
60	CaixaBank	Spain	334.16	4/25/2016	1/13/2016	YES	YES		
61	Banco Popular	Spain	155.21	4/25/2016	1/13/2016	YES	YES	YES	YES
62	Banco Sabadell	Spain	202.05	4/25/2016	1/13/2016	YES	YES	YES	YES
63	Banco Santander	Spain	1318.22	4/25/2016	1/13/2016	YES	YES	YES	YES
64	Nordea Bank AB	Sweden	640.8	4/25/2016	10/14/2015	YES	YES	YES	YES
65	Skandinaviska Enskilda Banken AB	Sweden	269.42	4/25/2016	10/14/2015	YES	YES	YES	YES
66	Svenska Handelsbanken AB	Sweden	272.25	4/25/2016	10/14/2015	YES	YES	YES	YES
67	Swedbank AB	Sweden	232.07	4/25/2016	10/14/2015	YES	YES	YES	YES
68	Barclays Plc	UK	1548.65	4/25/2016	8/4/2016	YES	YES	YES	YES
69	HSBC Holdings Plc	UK	2263.24	4/25/2016	8/4/2016	YES	YES	YES	YES
70	Lloyds Banking Group Plc	UK	1114.75	4/25/2016	8/4/2016	YES	YES	YES	YES
71	Royal Bank of Scotland Group Plc	UK	1128.78	4/25/2016	8/4/2016	YES	YES	YES	YES
72	Standard Chartered Plc	UK	602.08	4/25/2016	8/4/2016	YES	YES	YES	YES
					Total number of events	*54*	*64*	*40*	*41*

Note: The table presents the sample of O-SIIs, with available data on stock prices and CDS spreads from Datastream and Bloomberg for the following events: the official event (corresponding to the date when the EBA published the O-SII list) and the national events (corresponding to the dates when the national regulatory authorities submitted the O-SII list to the EBA). Bulgarian and Polish banks are not included on the EBA list, but their national regulatory authorities have notified the ESRB on their O-SIIs and we consider this as the national event day for them. The national events date for Germany is set after the official event because at the time of the publication of the EBA list the identification process was pending German administrative procedures.

Table 2. Description of variables

Variable name	Description	Source
Market variables		
Stock Return	Log-return of banks' stock prices	Own computation, Datastream
CDS log-change	Log-change of banks' CDS spreads	Own computation, Datastream, Bloomberg
AR/AC	Abnormal returns of banks' stock prices/abnormal changes of CDS spreads	Own computation
AAR/AAC	Average abnormal returns of banks' stock prices/average abnormal changes of CDS spreads	Own computation
CAR/CAC	Cumulative abnormal returns of banks' stock prices/cumulative abnormal changes of CDS spreads over the event window	Own computation
CER/CEC	Cumulative effective returns of banks' stock prices/cumulative effective changes of CDS spreads over the event window	Own computation
MSCI World Index	Log-return of the MSCI World Index	Datastream
Euro STOXX 50 index	Log-return of the Euro STOXX 50 index	Datastream
STOXX 600 excluding euro zone index	Log-return of the STOXX 600 excluding euro zone index	Datastream
MSCI Europe index	Log-return of the MSCI Europe index	Datastream
MSCI USA index	Log-return of the MSCI USA index	Datastream
MSCI Pacific index	Log-return of the MSCI Pacific index	Datastream
Euro zone short-term rate	The level of the one-month EURIBOR rate	Datastream
National short-term rates	The level of the one-month national interbank offered rates for countries from our sample	Datastream
One-month T-bill rate	The level of the one-month T-bill rate	Bloomberg
iTraxx Europe 5 years CDS index	The log-change of the iTraxx Europe 5 years CDS index	Bloomberg
Datastream Europe Banks 5 years CDS index	The log-change of the Datastream Europe Banks 5 years CDS index	Datastream
O-SII characteristics		
Dummy buffer	Dummy variable which takes the value of 1 if the value of the CET1 capital buffer that the O-SIIs must hold (up to 2% of the total risk exposure) is non-zero and 0 otherwise	European Banking Authority
Dummy supervisory judgment	Dummy variable which takes the value of 1 if the O-SII is identified through supervisory judgment and 0 otherwise	European Banking Authority
Dummy BHC designation	Dummy variable which takes the value of 1 if the BHC appears in the O-SIIs designation list more than once (i.e., as BHC and as subsidiary in other countries) and 0 otherwise	European Banking Authority
Bank characteristics		
Size	Natural logarithm of Total assets	Worldscope
Equity to Total assets	Equity/Total assets	Worldscope
Distance to Default	Distance to Default risk measure of Duan and Wang (2012) expressed in standard deviations of banks' distance to default. Higher values are associated with reduced banks' individual risk.	Credit Research Initiative of Risk Management Institute
Dummy state ownership	Dummy variable that takes the value of 1 if the state is a shareholder, regardless its participation, and 0 otherwise	Orbis Banks; banks' annual reports
Dummy intervened bank	Dummy variable which takes the value of 1 if the bank received bailouts from government and 0 otherwise	European Commission Financial Aid reports; Nistor and Ongena (2019)

Table 3. Descriptive statistics

Panel A: EBA official event

Cumulative average returns	Obs.	Mean	Std. Dev.	Min	Max	Non-euro zone (mean)	Euro zone (mean)	Difference in means (Non-euro zone vs. euro zone)	Small banks (mean)	Large banks (mean)	Difference in means (Small vs. Large)
CER [0; 0]	54	-1.57	1.91	-7.75	2.26	-1.16	-1.83	0.67	-1.19	-2.22	1.03 *
CAR [0; 0]	54	-1.04	1.77	-7.16	2.82	-0.96	-1.09	0.13	-0.71	-1.68	0.97 *
CER [1; 5]	54	-1.15	4.25	-10.96	6.60	-1.90	-0.68	-1.22	-2.61	-1.11	-1.50
CAR [1; 5]	54	0.82	4.38	-9.07	14.27	-1.11	2.05	-3.16 ***	-0.67	0.85	-1.53
CDS CER [0; 0]	40	139.60	182.96	-103.56	667.64						
CDS CAR [0; 0]	40	129.92	180.19	-104.39	666.44						
CDS CER [1; 5]	40	133.56	313.28	-1310.23	603.39						
CDS CAR [1; 5]	40	57.04	303.90	-1394.64	499.78						

Panel B: National events

Cumulative average returns	Obs.	Mean	Std. Dev.	Min	Max	Non-euro zone (mean)	Euro zone (mean)	Difference in means (Non-euro zone vs. euro zone)
CER [0; 0]	64	-0.99	4.95	-35.91	7.10	-0.82	-1.15	0.33
CAR [0; 0]	64	-0.63	4.28	-30.02	7,42	-0.88	-0.40	-0.48
CER [1; 5]	64	-4.34	18.43	-108.82	13.54	-0.89	-7.58	6.69
CAR [1; 5]	64	-3.47	16.75	-97.55	10.80	-1.68	-5.15	3.46

Panel C: EBA official event and national events. Difference in means analysis

Cumulative average returns	Official event (mean)	National events (mean)	Difference in means (Official vs. National events
CER [0; 0]	-1.57	-0.99	-0.58
CAR [0; 0]	-1.04	-0.63	-0.41
CER [1; 5]	-1.15	-4.34	3.19
CAR [1; 5]	0.82	-3.47	4.29 *

Note: The table presents the descriptive statistics for the cumulative effective returns (CER) and cumulative abnormal return (CAR) for [0; 0] and [1; 5] event windows, including both stock returns (%) and CDS spread changes (basis points). To be consistent across notations, we use CER and CAR for both stock returns and CDS spread changes. In Panel A the data refers to the official event, corresponding to the date when the EBA published the O-SII list, the statistics being averaged across a sample of 54 banks in case of stock returns and 40 banks in case of CDS spread changes. In Panel B the data correspond to the national events (when the national regulatory authorities submitted the O-SII list to the EBA), the statistics being averaged across a sample of 64 banks. Panel C provides the difference in means analysis between the official event and the national events. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Table 4. Market reaction to the official O-SII list disclosure by EBA. Event study on stock returns

	Stock CAARs EBA date (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	-1.04	1.20	3.26	0.82
Euro zone banks	-1.09	1.40	5.84	2.05
Noneuro zone banks	-0.96	0.88	-0.78	-1.11
Significance tests: Full sample				
t-test	**-2.41**	**2.77**	**2.81**	0.84
(p-value)	(0.02)	(0.01)	(0.01)	(0.40)
Boehmer test	**-5.35**	**3.82**	**3.72**	**2.29**
(p-value)	(0.00)	(0.00)	(0.00)	(0.02)
Generalized sign test	**-3.95**	**3.40**	**2.85**	**1.76**
(p-value)	(0.00)	(0.00)	(0.00)	(0.08)
Corrado and Zivney rank test	-1.59	**1.70**	**1.86**	0.82
(p-value)	(0.11)	(0.09)	(0.06)	(0.41)
Significance tests: Euro zone banks				
t-test	-1.62	**2.09**	**3.28**	1.36
(p-value)	(0.11)	(0.04)	(0.00)	(0.17)
Boehmer test	**-3.95**	**3.30**	**5.39**	**4.67**
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)
Generalized sign test	**-3.31**	**2.70**	**3.05**	**1.99**
(p-value)	(0.00)	(0.01)	(0.00)	(0.05)
Corrado and Zivney rank test	-1.56	1.38	**2.20**	0.87
(p-value)	(0.12)	(0.17)	(0.03)	(0.39)
Significance tests: Noneuro zone banks				
t-test	**-2.57**	**2.35**	-0.72	-1.28
(p-value)	(0.01)	(0.02)	(0.47)	(0.20)
Boehmer test	**-3.57**	**1.96**	0.03	-0.25
(p-value)	(0.00)	(0.05)	(0.97)	(0.80)
Generalized sign test	**-2.31**	**2.17**	0.83	0.38
(p-value)	(0.02)	(0.03)	(0.41)	(0.70)
Corrado and Zivney rank test	-1.22	**1.77**	0.89	0.77
(p-value)	(0.22)	(0.08)	(0.38)	(0.44)

Note: This table shows the cumulative average abnormal returns (CAARs) of banks' stock returns for the full sample, the euro zone subsample and noneuro zone subsample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. Data refers to the official event, corresponding to the date when the EBA published the O-SII list. The estimation window is 250 days and the model employed to compute the expected returns is a hybrid CAMP model that allows for global and regional factors as described in Eq. (1). The number of observations is as follows: full sample – 54, euro zone banks – 33, noneuro zone banks – 21. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Table 5. Market reaction to the official O-SII list disclosure by EBA. Event study on CDS spreads

	CDS CAARs EBA date (b. p.)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	129.92	-21.46	-364.71	57.04
Significance tests				
t-test	**2.09**	-0.35	**-2.22**	0.41
(p-value)	(0.04)	(0.73)	(0.03)	(0.68)
Boehmer test	**4.24**	-0.67	**-4.48**	-0.03
(p-value)	(0.00)	(0.50)	(0.00)	(0.98)
Generalized sign test	**3.19**	**2.23**	**-3.20**	**2.55**
(p-value)	(0.00)	(0.03)	(0.00)	(0.01)
Corrado and Zivney rank test	0.71	-0.01	**-2.02**	-1.01
(p-value)	(0.48)	(0.99)	(0.04)	(0.31)

Note: This table illustrates the cumulative average abnormal change of banks' CDS spreads for the full sample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. To be consistent across notations, we use cumulative average abnormal return (CAAR) for both stock returns and CDS spread changes. Data refers to the official event, corresponding to the date when the EBA published the O-SII list. The estimation window is 250 days and the model employed to compute the expected returns is a market model that uses as market portfolio the iTraxx Europe 5 years CDS index as described in Eq. (3). The number of observations is 40. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Table 6. Determinants of stock prices AR for the official EBA event. Short-term analysis

Dependent variable	**Stock AR (0)**								
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
O-SII characteristics									
Dummy buffer	**0.010****								**0.009*****
	(0.004)								**(0.003)**
Dummy supervisory judgment		**-0.008***							**-0.014****
		(0.004)							**(0.006)**
Dummy BHC designation			-0.005						-0.007
			(0.005)						(0.005)
Bank characteristics									
Size				**-0.003*****					**-0.003****
				(0.001)					**(0.001)**
Equity to Total assets					-0.004				-0.172
					(0.094)				(0.118)
Distance to Default						0.002			0.003
						(0.002)			(0.002)
Dummy state ownership							0.000		0.002
							(0.004)		(0.005)
Dummy intervened bank								0.001	0.002
								(0.005)	(0.005)
Constant	-0.018***	-0.010***	-0.008*	0.046***	-0.010	-0.014***	-0.010***	-0.011***	0.056*
	(0.003)	(0.003)	(0.004)	(0.012)	(0.008)	(0.004)	(0.003)	(0.004)	(0.032)
Observations	54	54	54	54	54	53	54	54	53
R-squared	0.064	0.010	0.021	0.110	0.000	0.021	0.000	0.000	0.264

Note: The table presents the empirical output regarding the determinants of abnormal returns of banks' stock prices when considering the EBA official event date. The following cross-sectional regression model has been estimated for the O-SIIs sample using the *OLS* estimator: $AR_{ij}\ (t) = \alpha + \beta_1 \times OSII\ Characteristics_{ij} + \beta_2 \times\ Bank\ Characteristics_{ij} + \varepsilon_{ij}$. The dependent variable is represented by the abnormal return (AR_{ij}) of bank *i*'s from country *j* stock prices during the event window [0; 0], which corresponds to the event day (short-term period). Expected returns are estimated by a hybrid CAMP model that allows for global and regional factors as described in Eq. (1). $O\text{-}SII\ Characteristics_{ij}$ is a vector of bank-level specific variables related to the capital requirements and identification of O-SIIs, $Bank\ Characteristics_{ij}$ is a vector of bank-level specific variables, and ε_{ij} is the error term. Country-level clustered standard errors in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Table 7. Determinants of stock prices CAR for the official EBA event. Long-term analysis

Dependent variable	**Stock CAR [1; 5]**								
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
O-SII characteristics									
Dummy buffer	-0.002								-0.000
	(0.014)								(0.015)
Dummy supervisory judgment		**0.033*****							**0.052*****
		(0.009)							**(0.017)**
Dummy BHC designation			-0.010						-0.002
			(0.012)						(0.017)
Bank characteristics									
Size				0.002					-0.003
				(0.004)					(0.005)
Equity to Total assets					**-0.440*****				**-0.563****
					(0.139)				**(0.216)**
Distance to Default						-0.006			**-0.006***
						(0.004)			**(0.003)**
Dummy state ownership							-0.001		-0.016
							(0.010)		(0.010)
Dummy intervened bank								0.011	0.004
								(0.011)	(0.013)
Constant	0.010	0.006	0.014	-0.033	0.042***	0.018**	0.008	0.002	0.120
	(0.012)	(0.007)	(0.010)	(0.069)	(0.012)	(0.007)	(0.006)	(0.007)	(0.111)
Observations	54	54	54	54	54	53	54	54	53
R-squared	0.001	0.030	0.012	0.010	0.088	0.036	0.000	0.016	0.194

Note: The table presents the empirical output regarding the determinants of cumulative abnormal returns of banks' stock prices when considering the EBA official event date. The following cross-sectional regression model has been estimated for the O-SIIs sample using the *OLS* estimator: $CAR_{ij}\ [t1;\ t2] = \alpha + \beta_1 \times OSII\ Characteristics_{ij} + \beta_2 \times\ Bank\ Characteristics_{ij} + \varepsilon_{ij}$. The dependent variable is represented by the cumulative abnormal return (CAR_{ij}) of bank *i*'s from country *j* stock prices during the event window [1; 5], which corresponds to a post-event period (long-term period). Expected returns are estimated by a hybrid CAMP model that allows for global and regional factors as described in Eq. (1). $O\text{-}SII\ Characteristics_{ij}$ is a vector of bank-level specific variables related to the capital requirements and identification of O-SIIs, $Bank\ Characteristics_{ij}$ is a vector of bank-level specific variables, and ε_{ij} is the error term. Country-level clustered standard errors in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Appendix

Appendix A

Determinants of CDS AR for the official EBA event. Short-term analysis

Dependent variable	CDS AR (0)								
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
O-SII characteristics									
Dummy buffer	**-0.010***								-0.002
	(0.005)								(0.006)
Dummy supervisory judgment		**-0.014*****							-0.001
		(0.005)							(0.009)
Dummy BHC designation			0.006						-0.001
			(0.007)						(0.009)
Bank characteristics									
Size				**0.008*****					0.007
				(0.002)					(0.005)
Equity to Total assets					**-0.238****				-0.043
					(0.106)				(0.131)
Distance to Default						-0.000			-0.002
						(0.002)			(0.002)
Dummy state ownership							-0.011		-0.010
							(0.007)		(0.009)
Dummy intervened bank								-0.002	0.007
								(0.007)	(0.009)
Constant	0.020***	0.015***	0.010**	-0.143***	0.028***	0.016**	0.018***	0.017***	-0.121
	(0.002)	(0.004)	(0.004)	(0.047)	(0.009)	(0.006)	(0.006)	(0.005)	(0.114)
Observations	40	40	40	40	40	33	40	33	33
R-squared	0.065	0.084	0.029	0.246	0.064	0.002	0.089	0.002	0.269

Note: The table presents the empirical output regarding the determinants of abnormal changes of banks' CDS spreads when considering the EBA official event date. To be consistent across notations, we use abnormal return (AR) for both stock returns and CDS spread changes. The following cross-sectional regression model has been estimated for the O-SIIs sample using the *OLS* estimator: $AR_{ij}\ (t) = \alpha + \beta_1 \times OSII\ Characteristics_{ij} + \beta_2 \times Bank\ Characteristics_{ij} + \varepsilon_{ij}$. The dependent variable is represented by the abnormal return (AR_{ij}) of bank *i*'s from country *j* CDS during the event window [0; 0], which corresponds to the event day (short-term period). Expected returns are estimated by a market model as described in Eq. (3). $O\text{-}SII\ Characteristics_{ij}$ is a vector of bank-level specific variables related to the capital requirements and identification of O-SIIs, $Bank\ Characteristics_{ij}$ is a vector of bank-level specific variables, and ε_{ij} is the error term. Country-level clustered standard errors in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Appendix B

Determinants of CDS CAR for the official EBA event. Long-term analysis

Dependent variable	CDS CAR [1; 5]								
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
O-SII characteristics									
Dummy buffer	-0.006								0.003
	(0.010)								(0.012)
Dummy supervisory judgment		-0.006							-0.015
		(0.008)							(0.022)
Dummy BHC designation			0.006						-0.002
			(0.013)						(0.016)
Bank characteristics									
Size				**0.008***					**0.016*****
				(0.004)					**(0.005)**
Equity to Total assets					-0.095				0.370
					(0.257)				(0.326)
Distance to Default						-0.001			-0.000
						(0.003)			(0.003)
Dummy state ownership							0.001		-0.001
							(0.009)		(0.005)
Dummy intervened bank								0.011	0.023
								(0.016)	(0.017)
Constant	0.010	0.007	0.003	-0.147*	0.012	0.008	0.005	-0.001	-0.357***
	(0.006)	(0.006)	(0.003)	(0.080)	(0.021)	(0.006)	(0.008)	(0.014)	(0.115)
Observations	40	40	40	40	40	33	40	33	33
R-squared	0.007	0.006	0.010	0.082	0.004	0.004	0.000	0.028	0.210

Note: The table presents the empirical output regarding the determinants of cumulative abnormal change of banks' CDS spreads when considering the EBA official event date. To be consistent across notations, we use cumulative abnormal return (CAR) for both stock returns and CDS spread changes The following cross-sectional regression model has been estimated for the O-SIIs sample using the *OLS* estimator: $CAR_{ij}\ [t1;\ t2] = \alpha + \beta_1 \times OSII\ Characteristics_{ij} + \beta_2 \times\ Bank\ Characteristics_{ij} + \varepsilon_{ij.}$ The dependent variable is represented by the cumulative abnormal return (CAR_{ij}) of bank *i*'s from country *j* CDS during the event window [1; 5], which corresponds to a post-event period (long-term period). Expected returns are estimated by a market model as described in Eq. (3). *O-SII* $Characteristics_{ij}$ is a vector of bank-level specific variables related to the capital requirements and identification of O-SIIs, *Bank* $Characteristics_{ij}$ is a vector of bank-level specific variables, and ε_{ij} is the error term. Country-level clustered standard errors in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Appendix C1

Market reaction to the national O-SII lists disclosure. Event study on stock returns

	Stock CAARs national event dates (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	-0.63	-0.65	-4.70	-3.47
Euro zone banks	-0.40	-0.88	-4.78	-5.15
Noneuro zone banks	-0.88	-0.39	-4.61	-1.68
Significance tests: Full sample				
t-test	**-1.72**	**-1.76**	**-4.54**	**-4.14**
(p-value)	(0.09)	(0.08)	(0.00)	(0.00)
Boehmer test	-1.20	-0.61	**-3.45**	**-1.98**
(p-value)	(0.23)	(0.54)	(0.00)	(0.05)
Generalized sign test	0.31	1.07	-0.20	0.31
(p-value)	(0.76)	(0.28)	(0.84)	(0.76)
Corrado and Zivney rank test	0.34	0.84	0.88	**1.84**
(p-value)	(0.73)	(0.40)	(0.38)	(0.07)
Significance tests: Euro zone banks				
t-test	-0.64	-1.40	**-2.87**	**-3.66**
(p-value)	(0.53)	(0.16)	(0.00)	(0.00)
Boehmer test	0.59	0.58	-0.80	-1.05
(p-value)	(0.56)	(0.56)	(0.43)	(0.29)
Generalized sign test	-0.18	1.22	-0.53	0.52
(p-value)	(0.86)	(0.22)	(0.60)	(0.61)
Corrado and Zivney rank test	0.16	0.51	-0.39	-0.67
(p-value)	(0.87)	(0.61)	(0.70)	(0.50)
Significance tests: Noneuro zone banks				
t-test	**-2.41**	-1.08	**-3.79**	**-1.90**
(p-value)	(0.02)	(0.28)	(0.00)	(0.06)
Boehmer test	**-2.72**	**-2.00**	**-3.94**	**-1.83**
(p-value)	(0.01)	(0.05)	(0.00)	(0.07)
Generalized sign test	0.68	0.29	0.29	-0.10
(p-value)	(0.49)	(0.77)	(0.77)	(0.92)
Corrado and Zivney rank test	0.11	0.38	1.44	**2.94**
(p-value)	(0.91)	(0.71)	(0.15)	(0.00)

Note: This table shows the cumulative average abnormal returns (CAARs) of banks' stock prices for the full sample, the euro zone subsample and noneuro zone subsample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. Data correspond to the national events date (when the national regulatory authorities submitted the O-SII list to the EBA). The estimation window is 250 days and the model employed to compute the expected returns is a hybrid CAMP model that allows for global and regional factors as described in Eq. (1). The number of observations is as follows: full sample – 64, euro zone banks – 33, noneuro zone banks – 31. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the national events date. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix C2

Market reaction to the national O-SII lists disclosure. Event study on CDS spreads

	CDS CAARs national event dates (b.p.)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	1.20	-66.11	-240.21	-191.66
Significance tests				
t-test	0.02	-1.08	-1.48	-1.39
(p-value)	(0.98)	(0.28)	(0.14)	(0.16)
Boehmer test	0.36	**-2.82**	-1.38	**-2.11**
(p-value)	(0.72)	(0.01)	(0.17)	(0.04)
Generalized sign test	-0.40	**-1.95**	-1.34	-1.03
(p-value)	(0.69)	(0.05)	(0.18)	(0.30)
Corrado and Zivney rank test	-0.93	**-2.66**	**-2.61**	**-2.99**
(p-value)	(0.35)	(0.01)	(0.01)	(0.00)

Note: This table shows the cumulative average abnormal change of banks' CDS spreads for the full sample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. To be consistent across notations, we use cumulative average abnormal return (CAAR) for both stock returns and CDS spread changes. Data correspond to the national events date (when the national regulatory authorities submitted the O-SII list to the EBA). The estimation window is 250 days and the model employed to compute the expected returns is a market model that uses as market portfolio the iTraxx Europe 5 years CDS index as described in Eq. (3). The number of observations is 41. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix D

Market reaction to the O-SII list disclosure (event study on stock returns). Robustness assessment using the hybrid market model

	A. Stock CAARs EBA date (%)				B. Stock CAARs national date (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	-1.03	1.21	3.30	0.85	-0.34	-0.35	-2.64	-2.01
Euro zone	-1.27	1.23	4.59	1.17	-0.50	-0.98	-5.47	-5.64
Noneuro zone	-0.67	1.18	1.27	0.35	-0.17	0.31	0.36	1.86
Significance tests: Full sample								
t-test	**-2.41**	**2.82**	**2.91**	0.89	-0.95	-0.99	**-2.81**	**-2.53**
(p-value)	(0.02)	(0.01)	(0.00)	(0.38)	(0.34)	(0.33)	(0.01)	(0.01)
Boehmer test	**-5.42**	**3.85**	**4.30**	**2.75**	-0.23	0.58	-1.47	0.19
(p-value)	(0.00)	(0.00)	(0.00)	(0.01)	(0.82)	(0.50)	(0.14)	(0.85)
Generalized sign test	**-4.19**	**3.98**	**3.16**	**2.62**	-0.39	1.11	-0.89	**2.61**
(p-value)	**(0.00)**	(0.00)	(0.00)	(0.01)	(0.70)	(0.26)	(0.38)	(0.01)
Corrado and Zivney rank test	**-1.90**	1.49	1.24	0.34	-0.15	0.48	-0.18	0.91
(p-value)	(0.06)	(0.14)	(0.21)	(0.73)	(0.88)	(0.63)	(0.86)	(0.37)
Significance tests: Euro zone banks								
t-test	**-1.89**	**1.82**	**2.58**	0.78	-0.79	-1.55	**-3.28**	**-4.01**
(p-value)	(0.06)	(0.07)	(0.01)	(0.44)	(0.43)	(0.12)	(0.00)	(0.00)
Boehmer test	**-4.74**	**2.80**	**-3.89**	**2.94**	0.30	0.28	**-1.72**	-1.61
(p-value)	(0.00)	(0.01)	(0.00)	(0.00)	(0.76)	(0.78)	(0.09)	(0.11)
Generalized sign test	**-3.04**	**3.23**	**3.23**	**2.53**	0.18	1.58	-0.86	0.53
(p-value)	(0.00)	(0.00)	(0.00)	(0.01)	(0.85)	(0.12)	(0.39)	(0.60)
Corrado and Zivney rank test	**-1.93**	1.29	**1.65**	0.48	0.08	0.29	-0.84	-0.95
(p-value)	(0.05)	(0.20)	(0.10)	(0.63)	(0.94)	(0.77)	(0.40)	(0.34)
Significance tests: Noneuro zone banks								
t-test	**-1.97**	**3.47**	1.41	0.46	-0.56	1.01	0.44	**2.68**
(p-value)	(0.05)	(0.00)	(0.16)	(0.65)	(0.58)	(0.31)	(0.66)	(0.01)
Boehmer test	**-2.72**	**2.62**	**1.95**	1.08	-0.73	0.73	-0.39	**2.11**
(p-value)	(0.01)	(0.01)	(0.05)	(0.28)	(0.46)	(0.47)	(0.69)	(0.04)
Generalized sign test	**-2.90**	**2.34**	1.03	1.03	-0.74	-0.02	-0.38	**3.21**
(p-value)	(0.00)	(0.02)	(0.30)	(0.30)	(0.46)	(0.98)	(0.70)	(0.00)
Corrado and Zivney rank test	-1.40	1.44	0.25	0.16	-0.30	0.37	0.62	**2.54**
(p-value)	(0.16)	(0.15)	(0.80)	(0.88)	(0.76)	(0.71)	(0.53)	(0.01)

Note: The table presents the results corresponding to the robustness assessment where we compute the expected returns using a hybrid market model, allowing simultaneously a global index (i.e., the MSCI World index) and two regional indices depending on the locations of the banks (i.e., the Euro STOXX 50 index for the Euro zone banks and the STOXX 600 excluding euro zone for the noneuro zone banks). The cumulative average abnormal returns (CAARs) of banks' stock prices are determined for the full sample, the euro zone subsample and noneuro zone subsample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. The estimation window is 250 days. In Panel A the data refers to the official event, corresponding to the date when the EBA published the O-SII list. In Panel B the data correspond to the national events date (when the national regulatory authorities submitted the O-SII list to the EBA). The number of observations for the official event day (Panel A) is as follows: full sample – 54, euro zone banks – 33, noneuro zone banks – 21; the number of observations for the national events date (Panel B) is as follows: full sample – 64, euro zone banks – 33, noneuro zone banks – 31. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA (Panel A) and the national events date when the central banks submitted the O-SII list to the EBA (Panel B). The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix E

Market reaction to the O-SII list disclosure (event study on stock returns). Robustness assessment using the simple CAPM model

	A. Stock CAARs EBA date (%)				B. Stock CAARs national date (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	-1.16	1.29	5.37	0.21	-0.65	-0.78	-4.28	-3.49
Euro zone	-1.30	1.51	8.62	1.17	-0.48	-1.21	-4.31	-5.32
Noneuro zone	-0.93	0.95	0.28	-1.29	-0.84	0.31	-4.25	-1.53
Significance tests: Full sample								
t-test	**-2.57**	**2.87**	**4.46**	0.21	**-1.74**	**-2.06**	**-4.04**	**-4.06**
(p-value)	(0.01)	(0.00)	(0.00)	(0.83)	(0.08)	(0.04)	(0.00)	(0.00)
Boehmer test	**-5.47**	**3.72**	**5.02**	**1.82**	-0.71	-1.35	**-2.63**	**-2.11**
(p-value)	(0.00)	(0.00)	(0.00)	(0.07)	(0.48)	(0.18)	(0.01)	(0.04)
Generalized sign test	**-3.76**	**3.86**	**3.59**	1.14	0.16	-0.86	0.41	-0.10
(p-value)	(0.00)	(0.00)	(0.00)	(0.26)	(0.88)	(0.39)	(0.68)	(0.92)
Corrado and Zivney rank test	-1.29	1.43	**2.22**	0.49	0.88	0.24	1.29	**1.67**
(p-value)	(0.20)	(0.15)	(0.03)	(0.63)	(0.38)	(0.81)	(0.20)	(0.10)
Significance tests: Euro zone banks								
t-test	**-1.87**	**2.17**	**4.67**	0.75	-0.75	**-1.88**	**-2.52**	**-3.68**
(p-value)	(0.06)	(0.03)	(0.00)	(0.45)	(0.46)	(0.06)	(0.01)	(0.00)
Boehmer test	**-4.23**	**3.20**	**7.10**	**4.07**	1.04	-0.62	0.32	-1.42
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.30)	(0.54)	(0.75)	(0.16)
Generalized sign test	**-3.12**	**2.86**	**3.92**	**1.81**	-0.03	-1.43	0.32	-0.38
(p-value)	(0.00)	(0.00)	(0.00)	(0.07)	(0.97)	(0.15)	(0.75)	(0.70)
Corrado and Zivney rank test	-1.33	1.22	**2.64**	0.52	0.66	-0.66	0.26	-0.83
(p-value)	(0.18)	(0.22)	(0.01)	(0.60)	(0.51)	(0.51)	(0.80)	(0.41)
Significance tests: Noneuro zone banks								
t-test	**-2.32**	**2.37**	0.24	-1.40	**-2.25**	-0.84	**-3.44**	**-1.70**
(p-value)	(0.02)	(0.02)	(0.81)	(0.16)	(0.03)	(0.40)	(0.00)	(0.09)
Boehmer test	**-3.39**	**1.92**	0.51	-0.39	**-2.81**	-1.57	**-3.71**	-1.59
(p-value)	(0.00)	(0.06)	(0.61)	(0.70)	(0.01)	(0.12)	(0.00)	(0.11)
Generalized sign test	**-2.23**	**2.71**	0.92	-0.43	0.28	0.28	0.28	0.28
(p-value)	(0.03)	(0.01)	(0.36)	(0.66)	(0.78)	(0.78)	(0.78)	(0.78)
Corrado and Zivney rank test	-0.96	1.56	1.27	0.43	0.23	0.78	1.46	**2.78**
(p-value)	(0.34)	(0.12)	(0.20)	(0.67)	(0.82)	(0.43)	(0.14)	(0.01)

Note: The table presents the results corresponding to the robustness assessment where the expected returns are computed using a simple CAPM model for both events (EBA date and national events date). The main market index is MSCI World index and the risk-free rate is the one-month interbank rates. The cumulative average abnormal returns (CAARs) of banks' stock prices are determined for the full sample, the euro zone subsample and noneuro zone subsample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. The estimation window is 250 days. In Panel A the data refers to the official event, corresponding to the date when the EBA published the O-SII list. In Panel B the data correspond to the national events date (when the national regulatory authorities submitted the O-SII list to the EBA). The number of observations for the official event day (Panel A) is as follows: full sample – 54, euro zone banks – 33, noneuro zone banks – 21; the number of observations for the national events date (Panel B) is as follows: full sample – 64, euro zone banks – 33, noneuro zone banks – 31. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA (Panel A) and the national events date when the central banks submitted the O-SII list to the EBA (Panel B). The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix F

Market reaction to the O-SII list disclosure (event study on CDS spreads). Robustness assessment using a different market index

	CDS CAARs EBA date (b. p.)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	126.78	-25.71	-346.33	82.03
Significance tests				
t-test	**2.06**	-0.42	**-2.13**	0.60
(p-value)	(0.04)	(0.68)	(0.03)	(0.55)
Boehmer test	**4.18**	-0.79	**-4.48**	0.26
(p-value)	(0.00)	(0.43)	(0.00)	(0.80)
Generalized sign test	**3.47**	1.54	**-2.97**	**2.83**
(p-value)	(0.00)	(0.12)	(0.00)	(0.00)
Corrado and Zivney rank test	0.62	-0.23	**-1.92**	-0.78
(p-value)	(0.54)	(0.82)	(0.05)	(0.43)

Note: The table presents the results corresponding to the robustness assessment where we employ the market model to compute the expected change as described in Eq. (3) based on the Datastream Europe Banks 5 years CDS index as market portfolio for the official EBA event date. The cumulative average abnormal change of banks' CDS spreads for the full sample are determined considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. To be consistent across notations, we use cumulative average abnormal return (CAAR) for both stock returns and CDS spread changes. The estimation window is 250 days. Data refers to the official event, corresponding to the date when the EBA published the O-SII list. The number of observations is 40. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix G

Market reaction to the O-SII list disclosure in terms of stock returns and CDS spreads. Robustness assessment for a different estimation window

	A. Stock CAARs EBA date (%)				B. CDS CAARs EBA date (b. p.)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	-0.89	1.31	4.06	1.52	132.24	-18.54	-350.59	64.57
Significance tests								
t-test	**-1.97**	**2.90**	**3.32**	1.50	**2.72**	-0.38	**-2.73**	0.59
(p-value)	(0.05)	(0.00)	(0.00)	(0.14)	(0.01)	(0.70)	(0.01)	(0.55)
Boehmer test	**-4.74**	**3.90**	**4.05**	**2.82**	**4.14**	-0.65	**-3.60**	-0.07
(p-value)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.52)	(0.00)	(0.94)
Generalized sign test	**-4.12**	**3.51**	**2.69**	1.60	**3.59**	**2.95**	**-3.07**	**2.00**
(p-value)	(0.00)	(0.00)	(0.01)	(0.11)	(0.00)	(0.00)	(0.00)	(0.05)
Corrado and Zivney rank test	-1.38	1.62	**1.86**	1.00	0.78	0.01	**-1.90**	-0.98
(p-value)	(0.17)	(0.11)	(0.06)	(0.32)	(0.43)	(1.00)	(0.06)	(0.33)

Note: The table presents the results corresponding to the robustness assessment where the estimation window is 150 days. The cumulative average abnormal returns of banks' stock prices and cumulative average abnormal change of CDS spreads are determined for the full sample, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. To be consistent across notations, we use cumulative average abnormal return (CAAR) for both stock returns and CDS spread changes. In Panel A the data correspond to the CAARs associated with stock returns. We employ a hybrid CAMP model that allows for global and regional factors as described in Eq. (1) to compute the expected returns. In Panel B the data correspond to the CAARs associated with CDS spreads. The model employed to compute the expected change is the market model that uses as market portfolio the iTraxx Europe 5 years CDS index as described in Eq. (3). In both panels the data refers to the official event, corresponding to the date when the EBA published the O-SII list. The number of observations is 54 for Panel A and 40 for Panel B. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix H

Market reaction to the O-SII list official disclosure (event study on stock returns). Estimation for different sub-samples

	A. Stock CAARs of large O-SIIs (%)				B. Stock CAARs of small O-SIIs (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
	-1.68	2.38	3.73	0.85	-0.71	-0.25	1.02	-0.67
Significance tests								
t-test	**-4.89**	**6.94**	**3.96**	1.10	-0.87	-0.31	0.46	-0.37
(p-value)	(0.00)	(0.00)	(0.00)	(0.27)	(0.38)	(0.75)	(0.65)	(0.72)
Boehmer test	**-6.89**	**6.88**	**4.35**	**2.78**	**-2.44**	-0.98	-0.09	-1.11
(p-value)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)	(0.33)	(0.93)	(0.27)
Generalized sign test	**-4.53**	**4.32**	**2.78**	1.24	-0.78	0.38	1.15	0.38
(p-value)	(0.00)	(0.00)	(0.01)	(0.21)	(0.43)	(0.71)	(0.25)	(0.71)
Corrado and Zivney rank test	**-2.14**	**2.25**	1.45	0.25	-0.57	0.45	**1.81**	1.36
(p-value)	(0.03)	(0.02)	(0.15)	(0.80)	(0.57)	(0.65)	(0.07)	(0.18)

	C. Stock CAARs of O-SIIs without G-SIBs (%)				D. Stock CAARs of O-SIIs without top 1 banks (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
	-0.96	0.46	1.73	-0.15	-1.25	1.44	2.88	-0.06
Significance tests								
t-test	**-1.64**	0.77	1.06	-0.11	**-2.16**	**2.47**	**1.80**	-0.04
(p-value)	(0.10)	(0.44)	(0.29)	(0.91)	(0.03)	(0.01)	(0.07)	(0.97)
Boehmer test	**-3.97**	1.15	1.08	0.12	**-4.75**	**3.50**	**2.63**	0.87
(p-value)	(0.00)	(0.25)	(0.28)	(0.91)	(0.00)	(0.00)	(0.01)	(0.38)
Generalized sign test	**-2.05**	1.48	**1.80**	0.52	**-3.21**	**3.22**	**2.88**	0.51
(p-value)	(0.04)	(0.14)	(0.07)	(0.60)	(0.00)	(0.00)	(0.00)	(0.61)
Corrado and Zivney rank test	-1.17	1.29	**1.74**	1.12	**-1.74**	**1.85**	1.51	0.30
(p-value)	(0.24)	(0.20)	(0.08)	(0.26)	(0.08)	(0.06)	(0.13)	(0.77)

Note: The table presents the results corresponding to sub-samples of the official EBA list. The cumulative average abnormal returns (CAARs) of banks' stock prices are determined for the large banks from the sample in Panel A (with the value of total assets at the end of 2015 greater than the median of the sample), the small banks in Panel B (with the value of total assets at the end of 2015 smaller than the median of the sample), for O-SIIs without the G-SIBS in Panel C, and for O-SIIs without the top one banks in Panel D (according to their size at the end of 2015) from their country, considering the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. The estimation window is 250 days and the model employed to compute the expected returns is a hybrid CAMP model that allows for global and regional factors as described in Eq. (1). The number of observations is the following: 27 banks for large O-SIIs, 27 banks for small O-SIIs, 39 banks for O-SIIs without G-SIBs and 35 banks for O-SIIs without top one banks. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the official event date of EBA (Panel A) and the national events date when the central banks submitted the O-SII list to the EBA (Panel B). The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix I

Market reaction to other events related to systemically important financial institutions (event study on stock returns)

Panel A. Market reaction to the publication of G-SIBs list by Financial Times and of the official G-SIBs list by FSB

	A1. Stock CAARs G-SIBs FT (%)				A2. Stock CAARs G-SIBs official date (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	0.41	-2.34	-2.41	-3.43	-0.66	-0.66	-5.57	-1.94
Significance tests								
t-test	0.44	**-2.51**	-0.98	**-1.65**	**-1.89**	**-1.89**	**-6.00**	**-2.47**
(p-value)	(0.66)	(0.01)	(0.33)	(0.10)	(0.06)	(0.06)	(0.00)	(0.01)
Boehmer test	1.43	**-7.35**	**-2.00**	**-8.43**	-1.14	**-3.09**	**-7.31**	**-3.69**
(p-value)	(0.15)	(0.00)	(0.05)	(0.00)	(0.26)	(0.00)	(0.00)	(0.00)
Generalized sign test	1.46	**-3.60**	**-1.76**	**-4.06**	-0.48	**-2.75**	**-4.27**	**-2.00**
(p-value)	(0.14)	(0.00)	(0.08)	(0.00)	(0.63)	(0.01)	(0.00)	(0.05)
Corrado and Zivney rank test	0.78	**-2.98**	-1.09	**-1.93**	-0.33	-1.13	-1.53	-0.83
(p-value)	(0.43)	(0.00)	(0.28)	(0.05)	(0.74)	(0.26)	(0.13)	(0.41)

Panel B. Market reaction to the publication of the lists of banks included in the Single Supervisory Mechanism by ECB

	Stock CAARs SSM (%)			
Event window	[0; 0]	[1; 1]	[-3; 3]	[1; 5]
Full sample	0.72	1.03	0.11	0.06
Significance tests				
t-test	**2.07**	**2.96**	0.12	0.08
(p-value)	(0.04)	(0.00)	(0.90)	(0.94)
Boehmer test	**2.61**	**4.03**	**-1.79**	0.50
(p-value)	(0.01)	(0.00)	(0.07)	(0.62)
Generalized sign test	**3.50**	**3.50**	0.81	0.00
(p-value)	(0.00)	(0.01)	(0.42)	(1.00)
Corrado and Zivney rank test	**1.63**	**2.21**	1.12	0.85
(p-value)	(0.10)	(0.03)	(0.26)	(0.40)

Note: This table shows the cumulative average abnormal returns (CAARs) of banks' stock prices when considering other events related to systemically important financial institutions: the first date when the *Financial Times* publication leaked the supposed G-SIBs list (November 30th, 2009) in Panel A (A1); the official publication of the G-SIBs list (November 4th, 2011) in Panel A (A2); and the publication of the lists of banks included in the Single Supervisory Mechanism by ECB in Panel B (September 4th, 2014). CAARs are determined using an estimation window of 250 days and the following event windows: [0; 0], [1; 1], [-3; 3], and [1; 5]. The expected returns are computed for G-SIBs using a hybrid CAPM described in Eq. (1), that allows simultaneously for a global index (MSCI World index) and three regional indices, depending on the location of the banks: MSCI Europe for the European G-SIBS, MSCI USA for the American G-SIBs and MSCI Pacific for the Asian G-SIBs. For the other events, we use the benchmark model from Eq. (1) to compute the expected return. As a risk-free rate we use the one-month T-Bill rate for G-SIBs and the one-month interbank rates for the remaining events. The number of the observations is 19 for Panel A (A1), 28 for Panel A (A2), and 59 for Panel B. The table also reports the statistics and the associated p-values of the tests used to assess the significance of CAARs over the *Financial Times* leaked G-SIBs list and over the official date when the list of G-SIBs was disclosed, and the publication of the lists of banks included in the Single Supervisory Mechanism by ECB. The data correspond to the parametric *t-test* and the *Boehmer et al. (1991) test*, the non-parametric *generalized sign test* of Cowan (1992) and the *Corrado and Zivney (1992) rank test.* In bold are the tests with a maximum level of significance of 10%.

Appendix J

Banks subject to the publication of different lists on systemically important financial institutions

Number	Bank	Country of origin	FT list & G-SIB	G-SIBs list	SSM list
1	Erste Group Bank	Austria	NO	NO	YES
2	Raiffeisen Bank International	Austria	NO	NO	YES
3	KBC Group	Belgium	NO	NO	YES
4	Dexia	Belgium	NO	YES	YES
5	Bank of China	China	NO	YES	NO
6	Bank of Cyprus	Cyprus	NO	NO	YES
7	Hellenic Bank	Cyprus	NO	NO	YES
8	BNP Paribas	France	YES	YES	YES
9	Societe Generale	France	YES	YES	YES
10	Credit Agricole	France	NO	YES	YES
11	Natixis	France	NO	NO	YES
12	Crédit Agricole Atlantique Vendée	France	NO	NO	YES
13	Crédit Agricole Normandie Seine	France	NO	NO	YES
14	Crédit Agricole Loire Haute Loire	France	NO	NO	YES
15	Crédit Agricole Touraine Poitou	France	NO	NO	YES
16	CRCAM LANGUED CCI	France	NO	NO	YES
17	Crédit Agricole Brie Picardie	France	NO	NO	YES
18	Crédit Agricole du Morbihan	France	NO	NO	YES
19	CRCAM NORD DE FRANCE CCI	France	NO	NO	YES
20	Crédit Agricole Toulouse	France	NO	NO	YES
21	Crédit Industriel et Commercial	France	NO	NO	YES
22	Crédit Agricole Alpes Provence	France	NO	NO	YES
23	Crédit Agricole d'Ile de France	France	NO	NO	YES
24	Crédit Agricole Sud Rhône Alpes	France	NO	NO	YES
25	Deutsche Bank	Germany	YES	YES	YES
26	Commerzbank	Germany	NO	YES	YES
27	Aareal Bank	Germany	NO	NO	YES
28	DVB Bank	Germany	NO	NO	YES
29	National Bank of Greece	Greece	NO	NO	YES
30	Alpha Bank	Greece	NO	NO	YES
31	Bank of Piraeus	Greece	NO	NO	YES
32	Eurobank Ergasias	Greece	NO	NO	YES
33	The Governor and Company of the Bank of Ireland	Ireland	NO	NO	YES
34	Allied Irish Bank	Ireland	NO	NO	YES
35	Permanent TSB Group Holdings	Ireland	NO	NO	YES
36	Unicredit Group S.p.A.	Italy	YES	YES	YES
37	Gruppo Monte dei Paschi di Siena	Italy	NO	NO	YES
38	Intesa Sanpaolo	Italy	NO	NO	YES
39	Unione di Banche Italiane	Italy	NO	NO	YES
40	Banca Carige	Italy	NO	NO	YES
41	Banca Popolare di Milano	Italy	NO	NO	YES
42	Banca Popolare di Sondrio	Italy	NO	NO	YES
43	Banco popolare - Societa Cooperativa	Italy	NO	NO	YES
44	Mediobanca	Italy	NO	NO	YES
45	Banco di Sardegna	Italy	NO	NO	YES
46	Mitsubishi UFJ FG	Japan	YES	YES	NO
47	Mizuho FG	Japan	YES	YES	NO
48	Sumitomo Mitsui FG	Japan	YES	YES	NO
49	Bank of Valletta	Malta	NO	NO	YES
50	HSBC Bank Malta	Malta	NO	NO	YES
51	ING Group	Netherlands	YES	YES	YES
52	Banco BPI	Portugal	NO	NO	YES
53	Banco Comercial Português	Portugal	NO	NO	YES
54	Banco Espirito Santo	Portugal	NO	NO	NO
55	Tatra Banka	Slovakia	NO	NO	YES
56	Vseobecna Uverova Banka	Slovakia	NO	NO	YES
57	Banco Santander	Spain	YES	YES	YES
58	Caixabank	Spain	NO	NO	YES
59	BBVA	Spain	NO	NO	YES
60	Banco Popular Espanol	Spain	NO	NO	YES
61	Banco de Sabadell	Spain	NO	NO	YES
62	Bankinter	Spain	NO	NO	YES
63	Liberbank	Spain	NO	NO	YES
64	Bankia	Spain	NO	NO	YES
65	Swedbank	Sweden	NO	NO	NO
66	Svenska Handelsbanken AB	Sweden	NO	NO	NO
67	Nordea Bank	Sweden	NO	YES	NO
68	Credit Suisse Group	Switzerland	YES	YES	NO
69	UBS Group	Switzerland	YES	YES	NO
70	HSBC Holdings Plc	UK	YES	YES	NO
71	Barclays Plc	UK	YES	YES	NO
72	Royal Bank of Scotland Group Plc	UK	YES	YES	NO
73	Lloyds Banking Group Plc	UK	NO	YES	NO
74	Bank of America	USA	YES	YES	NO
75	Bank of New York Mellon	USA	NO	YES	NO
76	Citigroup	USA	YES	YES	NO
77	Goldman Sachs Group	USA	YES	YES	NO
78	JP Morgan Chase	USA	YES	YES	NO
79	Morgan Stanley	USA	YES	YES	NO
80	State Street	USA	NO	YES	NO
81	Wells Fargo	USA	NO	YES	NO
	Total number of events		*19*	*28*	*59*

Note: The table shows the list of G-SIBs disclosed by the *Financial Times* (FT) that were included in the official G-SIBs list published by the Financial Supervisory Board, the official list of G-SIBs published by the Financial Supervisory Board on November 4th, 2011, and the banks included in the Single Supervisory Mechanism of ECB with data available on Datastream and Bloomberg.

Appendix K

Description of the statistic tests used to assess the abnormal returns

In our event study, we examined the cumulative average abnormal return (CAAR) for the whole sample and we employed parametric and non-parametric tests in order to evaluate the significance of the CAARs. All tests have the following null hypothesis:

$$H_0: CAAR\ [t_1;\ t_2] = 0$$

The alternative hypothesis is:

$$H_a: CAAR\ [t_1;\ t_2]\ \neq 0$$

A. **Parametric tests.** The parametric tests are based on the assumption that the abnormal returns are normally distributed.

A1. The t-test. The t-test for the CAAR has the following form:

$$t_{CAAR_{T1,T2}} = \frac{CAAR\ [t_1; t_2]}{\sigma_{CAAR\ [t_1; t_2]}} \quad \text{(K1)}$$

where $\sigma_{CAAR\ [t_1; t_2]}$ is the estimated standard deviation of the $CAAR\ [t_1;\ t_2]$ for the $[t_1;\ t_2]$ event window defined as

$$\sigma_{CAAR\ [t_1; t_2]} = \sqrt{\frac{1}{N(N-d)} \sum_{i=1}^{N} (CAR_i[t_1;\ t_2] - CAAR\ [t_1;\ t_2])^2} \quad \text{(K2)}$$

N is the number of the firms in the sample, $CAR_i[t_1;\ t_2]$ is the cumulative abnormal return of firm *i* for the $[t_1;\ t_2]$ interval and *d* represents the degrees of freedom. The *t-test* assumes cross-sectional independence, i.e., the residuals are not correlated across firms.

A2. Boehmer et al. (1991) test (also known as the BMP test). This test is corrected for event-induced changes in volatility and autocorrelation and it is based on the standardization process of abnormal returns (ARs), as in the Patell's (1976) test, which is robust to heteroscedastic event-window abnormal returns:

$$SAR_{it} = \frac{AR_{it}}{\sigma_{AR_i}} \tag{K3}$$

where SAR_{it} is the standardized abnormal return for firm *i* at time *t*. The standard deviation is estimated using the following formula:

$$\sigma_{AR_i} = \sqrt{\frac{1}{D_i - d} \sum_{t=t1}^{t2} (AR_{it})^2} \tag{K4}$$

where D_i is the number of days in firm i's estimation period (usually 250 or 150). Under the null hypothesis, each SAR_{it} follows a Student t-distribution with $D_i - d$ degrees of freedom. SARs can be cumulated over different intervals $[t_1;\ t_2]$ to get the cumulative standardized abnormal return (CSAR):

$$CSAR_i[t_1;\ t_2] = \sum_{t=t_1}^{t_2} SAR_{it} \tag{K5}$$

The expected value of the $CSAR_i[t_1;\ t_2]$ is zero and the standard deviation is given by:

$$\sigma_{CSAR_i[t_1;\,t_2]} = \sqrt{(t_2 - t_1 - 1)\frac{D_i - d}{D_i - 2d}} \tag{K6}$$

Under the null hypothesis of statistically indistinguishable from zero CAARs, the test is given in Eq. (K7):

$$Boehmer\ test = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{CSAR_i[t_1;\,t_2]}{\sigma_{CSAR_i[t_1;\,t_2]}} \tag{K7}$$

where the denominator (cross-sectional standard deviation) is defined as

$$\sigma_{CSAR_i[t_1;\, t_2]} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(CSAR_i[t_1;\; t_2] - \frac{1}{N}\sum_{i=1}^{N} CSAR_i[t_1;\; t_2])}^{2} \quad \text{(K8)}$$

B. Non-parametric tests. Unlike the parametric tests, the non-parametric tests do not assume a specific distribution of the abnormal returns.

B1. The generalized sign test. This test assesses whether the firms with positive CARs in the event window exceeds the number expected from a period unaffected by the event (Cowan, 1992). The number expected is based on the fraction of positive CARs in the estimation period (*T*), usually set at 250 or 150 days:

$$\hat{p} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{T}\sum_{t=1}^{T} S_{it} \quad \text{(K9)}$$

where

$$S_{it} = \begin{cases} 1 & if\ AR_{it} > 0 \\ 0 & otherwise \end{cases} \quad \text{(K10)}$$

The ratio of positive cumulative abnormal returns is a binominal random variable, and the generalized sign test statistic has the following form (with the null $CAAR\ [t_1;\ t_2] = 0$):

$$Generalised\ sign\ test = \frac{w - n\hat{p}}{\sqrt{n\hat{p}(1-\hat{p})}} \quad \text{(K11)}$$

where w is the number of firms in the event window for which $CAR_i\ [t_1;\ t_2]$ is positive and n is the number of firms. The generalized sign test is well specified in the presence of skewed returns.

B1. Corrado and Zivney's (1992) rank test. Corrado (1989) assigns a rank based on abnormal return to each day *t* of each individual firm *i* in the sample:

$$K_{it} = rank(AR_{it}) \quad \text{(K12)}$$

Based on the estimation window, rank one denotes the smallest abnormal return and rank *t* denotes the largest abnormal return. Corrado and Zivney (1992) standardize the ranks to allow for missing returns:

$$U_{it} = \frac{K_{it}}{(1+M_i)} \tag{K13}$$

where M_i is the number of non-missing returns during the event period. For each day the test can be written as follows:

$$Corrado\ and\ Zivney\ rank\ test = \frac{1}{\sqrt{N}}\sum_{i=1}^{N}\frac{\sum_{i=1}^{N}(U_{it}-\frac{1}{2})}{\sigma_{U_{it}}} \tag{K14}$$

where *N* is the number of the firms in the sample and $\sigma_{U_{it}}$ is the standard deviation of the ranks. For the CAARs, we use the aggregation formula from Cowan (1992). In Eq. (K11), M_i represents the number of non-missing returns of firm *i*. If there are no missing returns, $M_i = M = t_2 - t_1 + 1$. The mean rank across estimation and event window period is:

$$\widetilde{K} = \frac{D+M+1}{2} \tag{K15}$$

where *D* is the length of the estimation window. For the $[t_1;\ t_2]$ event window the Corrado and Zivney rank test has the following form:

$$Corrado\ and\ Zivney\ rank\ test = \sqrt{t_2 - t_1 + 1}\frac{\overline{\overline{K}}\,[t_1; t_2]- \widetilde{K}}{[\sqrt{\sum_{t=1}^{D+E}(\overline{K_t}- \widetilde{K})^2/(D+E)}]} \tag{K16}$$

where $\overline{\overline{K}}\ [t_1;\ t_2] = \frac{1}{t_2 - t_1+1}\sum_{t=t_1}^{t_2}\frac{1}{N}\sum_{i=1}^{N} K_{it}$ is the average rank across all *N* firms in the sample and $t_2 - t_1 + 1$ days of the event window and $\overline{K_t} = \frac{1}{N}\sum_{i=1}^{N} K_{it}$ is the average rank across *N* firms on day *t* of the combined estimation and event period. The Corrado and Zivney rank test is corrected for event-induced volatility of rankings and cross-correlation.