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Identifying, Ranking and Tracking Systemically Important Financial Institutions (SIFIs), from a global, EU and Eurozone perspective

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This paper develops a methodology to identify systemically important financial institutions building on that developed by the BCBS (2011) and used by the Financial Stability Board in its yearly G-SIFIs identification. This methodology is based on publicly available data, providing fully transparent results with a G-SIFIs list that helps to bridge the gap between market knowledge and supervisory decisions. Moreover the results encompass a complete ranking of the banks considered, according to their systemic importance scores. The methodology has then been applied to EU and Eurozone samples of banks to obtain their systemic importance ranking and SIFIs lists. A statistical analysis and some geographical and historical evidence provide further insight into the notion of systemic importance, its policy implications and the future applications of this methodology.

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1. Introduction

The global financial crisis of 2007-2009 highlighted the fallacies and inadequacies of banking regulation, microprudential and macroprudential policies. Moreover, the Lehman Brothers bankruptcy in 2008 showed how the collapse of a single, big enough, financial institution could jeopardize financial stability almost to the level of bringing the entire financial system on its knees.

In this light, and acknowledging the importance of macroprudential policies to preserve financial stability, it's not surprising that regulators around the World turned their attention to this issue and to the measures needed to address it. The IMF/BIS/FSB Report (2009), written upon a request of the G-20 Leaders, provided "guidance for national authorities to assess the systemic importance of financial institutions, markets and instruments". In the view of this seminal report, a financial institution is considered systemically important if its failure or malfunction causes widespread distress either as a direct impact or as a trigger for broader contagion. Based on this framework, the Basel Committee on Banking Supervision (BCBS) issued the rule text – BCBS (2011) – containing the assessment methodology to identify global systemically important financial institutions (G-SIFIs) to be more closely supervised and required to hold additional loss absorbency capital. Then, the Financial Stability Board (FSB) adopted this approach to identify a first list of G-SIFIs in November 2011 and updated it one year later.

Given the regulatory and financial stability implications of the identification of a list of G-SIFIs, it is important to improve the comprehension of the issue. Even if the BCBS approach can be considered the most-comprehensive methodology to assess the systemic importance of financial institutions, its reliance on a certain degree of judgement and on non-public supervisory data can well hamper the confidence of market participants in its results.

This paper has two objectives. The first objective is to shed more light on the BCBS methodology, bridging the gap between market agents' information and regulators information. The BCBS methodology has been adapted, with a limited set of reliable assumptions, to rely on public data only. This new methodology is carefully described and evaluated in the following sections in order to make it easily understandable and replicable in different contexts. The results obtained are then compared with the FSB ones. This procedure allows not only to identify the market-based list of G-SIFIs, but also to rank all the banks under review according to their systemic importance. This ranking makes it possible to track some less evident features, like the geographical and temporal distribution of systemic importance, its state-dependency and its statistical properties, and draw some policy implications from this additional set of information.

The second objective of the paper is to refocus this approach in order to identify the list of SIFIs in the European Union and in the Eurozone. As the BCBS (2012) consultative document for dealing with domestic systemically important financial institutions (D-SIFIs) clearly states, there might be several financial institutions that are not significant at the global level but could have an important impact on their domestic financial system or economy. In this light, the Sovereign Debt Crisis of the Eurozone highlighted how cross-country spillovers between different banking systems have been magnified by the area's deep financial integration and how the transmission of the vicious link between banks and their sovereigns to the whole area have been favoured by the area's asymmetric financial architecture, with a unique monetary policy and national micro and macroprudential policies. Given the interactions between these policies in preserving price and financial stability (Angelini et al. (2012)), it's not surprising that the European Union is moving towards the creation of a banking union that would bring these three policies under the same umbrella. Even if neither the European Union single market, neither the smaller Eurozone could be considered a domestic financial system alike the BCBS (2012) definition, both have some features of a single jurisdiction and can have more of them in the future (especially when a single banking

union will be completed)[1]. In this light it is of paramount importance to identify the systemically important financial institutions at the EU and Eurozone level (henceforth EU-SIFIs and EZ-SIFIs), both from a microprudential and macroprudential perspective. The identification of these banks and their analysis through geography and through time sheds further light on the systemic importance issue, its definition and its behaviour. Moreover, the comparison between different samples could help understand the effects of past policy choices and the challenges lying ahead for regulatory authorities and for the construction of a fully fledged banking union. Another important issue is the help that supervisory authorities could gain from this list in designing the SSM and the overall banking union.

The literature on the topic has flourished in recent years, but often definitions of systemic importance and methodologies to assess it greatly differ, so Section 2 is dedicated to review the related literature and clarify some relevant definitions. Section 3 explains the BCBS approach. Section 4 describes the methodology followed to adapt the BCBS approach to public data and all the relevant assumptions to build the dataset. Section 5 presents the lists for the global, EU and Eurozone samples, while Section 6 discusses the statistical properties of systemic importance, its geographical and dynamic evidence relative to the different samples and some relevant policy implications. Section 7 concludes.

2. Systemic importance in theory and practice: literature review

The assessment of systemic importance of financial institutions, markets and instruments, its identification and the following policy responses belong to the broader literature related to systemic risk. It is thus important to understand the relationship between the two notions of systemic risk and systemic importance.

A unique definition of systemic risk does not exist. Definitions range from the risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy (IMF/BIS/FSB (2009))[2], to externalities which, if unheeded, could jeopardize financial stability (Angelini et al. (2012)). Conversely, the clearest definition of systemic importance, following IMF/BIS/FSB (2009), says that a financial institution is considered systemically important if its failure or malfunction causes widespread distress either as a direct impact or as a trigger for broader contagion. The distance between the two notions is bridged by the notion of contribution to systemic risk. In fact, systemic importance has to be considered in terms of the impact that the failure of an institution could have on the global financial system – much alike a loss-given-default (LGD) concept (BCBS (2011)). On the contrary, the contribution to systemic risk – being state-dependent in nature – should be regarded as the interaction between LGD and the probability of default (PD). This distinction is not often clearly dealt with in the literature.

In this light, the branches of literature dealing with systemic importance (SI) and systemic risk contribution (SRC) differ. While the academic focus has so far been concentrated on SRC, policy makers have been more interested in SI for its policy usability. In fact, the models developed

[1] The European Union supervisory architecture is structured as follows: banking supervision, up to the end of 2012, is a national responsibility. However, in 2011, three European Supervisory Authorities (ESAs) had been created to coordinate the national supervisory authorities. Among them is the European Banking Authority (EBA) in charge of coordinating the banking supervision in the EU and writing the single rulebook of banking activity in the EU. The European Systemic Risk Board (ESRB) had been created with the three ESAs. It has duties of macroprudential supervision and coordination. The path towards a banking union, including all the Eurozone countries and others belonging to the EU, will go through a unique supervisory authority, labelled Single Supervisory Mechanism (SSM). However this is not enough to consider the banking system under the SSM supervision as a "domestic" banking system in the BCBS sense, as a single resolution mechanism and a single deposit insurance scheme are still to be implemented.

[2] This definition is very close to Trichet (2009) definition of systemic risk, as the threat that developments in the financial system can cause a a break-down of the financial system and massive damages to the real economy.

to measure SRC are often complex and not very suitable for supervisory purposes. Anyway, the existing literature disentangles several important aspects of systemic risk and the contribution by individual financial institutions based on their business models, risk taking, market linkages and so on. Acharya et al. (2010) define SRC as the propensity of an institution to be undercapitalized when the system as a whole is undercapitalized (systemic expected shortfall, SES). Huang et al. (2012) suggest a framework for measuring and stress testing the systemic risk of a group of financial institutions as the price of insurance against financial distress, based on default probabilities of individual banks and forecasted asset return correlations. Adrian and Brunnenmeier (2011) propose CoVaR as a general measure of systemic risk, which is the Value-at-Risk of the overall financial system conditional on an individual institution being under distress. Then, an institution's contribution to systemic risk is defined as the difference between CoVaR conditional on the institution being under distress and the same measure in the median state of the institution. Tarashev et al. (2009) instead present a methodology that takes as inputs measures of system-wide risk and allocates them to individual institutions relying on the Shapley value. Based again on Shapley values, Drehmann and Tarashev (2011) propose a measure to evaluate the contribution of interconnected banks to systemic risk which depends materially on the bank's role in the interbank network. Dungey et al. (2012) propose a network-based methodology to rank SRC, also encompassing some firms characteristics. Another paper accounting for firms characteristics is Moore and Zhou (2012). ECB (2010a) and ECB (2010b) provide two valuable surveys of several other quantitative measures of systemic risk and systemic risk contributions.

What all the aforementioned measures have in common is that they are market-based. Thus they share the problem of not being stable over time and over the cycle (DB Research 2011). In fact, relying on several different market data, they are likely to encompass the overall degree of risk aversion and the market's idiosyncratic risk perceptions towards an institution. In this light it is important to have a measure of SI free of the underlying risk-sensitive measures. Moreover concerns about the robustness of the results remain, as these model-based approaches often yield very different indications. These models often rely on peculiar assumptions and specifications and on limited sets of data, thus they could not capture all the dimensions of systemic importance. Another drawback of these models lies in their limited universality, being based on financial markets data they can be applied only to a subset of existing financial institutions – those publicly listed and traded – letting aside non-listed banks and foreign subsidiaries.

Given these shortcomings, it's straightforward that regulators and policy makers rely on an alternative approach. Firstly, since they are more interested for policy purposes in evaluating the impact of systemic importance of a financial institution, rather than its contribution to systemic risk, they tend to prefer indicator-based approaches that rest on firm characteristics, business models, and levels of transactions in specific markets or instruments, rather than on risk-dependent and market-sensitive data. Even if size is often one of the main determinants of systemic importance, it can become more or less significant depending on the connections to other institutions (Moore and Zhou (2012)). Moreover size can be of greater systemic concern when institutions are complex (IMF/BIS/FSB (2009)).

The three main examples of this kind are the aforementioned BCBS (2011) methodology to identify the G-SIFIs, the FSOC (2011) definition to identify US significant non-banks financial institutions and the ECB (2006) methodology to identify large and complex banking groups for financial system stability assessment. The advantage of these approaches is that they encompass many dimensions of systemic importance – reflected by both quantitative and qualitative indicators –, are relatively simple, and are more robust than currently available model-based measurement methodologies that rely on a small set of indicators or market variables. Moreover, they can be more-easily implemented and replicated than a model-based approach. However, as the literature often shows (Elliott (2012)), there are no absolutes in the topic and no exact methods to assess systemic importance. Then, since there is no clear consensus about the methods to determine systemic importance, these rules always allow a certain degree of judgement.

3. The BCBS Approach

As previously stated, the objective of this paper is to assess the systemic importance of financial institutions – at various geographical levels – following the BCBS methodology and relying on public data only. Given the global implications of the FSB this is certainly the most relevant approach, both from a policy-making and a market perspective. In this light, eliminating the judgement component of the assessment and selection process, adding more transparency, would certainly increase the disclosure of regulatory decisions and, after all, their understanding by market operators[3].

Moreover, the BCBS methodology comes from a careful development process that involved several supranational authorities (IMF, BIS, FSB, etc.) and several national supervisory authorities, besides comments coming from other authorities and market participants. Thus it can be considered the best practice in terms of the current know-how to evaluate the systemic importance of a financial institution.

The BCBS approach, as described in BCBS (2011), provides a framework to easily and robustly rank the systemic importance of a sample of banks. In order to apply this methodology, the FSB agreed a sample of 73 banks to start with, based on size and supervisory judgement by supervisors. The whole approach has been fixed for three years and then will be reviewed and improved to capture developments in the banking sector.

The approach is based on five main categories of systemic importance (size, interconnectedness, substitutability, complexity, and cross-jurisdictional activity), providing the backbone to build the indicators. Each category is given an equal weight of 20%. With the exception of size, the BCBS has identified multiple indicators in each category, with each indicator equally weighted within its category, as shown below.

1. Size (20%): total exposures as defined for use in the Basel III leverage ratio (20%);
2. Interconnectedness (20%):
   a) Intra-financial system assets (6.67%);
   b) Intra-financial system liabilities (6.67%);
   c) Total marketable securities (6.67%);
3. Substitutability (20%):
   a) Assets under custody (6.67%);
   b) Payments cleared and settled through payments systems (6.67%);
   c) Values of underwritten transactions in debt and equity markets (6.67%);
4. Complexity (20%):
   a) OTC derivatives notional value (6.67%);
   b) Level 3 assets (6.67%);
   c) Held for trading and available for sale value (6.67%);
5. Cross-jurisdictional activity (20%):
   a) Cross-jurisdictional claims (10%);
   b) Cross-jurisdictional liabilities (10%).

For each bank, the score for a particular indicator is calculated by dividing the individual bank amount by the aggregate amount summed across all banks in the sample for a given indicator, as follows:

[3] Anyway the BCBS has provided for a gradual disclosure of the data used in the methodology, in order to increase its transparency and reliability, starting from November 2014.

(1) $$I_{i|i=1,..,5} = \frac{X_{ij}}{\sum_{j=1}^{n} X_{ij}}$$

Where I_i is the indicator i, X_{ij} is individual bank amount for that indicator, n is the sample size[4]. The score is then weighted by the indicator weighting within each category. Each of the five categories is normalized to 1, thus the maximum possible total score is 5 (if there is only one bank in the sample). Supervisory judgement can be used to amend results of the assessment methodology in exceptional cases, with the help of verifiable qualitative arguments.

Based on the results of applying this methodology on 2010 data, the BCBS and the FSB selected a number of 29 G-SIFIs in 2011. A tentative cut-off point between G-SIFIs and the rest of the sample was set between the 27th and 28th banks, based on the clustering of scores produced by the methodology (however the clustering methodology was not disclosed), then two banks have been added based on supervisory judgement applied by their home supervisor. In 2012 the exercise was replicated, based on 2011 data, ending with a list of 28 G-SIFIs, slightly different from the year before (the differences are to be explained in greater detail below).

Afterwards, following a bucketing approach, the selected G-SIFIs have been grouped into four different categories of systemic importance, called buckets, on the basis of the overall score produced by the indicator-based measurement approach. Buckets are equal sized in terms of the scores. Each bucket corresponds to a different capital surcharge.

The bucketing phase serves the scope of ordering the systemic banks in order to endogenously establish the additional capital surcharges. Thus it helps to distinguish between the different systemic scale of banks. The results of the bucketing phase were disclosed in the 2012 exercise only (as shown in Table 1), while in 2011 only the list of G-SIFIs in alphabetical order was provided.

Table 1. 2012 FSB G-SIFIs list

Bucket (Capital surcharges)	Banks	Bucket (Capital surcharges)	Banks
4 (2.5%)	Citigroup	1 (1.0%)	Bank of China
	Deutsche Bank		Banque Populaire CdE
	HSBC		BBVA
	JP Morgan Chase		Group Crédit Agricole
3 (2.0%)	Barclays		ING Bank
	BNP Paribas		Mizuho FG
2 (1.5%)	Bank of America		Nordea
	Bank of New York Mellon		Santander
	Credit Suisse		Société Générale
	Goldman Sachs		Standard Chartered
	Mitsubishi UFJ FG		State Street
	Morgan Stanley		Sumitomo Mitsui FG
	Royal Bank of Scotland		Unicredit Group
	UBS		Wells Fargo

Source: FSB (2012). The 2010 FSB G-SIFIs list was longer, ecompassing 29 banks – see FSB (2011). Compared to this list, it did not include BBVA and Standard Chartered, while included Dexia, Commerzbank and Lloyds Banking Group.

[4] Actually, when considering the indicators I_i across multiple years a time index should be added as well. In fact, in the BCBS approach, while the denominator is fixed for three years, the numerator is obviously year-dependent.

4. Data and Methodology

This Section discusses the data and the assumptions chosen to adapt the BCBS methodology in order to be operated with public data, in the global, EU and Eurozone case. As previously stated the rationale for relying on public data is to be found in the increased transparency these data could yield compared to the supervisory-cum-judgement data actually used by the FSB. Moreover public data offer the market perspective and this exercise will then help to bridge the gap between market and regulatory perspective. The G-SIFIs list arising from this exercise will be both clear and complete, providing a full ranking of banks according to systemic importance, compared to the FSB (2011) and FSB (2012) where the disclosure of the results is more limited (see Table 1). The comparison between the market G-SIFIs and the FSB G-SIFIs sheds light on the differences between market perceptions and supervisory assessment. It will also allow understanding whether the market has enough information to identify the systemically relevant banks by itself and whether it was able to do it before the first FSB list was published. Moreover this procedure permits, not only to identify the subset of G-SIFIs, but also to rank the whole set of banks in the sample according to their systemic importance[5]. Since the FSB published two G-SIFIs lists (in 2011 and 2012, based on end-of-2010 and 2011 data), the exercise will be similarly run twice.

Differences and similarities between the lists of SIFIs will greatly help the evaluation and interpretation of the results, once the exercise is extended to the EU and Eurozone level. In fact, as far as it is known, there are not widely acknowledged lists of systemically important financial institutions for the European Union and the Eurozone. One of the purposes of this paper is just to fill this gap. Moreover, the comparison between the SIFIs lists at different levels will increase their reliability and robustness. Thus, this paper could offer a significant added value both in policy and in supervisory terms.

As explained in Section 3, following the BCBS (2011) approach every type of calculation cannot start without firstly identifying the sample to start with. The BCBS selected a sample of 73 banks according to size and supervisory judgement, from these countries: Australia, Belgium, Brazil, Canada, China, France, Germany, India, Italy, Japan, Korea, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States. However, this paper's exercise can't rely on supervisory judgement. Moreover, in order to make the chosen criteria as objective and unbiased as possible, the sample dimension was broadened and the largest 100 banks in the World were chosen. The inclusion of the largest 100 banks is very likely to encompass all the banks with potential systemic relevance. Moreover the largest 100 banks in the world account for broadly the 70% of the total banking assets in the world. This is also true for the EU and Eurozone sample. Moreover, unlike the BCBS approach, the 100-bank sample is not fixed and is allowed to change composition according to evolving size data from 2010 to 2011. This choice is aimed at more accurately include all the relevant banks in the sample.

Since the 100 largest banks in the World would also include banks from Austria, Denmark, Ireland, Norway, Portugal, Russia and Singapore – countries not included in the BCBS sample – the global exercise is to be replicated with this broader country-sample, besides the restricted BCBS country-sample. While results from the latter sample are best suited for a comparison with the FSB lists, results from the former sample would yield a more accurate picture of systemic importance across the World[6].

Considering the identification of SI for EU and Eurozone banks, the same pattern outlined above was followed, with one main difference. In fact, in these two samples, the population and the

[5] The complete dataset is available upon request.

[6] The comparison between the two sets of results would also be very useful to grasp the systemic importance of the excluded countries' banking systems.

100-bank sample are drawn from banks headquartered in the area under review, but also from subsidiaries of foreign banks. This choice follows the BCBS (2012) consultative document on D-SIFIs. While it is quite straightforward to consider banks headquartered in the EU (or in the Eurozone) from a consolidated perspective, since their activities outside the home jurisdiction can have a significant negative impact on the domestic economy, in case of failure, the case for subsidiaries of foreign banks might appear less self-explaining. In fact, the failure of a banking group engaging in cross-border activity could impact its home economy by the extent of the whole group and not just the part of the group that undertakes the domestic activity. By the same token, the inclusion of foreign subsidiaries in the analysis accounts for the fact that the failure of a foreign banking group could impose costs to the economy hosting the subsidiary (and its taxpayers), especially when foreign subsidiaries play an important role in the host financial system. Thus the identification of systemically important financial institutions at the EU and Eurozone level looks particularly up-to-date from a policy perspective. In fact, in the light of a banking union inside the EU, its taxpayers may bear the cost for the bailout of a subsidiary[7]. From a technical perspective, including foreign subsidiaries in the analysis does not bring any particular impediment, because subsidiaries publish their own financial statements. Moreover, the reliance, across the EU, on IFRS, greatly helps the comparability of data across banks, limiting the number of assumptions needed.

The dataset is made of data collected on published financial statements and, where available, of data collected on a broad set of data providers (SNL Financial; Bloomberg; Dealogic; Bankscope)[8]. Public data are readily available to all market participants and quickly operable. In the view of the enhanced disclosure of recent years, their reliability is quite high. However these data can sometimes fall short of the definitions provided in the BCBS (2011) rule text and could not be as reliable as data checked by national supervisory authorities. They might also not be as complete as supervisory data. Thus a certain degree of caution in reading and interpreting them might be needed. While some data are easy to understand and ready to collect, others are not immediately available and some assumptions are necessary. As assumptions are always questionable, the resulting conclusions can be questioned as well. The purpose of this section also lies in the clear explanation of the reliability and robustness of the necessary assumptions. Moreover, the appendix provides a sensitivity analysis of the assumptions chosen, testing for alternative assumptions.

In the global sample some care is needed in the comparison of data from different regions. In fact IFRS are not adopted everywhere and differences with the US GAAP can make widely vary some variables (e.g. derivatives accounting rules)[9].

Some care is also needed to identify the reference population of financial institutions where the starting sample has to be selected. In fact, the distinction between banks and other financial institutions is increasingly blurred. Restricting the sample to institutions holding a banking licence is not enough for the purposes of this paper. In fact, the focus is on institutions engaging in the typical banking activity in a broad sense (from collecting retail deposits to entering derivatives transactions, etc.). Thus, all special-purpose institutions were excluded from the reference population, ranging from government-controlled development banks – like KfW, CdP, CDC – to government-sponsored entities – like Fannie Mae and Freddie Mac – other specialised financial arms of non-financial enterprises – like GE Capital – and insurance companies – like MetLife, Prudential Financial, Swiss Life. Given the variability in ownership structures, only banks on a

[7] Depending on the year-end data, usually among the 100 largest banks in the EU, there are 13 subsidiaries of non-EU banks: Goldman Sachs International, Credit Suisse International, Merrill Lynch International (Bank of America subsidiary), Morgan Stanley International, UBS, Nomura International, JP Morgan Securities, Citigroup Global Markets, Clydesdale Bank (NAB subsidiary), Mitsubishi UFJ Securities, Bank of New York Mellon, RBC Europe. The great majority of them is established in the UK.

[8] Since the data may be originally reported in different currencies, we chose to use the Euro as the reference currency and use the end-of-year relevant exchange rate to convert other currencies in euros.

[9] A comprehensive comparison between the main features of IFRS and US GAAP can be found in SEC (2011).

consolidated basis were considered, collecting data of the ultimate parent entity[10]. However, when dealing with financial conglomerates, encompassing both banking and insurance activities, only the banking arm was selected (e.g. ING Bank is in the population, rather than the whole group ING Groep that also encompasses insurance activities).

As explained in Section 2, the BCBS approach calculates systemic importance as the sum of 5 categories that encompass all the different aspects of systemic importance: size, interconnectedness, substitutability, complexity, cross-jurisdictional activity. The remainder of the Section provides an explanation of the data used for every category and the assumptions needed.

4.1 Size

Size, both for the 100-bank sample selection and for the calculation of the first indicator is calculated in the same way. The BCBS (2011) rule text follows the same definition as the BCBS (2010) total exposure definition. It's a broad definition capturing on-balance and off-balance sheet items. Then, the Size variable has been calculated as the sum of total assets and off-balance sheet items (a heading most relevant for US banks). Data were collected from Bankscope BvD and cross-checked with SNL Financial and published financial statements. The score for each bank is calculated according to (1).

4.2 Interconnectedness

The interconnectedness category is made by three sub-categories: intra-financial assets, intra-financial liabilities, and total marketable securities. All the three sub-categories are calculated summing various headings of the balance sheet, following as closely as possible the guidelines of the BCBS rule text.

Intra-financial assets are proxied summing: Loans and Advances to Banks; Reverse Repos and Cash Collateral; Trading and at Fair Value Securities; Cash and Due from Banks. Intra-financial liabilities are proxied summing: Deposits from Banks; Repos and Cash Collateral; Other Deposits and Short-term Borrowings; Other Funding; Trading Liabilities. Total Marketable Securities are calculated subtracting Total Deposits, Money Market and Short-term Funding from Total Liabilities. Data for all of the sub-categories were collected from Bankscope BvD. Alternative assumptions and their effects in terms of results are further explained in the appendix. The overall category score for each bank is calculated applying (1) to each sub-category and then the three sub-category scores are added for every bank, and divided by 3, in order to normalize the overall interconnectedness indicator to 1.

4.3 Substitutability

This category is made of three sub-categories: assets under custody, values of underwritten transactions in debt and equity markets, payments delivered through payments and settlements systems.

It has been very difficult to rely on some data provider for the Assets Under Custody (AUC) sub-category, given the lack of completeness from many sources. Thus data for the AUC sub-category were collected relying on published financial statements, banks' websites, market news

[10] A special exception has been made for German regional and saving banks, in agreement with the results published by the FSB. In fact all of these banks, although run independently, participate in a Joint Liability Scheme within the Saving Banks Financial Group. This scheme protects all customer deposits held with Group institutions, meaning that on a ultimate basis all these financial institutions could be regarded as a single entity (as it is actually explained in the Saving Banks Financial Group published financial statements). This bank, according to end-of-2011 data, would be the largest in the World with total assets of € 2,384 billions.

and reports and some public information provided by GlobalCustody.net and other data providers. One distinct feature of the custodian business is its extreme concentration, with a bunch of giants accounting for more than 90% of the global market share. Many banks exited the custodian business in recent years and rely on some of the main custodian banks for their own assets, thus it should be no surprise that this sub-category values 0 for many banks.

When dealing with the EU/EZ exercise, an additional problem emerged: data for sub-custody don't exist and the value of AUC always encompasses the global custody activity of a bank. Thus, according to the general rule set up at the beginning of this section, the total AUC value is considered for EU/EZ-headquartered banks, while for subsidiaries of non-EU (or non-Eurozone) banks, only their AUC European business is considered. The share of European AUC is estimated according to the share of each foreign bank European activity – proxied by the share of European gross income to total gross income – as retrieved from Bloomberg.

The Value of underwritten transactions in debt and equity markets is calculated summing the deal values for these two variables as they emerge in the Dealogic DCM and ECM league tables. These league tables look quite reliable, with only some minor holes in the data. Data were also cross-checked with the Bloomberg league tables, which appeared to be somewhat less complete. For the EU/EZ exercise, only the league tables about Europe were considered, since this is the reference market where substitutability has to be assessed[11]. The impact of alternative assumptions is evaluated in the appendix.

The third sub-category – payments delivered through payments and settlements systems – could not be filled, neither with actual data, neither with estimated data. Unfortunately data of this kind are not public at the institution level and there are not comprehensive and reliable studies about the topic. As a consequence any estimate would have relied on too similar assumptions to data collected for other categories, unduly increasing the correlation between different categories, without any clue of being close enough to actual data. Thus this sub-category has been left blank. Even if this is certainly a drawback, its impact on the final score is limited, accounting for less than 7% of the overall final score. Being this sub-category blank, there are two different path to complete the substitutability category: leaving the averaging of the three sub-categories as it is – then summing to 2/3 – or averaging the AUC and underwritten transactions sub-categories as if the substitutability category was made of these two subcategories only - in order to make it sum up to 1. Since changing the weights of the sub-categories contrasts with the original weights given by the BCBS and could make the results less comparable, the former solution is followed. Every bank's score in the two sub-categories is calculated applying (1), then the three sub-categories indicators are added for every bank, and divided by 3. The indicator adds up to 2/3.

4.4 Complexity

Complexity is made of three sub-categories: OTC derivatives in notional value, Level 3 Assets and Held for Trading and Available for Sale Securities value.

Data about OTC derivatives are not easy to find: in fact only a negligible share of banks in the sample provides the detail of their OTC derivatives positions in published financial statements or in Pillar 3 statements. Therefore, assuming that the share of OTC derivatives to total derivatives is constant across banks, notional values of total derivatives positions shown in the balance sheets are considered as a proxy of OTC derivatives[12]. The sum of derivatives held appearing on both the

[11] In the EU and EZ samples, the values of underwritten transactions for subsidiaries of foreign banks has been set equal to the values provided by the DCM and ECM league tables when the subsidiary was properly cited, and to half of its value when it wasn't.

[12] This assumption may be questioned, since larger banks are more likely to hold a larger share of OTC derivatives. But this simple assumption is more robust than other more complicated assumptions that could even have a weaker ground. Moreover it is conservative, in the sense that high scores for bigger banks (with higher levels of total derivatives) might

asset and the liabilities sides of the balance sheet is considered, in order to get rid of any state-dependent mark-to-market effect.

However derivatives data are not easily comparable, since banks following IFRS show the notional value of their derivatives holdings, while banks following the US GAAP (mainly in the US and Japan) only show the marked-to-market netting of their derivatives positions[13]. Thus the derivatives holdings of American and Japanese banks appear to be several times smaller than their competitors' in other regions of the world. This difficulty was overcome, scaling up derivatives holdings of American and Japanese banks to make them comparable across the sample. The average share of derivatives to total assets for European (K_{eu}), American (K_{us}) and Japanese (K_{jp}) banks were calculated, with the objective of beefing up the derivatives holdings of American and Japanese banks, until their average share of derivatives to total assets is equal to the average European share (K_{eu}). Even if initially the scaling factor δ could look equal to K_{eu}/K_{us} and K_{eu}/K_{jp}, this formula is not correct. In fact, the way derivatives are accounted under IFRS also scales up the overall size of the balance sheet. Then, derivatives holding of US and Japan banks needs to be scaled up until

$$K_{eu} = \frac{D_{us}(1+\delta)}{(TA_{us} + \delta D_{us})} \tag{2}$$

where D_{us} is the average holding of derivatives in the US, and TA the total assets. This ratio, after some trivial algebra, leads to the correct scaling factor:

$$\delta = \frac{K_{eu}(1-K_{us})}{K_{us}(1-K_{eu})} \tag{3}$$

Obviously, when considering the EU and Eurozone sample, none of the aforementioned assumptions and scaling factors is needed, as all the banks in the EU follow the IFRS and then their reported holdings of derivatives are easily comparable[14]. The sources for these data were Bankscope, SNL Financial and published financial statements (especially for Japanese banks).

The HFT + AFS sub-category is easily calculated as these values are published in every bank's financial statement. The sources were: Bankscope, SNL Financial and published financial statements.

Level 3 assets are published in financial statements, so also this sub-category is easily filled. The data sources were, as usual, Bankscope, SNL Financial and published financial statements. However some banks does not provide a complete disclosure of this variable, thus some hypotheses are needed to fill a bunch of holes in the data. Usually, when missing, Level 3 assets were set equal to the average share of Level 3 assets to total assets in the country of the bank under review.

Once the data are collected, the indicators for every sub-category are calculated with the usual (1) formula. Then, the three sub-categories indicators are added for every bank, and divided by 3, in order to normalize the overall complexity indicator to 1.

4.5 Cross-jurisdictional activity

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be even bigger, according to common sense, thus the function of scores for this sub-category could be steeper than actually is.

[13] IFRS prevail in Europe, Australia, India (since 2011) and Brazil. China substantially converged to IFRS for its financial reporting. Japan and the US follow the US GAAP.

[14] For a couple of EU subsidiaries of non-EU banks the value of total derivatives had been estimated as a fraction of total derivatives held by their ultimate parent, since derivatives holdings are not published in the subsidiary's financial statements.

Cross-Jurisdictional Activity is split between cross-jurisdictional claims and cross-jurisdictional liabilities.

As explained in the BCBS (2011) rule text, cross-jurisdictional claims have the same definition of Total Foreign Claims data collected by the BIS at a country-level basis for the compilation of its consolidated banking statistics. Relying on these statistics, Total Foreign Claim data (Table 9C:S Total foreign claims on ultimate risk basis) can be selected. However these data, divided by country, need to be attributed – with some assumptions – to individual institutions. Two main assumptions could be followed. Firstly, every bank could be attributed a share of its country's cross-jurisdictional claims according to its share of the country's total banking assets, following the simplifying idea that banks in the same country have the same share of cross-jurisdictional activity. Secondly, every bank could be attributed a share of its country's cross-jurisdictional claims, according to the share of its cross-border gross income to total gross income, weighted for the country's banking system total level of cross-border gross income. The first assumption can be over-simplifying as the share of cross-jurisdictional activity often increases with size and complexity – the international evidence shows that its bulk is provided only by the largest banks in a country – while here every bank in the same country is assumed to have the same share of cross-jurisdictional activity. Thus this assumption probably flattens too much the cross-jurisdictional category function. Moreover it unduly increases the correlation between this category and the size category. The second assumption might cause distortions in the opposite direction, since cross-jurisdictional claims are not limited to profits made abroad, but could also include transactions that do not affect the ownership or profit and loss profile. Thus this assumption probably steepens too much the cross-jurisdictional category function. In this light cross-jurisdictional claims – for bank *i* of country *j* – were estimated with a merge of the two assumptions, as follows:

$$CJclaims_{ij} = \alpha\left(TA_{ij}\frac{X_j}{TA_j}\right) + (1-\alpha)\left(\beta_{ij}TA_{ij}\frac{X_j}{\beta_j TA_j}\right) \tag{4}$$

where α is the weighting factor, TA_{ij} are the total assets of bank *i*, while TA_j are the total banking assets of country *j*, X_j are the cross-jurisdictional claims for country j and β is the share of cross-border gross income. In the baseline, the two assumptions are equally weighted, so $\alpha = 0.5$. The impact of using different weightings is explored in the appendix. To calculate cross-jurisdictional liabilities the approach was absolutely analogous. The data provided by table 9C:S of the BIS consolidated banking statistics are rearranged, in order to calculate the total foreign claims of the World against a given country, that is its total foreign liabilities. Then, cross-jurisdictional liabilities at the bank level are calculated following (4).

This procedure for cross-jurisdictional liabilities does not allow completing the liabilities country table, as the reporting values are missing for China, Brazil and Korea in the global sample; for Denmark and Poland in the EU sample; for Cyprus and Luxembourg in the Eurozone sample. In those cases the total amount of a country's cross-jurisdictional liabilities has been set equal to its claims. An alternative assumption is evaluated in the appendix.

An amendment is necessary for the EU and Eurozone cases. In fact – as explained in BIS (2009) – since the BIS consolidated banking statistics cover worldwide consolidated claims of domestically owned banks, these data do not account for subsidiaries of foreign banks established in a given country. Therefore, for the EU and EZ sample the BIS locational banking statistics are chosen, which cover international claims and liabilities of all banks in a given country using standard balance-of-payment concepts[15].

[15] For detailed methodological explanations of BIS banking statistics concepts see: BIS (2012), "Guidelines to the international consolidated banking statistics".

The source of both cross-jurisdictional claims and liabilities at the country level is the BIS. Total banking assets were retrieved from the ECB CBD and Datastream for the global sample and from SNL Financial for the EU and Eurozone samples. Cross-border gross income data are collected from Bloomberg and SNL Financial. Once the data are collected, scores for the sub-categories are calculated with the usual formula. Then, the two sub-categories indicators are added for every bank, and divided by 2, in order to normalize the overall cross-jurisdictional activity indicator to 1.

4.6 Ranking, Clustering and Bucketing

Once all the 5 categories are completed, it's possible to calculate the overall score of every bank by simply adding up the score totalled in each category. This score represent the actual systemic importance according to the BCBS methodology. Ranking all the 100 banks in every chosen sample according to their overall score, the list of banks according to their systemic importance is completed.

To identify the subsample of systemically important financial institutions, the threshold selection problem is addressed through a clustering analysis, a statistical methodology that separates the population in a sample into different groups according to measures defining the population's characteristics. A survey of various clustering methods can be found in ECB (2006). The BCBS methodology relies on the clustering analysis to identify its G-SIFIs sample, but does not disclose which clustering method has been followed. Thus, the same clustering methodology as in ECB (2006) – where a subsample of large and complex banking groups is selected out of a larger sample – has been chosen, since its objective is very close to this paper's philosophy. ECB (2006) uses an agglomerative hierarchical clustering method, the average linkage method, which can be viewed as a superior, compromise solution between the single linkage and the complete linkage methods[16].

The bucketing phase that follows is relatively straightforward. Given the number of banks selected in the SIFIs subsample, the bucketing score space is given by the difference between the highest and the lowest SI score of the banks deemed to be systemic, is then split into 4 equally sized buckets and the banks are allocated into these buckets according to their SI score.

5. Results: G-SIFIs, EU-SIFIs and EZ-SIFIs Lists

This section provides the results of the methodology described in Section 4, applied to global, EU and Eurozone data for 2010 and 2011. Once the data has been collected, the 5 categories filled and the final SI scores calculated, the 100 banks within each sample can be ranked according to their systemic importance (the complete rankings are available upon request). As previously explained, even if every bank in the sample can be associated with a certain level of systemic importance, only a subset of banks can be considered systemically important, that is with a relevant impact on the broader financial system in case of distress. The clustering analysis is in fact aimed at identifying this subset of banks.

5.1 G-SIFIs

According to clustering, the market-based G-SIFIs list is made of 27 banks, both in 2010 and 2011 (as shown in Table 2). The clustering phase offered fairly stable results, showing no variation in the G-SIFIs sample dimension with different cluster selections. Moreover the results of the clustering phase are also robust to changes in the categories composition of the SI indicator. The

[16] As robustness checks, both the single and complete linkage methods had been also used. Moreover, the robustness had been checked also with an alternative approach, explained in Keller and Klawonn (2000), based on a generalization of the fuzzy c-means clustering algorithm.

2010 G-SIFIs sample includes all the banks deemed to be systemic by the FSB, thus highlighting how this methodology is close to the BCBS philosophy. However the list published by the FSB includes 29 banks – the BCBS (2011) document explains that two banks had been added relying on supervisory judgement – leaving two banks outside of the list shown in Table 2 lhs. The two banks missing from this, market-based, G-SIFIs list – Nordea and Bank of China – are respectively ranked 30th and 32nd in this exercise, close enough to the threshold, suggesting a contained role for the supervisory judgement. The 2010 G-SIFIs list is ranked according to each bank's SI score and is also associated with 4 distinct buckets – unlike the FSB list published in alphabetical order – letting grasp the different level of systemic importance inside the group.

Table 2. G-SIFIs

Rank	2010				2011			
	Bank	**Bucket**	**FSB G-SIFIs**		**Bank**	**Bucket**	**FSB G-SIFIs**	**FSB Bucket**
1	JP Morgan	2.5%	√		JP Morgan	2.5%	√	2.5%
2	Deutsche Bank	2.5%	√		Deutsche Bank	2.5%	√	2.5%
3	BNP Paribas	2.5%	√		Citigroup	2.0%	√	2.5%
4	Barclays	2.5%	√		HSBC	2.0%	√	2.5%
5	Citigroup	2.0%	√		Barclays	2.0%	√	2.0%
6	HSBC	2.0%	√		BNP Paribas	2.0%	√	2.0%
7	Bank of America	2.0%	√		Bank of America	1.5%	√	1.5%
8	Royal Bank of Scotland	1.5%	√		Royal Bank of Scotland	1.5%	√	1.5%
9	UBS	1.5%	√		UBS	1.5%	√	1.5%
10	Crédit Agricole	1.5%	√		Crédit Agricole	1.5%	√	1.0%
11	Société Générale	1.5%	√		Mitsubishi UFJ	1.5%	√	1.5%
12	Goldman Sachs	1.5%	√		Goldman Sachs	1.5%	√	1.5%
13	Credit Suisse	1.5%	√		Société Générale	1.5%	√	1.0%
14	Mitsubishi UFJ	1.5%	√		Credit Suisse	1.0%	√	1.5%
15	Morgan Stanley	1.0%	√		Bank of New York Mellon	1.0%	√	1.5%
16	Bank of New York Mellon	1.0%	√		Morgan Stanley	1.0%	√	1.5%
17	Banco Santander	1.0%	√		Banco Santander	1.0%	√	1.0%
18	Mizuho FG	1.0%	√		Wells Fargo	1.0%	√	1.0%
19	ING Bank	1.0%	√		Mizuho FG	1.0%	√	1.0%
20	Unicredit	1.0%	√		BPCE Group	1.0%	√	1.0%
21	BPCE Group	1.0%	√		ING Bank	1.0%	√	1.0%
22	Wells Fargo	1.0%	√		Unicredit	1.0%	√	1.0%
23	Dexia	1.0%	√		State Street Corporation	1.0%	√	1.0%
24	Lloyds Banking Group	1.0%	√		Sumitomo Mitsui	1.0%	√	1.0%
25	State Street Corporation	1.0%	√		Lloyds Banking Group	1.0%		
26	Sumitomo Mitsui FG	1.0%	√		ICBC	1.0%		
27	Commerzbank	1.0%	√		Nordea Bank	1.0%	√	1.0%

The years above – 2010 and 2011 – refer to the financial year considered in the construction of the indicator.

As the common wisdom might suggest, the 2011 G-SIFIs list – presented in Table 2 rhs – does not show large swings in the list (only two banks change). In fact, banks' characteristics may change only slowly from year to year, even if a global overhaul is underway in the banking system in recent years. The differences are somewhat larger in comparison with the 2012 FSB list, even if both lists agree on Dexia and Commerzbank leaving the G-SIFIs group. In fact the FSB list is made of 28 banks, but only 25 appear in the 27-long G-SIFIs list. Two banks of Table 2 rhs – Lloyds Banking Group and ICBC – are not in the FSB sample, which includes three other institutions – Bank of China, BBVA and Standard Chartered. While Bank of China, ranked 30th in the SI ranking, remains very close to the selected threshold, BBVA (36th) and Standard Chartered (38th) are more far apart, showing that the role of supervisory judgement may have had a greater role in the

selection of the 2012 FSB list. The relatively high score of these two banks into the cross-jurisdictional activity category – compared with the low score registered for Lloyds – might show an increasing attention associated to this category by the FSB. As an additional comparison, the 2011 public-data buckets are broadly in line with the FSB ones. Some minor differences could be ascribed, on the one hand, to differences in the banks' SI score connected with differences in collected data and, on the other hand, on supervisory judgement. Analogously, the comparison between 2010 and 2011 public-data buckets shows a high, but not complete, stability of the buckets. While this result could be reassuring from a methodological point of view, even few banks shifting between buckets could be more problematic to treat from a supervisory perspective. Concluding, the methodology used in this paper shows a high degree of overall reliability, matching more than 95% of the G-SIFIs identification over the two years. It also shows that the role of supervisory judgement in the FSB list has been limited, but rising from 2010 to 2011.

As a robustness check and to grasp a more accurate picture of global SI, the exercise has been replicated, differently from the BCBS sample, without country limitations in the sample selection. The G-SIFIs list remains unchanged for both years and so does the buckets allocation. Anyway, it adds relevant information because, considering 2011 data, Danske Bank would rank 34th in the extended sample exercise, resulting more systemically relevant than BBVA (37th) and Standard Charted (39th), both included in the FSB G-SIFIs list. This result is particularly relevant because, aside from the FSB G-SIFIs group, it shows that some relevant information is not being properly taken into account, leaving room for improvements in the BCBS sample selection.

5.2 EU-SIFIs

Similarly to the global exercise the procedure had been run for the EU, leading to the ranking of the 100-bank sample according to SI. The clustering phase offered a somewhat less clear-cut picture than in the global case. In fact, relying on up to 4 clusters, only a small subsample of 9 banks was captured. However, from 5 clusters onwards, the clustering analysis provides a clear evidence for the threshold being between the 35th and 36th banks. This conclusion is true for both 2010 and 2011 and is robust to changes in the aggregate categories composition. The 35-long EU-SIFIs list is shown in Table 3.

The EU-SIFIs lists cannot be compared with any list, but with each others, since this identification exercise according to systemic importance is rather new. The global exercise, showing the close relationship between the public-data G-SIFIs list and the FSB one, except for the supervisory judgement, guarantees on the reliability of the methodology and results.

The comparison between 2010 and 2011 shows again a high level of stability in the EU-SIFIs list. In fact, only two banks, ranking 34th and 35th, are replaced (namely, Hypo Real Estate and KBC Bank by Svenska Handelsbanken and Banca Civica[17]). However some shifts in the ranking appear. The four buckets, that show the different degrees of systemic importance, show that the banks ranking in the first two of them have a more stable ranking, than the third and fourth buckets.

Other striking evidence concerns subsidiaries. As can be seen in both lists, 9 banks out of 35, are subsidiaries of non-EU banks (6 American, 2 Swiss and 1 Japanese banks), mostly based in the UK, which account for 12 out of 35 EU-SIFIs. Moreover, the 2011 ranking shows that their overall systemic importance in the European Union banking system is rising (e.g. 3 subsidiaries are included in the third bucket in 2011, compared to only 1 in 2010). This result is a logical consequence of the relative openness of the EU banking system and highlights its high degree of

[17] Having Banca Civica among the EE-SIFIs, rather than its far larger Spanish peers Bankia or La Caixa might seem very surprising at first glance. However this result, although counterintuitive, is perfectly in line with the data. Banca Civica – similarly to other Spanish saving and regional banks, but differently from Bankia and La Caixa – holds an enormous amount of Level 3 Assets that, according to subsection 4.4, makes its 'complexity' score soar.

interconnectedness with banks headquartered elsewhere. It can also be related to the larger role played by non-EU banks in investment banking and wealth management activities. Moreover the rising weight of the subsidiaries group might be related with EU-based banks pulling back from some business lines. This dynamic is an invitation to supervisors to carefully evaluate these connections, in agreement with BCBS (2012). This is even truer for UK regulators, given that 12 EU-SIFIs fall under their jurisdiction. Moreover, since most of the subsidiaries deemed to be systemically important have a broad EU projection in their business, it emerges that the systemic importance of these institutions is a matter of interest also for other EU countries' regulators.

Table 3. EU-SIFIs

Rank	2010					2011			
	Bank	Country	Bucket	Subsidiary		Bank	Country	Bucket	Subsidiary
1	BNP Paribas	France	1			Deutsche Bank	Germany	1	
2	Deutsche Bank	Germany	1			HSBC	UK	1	
3	HSBC	UK	1			Barclays	UK	1	
4	Barclays	UK	1			BNP Paribas	France	1	
5	Crédit Agricole	France	2			Royal Bank of Scotland	UK	2	
6	Royal Bank of Scotland	UK	2			Crédit Agricole	France	2	
7	Société Générale	France	2			Société Générale	France	2	
8	JP Morgan Securities	UK	3	√		Goldman Sachs International	UK	3	√
9	Banco Santander	Spain	3			Banco Santander	Spain	3	
10	UniCredit	Italy	3			JP Morgan Securities	UK	3	√
11	BPCE Group	France	3			BPCE Group	France	3	
12	ING Bank	Netherlands	4			Credit Suisse International	UK	3	√
13	Goldman Sachs International	UK	4	√		Merrill Lynch International	Ireland(*)	4	√
14	Lloyds Banking Group	UK	4			Lloyds Banking Group	UK	4	
15	Commerzbank	Germany	4			Nordea Bank	Sweden	4	
16	Dexia	Belgium	4			ING Bank	Netherlands	4	
17	Credit Suisse International	UK	4	√		Unicredit	Italy	4	
18	Merrill Lynch International	Ireland(*)	4	√		Citigroup Global Markets	UK	4	√
19	UBS	UK	4	√		UBS	UK	4	√
20	Nordea Bank	Sweden	4			Commerzbank	Germany	4	
21	Morgan Stanley International	UK	4	√		Morgan Stanley International	UK	4	√
22	Bank of New York Mellon	Belgium(*)	4	√		Danske Bank	Denmark	4	
23	Rabobank	Netherlands	4			Rabobank	Netherlands	4	
24	Intesa Sanpaolo	Italy	4			Bank of New York Mellon	Belgium(*)	4	√
25	Citigroup Global Markets	UK	4	√		Dexia	Belgium	4	
26	BBVA	Spain	4			BBVA	Spain	4	
27	Danske Bank	Denmark	4			Nomura International	UK	4	√
28	Credit Mutuel	France	4			Standard Chartered	UK	4	
29	Nomura International	UK	4	√		Landesbank BW	Germany	4	
30	Landesbank BW	Germany	4			Intesa Sanpaolo	Italy	4	
31	DZ Bank	Germany	4			DZ Bank	Germany	4	
32	Standard Chartered	UK	4			Bayerische Landesbank	Germany	4	
33	Bayerische Landesbank	Germany	4			Credit Mutuel	France	4	
34	Hypo Real Estate	Germany	4			Svenska Handelsbanken	Sweden	4	
35	KBC Bank	Belgium	4			Banca Civica	Spain	4	

The years above – 2010 and 2011 – refer to the financial year considered in the construction of the indicator.

(*) Merrill Lynch International and Bank of New York Mellon are subsidiaries of bank headquartered in the USA, based respectively in Ireland and Belgium. However the bulk of their banking operations is run from the UK.

5.3 EZ-SIFIs

Finally, the exercise has been replicated for the Eurozone sample. The 100 banks had been ranked according to SI for both 2010 and 2011. The clustering phase for the 2010 sample offered quite stable results in the threshold identification, showing no variation with different cluster

selections. The 30-long EZ-SIFIs list is shown in Table 4 lhs. The selected sample is also robust to changes in the aggregate categories composition (going from the simple SI indicator to all the categories). However the threshold selection had been more cumbersome for year 2011. Up to 9 clusters, the threshold had been put at 22 banks, while increasing the number of clusters suggests the threshold should be put at 40 banks. Compared with the stability shown by clustering analysis in the global and EU sample this difference between the two thresholds in the Eurozone samples can depend on the changing environment of the Eurozone banking system, rather than on methodological instability. In fact the share of banks being under serious overhaul after distress is higher in this sample than in the previous two. Thus this sample, experiencing larger changes in underlying data, is intrinsically less stable. Table 4 rhs shows the list of 2011 EZ-SIFIs, where the bucketing phase had been run on the first 22 banks only, then implicitly considering the 23rd-to-40th banks as a tier 2 group in the 2011 EZ-SIFIs group.

The comparison between the 2010 and the 2011 EZ-SIFIs samples is less straightforward, since they have different dimensions. But restraining the analysis to the first 22 (as in the 2011 EZ-SIFIs list) or 30 banks (as in the 2010 EZ-SIFIs list), only one bank is replaced in both groups, thus showing a high stability in terms of ranking. This stability is even more evident in the upper bound of the EZ-SIFIs group, corresponding with the first three buckets. In fact, the buckets composition remains constant in terms of dimensions and banks, and only two banks switch position from 2010 to 2011.

Considering subsidiaries, their role appears to be more limited in this case. In fact, only 4 out of 30 subsidiaries of foreign banks appear in the 2010 EZ-SIFIs list. Two of them are subsidiaries of banks headquartered in the EU: in the UK and in Sweden, respectively. According to the EU sample, the development of subsidiaries' raking in 2011 shows a fairly stable weight in their systemic importance. These results, seen in connection with the EU results, lead to two main conclusions. Firstly, the EZ banking system appears to be very integrated and interconnected with the rest of the EU banking systems. However, following the sovereign debt crisis and the connected difficulties of many Eurozone banks, the systemic importance of non-Eurozone banks is rising. In fact, the UK appears to be the main gateway of the Eurozone banking system to the rest of the World and vice versa, since the prominent role of many non-EU banks in the EU (and after all, in the Eurozone that is the bulk of the EU) is played from the UK.

From a supervisory point of view it's also important to stress the paramount role played by two jurisdictions, given the composition of the EZ-SIFIs list. In fact, banks ranked 2nd, 3rd, 4th and 6th are all based in France, while on the other hand 9 out of the first 30 banks are based in Germany.

Concluding, it's important to note that this methodology, even if simple and stable in providing reliable results, it can be further refined. In fact, the SI scores are sample dependent, but given the changing yearly-composition of the 100-banks samples, the comparisons between different years are not straightforward. The only sample design robust to composition changes would be one encompassing all the banks in the reference population. Holding the starting sample fixed, as in the FSB exercise, incurs the risk of losing important information, coming from the banks excluded from the original sample, and would analogously leave the scores sample-dependent.

Additionally, this sample dependency of scores means that the scope of comparison between different samples (e.g. global with EU sample) can be very limited for several reasons. Firstly, restraining the starting sample to a limited geographical dimension (like the EU or EZ case) means including several smaller banks, often with different characteristics from larger banks, and several subsidiaries, with their own specificities. Secondly, some data and some methodology assumptions differ in the two cases (the global and the restrained ones). Thirdly, changing the reference sample means that the relative weight and score in a given indicator can change a lot for some banks with respect to the rest of the sample. This last reason is why, somewhat counterintuitively, the relative ranking of some banks can change depending on the reference sample.

Table 4. EZ-SIFIs

Rank	2010					2011			
	Bank	Country	Bucket	Subsidiary		Bank	Country	Bucket	Subsidiary
1	BNP Paribas	France	1			Deutsche Bank	Germany	1	
2	Deutsche Bank	Germany	1			BNP Paribas	France	1	
3	Crédit Agricole	France	2			Crédit Agricole	France	2	
4	Société Générale	France	2			Société Générale	France	2	
5	Banco Santander	Spain	3			Banco Santander	Spain	3	
6	BPCE Group	France	3			BPCE Group	France	3	
7	UniCredit	Italy	3			Unicredit	Italy	3	
8	ING Bank	Netherlands	4			ING Bank	Netherlands	4	
9	Commerzbank	Germany	4			Merrill Lynch International	Ireland (*)	4	√
10	Dexia	Belgium	4			Commerzbank	Germany	4	
11	Merrill Lynch International	Ireland (*)	4	√		Rabobank	Netherlands	4	
12	Rabobank	Netherlands	4			Dexia	Belgium	4	
13	Intesa Sanpaolo	Italy	4			BBVA	Spain	4	
14	Bank of New York Mellon	Belgium (*)	4	√		Intesa SanPaolo	Italy	4	
15	BBVA	Spain	4			Bank of New York Mellon	Belgium (*)	4	√
16	Credit Mutuel	France	4			Landesbank BW	Germany	4	
17	Landesbank BW	Germany	4			Credit Mutuel	France	4	
18	DZ Bank	Germany	4			ABN AMRO Bank NV	Netherlands	4	
19	HSBC France	France	4	√		DZ Bank	Germany	4	
20	Hypo Real Estate	Germany	4			Nordea Bank Finalnd Plc	Finland	4	√
21	Bayerische Landesbank	Germany	4			HSBC France	France	4	√
22	Nordea Bank Finland	Finland	4	√		Bayerische Landesbank	Germany	4	
23	KBC Bank	Belgium	4			KBC Bank	Belgium		
24	ABN AMRO Bank NV	Netherlands	4			Banca Civica	Spain		
25	Bankia	Spain	4			Bankia	Spain		
26	Norddeutsche Landesbank	Germany	4			Norddeutsche Landesbank	Germany		
27	Portigon AG	Germany	4			Hypo Real Estate	Germany		
28	HELABA	Germany	4			HELABA	Germany		
29	Banca Monte dei Paschi di Siena	Italy	4			La Caixa	Spain		
30	La Caixa	Spain	4			Portigon AG	Germany		
31						HSH Nordbank	Germany		
32						Banca Monte dei Paschi	Italy		
33						Erste Group Bank	Austria		
34						Kutxabank	Spain		
35						DekaBank	Germany		
36						Raiffeisen Group	Austria		
37						Bank of Ireland	Ireland		
38						Banco de Sabadell	Spain		
39						Banco BPI	Portugal		
40						Ibercaja Banco SAU	Spain		

The years above – 2010 and 2011 – refer to the financial year considered in the construction of the indicator.

(*) Merrill Lynch International and Bank of New York Mellon are subsidiaries of bank headquartered in the USA, based respectively in Ireland and Belgium. However the bulk of their banking operations is run from the UK.

6. Selected Empirical Evidence on Systemic Importance

Aside from having the lists of systemically important financial institutions, analysing the statistical properties of SI as whole (i.e. over the entire sample) and its geographical and historical developments could shed further light on the concept and be of great help in the broader financial stability evaluation.

In this light, Table 5 presents a wide set of statistical indicators for systemic importance showing its relation with the underlying categories[18]. The linear correlation of every category with SI is quite high and increases from the global to the EZ sample. Then, the information provided by

[18] Tables presenting complete results for the statistical indicators are available upon request.

any of the category can be viewed as close to the overall SI information. However, relying on the tests shown in Gibbons and Chakraborti (2003), based on the hyperbolic tangent function, the correlations results are significantly lower than one[19]. Thus, it can be concluded that this methodology adds relevant information over and above a selection based simply on one of the selected categories. This result is in agreement with that shown in ECB (2006). The 'substitutability' category is the less correlated with SI and with the other categories as well. While a small decline in linear correlations through time can be seen across samples, its magnitude is probably too small to give any indication about the development of SI.

Table 5. Selected Statistics

Linear Correlation	**G-SIFIs**		**EU-SIFIs**		**EZ-SIFIs**	
year	2010	2011	2010	2011	2010	2011
Size	0.884	0.857	0.952	0.952	0.968	0.972
Interconnect.	0.933	0.930	0.973	0.967	0.972	0.972
Substitutability	0.753	0.761	0.769	0.754	0.876	0.873
Complexity	0.958	0.958	0.936	0.919	0.933	0.930
C-J Activity	0.927	0.926	0.960	0.925	0.975	0.968

Spearman Correlation	**G-SIFIs**		**EU-SIFIs**		**EZ-SIFIs**	
year	2010	2011	2010	2011	2010	2011
Size	0.885	0.882	0.865	0.880	0.883	0.901
Interconnect.	0.902	0.903	0.883	0.896	0.842	0.853
Substitutability	0.847	0.856	0.825	0.849	0.768	0.829
Complexity	0.906	0.905	0.876	0.880	0.842	0.878
C-J Activity	0.888	0.880	0.861	0.876	0.835	0.837

Kendall tau-b	**G-SIFIs**		**EU-SIFIs**		**EZ-SIFIs**	
year	2010	2011	2010	2011	2010	2011
Size	0.733	0.716	0.734	0.747	0.749	0.777
Interconnect.	0.769	0.767	0.743	0.752	0.694	0.711
Substitutability	0.660	0.676	0.648	0.679	0.602	0.663
Complexity	0.750	0.745	0.732	0.728	0.672	0.722
C-J Activity	0.721	0.713	0.705	0.721	0.686	0.683

HHI*	**G-SIFIs**		**EU-SIFIs**		**EZ-SIFIs**	
year	2010	2011	2010	2011	2010	2011
Size	0.0085	0.0084	0.0187	0.0196	0.0260	0.0274
Interconnect.	0.0111	0.0105	0.0217	0.0208	0.0292	0.0297
Substitutability	0.0153	0.0151	0.0134	0.0138	0.0258	0.0277
Complexity	0.0222	0.0225	0.0243	0.0294	0.0383	0.0371
C-J Activity	0.0186	0.0182	0.0263	0.0295	0.0389	0.0386
SI	*0.0143*	*0.0140*	*0.0213*	*0.0221*	*0.0334*	*0.0337*

The Spearman correlation and Kendall tau-b tables present two different measures of rank correlation[20]. These results provide a different picture from the linear correlation table. In fact, the

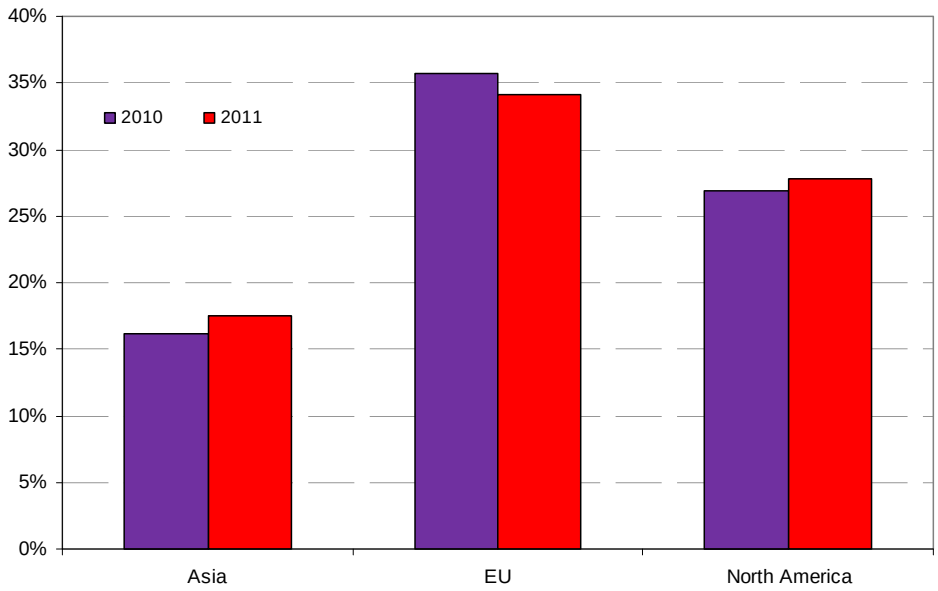
[19] The hypothesis $\rho = 1$ cannot be tested directly, as in this case the hyperbolic tangent tends to infinity. However results based on finite hypotheses gradually distanced from $\rho = 1$, confirm the statistical significance of the correlations.

[20] The Spearman correlation and the Kendall tau-b are nonparametric statistics based on ranked data. The former is

rank correlations of SI are lower in both cases – especially for Kendall tau-b – for any of the considered categories. Gibbons and Chakraborti (2003) provide a useful test that confirms the statistical significance of both the indicators (i.e. they are significantly different from 0 and 1). Then, the informational value of the SI indicator looks greatly enhanced from these results. Moreover, while linear correlations are higher for smaller samples, the opposite is true for rank correlations, showing slightly lower correlations for smaller samples. Hence, this provides increased scope for ranking EU and Eurozone banks according to SI, rather than according to only size or other simple indicators.

Finally the bottom panel of Table 5 provides the values of the normalised Herfindhal Index (HHI*), a widely acknowledged measure of market concentration. It ranges from 0 (no concentration) to 1 (only one bank in the market). Three main conclusions arise from the results. Firstly, the market concentration of systemic importance is not high, but increases with the shrinkage of the sample, showing a relative higher concentration for the Eurozone, then diminishes for the European Union and the global level. Secondly, the historical development shows that, while the concentration has actually decreased on a global level, it has increased in the EU and in the Eurozone. Thirdly, while SI is more concentrated than size and interconnectedness across samples, it is less concentrated than complexity and cross-jurisdictional activity (the evidence for substitutability is more blurred).

Figure 1. Cumulative SI distribution across regions

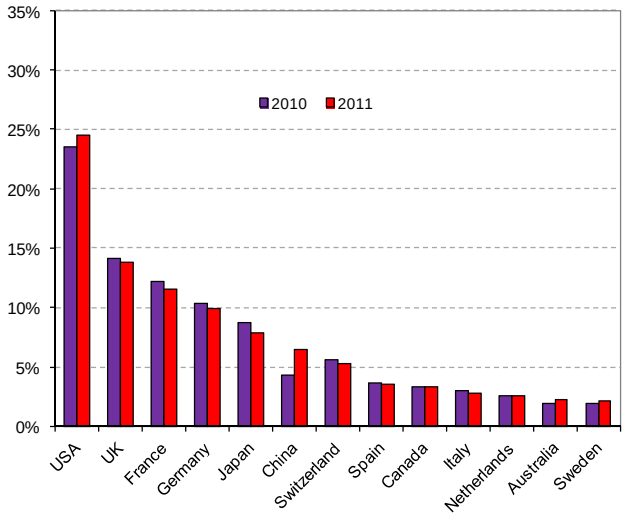


Region values are calculated summing the SI scores of all the banks based in a given region. These values are then re-scaled as percentages.

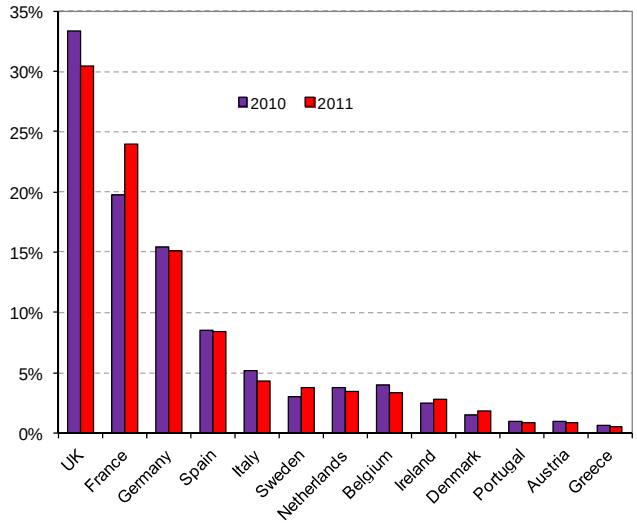
obtained by computing correlations on ranks, where ties are handled through averaging. The latter relies only on the relative ordering of ranks and not on the absolute values of the ranks.

Figure 2 – Cumulative SI distribution across countries

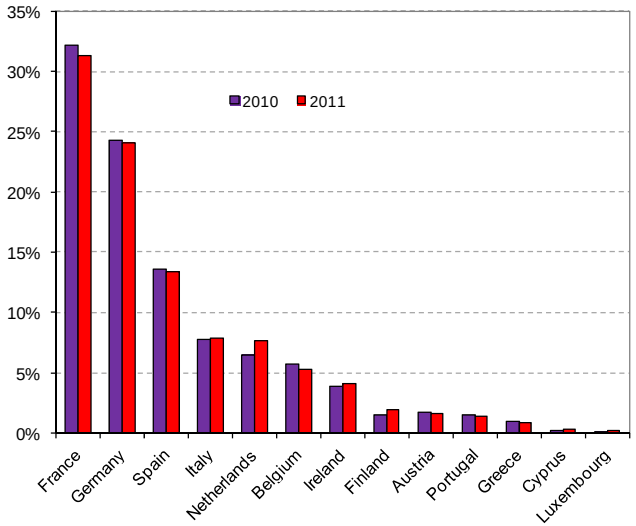
Global SI



EU SI



Eurozone SI



Country values are calculated summing the SI scores of all the banks based in a given country. These values are then re-scaled as percentages.

The first two conclusions arising from the HHI* values lead to interesting interpretations. In fact, although different samples should be compared with care, the decreasing concentration with market size shows that the larger the market the more evenly distributed is systemic importance. By the same token, it is reasonable to expect to have an even higher degree of market concentration when single jurisdictions are considered. The dynamics of SI concentration leads to a further issue. In fact, while widening the reference market dimension is set to reduce concentration, regulators are left with the question of whether it is best to leave the SI concentration rise or not. While it would be advisable to avoid an excessive SI concentration in a limited number of financial institutions, an excessive dispersion could make the supervision more difficult and increase risks. In this sense, the proposal for a banking union inside the EU – widening the reference market to be supervised by a single supervisory mechanism (SSM) – implicitly shows a preference for the decrease in SI concentration. However, no matter what the preferences of regulators are, these results show that policy decisions would need to better take account of their impact on systemic importance. In this light, SI evaluation could become an additional instrument of the macroprudential policy toolkit to maintain financial stability. Moreover, given the expected government support enjoyed by SIFIs – see for instance Ueda and Weder di Mauro (2012) – the SI evaluation could also help microprudential policy in maintaining a sound competition in financial markets.

The second fact mentioned above compares the development of HHI* through time, showing a decrease in market concentration for the global sample and an increase for the EU and Eurozone sample. This fact can be interpreted as follows: while the SI concentration is increasing in one region of the world (in fact, the EU and the Eurozone can be roughly assimilated to the same region), it is becoming more evenly distributed across different regions of the world, regardless of what is happening to SI concentration in other regions of the world.

The interpretation above is confirmed by Figure 1, where the cumulative percentage share of SI in different regions is shown. The percentage share of SI is highest in Europe, while it's lower in Asia (including Australia), with North America in an intermediate position. 2011 witnessed a moderate increase in North American SI share, rising 3% yoy, and a sharper increase in the Asian SI share, rising 8% yoy. Conversely, the European SI share decreased by almost 5% yoy, contributing to a redistribution of SI across regions. This interpretation is broadly in line with recent developments in the international banking system, where several European banks, in a combined effort to deleverage, are retreating from several markets, especially Asian ones, leaving room for the organic growth of local banks.

Figure 2 provides a higher level of geographical breakdown of SI percentage shares at the country level in the three samples (showing the first 13 countries according to SI share). The breakdown of the global sample (left panel) shows that, while most of the countries present only small variations from 2010 to 2011, the SI share of banks headquartered in China registered an enormous increase, probably far larger than what overall economic and financial indicators might otherwise suggest. The sustained growth of its banking system and of its SI should be closely monitored in order to avoid the concentration of risks and fragilities. Moreover, these developments provide some evidence to the pro-cyclicality of systemic importance and systemic risk.

The comparison between the three graphs clearly show how the distribution of SI shares becomes more concentrated once the sample is geographically restricted, even if this observation does not tell anything about the aggregate level of systemic importance, which is considered only in terms of the reference sample. To make a more accurate comparison between the three graphs a proper way to measure systemic importance in absolute terms should be found. Finally, the Eurozone graph (right panel) highlights that the first three countries account for almost 70% of the SI of the area. Future developments of systemic importance in the banking system will have to be closely monitored and evaluated as a policy tool, in order to better assess the resilience of the banking system.

7. Concluding Remarks

This paper provided an empirical framework to adapt the BCBS (2011) methodology to assess the systemic importance of financial institutions in order to rely on publicly available data. The aim of this framework is to offer the view embedded in market data for systemic importance. Moreover, since the G-SIFIs identification by the FSB rely also on supervisory judgement, this framework sheds light on its role and identifies the market-based G-SIFIs list.

Moreover, given the flexibility of this framework and its ease of implementation, it has been applied to the European Union and the Eurozone. This extension provided a list of EU- and EZ-SIFIs, suggesting a closer supervision of the selected banks. This conclusion is even truer if the developments towards a banking union inside the European Union – including a single supervisory mechanism – are considered.

This work adds some further insights about the statistical properties, geographical and historical distribution of systemic importance. The systemic importance is confirmed to add relevant information from that provided by the underlying indicators. Its distribution is becoming more even across different regions of the world, but at the same time is becoming more concentrated inside the EU and the Eurozone. The systemic importance of the Chinese banking system is swelling, while the UK concentrates in its baking system the highest degree of systemic importance in the EU. These facts have to be considered with special care by national and supranational regulators, as their future developments.

However, to improve the usefulness of systemic importance analysis for future policy purposes some further steps are needed. In fact, replying the exercise for some years before 2010 would greatly help to shed more light on SI developments during the crisis years and on its relationship with other economic and financial variables.

On a longer term, some improvements on the BCBS methodology might be needed. In fact, since it is thought for identifying SI on a global scale, it doesn't take account of some European specificities (e.g. the bank-sovereign link through primary dealership agreements, holding of sovereign bonds, etc.). Moreover its sample-dependent structure limits the ease of comparability of data through time and different geographical samples. This issue let raise some questions about the changing compositions of SIFIs lists and the way supervisors shall deal with these changes.

On a broader perspective, as Elliott (2012) points out, no financial institutions should receive an automatic exclusion from SIFI designation. This framework to assess the systemic importance of financial institutions is specifically addressed to banks. It could be an extremely useful tool for regulators and supervisors, but it does not tell anything about systemic importance developments in other parts of the financial system. The closer supervision over systemically important financial institutions can increase the risk of shifting systemic importance to less regulated part of the financial system. This risk should not be underestimated. Finally, since systemic importance is only a component of the overall systemic risk, the relationship between them should be more closely evaluated, maybe establishing a link through systemic risk contribution models.

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Appendix

The sensitivity analysis performed in this appendix has the aim to ascertain how the values of the SI indicator can be affected by changes in the input of the model. To complete the SI indicator with public data a number of assumptions was necessary. They are explained in Section 4. However, as assumptions are always questionable, it is necessary to analyse the variability of the SI indicator once alternative assumptions are considered. The robustness of the indicator would increase the lower the impact of a change in the assumptions is.

As in Saltelli et al. (2006), changes in the input of a model can be ascribed to: changes in the selection of the underlying indicators, errors in the underlying indicators, changes in the scaling method, changes in the aggregation weights. Since the structure of the SI indicator is not questioned, the role of changes in the aggregation weights is not taken into consideration. Several changes in the basic assumptions are considered. The method chosen to evaluate the sensitivity of the SI indicator to changes in the underlying assumptions is similar in spirit to the method of Morris (1991).

Given the SI indicator calculated under baseline assumptions, $SI(I)$, alternative results can be calculated under *i* different assumptions – $SI(\tilde{I}_i)$. Once a number of $SI(\tilde{I}_i)$ is calculated, the average – $\mu(SI(\tilde{I}_i))$ – and standard deviation – $\sigma(SI(\tilde{I}_i))$ – of the distribution can be derived. They can be used as global measures of uncertainty. Moreover they can also be used to build confidence intervals to verify whether H0: $SI(I)$ falls in the rejection region for some banks.

The alternative results of $SI(\tilde{I}_i)$ have been calculated under the following assumptions. Given the straightforwardness of the Size category, no alternative assumptions have been considered. In the Interconnectedness category, total marketable securities have been substituted by the wholesale funding ratio (WFR), as in the preliminary version of the BCBS methodology. The WFR is calculated as the ratio of total marketable securities to total assets.

The Substitutability category, given the lack of data for payments delivered through payments and settlements systems, adds up to 2/3. Thus, the first alternative assumption rescaled the category to 1. Regarding the values of underwritten transactions in debt and equity markets, an alternative assumption was based on DCM and ECM fees income, rather than deal values, since the former is another reliable indicator of a bank's market share. Additionally, since DCM aggregated values – both as deal values and fees income – are usually far larger than ECM values, the average value of the two variables, rather than the sum, was be considered.

In the Complexity category, the only relevant assumption was about OTC derivatives in notional value, thus the category was rebuilt without this sub-category and rescaled to 1. In the Cross-jurisdictional activity category, two different assumptions were used to calculate cross-jurisdictional claims and liabilities, as in eq. (4), then they were averaged with so α = 0.5. As alternative assumption α was set equal to 0 and 1. An additional alternative assumption regards the few countries with unknown cross-jurisdictional liabilities (see subsection 4.5). While the baseline sets them equal to cross-jurisdictional assets, here they are set equal to cross-jurisdictional assets plus their current-account balance as a percentage of GDP.

Table A1. Sensitivity Analysis Results

Sample	Global		EU		Eurozone	
	2010	2011	2010	2011	2010	2011
H0 Rejected						
Top-50 Banks	10%	10%	14%	12%	12%	12%
Bottom-50 Banks	32%	29%	36%	34%	34%	34%
Total	21%	20%	25%	23%	23%	23%

As explained above, $\mu(SI(\tilde{I}_i))$, $\sigma(SI(\tilde{I}_i))$ and bidirectional intervals at the 95% confidence level were calculated for every bank, in any of the samples and years considered. Table A1 shows the percentage share of rejection of the null hypothesis for every sample. The maintained hypothesis $SI(I)$ was not rejected for a relevant number of banks. Thus the baseline scores appear fairly robust to changes in the underlying assumptions. The SI scores appear to be more stable for the top 50 banks, ranked according to the SI score, while its variability increases for the bottom 50 banks. This result may depend on the very low scores that many banks have at the bottom of every sample. In fact, even minor changes in the underlying assumptions could cause large swings in the output for very low SI scores. Even when the SI scores falls in the rejection region, the confidence interval is not large enough to justify relevant changes in the overall rankings, neither changes of magnitude in the SI scores.