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Banks: too big to fail? A regulatory update and empirical analysis on a set of systemic important banks

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Banks: too big to fail?
A regulatory update and empirical analysis on a set of systemic important banks

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Abstract

This paper summarizes the evolution of the regulatory framework of banks starting from the Basel agreements and going until the introduction of the capital directive in Europe (CRD IV).
One of the main milestone of the regulatory framework was the introduction of the concept of Systemic important banks for which higher capital requirements are needed. This paper goes further in Measuring systemic importance of financial institutions taking a sample of 17 systemic banks in a given time framework and looks to the share prices, stock exchanges Indexes and government bond yields correlation.
It derives an high correlation among these measures showing the importance to protect these types of institutions in order to prevent market crisis on the financial markets potentially spreading negatively on real economy, companies and countries' GDP.

Regulatory Framework evolution

The 2007-2008 crisis shew that, in addition to the questionable behavior of financial institutions, the legislation was not ready to deal with this particular adverse situation. The legislator, over the years, has intervened several times to impose a path to follow in order to achieve greater financial stability. Since the 80s we have had 3 major agreements that imposed greater constraints on the banks and, at the same time, guaranteed greater solidity of the whole system: the Basel agreements. The Basel agreements are guidelines on capital requirements are drawn up by the members of the G10 plus Luxembourg. These agreements represent an attempt to standardize globally the law. This is a necessary goal to be achieved since the system turns out to be interconnected and leaving the operation of this system in the hands only to mathematical models without the intervention of the legislator would not be efficient. Basel agreements are summarized as follows:
- Basel 1: the first agreement has been done in 1988 and it establishes minimum capital requirements for banks; it was drafted by the Basel Committee, which is the representative authority of the main central banks.
- Basel 2: in 1999 negotiations began to define a new agreement that led to the creation of new capital requirements and new possible modus operandi in the field of credit risk management. Those regulations entered into force in 2008.
- Basel 3: in 2013 Basel 3 enters into force, with a transition period until 2019, which introduces changes to the calculation of the minimum capital required and the liquidity requirements to assess also the quality of capital.
The activity of the legislator does not end only in these 3 major agreements, but is expressed in other international standards, such as IFRS 9, which will be discussed later, and then also national legislation. The results obtained through these rules seem to be moving in the right direction in order to obtain solid financial institutions. However, the issue is always dealt indirectly[1].

[1] Systemic risk is considered as a fundamental problem within the financial system. The systemic risk has various natures and forms and must be eliminated in order to have a stable system. The presence of financial companies with certain capital guarantees may not be enough if the failure of one of these worsens the situation of even other healthy companies. It is very often recalled that, despite all these restrictions and deposit guarantees, reimbursement to all depositors, up to € 100,000, could not be guaranteed if a bank such as Unicredit fails. This risk is not much perceived by the common saver and for the banking system it is better that this risk is not perceived. In fact, in the Italian case, the FITD (Italian fund for deposit

The nostalgic of the past, sometimes with good reason, affirm the need for a return to the separation between commercial bank and investment bank in order to allow a stability of deposits and to make clear the different risk associated with different activities.
It is precisely this separation, which took place after a process of liberalization of finance, which is seen as one of the main causes of excessive risk-taking by credit institutions. The process of liberalization of finance in the 1980s, in fact, shows a shift from a system of structural supervision to a system of prudential supervision. That is, while previously the whole life of the institutes was regulated, by binding their activities and indicating precisely what should or should not be done, since the 80s there has been a transition to a different system. With Basel 1 in 1988 a new step has been done. The institutions became free to act as they wished, in a market that became liberalized and competitive, provided that they respected some constraints on the minimum capital necessary to operate. This liberalization undoubtedly had positive aspects on the general level of development of the financial system, but, in the absence of legislation ready for certain events, it allowed the continuation of illicit behavior until 2007 when the system then collapsed. In the US, we have moved from a system: "generate to hold" to "generate to distribute".
This shift saw the change in what was the fundamental principle of the loan provisioning, namely to hold it in the portfolio and earn from the periodic coupons that were repaid by the borrower of funds. In fact, the loans were disbursed and then through the use of derivative instruments were sold on the market starting to feed a secondary credit market that will become in the period immediately preceding the crisis much more "profitable and interesting" than the credit market itself. This new credit management was made possible thanks to the introduction of so-called credit derivatives, among which the best known are the CDS. As we will see later in the specifics the CDS allow to transfer the credit risk from one person to another and therefore allow both a greater diversification among the portfolio (positive effect) and a speculation on the ability of the subject to honor the loan (negative effect).
In countries where the financial system exists, but it is not the first channel of financing for businesses and families, such as Italy, the problem arose from the presence of loans provided in an unusual way, to subjects who had no guarantees, disbursement on the basis of bank/political relations. This caused the whole NPL bubble that we still hear about and we will hear about it for a long time.
It is understood that the management of credit for a financial institution becomes fundamental and it is correct to state that: "A bank is as solid as its loans".

Basel 1

In July 1988 this agreement was reached, according to which the assets of a bank must be related to the risks it assumed. This requirement becomes binding for all banks belonging to the G10 group plus the member countries (more than 100). In Basel 1 it has been introduced the concept of capital ratio expressed as :

$$\frac{Capital}{RWA} \geq 8\%$$

RWA= Risk Weighted Assets
The weighting coefficients in Basel 1 are:
1. Cash, assimilated values and loans to central governments central banks and the European community: 0%
2. Values for collection and credit activity to central and local public sector entities, banks and SIMs: 20%
3. Mortgage loans and leasing transactions on properties: 50%
4. Loans to the private sector: 100%
5. Investments in non-financial companies: 200%

We observe that we move from safer values to less secure ones with a relative increase in the percentage to be set aside. The percentage data proposed above means that for each euro disbursed the banks must set aside that specific percentage in reserve and this total reserve must be greater than or equal to 8% of all the loans disbursed. The sums of money lent to central governments are considered extremely safe since the possible default of a state was not taken into account, while the sums lent to other financial companies provide for a provision twice as large

protection) rather than a real fund with real money agrees upon guaranteing deposits among the banks. The bankruptcy of a bank like Unicredit could make it impossible to meet these obligations.

as the sum invested / invested. In this second case the financial companies are considered much more volatile than the industrial ones and subject to the same forces.

Basel 2

As already mentioned previously, in 1999, consultations were opened to renew the Basel agreements regarding minimum capital requirements and to introduce a new possible credit management based on internal rating assessments (IRB). Let's say that the Basel 2 agreement is based on 3 pillars:

1) Minimum capital requirements:

With regard to minimum capital requirements, we see that the denominator becomes an expression of 3 elements. In calculating the minimum capital requirements in Basel 2, first pillar, we note that our de-nominator envisages the presence of an additional term that assesses the possible market and operational risk to which the bank could be subjected. We define very simply:

1. Market risk: the possibility that the bank may suffer losses deriving from operations on the markets concerning financial instruments, currencies and commodities.

2. Operational risk: the possibility that the bank may suffer losses deriving from the inadequacy or the failure of procedures, human resources and internal systems, or from external events. With the introduction of Basel 2, this risk can be calculated in 3 different ways:

a. Basic method (BIA): a regulatory coefficient is used with an indicator of company operations

b. Standardized method (TSA): separate regulatory coefficients for each business line are applied to the brokerage margin.

c. Advanced method (AMA): processing of the bank itself through cal- culation models based on operational loss data.

2) Prudential control process

Furthermore, with Basel 2, second pillar, the intermediary is called upon to carry out a self-risk assessment process (ICAAP). Then we have an external review (SREP).

The risks to be included in the ICAAP are:

1. Credit, market and operational risk assessed in the first pillar in an imprecise manner

2. Risks not considered in the first pillar: banking book rate risk, liquidity risk, risk mitigation, securitization, strategic and reputational risk.

3) Market discipline

A fundamental aspect of Basel 2 is the introduction of the internal rating method for the evaluation of the minimum capital requirements necessary to be set aside. Basel 2 believes that all banks can quickly acquire advanced credit risk assessment tools. Banks can use 2 macro approaches:

1. Standard Approach: the total to be set aside derives from weighting factors previously defined by the supervisory authorities. Therefore the fundamental variables, from which derives the "weight" to be applied, are calculated outside (PD, EAD, LGD, M, Granularity). The standard method provides for the use of external ratings:

Table 1.weight and rating

Standard & Poor's rating classes							
Rating	AAA to AA	A+ to A-	BBB+ to BBB-	BB+ to BB-	B+ to B-	Below B-	Without rating
Merit classes	1	2	3	4	5	6	
Weight	20	50	100	100	150	150	100

2. Internal Rating-based approach (IRB): reserves the possibility for some banks that meet certain organizational and management requirements to be able to create the necessary variables for the purpose of calculating the weighting factors. It represents an opportunity especially for those banks that operate with many small, unlisted companies. The variables to be taken into account (PD, EAD, LGD, M, G) can be calculated for your internal business. Within the IRB method we find two sub-categories:

(1) IRB base: it allows to calculate the PD autonomously while the other variables are supplied in a standardized way by the authorities.

(2) Advanced IRB: All variables can be calculated internally by banks.

The capital requirement calculation includes the following analytical formula:

$$K = 1.06 * LGD \{ N \{ 1/ (1 - R)^{0,5} * G (PD) + [R/ (1-R)]^{0,5} * G (0.999) \} - PD \} * [1+(M-2.5)*b]/ (1-1.5*b)$$

K = capital requirement
PD = probability of default
LGD = loss rate in the event of insolvency
N(x) = standard normal cumulative distribution
G(z) = reverse cumulative distribution function of a normal standard
R = correlation
B = adjustment according to maturity

$$R = 0.12 * [1 + EXP(-50 * PD)]$$

$$b = [0.11852 - 0.05478 * LN(PD)]^2$$

Once a certain portfolio has been obtained and the right sums are set aside, Basel 2 provides for the possible use of the VaR method to assess credit exposure. The VaR of the loan portfolio is calculated as the sum of the VaR of individual credit exposures.

Basel 3

Basel 3 is a set of new rules relating to banking supervision, published in response to the 2007-2008 financial crisis. In 2010 the Governors and the Heads of the G20 Supervisory Authorities approved the proposals of the Basel Committee which were then submitted to the Heads of State and Government again in 2010 in Seoul. The rules came into force in 2013 although a transitional period was envisaged until 2019 to allow a gradual adaptation of the operating strategies in order to avoid negative impacts on the company's activities and on the process of general economic recovery. The objectives set by these agreements are, more or less, always the same. In fact, the ultimate goal is to create a stable, solid system and thus guarantee a truly uniform playing ground.

Table 2: Basel 3 timetable

	2013	2014	2015	2016	2017	2018	2019
Leverage Ratio	Experimentation: 1.1.2013 – 1.1.2017 Informative from 1.1.2015					Migration to the first pillar	
Common Equity	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Buffer Conservation Capital				0.625%	1.25%	1.875%	2.5%
Capital base Tier 1	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum capital	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%

Minimum capital + Buffer	8.0%	8.0%	8.0%	8.625%	9.25%	9.875%	10.5%

Liquidity Co-verage Ratio			Introd.				
Net Stable Funding Ratio						Introd.	

A fundamental introduction of Basel 3, in addition to changing some percentages to be taken into consideration, is the introduction of liquidity requirements and two liquidity indicators that can be seen in the second part of the table. Please find hereunder a brief description of these two indicators:

1) Liquidity Coverage Ratio: assess if the bank has high quality assets to cope with stressed outflows in 30 days. In estimating the outgoing cash flows we take into account the liabilities that require different weightings. It shall be considered the liabilities that are considered such as deposits from retail customers which provide for a weighting of 5%, and the liabilities deemed highly unstable, such as deposits from other banks that provide for a 100% weighting.
2) Net Stable Funding Ratio: the sources of funding are evaluated on the basis of stability and an attempt is made to forecast the trend in the medium and long term. The NSFR is calculated with the following formula:

NSFR = (Available amount od stable funding (ASF))/ (Required amount of stable funding (RSF)) > 1

In this case we see a relationship between investments and sources of investment. Also in this case we have different weightings according to the different activities and the stability of the investments or the collection.
Therefore, we can note that, with these agreements, it has been possible to focus on the "quality" of assets. Notwithstanding the minimum capital requirement of 8% remains unchanged, also from the above table:
- Common Equity (ordinary shares + profit reserves): increase from the current 2% to 4.5%;
- Tier 1 (Common Equity + Other Financial Instruments): increase from the current 4% to 6%.

The Basel Committee also focused on some fundamental issues:
1. Risk hedging: in order to assess the possible market risk and avoid underestimating the risks inherent in credit transformation activities, the new rules provide that some important parameters are calculated taking into account the stress condition.
2. Financial Leverage: In order to avoid over-indebtedness, a minimum capital requirement (Tier 1) has been set for banks to be held in relation to the total risk-weighted assets.
3. Countercyclical measures: it is expected that banks will hold a capital buffer above the minimum regulatory requirements (2.5% of common equity in relation to assets at risk). In addition, it is introduced a mechanism that should allow banks to accumulate capital resources in the growth phases.

FROM IAS 39 TO IFRS 9

First of all, starting from IAS39, we can say that this accounting principle aims to establish the principles for recognizing and evaluating financial assets and liabilities. Together with IAS39 we must also briefly evaluate the IAS32 which gives us some important definitions.
First of all, according to IAS 32, a financial instrument means "any contract that gives rise to a financial asset for a financial entity and a financial instrument or a financial liability or an instrument representing capital for another entity.
IAS39 classifies financial activities according to their scope:
1. Financial assets of "fair value through profit and loss". They belong to this category:
a. assets held for trading
b. originally designated by the company as valued at fair value in the income statement
2. "Held to maturity" financial assets. Fixed or determinable payments are envisaged with a fixed expiry date. This section raises questions about the prospect that the company will continue to hold this particular

activity until maturity, i.e. that it has the interest and the possibility of continuing to finance this activity. In case of doubts about the possibility of holding a certain asset until maturity, this activity can not be classified in this category.

3. Loans and credits. These are the simple commercial and financial receivables that arise as a result of the company's activity.

4. Financial assets available for sale. Residual category, including all the activities not included in the previous categories.

IAS 39 defines as financial liability:

1. A contractual obligation:

a. Deliver cash or another financial asset

b. Exchange financial assets or liabilities on unfavorable terms

2. A contract that will or can be terminated through instruments representative of the company's capital:

a. Non-derivative instrument: to be extinguished with variable number of instruments representing the capital

b. Derivative instrument: different methods of extinction.

Financial liabilities are classified in two categories:

1. Financial liabilities of "fair value through profit and loss". Those are liabilities that arise for the purpose of benefiting from fluctuations. We obtain:

a. Liabilities held for trading, held to be traded

b. Liabilities fair value option, instruments designated at company's choice fair value.

2. Financial liabilities denominated "financial liability at amortized cost". These are the typical activities of the company from the purchase of assets to obtaining loans.

IAS39 requires that financial instruments are recognized when the entity / company becomes a party to the contractual clauses of the instrument with the transfer of risks and benefits connected to the financial instrument. Derivative instruments, on the other hand, are registered from the beginning in the financial statements. The initial recognition of a financial asset or of a financial liability must occur at the fair value including transaction costs, with the exception of financial instruments valued at fair value recorded in the income statement. We highlight that:

1. Fair value: this is the price that would be received from the sale of an asset or the transfer of a liability in a regular transaction between market operators at the valuation date.

2. Transaction costs: marginal costs directly attributable to the acquisition, issue or disposal of a financial asset or financial liability. That is a cost that would not have been occurred if the entity had not acquired, issued or disposed the financial instrument. After the initial recognition we can have a mixed situation that requires valuation at fair value and amortized cost.

At this point we can say that during the financial crisis of 2007-2008 the IAS39 was considered an element that has fueled this crisis precisely because of the marked use of fair value. In fact, in a negative situation the weaknesses in the evaluation and diffusion of information practices have been highlighted and, when the markets cease to operate correctly, all the assessments are falsified causing enormous problems. The doubts on the use of fair value arise before the crisis, since it was understood that using the fair value for instruments or assets / liabilities that were difficult to assess, could significantly alter the company's assets. In situations where the valuation was not reliably calculable, through the use of fair value a certain degree of subjectivity was permitted. How this can be perceived is not a positive aspect. Furthermore, the use of fair value makes the profit (loss) for the year extremely volatile. The crisis highlighted the absence of valid legislation in promptly seizing the deterioration of credit quality in the banking industry.

In view of the above considerations, the G20 representatives called for the implementation of improved standards and the IASB, following this request and general external pressures, instituted the transition from an "incurred loss" model (IAS39) to an "expected loss" model (IFRS9). The new model provides for a prospective view that may require the immediate detection of all losses expected over the life of a loan. All available and accessible information (obtainable without unreasonable costs or effort) should be assessed, including both historical information and prospective assessments. The impairment model envisaged by IFRS 9 provides for the classification of credits into three "stages":

1. First stage: the expected loss is measured over a time horizon of 1 year

2. Second stage: the loss is measured on a time horizon that considers all the residual life of the instrument. This approach is used for those instruments that have seen a significant increase in their riskiness.

3. Third stage: this stage includes all activities whose riskiness has increased so much that they must be considered “impaired” assets.

IFRS9 provides for 3 macro-areas intervention:

1. Classification and Measurement: a new approach is introduced for the classification of all financial instruments, including derivatives embedded in other financial instruments, based on the logic of "Cash Flow" and on the "business model" for which the asset is held, replacing the previous classification rules that are difficult to apply. This principle includes:

a. Elimination of the category of instruments held to maturity (HTM)

b. Elimination of the Avaible for Sale (AFS) instruments category

c. Elimination of the separate recognition of derivatives implicit in financial assets

d. Changes in the fair value of financial liabilities measured at "Fair Value Trough Profit or Loss"

e. Elimination of the possibility of evaluating investments in equity not quoted at cost rather than at fair value when the amount of fair value stands at a significant amount.

2. Impairment: responds to the need to receive the expected losses more quickly. The provision for expected losses is expected to start as soon as the receivable is posted, and these expected losses are accounted for throughout the residual life of the same. This assessment of the expected loss applies to:

a. Financial assets measured at amortized cost

b. Debt investments valued at "fair value through other comprehensive income"

c. Some contracts that provide commitments to finance or guarantees.

3. Hedge Accounting: many tools are being used for hedging activities. A review of all aspects of hedge accounting is carried out and a new one is introduced with more information relating to the Risk Management activity. The new simpler model allows for hedging operations on a larger scale and reduces the volatility of profits or losses. The main changes are:

a. Simplification of the hedge effectiveness test with the removal of the 80-125% threshold previously envisaged2.

b. Many items are expected to qualify as hedging transactions.

c. More effective hedging is allowed for exposures that give rise to two risk positions (rate and exchange rate) that are managed by different derivatives over different periods.

d. Less volatility of gains or losses when using foreign exchange options or swaps.

CRD IV

The European Union has also intervened over time by issuing rules that not only seek to follow the same line of the Basel agreements and therefore create a stable system, but also seek to be a glue for the process of European integration that is continuing among a thousand difficulties. An important directive, which follows the Basel 3 agreement, is CRD IV (Capital Requirements Directive). In March 2013, the Permanent Representatives Committee approved CRD IV, the fourth European directive on minimum capital requirements.

The new European regulatory framework introduces new rules regarding:

1. Capital: both the quality and the minimum regulatory level of the regulatory capital have been increased.

2. Counterparty risk: several instruments have been introduced. We have:

a. Ad hoc capital requirement (credit valuation adjustment-CVA) to cover losses arising from changes in the market value of OTC contracts as a result of changes in creditworthiness.

b. Specific treatment for exposures to central counterparties (Central Coun- terparty- CCP).

3. Leverage ratio: specific disclosure requirements on "leverage" are introduced for both banks and SIMs.

4. Liquidity: we had a monitoring period (2014) during which banks and SIMs were obliged to comply with specific reporting obligations for the assessment of their exposure to liquidity risk.

5. Capital buffer: reference is made to Basel 3

[2] The hedge is effective if the ratio between the change in fair value or the flows of the hedged instrument and the hedging instrument is included in the following range 125% -80%.

6. Disclosure obligations: we have new annual disclosure obligations regarding utilities / losses before taxes, amount of taxes, obtainment of public contributions.

Other important aspects related to CRD IV could be the following:

1. The regulation empowers national authorities to allow for the weighting, instead of deduction, of significant investments in insurance and reinsurance undertakings.

2. Where banks or SIM hold shares in non-financial corporations above the limits of 15% or 60% of the eligible capital, national authorities may:

a. Apply a weighting factor of 1250% to the higher amount between the participation exceeding 15% or that which exceeds 60%

b. Prohibition to hold stakes in excess of the aforementioned limits.

3. With regard to credit risk, the Basel 2 approach is confirmed.

4. The fundamental indicators of liquidity remain those expressed in Basel 3, i.e. LCR and NSFR.

Too big to fail: Empirical analysis

The presumption that credit institutions were too large to fail proved to be absolutely wrong during the 2007 crisis. A giant "Lehman Brothers", for years at the top of US and international finance, finds itself on the brink of the abyss without anyone who could, or desired, to do anything to prevent it. It was not only Lehman Brothers who found themselves in trouble and then plummeted, but also Merrill Lynch, which was acquired by Bank of America and Bear Sterns, which was acquired by J.P.Morgan Chase. No one is more immune to the outbreaks of speculative bubbles and crises that, from simple outbreaks, become devastating global fires.

This growing fear of the financial markets led the authorities to take remedies and to make sure that the activities were carried out in a controlled manner, avoiding that the unconscious behavior of a few subjects could have effects on the whole system. The system becomes the ultimate object of vigilance. In 2011, the Basel Financial Stability Board[3] drew up the list of the so-called 29 system banks, i.e. those banks deemed relevant at a global level and which should have met the capital requirements laid down by Basel3. Among these 29 banks, 17 were subject to the following statistical analysis, namely:

1.	Bank Of China	3988 hk Equity
2.	Bank of America	Bac us Equity
3.	Barclays	Barc ln Equity
4.	BNP Paribas	BNP FP equity
5.	Citigroup	C US equity
6.	Credit Agricole	ACA FP equity
7.	Societe Generale	GLE FP Equity
8.	Deutsche Bank	DBK GR equity
9.	GS	GS US equity
10.	HSBC	HSBA LN Equity
11.	JP Morgan Chase	JPM US Equity
12.	Mitsubishi	8306 JT Equity
13.	MS	MS US Equity
14.	Sumitomo	8316 JT Equity
15.	Unicredit	UCG IM Equity
16.	Wells Fargo	WFC US Equity
17.	Santander	SAN SM Equity

These banks represent not the first of the class, but those most at risk in the event of a negative market situation/market disruption and therefore those most subject to prudential supervision and those requested to have higher capital and liquidity requirements.

[3] "Policy measures to Address Systemically Important Financial institutions"

In the following statistical analysis, the sample of 17 banks is taken into consideration quoted over a period of 6 years: 01.01.2012 - 31.12.2017.
Starting from the analysis of prices and yields, we will try to observe the performance of the banks within the market by relating them to each other (in order to evaluate their correlation) and to the various stock indices (in order to evaluate the presence or absence of an explicit link). Subsequently we will report the returns of these banks with the yields of the respective government bonds and then with a hypothetical risk-free title (Bund ten years) and see how extra-returns are assessed.
In order to make the reading of the data clear, the names of the shares of the respective banks are shown as expressed on Bloomberg.
As regards, instead, the stock indices taken into consideration for the following analysis we have:

1. Italian Index — Ftsemib Index
2. German Index — Dax Index
3. French index — CAC Index
4. USA S& P 500 — SPX Index
5. USA Dow Jones — DJI Index
6. USA Nasdaq — NDX Index
7. Japan — NKY Index
8. Shangai China — SHComp Index
9. Madrid — IBEX Index

Once the prices of the shares and of the respective indices have been analyzed, the relationship between banks, indices and government bonds must be analyzed. For the following analysis 10-year government bonds are taken into consideration with reference to the same time span: 01.01.2012 -31.12.2017.

Analysis of prices and returns on bank shares

Within the financial markets, the price of shares is considered an important element for understand the state of health of a given subject. In general, the price of an action is determined from:

- The recent performance of the company;
- Expectations about its future performance;
- The growth prospects of the sector in which the company operates;
- The growth prospects of the national and global economy

Through the evaluation of a descriptive price analysis we are moving towards understanding the situation of these banks within the international financial landscape. In fact, from the prices we can derive returns through a simple relationship:

$$R_t = ln \frac{P_t}{P_{t-1}}$$

Starting from the returns we see how these are distributed around zero and if the shape of their distribution is approximable to the normal one through the Pearson kurtosis index[4].

$$\frac{1}{T} \sum_{i=1}^{T} \left(\frac{R_i - \bar{R}}{\sigma} \right)^4$$

> 0 the curve is called leptokurtic, ie more "pointed" than a normal one.

< 0 the curve is called platykurtic, ie more "flat" than a normal one.

= 0 the curve is called normo kurtyc (or mesokurtic), ie "flat" like a normal one.

The Fisher asymmetry index, on the other hand, tells us if the distribution is symmetric and therefore if the negative yields have the same weight as the positive ones. The formula is similar to that of kurtosis, but elevated to the third:

[4] According to the formula we use we can have value that can be greater, less than or equal to 3. If we subtract 3 from the formula then we have everything expressed around zero.

$$\frac{1}{T}\sum_{t=1}^{T}\left(\frac{R_t - \bar{R}}{\sigma}\right)^3$$

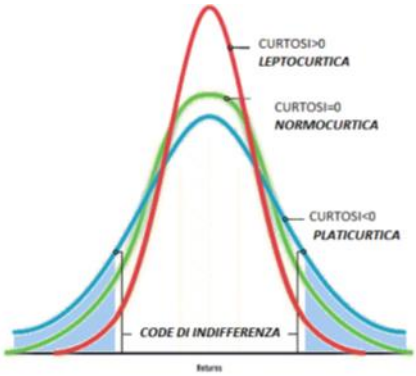


Table 3. Descriptive Statistics Returns-Banks

	3988	BAC	BARC	BNP	C	ACA	GLE	DBK	GS	HSBA	JPM	8306	MS	8316	UCG	WFC	SAN
Media	0,00013	0,00076	0,00010	0,00033	0,00048	0,00053	0,00042	-0,00021	0,00047	0,00020	0,00053	0,00042	0,00057	0,00037	-0,00014	0,00036	-0,00002
Errore Std.	0,00026	0,00031	0,00037	0,00035	0,00029	0,00040	0,00042	0,00039	0,00026	0,00023	0,00024	0,00035	0,00032	0,00033	0,00054	0,00021	0,00037
Dev. Std	0,01207	0,01461	0,01755	0,01651	0,01379	0,01884	0,01975	0,01824	0,01203	0,01059	0,01144	0,01634	0,01501	0,01532	0,02513	0,01004	0,01717
Var. Camp.	0,00015	0,00021	0,00031	0,00027	0,00019	0,00036	0,00039	0,00033	0,00015	0,00011	0,00013	0,00027	0,00023	0,00024	0,00063	0,00010	0,00029
Curtosi	6,23389	4,31979	19,74257	11,13466	5,56050	6,66357	12,79707	8,24323	4,08208	5,16211	7,57587	5,63097	4,96732	6,32193	12,47511	5,05342	17,85285
Asimmetria	-0,19940	0,10411	-1,38574	-0,56420	-0,17036	0,05510	-0,47660	-0,12021	-0,12509	-0,10409	-0,12187	0,32613	-0,14408	0,30597	-0,48713	0,18352	-1,20805
Intervallo	0,16497	0,15952	0,29048	0,28384	0,17221	0,28109	0,35386	0,30274	0,13904	0,13218	0,17737	0,20366	0,18767	0,19262	0,41942	0,13389	0,32312
Minimo	-0,08279	-0,07696	-0,19454	-0,19117	-0,09824	-0,15088	-0,23034	-0,17294	-0,07337	-0,06766	-0,09737	-0,09760	-0,10703	-0,09396	-0,27166	-0,06078	-0,22170
Massimo	0,08219	0,08256	0,09594	0,09268	0,07397	0,13022	0,12352	0,12981	0,06567	0,06452	0,08000	0,10606	0,08064	0,09866	0,14776	0,07311	0,10142

Source: Own processing on Bloomberg data

Table 3 shows the results of the descriptive statistical analysis carried out on the aforementioned banks. As can be seen, the mean values are attested around zero with a very low standard deviation (typical of the financial sector). Kurtosis gives us some high values: for example

- Barclays (19.74)
- Santander (17.85).

This means that we have more centralized distributions towards zero (more pointed). It should also be noted that skewness is very often negative; this could lead us to affirm the hypothesis that negative returns have a greater weight in financial markets.
It could be very useful to graphically observe the fluctuation of returns over time, in order to understand the performance of these banks within the market. It is observed within these charts, easy to obtain and that are not shown below, a phase of relative tranquility between 2013 and 2015 and, rather, a turbulent 2016. All banks have shown similar movements over time. These evidences lead us to assume the presence of correlation between the fluctuations of returns.
In order to evaluate the correlation, we have used the well known following formula:

$$\rho = \frac{\frac{1}{T}\sum_{t=1}^{T}(X_t - \bar{X})(Y_t - \bar{Y})}{\sigma_x \sigma_y}$$

Starting from the correlation formula, it is also possible to evaluate the autocorrelation measure. In this way it is possible to evaluate how much a yield at time t is influenced by a yield at time t-1 or influences it at time t + 1.
The autocorrelation formula is defined as follows:

$$\rho_1 = \frac{\frac{1}{T-1}\sum_{t=2}^{T}(R_t - \bar{R}_t)(R_{t-1} - \bar{R}_1)}{\sigma_t \sigma_1}$$

In the following tables (table 4, 4.1 and 5) we can have a numerical view of the correlation and the autocorrelation between the returns of these banks.

Table 4. correlation matrix

correlazione	3988	BAC	BARC	BNP	C	ACA	GLE	DBK	GS	HSBA	JPM	8306	MS	8316	UCG	WFC	SAN
3988	1,000																
BAC	0,116	1,000															
BARC	0,190	0,439	1,000														
BNP	0,214	0,467	0,694	1,000													
C	0,168	0,833	0,490	0,529	1,000												
ACA	0,187	0,415	0,644	0,801	0,462	1,000											
GLE	0,209	0,466	0,691	0,872	0,522	0,826	1,000										
DBK	0,169	0,545	0,629	0,729	0,595	0,671	0,726	1,000									
GS	0,173	0,753	0,450	0,494	0,794	0,433	0,489	0,566	1,000								
HSBA	0,352	0,412	0,584	0,576	0,458	0,518	0,550	0,494	0,441	1,000							
JPM	0,131	0,794	0,459	0,482	0,831	0,417	0,474	0,548	0,796	0,435	1,000						
8306	0,244	0,134	0,242	0,197	0,167	0,166	0,198	0,179	0,154	0,208	0,146	1,000					
MS	0,145	0,788	0,445	0,499	0,811	0,438	0,498	0,565	0,842	0,416	0,773	0,150	1,000				
8316	0,255	0,133	0,237	0,206	0,174	0,171	0,218	0,179	0,155	0,209	0,151	0,921	0,156	1,000			
UCG	0,131	0,374	0,567	0,748	0,420	0,692	0,749	0,656	0,391	0,458	0,386	0,147	0,399	0,165	1,000		
WFC	0,157	0,719	0,404	0,450	0,727	0,384	0,445	0,525	0,713	0,418	0,747	0,163	0,699	0,157	0,369	1,000	
SAN	0,212	0,428	0,615	0,798	0,485	0,728	0,767	0,665	0,455	0,531	0,446	0,190	0,461	0,203	0,730	0,420	1,000

Source: Own processing on Bloomberg data

Table 4.1 correlation matrix –graphical representation

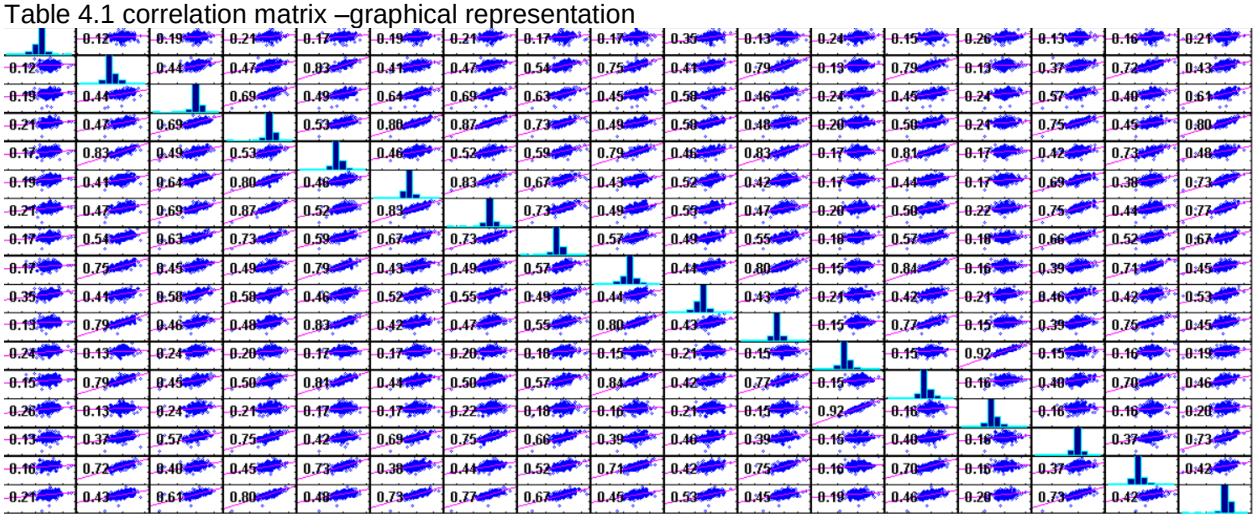


Table 5. Linear autocorrelation

autocorr_ritardo	3988	BAC	BARC	BNP	C	ACA	GLE	DBK	GS	HSBA	JPM	8306	MS	8316	UCG	WFC	SAN
1	0,36%	1,32%	-1,23%	-1,78%	0,10%	-0,87%	-1,16%	2,09%	-0,69%	-4,87%	-1,36%	4,62%	-0,98%	3,59%	0,35%	1,53%	-0,89%
5	0,15%	1,04%	-1,65%	-0,61%	0,29%	1,23%	-0,23%	1,35%	-2,17%	2,56%	1,72%	-2,00%	-1,45%	-1,57%	2,00%	1,17%	1,47%
10	0,67%	4,09%	0,34%	1,75%	3,46%	2,20%	1,35%	3,73%	4,74%	0,59%	2,74%	1,31%	3,13%	1,61%	1,00%	3,63%	2,57%
15	-7,26%	0,17%	-0,18%	0,79%	-0,51%	-0,37%	1,47%	-1,24%	0,83%	-4,63%	0,09%	-2,96%	-1,32%	-4,23%	0,85%	2,10%	-0,63%
20	0,56%	-2,78%	-6,40%	-6,35%	-4,50%	-5,96%	-5,63%	-3,51%	-4,44%	-7,35%	-7,01%	3,04%	-7,50%	3,63%	-3,96%	-1,69%	-4,41%
25	0,14%	-2,61%	3,52%	4,47%	-0,43%	2,50%	2,90%	0,70%	1,78%	0,11%	-0,88%	3,66%	-1,00%	5,04%	2,26%	-0,77%	2,86%
30	-3,92%	-2,24%	2,16%	0,41%	-2,29%	-1,14%	1,26%	-0,56%	1,48%	2,06%	-1,72%	-1,68%	0,39%	-0,36%	-0,12%	-1,15%	-1,27%

Source: Own processing on Bloomberg data

In the correlation matrix (table 4), we note that there is a high correlation for banks belonging to the same country. Evaluating the correlation of American banks, these have a correlation index that is around 0.75, or a synchrony of movements of about 75%[5]. The same correlation is reduced when we consider banks belonging to different

[5] Remember that the correlation index measures the degree of linear interdependence between two variables X and Y and varies between -1 and 1. For ρ = 1 (ρ = -1) there is a perfect (negative) linear correlation. For ρ = 0 there is no linear-line correlation. STATISTICAL METHODS IN THE ANALYSIS OF FINANCIAL VARIABLES (2001)

countries an average around 30-40%. This high interconnection makes us understand that these systemic banks belong strongly to a "national" system and in an "accentuated" way to an international system.

The reading the autocorrelation table (table 3), does not show any relevant autocorrelation. In fact we have an average, for a single bank, very low. The horizontal average of autocorrelations confirms, in general, the presence of unpredictable movements within the markets. Nevertheless, a correlation of 10 days equals to 2.29% (as the average of all banks) could be used together with other indicators to evaluate the percentage market growth over the short period.

Shares Indexes and Banks

A market index is the composite value of a group of securities traded in a given market. The fluctuations of an index offer investors useful information about the performance of a wide range of securities[6]. In our case this range of securities allows us to understand if the economy of a Country, represented by its index, influences or it is influenced by the performance of the banking sector in general and of these banks in particular. The indices taken into consideration are those mentioned on page 18 while as government bonds, we consider securities with ten-year expiry. In Table 6 we have a statistical-descriptive summary of the indexes returns in the same period of time considered for banks. There is nothing different from the same descriptive statistics considered for banks. We have returns that oscillate around zero and a distribution that approximates to a normal function, even if "leptokurtic".

Table 6. Descriptive Statistics Returns-Indexes

	Ftsemib	Dax	CAC	SPX	DJI	NDX	NKY	SHComp	IBEX
Media	0,00017	0,00036	0,00024	0,00034	0,00032	0,00047	0,00045	0,00019	0,00007
Errore Std.	0,00027	0,00020	0,00021	0,00013	0,00013	0,00016	0,00024	0,00025	0,00024
Dev. Std	0,01274	0,00946	0,00962	0,00630	0,00605	0,00763	0,01102	0,01168	0,01133
Var. Camp.	0,00016	0,00009	0,00009	0,00004	0,00004	0,00006	0,00012	0,00014	0,00013
Curtosi	8,35641	4,50748	5,98558	4,91582	4,69198	4,76555	7,89727	12,57594	11,47533
Asimmetria	-0,55732	-0,33590	-0,35052	-0,31386	-0,25773	-0,31087	-0,35414	-1,35913	-0,79120
Intervallo	0,19717	0,11919	0,13025	0,07850	0,07516	0,09316	0,15679	0,14477	0,19069
Minimo	-0,13331	-0,07067	-0,08384	-0,04021	-0,03640	-0,04378	-0,08253	-0,08873	-0,13185
Massimo	0,06386	0,04852	0,04641	0,03829	0,03875	0,04937	0,07426	0,05604	0,05884

Source: Own processing on Bloomberg data

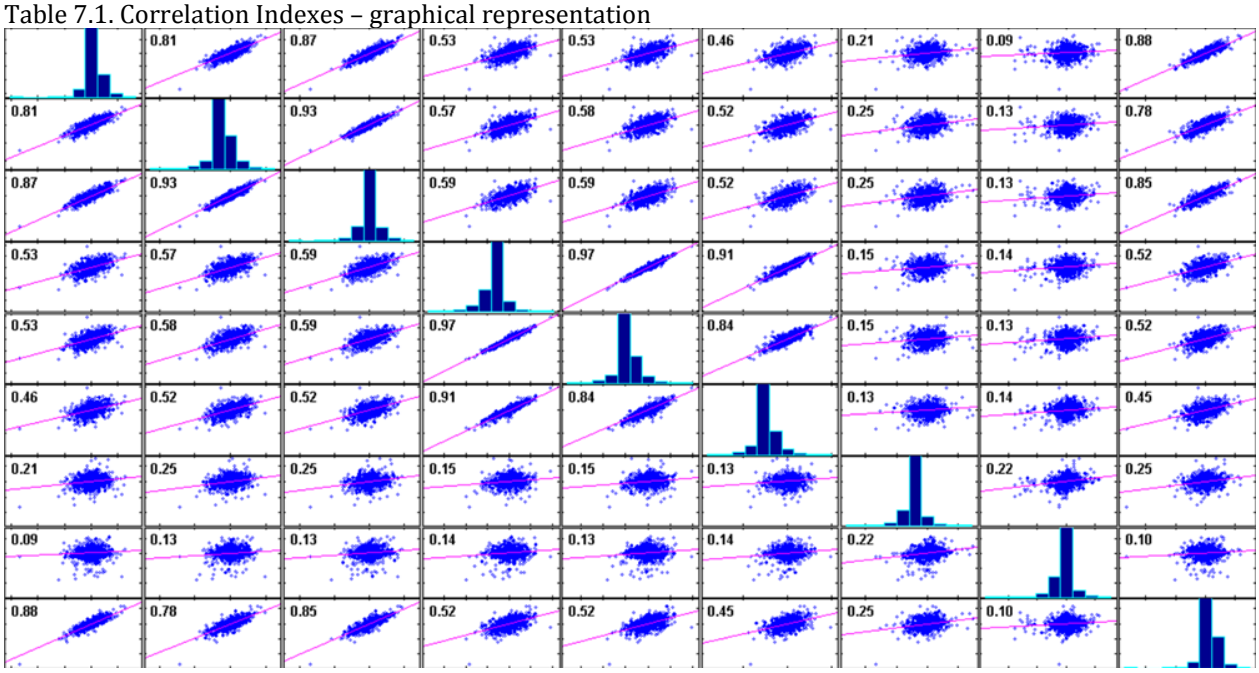
By observing the performance charts, as previously happened for banks, we notice a period of high frequencies between the end of 2015 and mid-2016. There is also a negative peak in July 2016. This means that in certain circumstances the markets are affected by the same information and react accordingly. The correlation and autocorrelation between the indices can be observed in the following tables.

Table 7. Correlation Indexes

correlazione	Ftsemib	Dax	CAC	SPX	DJI	NDX	NKY	SHComp	IBEX
Ftsemib	1								
Dax	0,810544	1							
CAC	0,865686	0,926	1						
SPX	0,533994	0,575	0,594	1					
DJI	0,528305	0,576	0,591	0,966	1				
NDX	0,456699	0,521	0,522	0,914	0,84	1			
NKY	0,207602	0,247	0,248	0,149	0,147	0,13	1		
SHComp	0,089136	0,126	0,132	0,14	0,129	0,142	0,215	1	
IBEX	0,875041	0,782	0,853	0,525	0,515	0,452	0,248	0,0988	1

[6] Istituzioni e Mercati Finanziari, Mishkin, Eakins, Forestieri , 2015

Table 7.1. Correlation Indexes – graphical representation



Source: Own processing on Bloomberg data

Table 8. Autocorrelation Indexes

autocorr_ritardo	Ftsemib	Dax	CAC	SPX	DJI	NDX	NKY	SHComp	IBEX
1	-9,81%	-2,96%	-4,55%	-2,42%	-1,79%	-1,71%	-5,36%	0,92%	-0,26%
5	2,29%	2,51%	1,22%	-2,40%	0,06%	-6,34%	-0,04%	-0,22%	-1,08%
10	2,85%	0,09%	1,74%	2,55%	2,89%	1,69%	2,82%	1,01%	2,93%
15	-0,58%	-0,86%	-1,32%	0,26%	-0,27%	1,47%	-5,19%	-1,68%	-1,93%
20	-2,67%	-3,79%	-4,10%	-3,14%	-2,69%	0,42%	1,44%	1,51%	-2,57%
25	2,45%	3,93%	3,39%	1,07%	1,67%	0,71%	-0,45%	1,81%	2,96%
30	2,69%	2,95%	2,89%	1,86%	1,38%	2,36%	1,74%	3,07%	-0,06%

Source: Own processing on Bloomberg data

The correlation matrix between the indices shows us very high values regarding the indices of the same State (see for example the correlation between the three U.S. Index). We have much higher peaks and lows than the correlation between banking institutions, which leads us to say that at the macroeconomic level, economies can be interconnected entities with much more force than the single economic areas.
By observing the autocorrelation, we do not notice anything anomalous. The agreement of positive sign to delay 10 seems to persist for both the indices and the banks. There is also a prevalence of negative signs to low delays.
At this point, we can evaluate the correlation between banks and indices. The following table clearly shows that the correlation between indices and banks is mostly due to the countries they belong to or by geographical area of operation[7].

[7] It is noted that, for example, Crédité Agricolé and BNP Paribas also have an important relationship with the FTSE MIB. This could be explained by the fact that part of the market of these banks is right in Italian territory.

Table 9. Correlation between Indexes and Banks

matrice_corr	3988	BAC	BARC	BNP	C	ACA	GLE	DBK	GS	HSBA	JPM	8306	MS	8316	UCG	WFC	SAN
Ftsemib	0,209509	0,457152	0,647019	0,815566	0,515884	0,758648	0,802165	0,682339	0,488333	0,581653	0,480238	0,17344	0,486754	0,189428	0,835818	0,450527	0,815216
Dax	0,256483	0,455477	0,593863	0,72854	0,501527	0,651588	0,707418	0,650022	0,495175	0,600479	0,48239	0,197543	0,481488	0,190837	0,588092	0,477542	0,689319
CAC	0,258485	0,472261	0,636219	0,816441	0,526227	0,71566	0,78013	0,65095	0,520707	0,627355	0,506094	0,195863	0,506778	0,196863	0,648381	0,4882	0,761689
SPX	0,174191	0,666855	0,419077	0,497576	0,730863	0,442678	0,479783	0,563814	0,730825	0,422839	0,724249	0,1356	0,714567	0,137528	0,395029	0,728766	0,459353
DJI	0,166231	0,648908	0,420868	0,487509	0,718596	0,435524	0,470126	0,552494	0,737301	0,421713	0,728123	0,134578	0,699489	0,134447	0,38609	0,722761	0,455383
NDX	0,175798	0,548283	0,353075	0,428054	0,599171	0,385249	0,411275	0,489222	0,608536	0,36384	0,584087	0,103995	0,588582	0,107103	0,325523	0,582586	0,378101
NKY	0,357751	0,125817	0,23839	0,215959	0,165844	0,177354	0,220696	0,179664	0,146112	0,239722	0,142377	0,753461	0,150658	0,760253	0,158115	0,167491	0,215211
SHComp	0,472029	0,100123	0,093322	0,08541	0,130318	0,081629	0,101418	0,08539	0,119446	0,172144	0,114988	0,152124	0,114415	0,162137	0,041293	0,107557	0,088417
IBEX	0,235935	0,433344	0,620812	0,80495	0,507198	0,744225	0,778421	0,646504	0,470583	0,559021	0,466991	0,200518	0,475442	0,207574	0,716607	0,439948	0,922459

Source: Own processing on Bloomberg data

A useful data to underline is the very strong correlation between Santander and the IBEX index and the correlation between Unicredit and the Italian index. Such a strong correlation presupposes that a negative trend of this specific bank normally has negative influence on the index as well. It is easy to understand why these can be considered systemic risky banks. As far as the values of the other correlations are concerned, we note a relationship between the bank and its reference index that varies between 30% and 60% and a very low correlation of the Shanghai stock exchange and the Japanese Nikkei with the various banks. This correlation, very low between Japanese and Chinese banks and Indexes could be the expression of a system that is not yet globally interconnected.
In general, these relationships between indices and banks with low correlations can also be essential elements for the assessment of diversified portfolios. We can also assume very different economic and debt structures.

Government bonds, banks and indixes

After observing the existence of a marked correlation between these 17 systemic banks and the relationship between the banks and the reference stock indexes, we now move on to the analysis of the Countries and relate them to what we have previously elaborated . Analyzing government bonds can be a valid step in order to understand, if we have relationships between the various government bonds and then between government bonds, indices and banks.
Government bonds are instruments issued by national governments to finance their debts, meet the needs of the country and cover institutional activities[8]. We know that, as in any other investment, the higher the rate of interest paid the greater the risk associated with that particular instrument. In this case, a higher rate of interest paid on a government bond means a greater cost by the State and therefore, over the long term, possible increase in public debt and loss of competitiveness. Government bonds, representing the debt of a given state, may be the subject of speculation by institutional investors and cause cascade problems also on the financial sector. Furthermore, it is recalled that the main purchasers of government securities are the same banks, including the aforementioned. If the portfolio of the banks is also composed of the presence of these certain securities, it is logical to understand that a change in the value of the latter causes effects on the soundness of the banks themselves.
Having to analyse the titles expressed as returns we have to divide our analysis into two parts:

1) Basic statistical-descriptive analysis
2) Correlation analysis

This is the list of government bonds analysed and the correspondent Bloomberg ticker:

1) Italy GBTPGR10 Index
2) China GCNY10YR Index
3) France GFRN10 Index
4) Japan GJGB10 Index
5) UK GUKG10 Index
6) USA USGG10YR Index
7) Spain GSPG10YR Index
8) Germany GDBR10 Index

[8] Definition “Italian Stock exchange”

Table 10. Descriptive Statistics Return on Government securities

	GBTPGR10	GCNY10YR	GFRN10	GJGB10	GUKG10	USGG10YR	GSPG10YR	GDBR10
Media	2,97834	3,56104	1,42321	0,41530	1,82582	2,15639	2,97430	0,91199
Errore Std.	0,03211	0,01006	0,01749	0,00723	0,01221	0,00789	0,03704	0,01345
Mediana	2,29150	3,55000	1,13900	0,44850	1,81700	2,18385	2,08950	0,78150
Dev. Std	1,50333	0,47102	0,81877	0,33836	0,57153	0,36940	1,73433	0,62981
Minimo	1,04200	2,65600	0,10300	-0,28700	0,51800	1,35790	0,88000	-0,18900
Massimo	7,15900	4,70000	3,36600	1,05200	3,07400	3,02820	7,62100	2,05600

Source: Own processing on Bloomberg data

In order to evaluate government bonds together with indices and banks, we can not use the data inside the table above. In fact, it is logical to understand that, even though we have recently seen negative yields, government bonds always have positive yields. For the computation of the government bonds yields we can not use the formula previously seen. In fact, the market has experienced a period of anomaly, i.e. the presence of negative returns. The presence of these negative yields makes impossible the use logarithms and therefore impossible to use the aforementioned formula. In this case the formula we use is a simple evaluation of the temporal variation of values:

$$R_t = \frac{(P_t - P_{t-k})}{P_{t-k}}$$

Once obtained these arithmetic returns it is possible to pass to the logarithmic returns through the following formula:

$$r_t = \ln(1 + R_t)$$

Table 11. Descriptive Statistics "Return Yields" of Government Bonds

	GBTPGR10	GCNY10YR	GFRN10	GJGB10	GUKG10	USGG10YR	GSPG10YR	GDBR10
Media	-0,00060	0,00007	-0,00057	0,00010	-0,00011	0,00019	-0,00057	0,00103
Errore Std.	0,00045	0,00014	0,00100	0,00400	0,00054	0,00039	0,00047	0,00334
Dev. Std	0,02117	0,00666	0,04680	0,18643	0,02518	0,01833	0,02208	0,15559
Var. Camp.	0,00045	0,00004	0,00219	0,03476	0,00063	0,00034	0,00049	0,02421
Curtosi	6,87340	13,72330	20,55686	57,65008	6,25835	2,81297	5,43352	70,35466
Asimmetria	0,66097	-0,30347	0,57635	1,41351	-0,15200	0,32251	0,32520	-2,13921
Minimo	-0,10218	-0,06418	-0,36422	-2,01490	-0,22096	-0,08158	-0,11549	-2,37955
Massimo	0,16938	0,04473	0,45648	2,42354	0,12328	0,10357	0,16849	1,34373

Source: Own processing on Bloomberg data

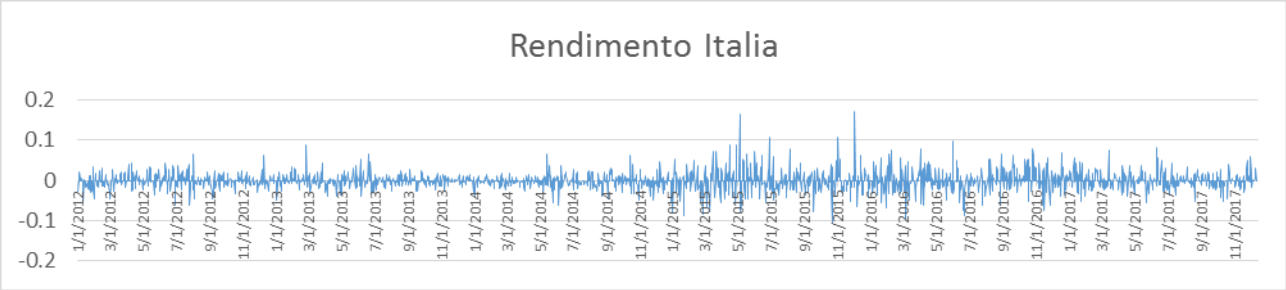
To read these data, some basic considerations must be made:

- These values do not refer to the yields of government bonds purchased;
- As these values can be considered as "yields of yields", the negative averages indicate a lowering of the yield on government bonds.
- As these values are yields on bonds, they should be read in the opposite direction. In other words, a reduction in yields identifies an improvement in the creditworthiness of a given state and vice versa.

By observing the data shown in the table above, we see anomalous kurtosis index, which would indicate the total absence of queues in the distribution of returns.
The minimum and maximum values of Germany and Japan are very marked compared

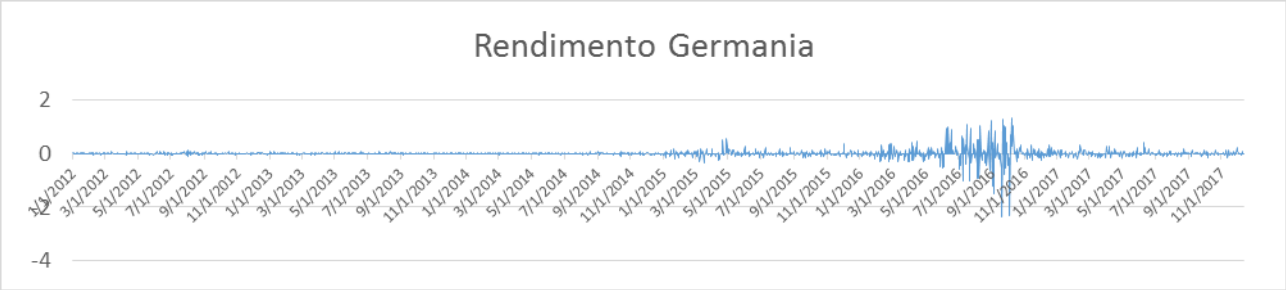
to others as the transition from a negative to a positive return has a higher intensity. Also in this case, as done previously, it may be useful to have a visual image of these "yields of yields" in order to observe the degree of stability or instability of government bonds during this period taken into consideration. The charts here reported are related to Italy (greater turbulence) and Germany (less turbulence):

Image 1



Source: Own processing on Bloomberg data

Image 2



Source: Own processing on Bloomberg data

Looking at the following graphs, we can draw two immediate conclusions:

- Germany has almost absolute stability in government bond yields. This is an indication of real economic stability.
- We note a volatile 2016, but not a clear correlation as with the indices and the equity returns.

Government bond yields depend on many factors that are not all "market dependent". They are influenced by many political, social and monetary parameters. In particular, the management of monetary policy has a direct influence on interest rates, exchange rates and, therefore effects on government bond yields. The following table shows the correlation between government bonds.

Table 12. Correlation among government bonds

correlazione	GBTPGR10	GCNY10YR	GFRN10	GJGB10	GUKG10	USGG10YR	GSPG10YR	GDBR10
GBTPGR10	1,000							
GCNY10YR	0,027	1,000						
GFRN10	0,533	0,035	1,000					
GJGB10	-0,009	0,019	-0,001	1,000				
GUKG10	0,213	0,073	0,626	0,055	1,000			
USGG10YR	0,074	0,049	0,424	0,031	0,611	1,000		
GSPG10YR	0,871	0,028	0,506	-0,015	0,230	0,089	1,000	
GDBR10	0,077	0,007	0,027	0,022	0,148	0,137	0,033	1,000

Source: Own processing on Bloomberg data

From the table we note that:

- Between China and Japan there is no significant (even moderate) correlation between government bonds.
- The US shows an almost significant correlation with France and significant with England.
- Italy has a significant correlation with France and Spain while it is moderate with England.
- Germany does not show significant correlations with the reference sample.

In the following tables, we see instead the correlation between government bonds, banks and reference indices. Since the "yields of yields" data must be read as reverse data (that is, an increase in the interest rate is a positive factor for banks, but negative for government bonds), in order to evaluate the presence of possible harmful correlations, we focus on the presence of negative correlations.
We do not have correlation levels that exceed the 50% threshold, but many of them are relevant. Germany and Japan are not affected by the performance of equities even if, as we can see, we have slight negative correlations with their banks. An emblematic case is the Italian one: all negative values result from matrix correlation.
Even if correlation levels are not significant, the numbers referring to Italy are the expression of the weaker economy among those taken into consideration. There is almost a 30% negative correlation (the one we were looking for) with the most important banks operating in Italy. So, if we consider the government bonds yields as expression of solidity of the same state, Italy is the only nation that, in case of banking system crisis, will be more in difficulty.

Table 10. Correlation between government bonds and banks

matrice_corr	3988	BAC	BARC	BNP	C	ACA	GLE	DBK	GS	HSBA	JPM	8306	MS	8316	UCG	WFC	SAN
GBTPGR10	-0,0867	-0,0897	-0,1663	-0,2406	-0,1186	-0,2476	-0,2488	-0,1900	-0,1119	-0,1088	-0,0987	-0,0425	-0,1178	-0,0559	-0,2484	-0,0983	-0,2286
GCNY10YR	0,0205	-0,0028	-0,0079	-0,0001	0,0086	0,0029	-0,0138	-0,0321	-0,0130	-0,0125	0,0297	0,0543	0,0219	0,0589	-0,0145	-0,0173	-0,0045
GFRN10	-0,0091	0,0844	0,0522	0,0569	0,0811	0,0477	0,0481	0,0456	0,0608	0,0850	0,0875	0,0219	0,0728	0,0177	0,0308	0,0791	0,0733
GJGB10	0,0039	0,0063	0,0016	0,0116	0,0197	0,0338	0,0349	0,0335	0,0063	0,0047	0,0219	-0,0213	0,0184	0,0019	0,0234	0,0131	0,0245
GUKG10	0,0402	0,2111	0,2130	0,2529	0,2214	0,2418	0,2435	0,1899	0,1924	0,2125	0,2220	0,0550	0,2118	0,0632	0,1918	0,2030	0,2400
USGG10YR	0,0446	0,3146	0,2300	0,2640	0,3214	0,2304	0,2612	0,2192	0,2932	0,2314	0,3217	0,0633	0,3192	0,0859	0,2081	0,2918	0,2348
GSPG10YR	-0,0720	-0,0844	-0,1504	-0,2251	-0,1158	-0,2216	-0,2259	-0,1732	-0,1112	-0,0990	-0,0959	-0,0399	-0,1133	-0,0467	-0,2323	-0,0967	-0,2379
GDBR10	-0,0228	0,0338	0,0277	0,0544	0,0352	0,0451	0,0494	0,0508	0,0305	0,0486	0,0387	-0,0139	0,0464	-0,0103	0,0350	0,0201	0,0520

Source: Own processing on Bloomberg data

Table 13. Correlation between government bonds and Indexes

matrice_corr	Ftsemib	Dax	CAC	SPX	DJI	NDX	NKY	SHComp	IBEX
GBTPGR10	-0,314	-0,253	-0,273	-0,164	-0,159	-0,144	-0,045	-0,051	-0,276
GCNY10YR	0,000	-0,005	0,000	-0,011	-0,007	-0,012	0,030	0,026	0,000
GFRN10	0,030	0,047	0,042	0,042	0,044	0,031	0,007	0,007	0,055
GJGB10	0,047	0,053	0,040	0,011	0,006	0,013	-0,008	0,013	0,020
GUKG10	0,242	0,243	0,257	0,197	0,201	0,167	0,070	0,019	0,255
USGG10YR	0,245	0,250	0,275	0,316	0,315	0,270	0,076	0,041	0,264
GSPG10YR	-0,293	-0,243	-0,265	-0,163	-0,154	-0,139	-0,044	-0,029	-0,283
GDBR10	0,049	0,048	0,061	0,013	0,015	0,012	0,017	0,006	0,062

Source: Own processing on Bloomberg data

In the table above we found the same results as before. The Italian situation, which is affected by the movements of all the indices, is always very problematic. The negative correlation with the FTSE_MIB exceeds 30%.

Conclusions

After having analysed the capital regulatory evolutions of banks we performed a statistical analysis on the period starting on the 1st of January 2012 until the end of December 2017.
Analysing the conclusions the statistical analyses supported the idea that systemic banks have a high correlation on Stocks indexes and higher capital requirements could be useful in order to prevent market crisis on the financial markets potentially spreading negatively on real economy, companies and countries' GDP, especially for countries such as Spain or Italy.
At the same time we found high correlation of the performance of the stock exchanges among banks of the same country. The same correlation is slightly reduced for banks belonging to different countries an average around 30-40%. We saw frequencies between the end of 2015 and mid-2016 and a negative peak in July 2016. This means that in certain circumstances the markets are affected by the same information and react accordingly. We saw an high correlation between the indexes of the same countries and a quite strong correlation especially for some countries between banks and indexes. In particular in Spain and Italy we found a strong correlation between Santander and the IBEX index and the correlation between Unicredit and the Italian index. Such a strong correlation presupposes that a negative trend of this specific bank normally has negative influence on the index as

well. It is easy to understand why these can be considered systemic risky banks and also with an important weight on the index itself. This correlation was lower on Asian banks.
Finally looking to the correlation among Indexes, Banks and Government Bonds we found how the BTP is negatively correlated with all the other banks and indexes performance underling the risker attitude of the Italian Stock exchange. On the other side , Germany and Japan government bonds are not really affected by the performance of equities.
As a future development could be interesting to examine how the regulatory evolution impacted on the performance of banks and indexes with a structural break econometric analysis.

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