SYSTEMICALLY IMPORTANT BANKS: A PERMUTATION TEST APPROACH

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1. Introduction and Objectives

The definition of Systemically Important Financial Institutions (SIFIs) was introduced by the Financial Stability Board (FSB) in October 2010 as the institutions "whose disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity", FSB (2010). The current methodology to determine the Globally Systemically Important Banks (G-SIBs) is outlined by the Bank for International Settlements (BIS, 2013). In particular, the banks included in the analysis have to fulfil any of the following criteria:

- Banks that the Committee identifies as the 75 largest global banks, according to the leverage ratio exposure measure, at the end of the financial year.
- Banks that were designated as G-SIBs in the previous year (unless supervisors agree about compelling reasons to exclude them).
- Banks with a score produced by the indicator-based measurement approach exceeding the cut-off level set by the Committee.
- Banks that have been added to the sample by national supervisors using supervisory judgment (subject to certain criteria).

One important feature in these criteria is that the cut-off is decided mostly by expert judgement. The main aim of the present investigation is to provide a quantitative criterion to choose this cut-off. In particular, the choice will be made by picking the suitable quantile from the distribution produced by the permutation test, see Pesarin and Salmaso (2010), that rejects the equality hypothesis for some cross sectional feature of the two groups, significant at level α. The dynamics of the quantile and of other characteristics of the groups may then be good candidates for a stress indicator, or even for an early warning signal for a systemic event.

The European Banking Union provides full disclosure[1] of the data used to identify the European SIFIs for the years 2014 (using 2013 dataset) and 2015

[1] https://www.eba.europa.eu/risk-analysis-and-data/global-systemically-important-institutions

(using 2014 dataset). Regarding some other Banks identified by the Committee, partial disclosure is provided on the BIS website[2] only for 2015. For a critical review of the literature on the G-SIBs see Iwanicz-Drodowska (2014) and Barth et al. (2013). Bongini et al. (2015) discuss the financial impact of the SIFIs selection. To the best of our knowledge our paper is the first one in which a permutation test approach is applied to this issue.

The paper is organized as follows. In Section 2 the methodology is presented. The results for the aggregated score and for the nonparametric combination of the indicators are shown in Section 3, finally the discussion of the results and proposal of some possible extensions conclude the paper.

2. Methodology

In this Section, we explain the statistical methodology to identify the group of Systemically Important Banks based on permutation tests, following Pesarin and Salmaso (2010). Let be **I**(·) the indicator function equal to 1 if the condition in parenthesis is satisfied and zero otherwise.

The baseline procedure can be summarized in the following steps:

1. Decide a significance level α.
2. Choose a quantile order q, with $q \in [0;1]$, for the considered cross sectional variable, X, observed on values x_i, i $= 1, \dots, n$, where n is the sample size.
3. Given the empirical quantile

$$X_q = \inf\left\{x : \frac{1}{n}\sum_{i=1}^{n} \mathrm{I}(x_i \le x) > q\right\}, \tag{1}$$

the observed units, corresponding to different banks, are divided into two groups, g_1 and g_2, in such a way: $i \in g_1$ if $x_i < X_q$ and $i \in g_2$ if $x_i \ge X_q$, $i = 1, \dots, n$.

4. Compute a relevant statistic for each group; in our case we use the coefficient of variation, defined as the standard deviation divided by the mean, and denoted by cv_{g_k}, $k = 1, 2$. The difference of the two statistics, i.e. $v = cv_{g_1} - cv_{g_2}$, will be our test statistic, and its observed value will be v_{obs}.
5. Exchange randomly the participants in the groups, retaining only their sizes, that is we randomly choose a permutation of the indices i, named π_b, $b = 1, \dots, B$, obtaining two new groups: $i^{\pi} \in g_1^b$ if $x_{i^{\pi}} < X_q$ and $i^{\pi} \in g_2^b$ if $x_{i^{\pi}} \ge$

[2] http://www.bis.org/bcbs/gsib/

X_q. Then, considering the exchangeability assumption of X and under the hypothesis of identical coefficients of variation for the two groups, $\mathcal{H}_0: CV_{g_1} = CV_{g_2}$, the statistic $v^b = cv_{g_1^b} - cv_{g_2^b}$ would have the same distribution of v.

6. Compute, according to Pesarin and Salmaso (2010), an approximated p-value by

$$P_B = \frac{1}{B}\sum_{b=1}^{B} \mathrm{I}\left(v^b \geq v_{obs}\right) \tag{2}$$

based on B random permutations generated in the previous step. Considering as alternative hypothesis $\mathcal{H}_1: CV_{g_1} > CV_{g_2}$ we can reject the null hypothesis at the α significance level if $P_B \leq \alpha$.

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If instead of having one single variable of interest there are several ones, X_j, $j = 1, \ldots, p$, we suggest to use a nonparametric combination of partial tests. But in that case, a specific way to define the groups must be chosen.

In the following we consider two kinds of combination. In the first one we compute the quantile for a weighted sum, X^w, of the variables of interest, **X,** in the form $X^w = \mathbf{w}'\mathbf{X}$, where **w** is an array of p non-negative weights summing to 1. Denoting the linear combination for each observation with x_i^w, the quantile of order q is defined as usual

$$X_q^w = \inf\left\{x : \frac{1}{n}\sum_{i=1}^{n} \mathrm{I}\left(x_i^w \leq x\right) > q\right\} \tag{3}$$

According to this quantile, the banks may be divided into two groups $i \in g_1$ if $x_i^w < X_q^w$ and $i \in g_2$ if $x_i^w \geq X_q^w$.

The second kind of aggregation of many variables uses the permutation technique. After the definition of the size of each group, we apply the procedure outlined before to get the permutation distribution of each partial test statistic t_j, typically $t_j = cv_{g_1}^{(j)} - cv_{g_2}^{(j)}$, $j = 1, \ldots, p$, where the coefficients of variation, $cv_{g_k}^{(j)}$, $k = 1,2$, refer to the observed values of X_j, furthermore we denote with t_j^b the partial test statistics computed on each permutation b of the two groups, with $b = 1, \ldots, B$. Then each dimension is transformed to an auxiliary variable related to the single p-values

$$I_j = \frac{1}{B+1}\left(\frac{1}{2} + \sum_{b=1}^{B} \mathrm{I}\left(t_j^b \geq t_{j,obj}\right)\right) \tag{4}$$

that takes values strictly inside the unit interval. So, it may be defined in such a way that they can be merged in a single variable using a combination function: in our case, we use a Fisher omnibus function with the same weights of the index $t = -\sum_{j=1}^{p} w_j \log(\lambda_j)$. In addition, we can obtain the value of the statistics in each permutation, by

$$I_j^b = \frac{1}{B+1}\left(\frac{1}{2} + \sum_{b=1}^{B} \mathrm{I}\left(t_j^r \geq t_j^b\right)\right) \tag{5}$$

in such a way to produce an approximated permutation distribution.
This procedure may be extended to the combined variable for each permutation, $t^b = -\sum_{\mathrm{j}=1}^{\mathrm{p}} \mathrm{w_j} \log(\lambda_j^b)$. Given B random permutations, as before, according to Pesarin and Salmaso (2010), we can obtain an approximated p-value by

$$P^b = \frac{1}{B}\sum_{b=1}^{B} \mathrm{I}\left(t^b \geq t\right) \tag{6}$$

and we can reject the global null hypothesis of equality in the variations of the two groups $\mathcal{H}_0: CV_{g_1}^g = CV_{g_2}^g$ at the α significance level if $P^b \leq \alpha$.

In the following, we will apply the procedure, in both ways, at first directly to permutations of the weighted index and then through the use of nonparametric combination. In addition, we choose the quantile level through a grid search with the aim of minimizing the difference between the observed and the nominal significance levels, i.e. p-value and α. With this methodology, a subdivision in groups corresponds to each significance level that can be compared with the one chosen by the regulator.

3. Empirical results

In this section, after the data description, we report and comment the Systemically Important European Banks obtained by our methodology, using 2014 data, at different significance levels, finally we compare them with the choice made by the Basel Committee.

G-SIB score evaluation and data

The primary indicator used by the Basel Committee for the choice of Systemically Important Banks is a composite indicator of annually balance-sheet variables that aim to take in consideration the different aspects of systemic risk: Size, Interconnectedness, Complexity and Cross-Jurisdictional Activity. Those categories come from 12 indicators, shown in Table 1 and obtained from BIS (2014). The single indicators for each bank are normalized by the total of that indicator for all the 75 banks. The final score is obtained by computing a weighted sum of the indicators with weights reported in the last column of Table 1.

Table 1 – *Indicators and relative score weights used by the Basel Committee for the evaluation of the Systemically Important Banks.*

Category	Indicator	Indicator weight
Size	Total exposures	1/5=20%
Interconnectedness	Intra-financial system assets	1/15= 6.66%
	Intra-financial system liabilities	1/15= 6.66%
	Securities outstanding	1/15= 6.66%
Substitutability/financial institution infrastructure	Payment activity	1/15= 6.66%
	Assets under custody	1/15= 6.66%
	Underwritten transactions in debt and equity markets	1/15= 6.66%
Complexity	National amount of OTC derivatives	1/15= 6.66%
	Trading and AFS securities	1/15= 6.66%
	Level 3 assets	1/15= 6.66%
Cross-jurisdictional activity	Cross-jurisdictional claims	1/10= 10%
	Cross-jurisdictional liabilities	1/10= 10%

Even if the vast majority of the balance-sheets, whose variables are used in the evaluation process, are available on the Bank of International Settlement website, the extraction of the relevant indicators would be a non trivial task. This is the main reason why we restrict our focus only to European banks for which the European Banking Union guarantees full disclosure of data in a much more manageable format. Although we are considering only European banks their indicators are normalized by the sum of the indicators of all the banks subject of the evaluation procedure taken from the Bank of International Settlement website. We consider the data from 2014 that were used for the choice of 2015 European G-SIB, within a pool of 37 European Banks and, as detailed in the following, we apply our procedure both to the aggregated score and to a nonparametric combination of the 12 indicators in two ways.

Aggregated Score Permutation

The first analysis done is the application of our single variable methodology directly on the aggregated score that represents the main tool in the decision of the Basel Committee. We used $B = 1000$ randomized permutations for the analysis. The names of the SIBs chosen using our methodology at different significance levels are reported followed by an asterisk, starting from the second column of Table 2, in Appendix. For comparison, in the first column we report also the choices made by the Basel Committee. In addition, in the last three rows of the Table, we indicate the percentage and the number of correctly predicted European SIBs with respect to the number of European G-SIBs considered by the Committee, the false positives that is the number of institution considered SIBs by our methodology but not chosen by the Committee, and the false negatives namely the number of banks chosen by the committee but not by our methodology.

The single variable analysis is, in general, not able to reproduce the choice of the Committee before the virtually meaningless significance level of 50% and it is generally much more conservative in the choice of SIBs. In particular, we note that the number of false positives is zero, or extremely low for all the significance levels. So even if in the technical documentation of the Bank of International Settlement the score is indicated as the principal variable driving the Committee through the choice of the SIBs, as investigated in the next Section, the selection process of the Committee seems to take into account the real multivariate dimension of the problem.

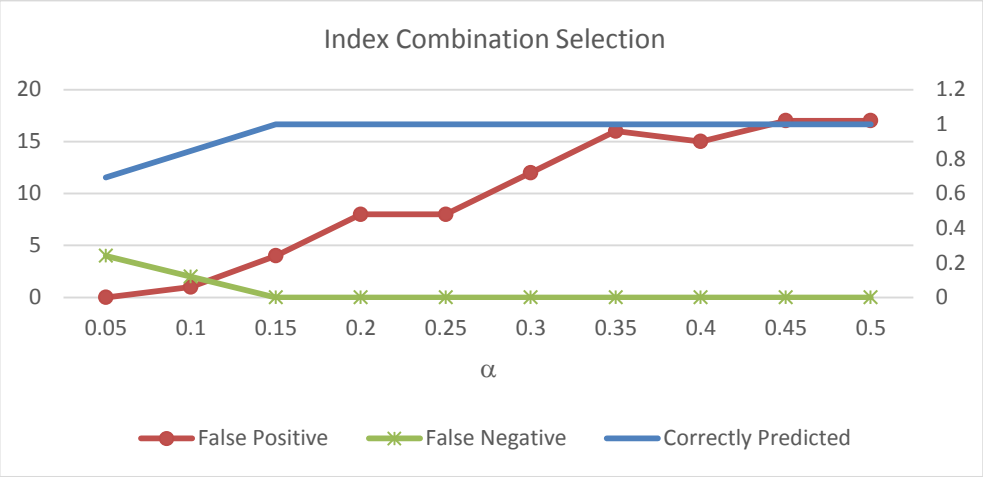
Indicators Combination

The second analysis aims to consider the SIBs choice in its entire multivariate dimension. Here we use again a quantile of the merged score, as in the previous subsection, but the test is conducted by computing a partial statistic for each one of the 12 indicators and then using a Fisher omnibus function with the same weights used in the aggregation of the score, to obtain the global test statistic. This approach allows us to test a joint multivariate hypothesis and should be more sensible with respect to a simple aggregation in determining two groups. This is exactly what our results reveal. As shown in Table 3, in fact it is sufficient a 15% significance level to predict correctly all the SIBs and already at the 5% level more than two thirds of the SIBs are properly chosen. This occurs at the price of a higher, but still acceptable, number of false positives, as graph in Figure 1 shows.

Those preliminary results suggest two considerations. The first is that, although not apparent from the technical documentation, the expert judgement decision process of the Basel Committee may capture the real multivariate decision,

performing well in considering all the dimensions of Systemic Risk. On the opposite side, even if expert judgment cannot be eliminated, having a reliable statistical procedure able to reproduce almost completely the expert judgement can be fruitful in several ways: it can be used as a better guide by the experts, and it can be transferred to different variables, for example variables available at an higher frequency, as the most common Systemic Risk measures (SRISK, CoVaR, DCI, etc.), to provide a more timely separation of the SIBs from the rest of the system.

Figure 1 – *Errors with Variables Combination Test*



4. Conclusions

In this paper, we propose to use some statistical methodologies based on nonparametric combination and randomized permutation tests to identify the group of European Systemically Important Banks. The procedure is completely nonparametric and, aside from the choice of a statistical significance level, it is fully automatic. The procedure outcomes are compared with those chosen by the Basel Committee that uses less quantitative methods; in fact, in this last case the discrimination threshold is also supplemented by the judgment of a panel of experts.

It is shown how the second methodology we propose, taking into account properly the multivariate features of the decision process, is able to reproduce results comparable with those done by the Basel Committee for 2015 to identify

the group of European Systemically Important Banks. Although encouraging, our preliminary results must be handled with care, given that only European banks are included in the analysis while the sample of banks considered by the Basel Committee has a world-wide span. But, in this regard, we must note that an extension to the whole sample considered by the Committee seems hard, due to data availability only in a non standardized balance-sheet form; furthermore, the normalization coming from the world wide sample has a mitigating effect on this issue.

Instead, a replication of the same analysis for different years is possible and necessary in order to support these results and will be addressed in the future. In addition, if these results are confirmed, a viable statistical methodology to select the SIBs paves the way of extending the selection to a higher frequency framework, by applying the procedure to measure systemic risk, usually available daily. In particular, it is possible to conceive an optimization procedure on the weights of the combination of the test coming from different systemic risk measures, in order to obtain average groupings, over one year, as close as possible to the choices of the Committee for that year. This tool, once developed, could be really important in timely monitoring of new SIBs by the Regulator.

Appendix

Tables

In the following we present the results of the performed procedures for the banks used by Basel Committee to identify the Systemically Important Banks (in the first columns of the Tables) in 2014, denoted with an asterisk. The other columns report the same indications using our statistical technique: Table 2 is devoted to the linear combination, as in Table 3 the results are referred to nonparametric combination. In both these last cases the procedures depend on the nominal significance level, indicated on the top of the columns. The three rows at the bottom of the Tables point out the correctness of the results, showing the percentages of evaluations in accordance with those of Basel Committee and the numbers of false positive and negative cases.

Table 2 – *Systemically Important Banks selection with aggregated score.*

	a						
G-SIB 2014 (Basel Commetee)	**5%**	**10%**	**15%**	**20%**	**30%**	**40%**	**50%**
ABN AMRO	ABN Amro	ABN Amro	ABN Amro	ABN Amro	ABN Amro	ABN Amro	ABN Amro
BANCA MONTE	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte
PASCHI SIENA	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena
BANQUE POSTALE	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale
BARCLAYS*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*
BAYERN LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB
BBVA	BBVA	BBVA	BBVA	BBVA	BBVA	BBVA	BBVA
BFA	BFA	BFA	BFA	BFA	BFA	BFA	BFA
BNP PARIBAS*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*
BPCE*	BPCE	BPCE	BPCE	BPCE	BPCE*	BPCE*	BPCE*
COMMERZBANK	Commerzbank	Commerzbank	Commerzbank	Commerzbank	Commerzbank	Commerzbank*	Commerzbank*
CREDIT AGRICOLE*	Credit Agricole	Credit Agricole	Credit Agricole	Credit Agricole*	Credit Agricole*	Credit Agricole*	Credit Agricole*
CREDIT MUTUEL	Credit Mutuel	Credit Mutuel	Credit Mutuel	Credit Mutuel	Credit Mutuel	Credit Mutuel	Credit Mutuel
DANSKE BANK	Danske Bank	Danske Bank	Danske Bank	Danske Bank	Danske Bank	Danske Bank	Danske Bank
DEUTSCHE BANK*	Deutsche Bank	Deutsche B.*	Deutsche B.*	Deutsche B.*	Deutsche B.*	Deutsche B.*	Deutsche B.*
DNB	DNB	DNB	DNB	DNB	DNB	DNB	DNB
DZ BANK	DZ Bank	DZ Bank	DZ Bank	DZ Bank	DZ Bank	DZ Bank	DZ Bank
ERSTE GROUP	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group
HANDELSBANKEN	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken
HELABA	Helaba	Helaba	Helaba	Helaba	Helaba	Helaba	Helaba
HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*
ING*	ING	ING	ING	ING	ING	ING	ING*
INTESA SANPAOLO	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo
KBC	KBC	KBC	KBC	KBC	KBC	KBC	KBC
LA CAIXA	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa
LBBW	LBBW	LBBW	LBBW	LBBW	LBBW	LBBW	LBBW
LLOYDS	Lloyds	Lloyds	Lloyds	Lloyds	Lloyds	Lloyds	Lloyds
NATIONWIDE	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide
NORDEA*	Nordea	Nordea	Nordea	Nordea	Nordea	Nordea	Nordea*
NORDLB	NordLB	NordLB	NordLB	NordLB	NordLB	NordLB	NordLB
RABOBANK	Rabobank	Rabobank	Rabobank	Rabobank	Rabobank	Rabobank	Rabobank
RBS*	RBS	RBS*	RBS*	RBS*	RBS*	RBS*	RBS*
SANTANDER*	Santander	Santander	Santander*	Santander*	Santander*	Santander*	Santander*
SEB	SEB	SEB	SEB	SEB	SEB	SEB	SEB
SOCIETE GENERALE*	Societe Generale	Societe Generale	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*
STANDARD CHARTERED*	Standard Chartered	Standard Chartered	Standard Chartered	Standard Chartered	Standard Chartered*	Standard Chartered*	Standard Chartered*
SWEDBANK	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank
correctly predicted	**23%**	**38%**	**54%**	**62%**	**85%**	**85%**	**100%**
false positive	**0**	**0**	**0**	**0**	**0**	**1**	**1**
false negative	**10**	**8**	**6**	**5**	**2**	**2**	**0**

The systemically important banks names are followed by an asterisk. The first column reports the choices of the Basel Committee, the remaining ones the choices obtained by our methodology at the given statistical level.

Table 3 – *Systemically Important Banks selection with a nonparametric combination of 12 indicators.*

				a			
G-SIB 2014 (Basel Committee)	**5%**	**10%**	**15%**	**20%**	**30%**	**40%**	**50%**
ABN AMRO	ABN Amro	ABN Amro	ABN Amro	ABN Amro	ABN Amro*	ABN Amro*	ABN Amro*
BANCA MONTE DEI	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte	Banca Monte
PASCHI DI SIENA	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena	Paschi Siena
BANQUE POSTALE	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale	Banque Postale
BARCLAYS*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*	Barclays*
BAYERN LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB	Bayern LB*	Bayern LB*	Bayern LB*
BBVA	BBVA	BBVA	BBVA*	BBVA*	BBVA*	BBVA*	BBVA*
BFA	BFA	BFA	BFA	BFA	BFA	BFA	BFA
BNP PARIBAS*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*	BNP Paribas*
BPCE*	BPCE	BPCE*	BPCE*	BPCE*	BPCE*	BPCE*	BPCE*
COMMERZBANK	Commerzbank	Commerzbank*	Commerzbank*	Commerzbank*	Commerzbank*	Commerzbank*	Commerzbank*
CREDIT AGRICOLE*	Credit Agricole*	Credit Agricole*	Credit Agricole*	Credit Agricole*	Credit Agricole*	Credit Agricole*	Credit Agricole*
CREDIT MUTUEL	Credit Mutuel	Credit Mutuel	Credit Mutuel	Credit Mutuel*	Credit Mutuel*	Credit Mutuel*	Credit Mutuel*
DANSKE BANK	Danske Bank	Danske Bank	Danske Bank	Danske Bank	Danske Bank*	Danske Bank*	Danske Bank*
DEUTSCHE BANK*	Deutsche Bank*	Deutsche Bank*	Deutsche Bank*	Deutsche Bank*	Deutsche Bank*	Deutsche Bank*	Deutsche Bank*
DNB	DNB	DNB	DNB	DNB	DNB	DNB*	DNB*
DZ BANK	DZ Bank	DZ Bank	DZ Bank	DZ Bank*	DZ Bank*	DZ Bank*	DZ Bank*
ERSTE GROUP	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group	Erste Group
HANDELSBANKEN	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken	Handelsbanken*
HELABA	Helaba	Helaba	Helaba	Helaba	Helaba	Helaba*	Helaba*
HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*	HSBC*
ING*	ING	ING	ING*	ING*	ING*	ING*	ING*
INTESA SANPAOLO	Intesa Sanpaolo	Intesa Sanpaolo	Intesa Sanpaolo*	Intesa Sanpaolo*	Intesa Sanpaolo*	Intesa Sanpaolo*	Intesa Sanpaolo*
KBC	KBC	KBC	KBC	KBC	KBC	KBC	KBC*
LA CAIXA	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa	La Caixa
LBBW	LBBW	LBBW	LBBW	LBBW*	LBBW*	LBBW*	LBBW*
LLOYDS	Lloyds	Lloyds	Lloyds*	Lloyds*	Lloyds*	Lloyds*	Lloyds*
NATIONWIDE	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide	Nationwide
NORDEA*	Nordea	Nordea	Nordea*	Nordea*	Nordea*	Nordea*	Nordea*
NORDLB	NordLB	NordLB	NordLB	NordLB	NordLB	NordLB*	NordLB*
RABOBANK	Rabobank	Rabobank	Rabobank	Rabobank*	Rabobank*	Rabobank*	Rabobank*
RBS*	RBS*	RBS*	RBS*	RBS*	RBS*	RBS*	RBS*
SANTANDER*	Santander*	Santander*	Santander*	Santander*	Santander*	Santander*	Santander*
SEB	SEB	SEB	SEB	SEB	SEB*	SEB*	SEB*
SOCIETE GENERALE*	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*	Societe Generale*
STANDARD CHARTERED*	Standard Chartered	Standard Chartered*	Standard Chartered*	Standard Chartered*	Standard Chartered*	Standard Chartered*	Standard Chartered*
SWEDBANK	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank	Swedbank
correctly predicted	**69%**	**85%**	**100%**	**100%**	**100%**	**100%**	**100%**
false positive	**0**	**1**	**4**	**8**	**12**	**15**	**17**
false negative	**4**	**2**	**0**	**0**	**0**	**0**	**0**

The systemically important banks names are followed by an asterisk. The first column reports the choices of the Basel Committee, the remaining ones the choices obtained by our methodology at the given statistical level.

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SUMMARY

Systemically Important Banks: A Permutation Test Approach

The framework of Systemically Important Banks (SIBs) was introduced by the financial stability board in the October of 2010 as the institutions "whose disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity". The current methodology for their determination is based on balance-sheet variables and expert judgment. We propose a cross-sectional statistical procedure based on a permutation test in order to cluster SIBs separating them from the rest of the financial system. This procedure divides the sample in two subsamples choosing a quantile of suitable statistics of the considered variable, in order to reject the null hypothesis of equality in distributions. Our procedure will be applied to the European banking institutions, monitored by EBA, for which this regulator fully discloses information used in the choice of SIFIs done by the Basel committee. The analysis is done considering both single variables and through a weighted combination of them.

The results obtained by the methodology we propose, taking into account properly the multivariate features of the decision process, reproduce those done by the Basel Committee for 2015 to identify the group of European Systemically Important Banks. Moreover these results, having a viable statistical methodology to select the SIBs, can open the possibility of extending the selection to a higher frequency framework, by applying the procedure to measure systemic risk, usually available daily.

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