2018 WEA ON LINE CONFERENCE

MONETARY POLICY AFTER THE GLOBAL CRISIS

How Important Are Economic (Divisia) Monetary Aggregates for Economic Policy?

(in honour of William A. Barnett)

15th February to 15th March, 2018

Title of the paper

Banking regulation and post crisis approach to bankruptcies: An analysis through shadow banking, moral hazard and too big to fail

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The work starts analyzing the pre and post 2007-2009 crisis banking regulation to later on deepen including mathematical finance and economic policy concepts and models into the application of the regulation among the US, Eurozone and Asia Pacific markets. The aim of the work is to analyze the application of the banking regulation in a bankruptcy or bailout scenario, through an empirical study of the authorities and consequently market agents. The model, based on the CAPM assumptions, is tested via the VaR implications and via the Black and Scholes application. The output of the analysis is to empirically demonstrate how the Moral Hazard concept and the speculative behaviours affect financial markets through the 2007-2009 crisis effects study, to then conclude with the inadequacy of the Too Big To Fail concept within the current financial system: if it is Too Big To Fail, then it is also Too Big To Exist.

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Banking Regulation and Post Crisis Approach to Bankruptcies, an Analysis through Shadow Banking, Moral Hazard and Too Big To Fail

Alessandro Zoino[1]

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The work starts analyzing the pre and post 2007-2009 crisis banking regulation to later on deepen including mathematical finance and economic policy concepts and models into the application of the regulation among the US, Eurozone and Asia Pacific markets. The aim of the work is to analyze the application of the banking regulation in a bankruptcy or bailout scenario, through an empirical study of the authorities and consequently market agents. The model, based on the CAPM assumptions, is tested via the VaR implications and via the Black and Scholes application. The output of the analysis is to empirically demonstrate how the Moral Hazard concept and the speculative behaviours affect financial markets through the 2007-2009 crisis effects study, to then conclude with the inadequacy of the Too Big To Fail concept within the current financial system: if it is Too Big To Fail, then it is also Too Big To Exist.

Keywords: **E52** Monetary Policy, **E58** Central Banks and Their Policies, **G01** Financial Crises, **G28** Government and Policy Regulation, **G33** Bankruptcy

Scientific areas: **E** Macroeconomics and Monetary Economics, **G** Financial Economics

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1. Banking regulation.

The banking regulation is composed by national and supranational rules which subject market agents to certain guidelines, restrictions and mainly requirements.
Through the elimination of borders now the financial sector has to be considered worldwide, thus each country financial market has to be considered a part of the worldwide financial market. Within markets there are still differences between regulations and running procedures across countries but empirically financial sectors do not have borders, activities can be run all over the world, while regulation busies following the new financial market equilibria.
That is the reason a crisis in the US real estate market can spread the crisis worldwide, it can affect also the European and Asian financial markets. Mechanisms which rely and spread crisis are always changing and they can be classified in two categories: the ones spreading the crisis nationally and the ones spreading the crisis internationally.
In the first class it is possible to include two different ways of contagious:

- Credit Crunch; when the banking market no longer works and banks do not provide any kind of loan. Thus, with lower liquidity the economy will slack.
- Wealth Effect; higher for banks which sold their assets before prices collapse and lower for families which have a negative wealth effect due to the negative effect of a decrease in the level of their own asset prices.

While, worldwide the crisis will be spread through:

- Toxic Asset Spread; when financial markets will be controlled and manipulated by asset characterized by high risk and at the same time high rating: a contradiction.
- Decreasing of Export; the crisis will be exported when a country is characterized by a financial distress and people are not still able to buy and import the same products at the same prices, thus exporting countries will not export the same quantities and they will not earn the same quantity of money.
- Capital Sudden Stop; when the Credit Crunch will spread the crisis not only in the stressed country but also in the countries where local banks have subsidiaries.

Once a crisis is effective there are several ways to repair the economies, such as: an aggressive monetary policy through low interest rates (facing the problem of the Zero Interest Rate Policy – see Tab 1) to re-boost or extend the credit market (usually in this case the Central Bank buys toxic assets from banks); bank bailout using taxpayers' money (facing the problem of Too Big To Fail –

see paragraph 2.2.1.); expansive fiscal policy (facing the problem of higher rigidity and higher cost in the long run of the fiscal policy than the monetary policy).

Each policy and each decision will lead to a different scenario, and, analyzing every different possible output in the future, the objectives of the banking regulation are: prudence, having CSR and protecting confidentiality, credit allocation and reducing the risk.

Tab 1 - Zero Interest Rate Policy.

ZIRP is a macroeconomic concept describing conditions with a very low nominal interest rate, such as those in contemporary Japan and, since 2008, in the US. It can be associated with slow economic growth. Under ZIRP, the Central Bank maintains a 0% nominal interest rate. It is an important milestone in monetary policy because the Central Bank is no longer able to reduce nominal interest rates. Conventional monetary policy is at its maximum potential to drive growth under ZIRP. It is very closely related to the problem of a liquidity trap, where nominal interest rates cannot adjust downward at a time when loanable funds market has not cleared.

1.1. Credit rating as warning.

Banks and financial intermediaries are obliged to obtain and keep a rating higher than junk, approved by a credit rating agency (see Figure 1), and also to disclose the rating with investors, highlighting its future prospective. The most known rating agencies, referred to as the "Big Three", are the Fitch Group, Standard and Poor's, and Moody's (see Tab 2). Since agencies assign the probability each institution has to repay the issued debt, split in several years, through assigning a rating, the concept may be used as a first warning of a healthiness or unhealthiness of an agent. Usually short curve debt (1-3) has a higher probability to be paid off than long curve debt (10+), so the short curve debt should get a higher rating.

What the ratings mean

	Rating service		
	Fitch	Moody's	Standard & Poor's
Highest quality "gilt edged"	AAA	Aaa	AAA
High quality	AA	Aa	AA
Upper medium grade	A	A	A
Medium grade	BBB	Baa	BBB
Predominantly speculative	BB	Ba	BB
Speculative low grade	B	B	B
Poor to default	CCC	Caa	CCC
Highest speculation	CC	Ca	CC
Lowest quality, no interest	C	C	C
In default, in arrears questionable value	DDD		DDD
	DD		DD
	D		D

Source: Barron's

Los Angeles Times

Figure 1 – CRA

Tab 2 - Credit Rating Agency (CRA).

It is a company that assigns credit ratings: rating of the debtor's ability to pay back the debt by making timely interest payments and of the likelihood of default. An agency may rate the creditworthiness of issuers of debt obligations, the debt instruments, and the servicers of the underlying debt, but not individual consumers.

Debt instruments the agencies rate may include government bonds, corporate bonds, CDS, Municipal Bonds, preferred stock, and collateralized securities, such as Mortgage-Backed Securities and Collateralized Debt Obligations (Alessi, 2013).

A credit rating permits or facilitates the trading of securities on a secondary market and it affects the interest rate a security pays out, with higher ratings leading to lower interest rates. Individual consumers are not rated for credit-worthiness by credit rating agencies, but by credit bureaus, which issue credit scores (McLean and Nocera, 2010).

1.2. CRA and crisis evaluation.

During the 2007-2009 crisis mortgages were originated to redistribute and when asset prices (in particular real estate market prices) began to drop, banks began the securitization process: through financial tools linked to the financial engineering a mortgage and its risk were transferred to other financial institutions. Thus, the evaluation of the risk was no longer an internal problem for banks which were going to provide a loan or a mortgage, the bank managers' objective was only to subscribe the operation (gaining fees), because the risk would have been transferred outside of the bank. The widely used financial derivatives were (and still are) the Asset Backed Securities (ABS), the Mortgage Backed Securities (MBS), and the Collateralized Debt Obligation (CDO).

An ABS and a MBS are characterized by the movement of the payment's risk from the bank that provided the loan (or the mortgage) to other financial institutions, through the transferring of packages composed by different loans (or mortgages): riskier and lower risky ones together. A CDO is an asset based on any kind of credit subscribed by the bank and its cash flows are sold to other institutions, transferring the default's risk, with the option of claiming on the collateral in case of default. Through an ABS and a MBS it is possible to create credit securities based on mortgages, loans, credit cards and any other kind of credit subscribed by the bank, while through a CDO the bank can only sell its cash flows. Banks created CDOs composed by risky assets (like subprime mortgages) and risk-free assets (like loans to companies), but these assets got a low rating by the CRAs. To obtain higher rating the financial engineering created the splitting of the single mortgages

in tranches: senior and junior. First class represents first installments (0-9 years), while second class includes installments paid after 10 years. If the mortgage's cashflows are not paid the other financial institution (which bought the credit from the bank) can claim its credit on the collateral: if the bought credit is a senior tranche the creditor will be one of the first paid, while if the bought credit is a junior tranche the credit will be paid once creditors with senior tranche are paid. Thus, in this way, senior tranche credits get higher rating and they are more expensive (in contradiction with the high level of risk they still have), while junior tranche credits get lower rating and they are really cheap. It is the "wizardry" of the financial engineering.

During the 2007-2009 crisis, when asset prices collapsed, several mortgages became underwater: it happens when the value of the subscribed mortgage is higher than the real worth of the asset and debtors tend to no longer pay and default.

When this process starts then the transfer of the risk becomes harder and the economy suffers the distress, which becomes worse by the influence of other distress factors such as:

- Compensation Schemes; mortgages are provided to everyone without an accurate evaluation of the risk, since managers are just interested in the fees clients are going to pay due to the risk transferred to other intermediaries.
- Securitization; the possibility of transforming mortgages in securities, working on the derivative market.
- Increasing in the level of leverage.

2. Challenges faced by banking regulation.

Among the reasons for maintaining close regulation of banking institutions is the aforementioned concern over the global repercussions that could result from a bank's failure: the idea that these bulge bracket banks are Too Big To Fail (Chicago FED, 2001). The objective of federal agencies is to avoid situations in which the government must decide whether to support a struggling bank or let it fail. The issue is that providing aid to crippled banks creates a situation of Moral Hazard (Summers, 2007).

2.1. Moral Hazard.

A Moral Hazard is a case where an institution tends to take risks since eventually costs would not be faced by the institution under analysis. It is a tendency to be more willing to take a risk since the potential costs of taking such risk will be paid by others (see Tab 3).

Tab 3 - Everyday Moral Hazard.
From the view point of an agent, owning an uninsured bicycle results in a protective behavior as if he loses it or it gets stolen, he has to pay for a new bicycle himself. On the other hand if he insures that object, he will have less incentive to protect it from getting stolen.

A Moral Hazard may occur where the actions of one party may change to the detriment of another after a financial transaction has taken place (Simkovic, 2011). Moral Hazard arises because an institution does not take the full consequences and responsibilities of its actions, and therefore has a tendency to act less carefully than it otherwise would. It is a special case of information asymmetry, a situation in which one party in a transaction has more information than another one (Nowak and O'Sullivan, 2012) (see Tab 4).

Tab 4 - P. Krugman, *The Return of Depression Economics and the Crisis of 2008*, WW Norton, 2009.
"Moral hazard is any situation in which one person makes the decision about how much risk to take, while someone else bears the cost if things go badly".

According to the World Bank, of the nearly 100 banking crises that have occurred internationally during the last 20 years, all were resolved by bailouts at taxpayer expense (Boyd, 2000).
Moreover, certain types of mortgage securitization contribute to Moral Hazard (see Tab 5). Moral Hazard can also occur with borrowers. They may not act prudently when they invest funds recklessly[2].

Tab 5 - Moody's Analytics Economist Mark Zandi describes the subprime mortgage crisis.
"The risks inherent in mortgage lending became so widely dispersed that no one was forced to worry about the quality of any single loan. As shaky mortgages were combined, diluting any problems into a larger pool, the incentive for responsibility was undermined. Finance companies weren't subject to the same regulatory oversight as banks. Taxpayers weren't on the hook if they

[2] Thedailyomnivore.net

went belly up (pre-crisis), only their shareholders and other creditors were. Finance companies thus had little to discourage them from growing as aggressively as possible, even if that meant lowering or winking at traditional lending standards. Moral hazard is a root cause of the crisis".

Thus, there is no one person responsible for verifying that any one particular loan is sound, that assets securing that one particular loan are worth what they are supposed to be worth, that the borrower responsible for making payments on the loan can read and write the language that the papers that he/she signed were written in, or even that the paperwork exists and is in good order. It has been suggested that this may have caused subprime mortgage crisis (Lewis, 2007).

Also, brokers, who were not lending their own money, pushed risk onto the lenders. They, who sold mortgages soon after underwriting them, pushed risk onto investors. Investment banks bought mortgages and chopped up mortgage-backed securities into slices, some riskier than others. Investors bought securities and hedged against the risk of default and prepayment, pushing those risks further along. In a purely capitalist scenario, the last one holding the risk (like a game of musical chairs) is the one who faces the potential losses. In the subprime crisis, however, national authorities (for instance the Federal Reserve in the US) assumed the ultimate risk on behalf of the citizenry at large (Wighton, 2009).

Others believe that financial bailouts of lending institutions do not encourage risky lending behavior since there is no guarantee to lending institutions that a bailout will occur. Decreased valuation of a corporation before any bailout would prevent risky, speculative business decisions by executives who conduct due diligence in their business transactions. The risk and the burdens of loss became apparent to Lehman Brothers (which did not benefit from a bailout) and other financial institutions and mortgage companies such as Citibank and Countrywide Financial Corporation, whose valuation plunged during the subprime mortgage crisis (Ahrens, 2009).

2.2. Post crisis regulation.

The 2007-2009 crisis has swept aside the consensual perception of banking risks, contagion and their implication for banking regulation. Risks where mispriced, they accumulated in neuralgic points of the financial system, and where amplified by pro-cyclical regulation as well as by the instability and fragility of financial institutions (Freixas, 2009).

During the last crisis several bankruptcies occurred, facing the concept of Too Big To Fail (TBTF). In banking, TBTF usually refers together with other concepts, such as: Too Big To Unwind, Too Big To Liquidate, Too Many To Fail, Too Important To Fail, Too Complex To Fail, Too

Interconnected To Fail, and, most recently, Too Big To Prosecute or Jail.

2.2.1. Too Big To Fail.

The theory asserts that certain financial institutions are so large and so interconnected that their failure would be disastrous to the economy, and they therefore must be supported by government when they face difficulty (Dash, 2009).
Economies of scale in banks are worth preserving, so long as they are well regulated in proportion to their economic clout, and therefore that Too Big To Fail status can be acceptable. The global economic system must also deal with sovereign states being Too Big To Fail (Krugman, 2010) (see Tab 6).

Tab 6 - The term's birth.
The term Too Big To Fail was popularized by US Congressman Stewart McKinney in a 1984 Congressional hearing, discussing the Federal Deposit Insurance Corporation's intervention with Continental Illinois.

One of the problems arising together with the Too Big To Fail concept is the Moral Hazard concept, whereby a bank that benefits from these protective policies will seek to profit by it, taking positions that are characterized by both high level of risk and high level of potential return, as they are able to leverage these risks based on the policy preference they receive. Some critics believe that such large banks should be broken up: if they are Too Big To Fail, they are Too Big To Exist (Stiglitz, 2009) (see Tab 7).

Tab 7 - J. Stiglitz, *Too Big To Live*, Project Syndicate, 2009.
"In the United States, the United Kingdom, and elsewhere, large banks have been responsible for the bulk of the (bailout) cost to taxpayers. America has let 106 smaller banks go bankrupt this year alone. It's the mega-banks that present the mega-cost, banks that are Too Big To Fail are Too Big To Exist. If they continue to exist, they must exist in what is sometimes called a "utility" model, meaning that they are heavily regulated".

The Too Big To Fail concept is a daily matter and it has been faced many times from authorities, banks and intermediaries. (see Tab 8).

Tab 8 - Former Federal Reserve Chair Ben Bernanke describes the Too Big To Fail concept.
"A Too Big To Fail firm is one whose size, complexity, interconnectedness, and critical functions are such that, should the firm go unexpectedly into liquidation, the rest of the financial system and the economy would face severe adverse consequences. Governments provide support to Too Big To Fail firms in a crisis not out of favoritism or particular concern for the management, owners, or creditors of the firm, but because they recognize that the consequences for the broader economy of allowing a disorderly failure greatly outweigh the costs of avoiding the failure in some way. Common means of avoiding failure include facilitating a merger, providing credit, or injecting government capital, all of which protect at least some creditors who otherwise would have suffered losses. If the crisis has a single lesson, it is that the Too Big To Fail problem must be solved".

2.2.2. Too Big To Fail's risks.

There are several risks related to the Too Big To Fail institutions:

- This kind of institutions generates severe Moral Hazard (see paragraph 2.1.).
- There is no parity between big and small institution conditions (see Tab 9).
- Huge institutions are in charge of the overall financial stability, particularly in the absence of adequate resolution tools.

Tab 9 - Former Federal Reserve Chair Ben Bernanke describes the subprime mortgage crisis.
"The failure of Lehman Brothers and the near failure of several other large, complex firms significantly worsened the crisis and the recession by disrupting financial markets, impeding credit flows, inducing sharp declines in asset prices, and hurting confidence. The failures of smaller, less interconnected firms, though certainly of significant concern, have not had substantial effects on the stability of the financial system as a whole".

Modern banks changed their approach in conducting businesses, turning to providing diversified services not only to clients and SME enterprises. Banks are now in aligning their core business to the financial intermediaries' core business, turning to growing and high-potential-return (thus also high potential risk) sectors. Investment banks, along with other innovations in banking and finance, referred to as the shadow banking system (see Tab 10).

Tab 10 - Shadow banking system.

It is a term for the collection of non-bank financial intermediaries that provide services similar to traditional and commercial banks.

"Shadow banking, as usually defined, comprises a diverse set of institutions and markets that, collectively, carry out traditional banking functions, but do so outside, or in ways only loosely linked to, the traditional system of regulated depository institutions. Examples of important components of the shadow banking system includes securitization vehicles, asset-backed commercial paper (ABCP) conduits, money market mutual funds, markets for repurchase agreements (repos), investment banks, and mortgage companies".

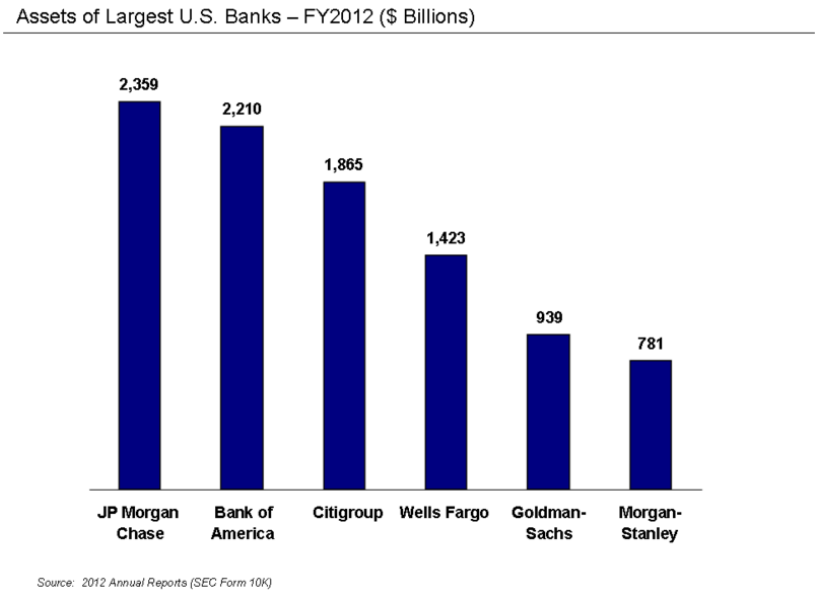
(Former Federal Reserve Chair Ben Bernanke, 2010).

During 2008, the five largest US investment banks either failed (Lehman Brothers), were bought out by other banks at fire sale prices (Bear Stearns and Merrill Lynch) or were at risk of failure and obtained depository banking charters to obtain additional Federal Reserve support (Goldman Sachs and Morgan Stanley) (Zandi, 2010) (see Tab 11).

Tab 11 - The Federal Reserve creation.

In November 2013 former Federal Reserve Chair Ben Bernanke described how the panic of 1907 was essentially a run on the non-depository financial system, with many parallels to the crisis of 2008. One of the results of the panic of 1907 was the creation of the Federal Reserve in 1913.

The largest US banks continue to grow larger while the concentration of bank assets increases. The largest six US banks had assets of $9,576 billion as of year-end 2012, per their 2012 annual reports (see Graph 1). For scale, this was 59% of the US GDP for 2012 of $16,245 billion. The top five US banks had approximately 30% of the US banking assets in 1998; this rose to 45% by 2008 and to 48% by 2010, before falling to 47% in 2011 (Federal Reserve Economic Data Bank Deposits to GDP for United States - Retrieved November 16, 2013).



Graph 1 – Largest US banks.

This concentration continued despite the subprime mortgage crisis and its aftermath. During March 2008, JP Morgan Chase acquired the investment bank Bear Stearns, Bank of America acquired the investment bank Merrill Lynch in September 2008, Wells Fargo acquired Wachovia in January 2009, and investment banks Goldman Sachs and Morgan Stanley obtained depository bank holding company charters, which gave them access to additional Federal Reserve credit lines (Zandi, 2010).

2.3. Post crisis regulation approaches.

There are two approaches to post crisis regulation (Freixas, 2009):

- Rare Event Approach; whereby financial crises will occur infrequently, but are inescapable. Crises are considered as an accident, a Poisson event that might on average occur every 80 years and all efforts should be made to reduce its impact.
- Manageable Event; where all efforts should be made to avoid its repetition.

Some of the regulatory reforms that have been agreed upon may not have been the most basic efficient ones and may lead to an inefficient banking industry, thus the difference between the two approaches is not so clear (Freixas, 2009).

3. Monetary policy.

The link between single institution bankruptcy and systemic crisis needs to be carefully analyzed, building a macroprudential regulation based on 4 aspects:

- A mechanism that declares a systemic crisis would be required and the statement can be based on a number of automatic thresholds.
- A mechanism for the identification of asset prices' bubbles, it should be a Central Banks' liability.
- A mechanism that takes into account contagion effects due to the distress of other banks (through the application of the Value at Risk, see paragraph 3.1.).
- A mechanism that imposes more stringent capital requirements during good times and could be lowered in bad times (capital requirements have to be increased during an economic expansion and at the same time they have to be decreased during recession).

A hawkish monetary policy during the pre-crisis period has been held responsible for nurturing asset price bubbles and macroeconomic fragility. During a crisis, monetary policy should become dovish and should be focused exclusively on the provision of liquidity at low interest rates.
The problem at the bottom is that Central Banks across the world have injected as much liquidity as required by the financial system. The difference between injecting liquidity and subsiding banks depends on the used collateral and the price set for the collateral. Central Banks liquidity injection has limited the number of distressed banks, avoiding a worsening of the crisis. An alternative to the Central Bank intervention is the Perotti and Suarez's mandatory liquidity insurance. During good times, an Emergency Liquidity Insurance Fund would receive the liquidity insurance premia and once a systemic crisis is declared it would be used.
By injecting liquidity at low interest rates banks solvency is generally improved. The efficient functioning of the interbank market is improved by setting low interest rates during a crisis and higher interest rates in normal times (Freixas, 2009). Perotti and Suarez argued the same statements, but about cost of liquidity: low during crisis and high in normal times (Perotti and Suarez, 2009).

3.1. Value at Risk (VaR).

The Value at Risk is a widely used measure of the risk: it shows the maximum potential loss of an asset, of a portfolio or of a capital structure in a finite time, in market equilibrium conditions. It is measured at a certain level of confidence, thus at a certain probability.

In financial mathematics and financial risk management there are several ways to calculate this type of risk measure of the risk of loss, but the useful ones in the analysis are the most used approaches to calculate the VaR and the parametric one, in which prices have a log-normal distribution (Black and Scholes, 1973).

Starting with the first approach, given a price S_t (strike price at time t) of a generic asset i:

$$\frac{S_t - S_{t-1}}{S_{t-1}} \tag{1}$$

Where:

$S_t = Strike\ price\ at\ time\ t$;

$S_{t-1} = Strike\ price\ at\ time\ t-1$.

It is the return on a generic asset and it is a simple growth rate. Then, the logarithm:

$$log\left(\frac{S_t - S_{t-1}}{S_{t-1}}\right) \tag{2}$$

Thus it would be:

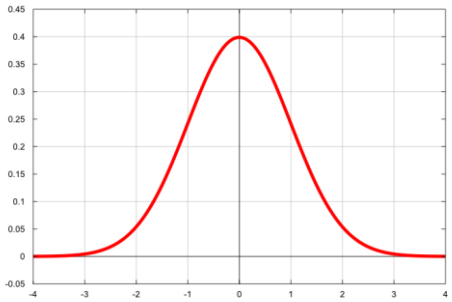
$$log\left(\frac{S_t}{S_{t-1}}\right) - log\left(\frac{S_{t-1}}{S_{t-1}}\right) \tag{3}$$

Since $log\left(\frac{S_{t-1}}{S_{t-1}}\right) = log(1)$, it is possible to indicate $log(1) = R_t$:

$$R_t = log\left(\frac{S_t}{S_{t-1}}\right) \tag{4}$$

Now it is possible to approximate R_t to the normal distribution as below:

$$R_t \sim N\ (\mu\ , \sigma_t^2) \tag{5}$$



Graph 2 - Normal Distribution

Source: Statsdirect

Continuing through indicating the probability as:

$$P(\mu - K\sigma < X < \mu + K\sigma) \tag{6}$$

Or rewriting:

$$\frac{1}{\sqrt{2\pi}} \int_{\mu-K\sigma}^{\mu+K\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}\, dx \tag{7}$$

Empirically, if a market agent has to buy an asset it will buy the one characterized by the effective return higher than the expected return. But the VaR approach has to be viewed from the losing point: the evaluation is done when the agent is in loss, thus when the expected return is higher than the effective return (the agent is long on an asset e he is evaluating its return). Since the agent is in loss when:

$$Effective\ Return > Expected\ Return$$

Then:

$$P(\mu - K\sigma < X < \mu + K\sigma) \tag{8}$$

It will be:

$$P(\mu - K\sigma < X < \mu + 0) \tag{9}$$

Thus, the agent is in loss when:

$$P(\mu - K\sigma < X < \mu) \tag{10}$$

Now it is possible to proceed with the standardization (through considering the variable *Z*, which has to be approximated to the normal with mean equal to 0 and variance equal to 1):

$$Z = \frac{x-\mu}{\sigma} \sim N\,(0,1) \tag{11}$$

Then:

$$P(\mu - K\sigma < X < \mu) \tag{12}$$

It becomes:

$$P(0 - K(1) < \frac{x-\mu}{\sigma} < 0) \tag{13}$$

It is possible to rewrite as:

$$P(-K\sigma < x - \mu < 0) \quad (14)$$

That is equal to the first formula:

$$P(\mu - K\sigma < X < \mu) \quad (15)$$

Now it has to be analyzed the left hand side of the formula:

$$P(\mu - K\sigma < X) \quad (16)$$

Because $(\mu - K\sigma)$ represents the VaR. It changes depending on the value of *K*:

Value of K	*Probability*	*Level of confidence*
$K = 1{,}28$	$VaR = 0{,}90$	90%
$K = 1{,}65$	$VaR = 0{,}95$	95%
$K = 2{,}33$	$VaR = 0{,}99$	99%

3.1.1. Empirical VaR.

For a given portfolio, a probability, and a time horizon, the VaR is defined as a threshold value such that the probability that the mark-to-market loss on the portfolio over the given time horizon exceeds this value (assuming normal markets and no trading in the portfolio) is the given probability level (Jorion, 2006).

Starting from the example in which the strike price at time 0 is \$100 ($S_0 = 100$), mean at 3% ($\mu = 0{,}03$), variance at 4% ($\sigma = 0{,}02$), and level of confidence at 99% ($C = 0{,}99$), thus $K = 2{,}33$:

$$P(\mu - K\sigma < x) = 0{,}99 \quad (17)$$

Including the value of *K*:

$$P(\mu - 2{,}33\,\sigma < x) = 0{,}99 \quad (18)$$

Where:

$VaR = \mu - 2{,}33\,\sigma VaR = 0{,}03 - (2{,}33)(0{,}02) VaR = -0{,}0166$

The maximum loss of the asset will be given by:

$$VaR_i = (E_i - K\sigma_i)\,V_i \quad (19)$$

Thus, the initial value of the asset *i* (strike price), equals $100, multiplied by the value of its VaR (–0,0166) to the power of the value of its VaR (–0,0166):

$$100\ (-0{,}0166)^{-0{,}0166} = -1{,}66 \tag{20}$$

Where $(-1{,}66)$ is the maximum potential loss of the asset *i*, while the following shows the minimum potential value of the asset in USD:

$$100 - 1{,}66 = 98{,}34 \tag{21}$$

Applying the theoretical process to the analyzed case (the concept of the VaR in the banking system) it has to be included the VaR of the portfolio, which represents the capital structure of a market agent.

The portfolio *(Y)* is composed by assets $-\ n$, by quantities $-\ R_i$, and by the total capital available $-\ V_i$:

$$Y = \sum_{i=1}^{n}(R_i)(V_i) \tag{22}$$

Then it is possible to represent the expected value $E(Y)$ and the variance $[\sigma(Y)]^2$ of the portfolio:

$$E(Y) = \sum_{i=1}^{n}(V_i)(E_i) \tag{23}$$

$$\sigma(Y) = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}(V_i)(V_j)(\sigma_{i,j})} \tag{24}$$

Since:

$$\rho_{i,j} = \frac{\sigma_{i,j}}{(\sigma_i)(\sigma_j)} \tag{25}$$

Thus:

$$\sigma_{i,j} = \rho_{i,j}\ (\sigma_i)(\sigma_j) \tag{26}$$

It is possible to replace $\sigma_{i,j}$ in the formula which shows the *sigma* of the portfolio:

$$\sigma(Y) = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}(V_i)(V_j)\rho_{i,j}\ (\sigma_i)(\sigma_j)} \tag{27}$$

Thus, the VaR will be:

$$VaR_y = E(Y) - K\ \sigma(Y) \tag{28}$$

By replacing variables $E(Y)$ and $\sigma(Y)$ with the prior formulas:

$$VaR_y = \sum_{i=1}^{n}(V_i)(E_i) - \left[K\sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}(V_i)(V_j)\rho_{i,j}\,(\sigma_i)(\sigma_j)}\right] \quad (29)$$

Moving the *K* under the square root:

$$VaR_y = \sum_{i=1}^{n}(V_i)(E_i) - \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}K^2(V_i)(V_j)\rho_{i,j}\,(\sigma_i)(\sigma_j)} \quad (30)$$

Rewriting:

$$VaR_y = \sum_{i=1}^{n}(V_i)(E_i) - \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}[K\,(V_i)(\sigma_i)]\left[K\,(V_j)(\sigma_j)\right]\rho_{i,j}} \quad (31)$$

With regard to the single generic asset the calculus of the VaR was:

$$VaR_i = E_i\,V_i - K\sigma_i V_i \quad (32)$$

Equals:

$$VaR_i = E_i\,V_i - K\,V_i\sigma_i \quad (33)$$

Equals:

$$K\,V_i\sigma_i = VaR_i - E_i\,V_i \quad (34)$$

Through putting these outputs in the formula of the VaR of the portfolio *(Y)*:

$$VaR_y = \sum_{i=1}^{n}(V_i)(E_i) - \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}[VaR_i-(V_i)(E_i)]\left[VaR_j - (V_j)(E_j)\right]\rho_{i,j}} \quad (35)$$

Assuming returns equal to 0, thus ($E_{i,j} = 0$):

$$VaR_y = \sum_{i=1}^{n}(V_i)(E_i) - \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}[VaR_i-(V_i)(E_i)]\left[VaR_j-(V_j)(E_j)\right]\rho_{i,j}} \quad (36)$$

$$VaR_y = \quad 0 \quad - \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}[VaR_i - \quad 0 \quad]\left[VaR_j - \quad 0 \quad\right]\rho_{i,j}} \quad (37)$$

$$VaR_y = -\sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n}\ VaR_i\ \ VaR_j\ \ \rho_{i,j}} \quad (38)$$

Under certain conditions of market equilibrium and given the assumptions of linearity and constancy of returns, last formula shows how to calculate the Value at Risk of a portfolio. It can be applied to the assets of a market agent and it shows the maximum loss and its probability a market agent is facing during its business.

3.2. Black and Scholes model.

The second approach is shown in the Black and Scholes model (Black and Scholes, 1973). Together with the binomial model, the Black and Scholes one is widely used in option pricing.
In the binomial model there is no chance for the price to remain constant, the variable price (in this case the strike price) from a discrete variable becomes continuous.
Given the assumptions of perfect market, no transaction costs, always open market, short stances allowed, absence of arbitrage, and starting by the stochastic differential equation:

$$dS(t) = \mu\, S(t)dt + \sigma\, S(t)dz(t) \tag{39}$$

Where:
$dS(t) = Variation\ of\ the\ Strike\ Price\ during\ the\ time$;
$\mu = Return\ on\ average\ of\ the\ asset\ at\ the\ infinitesimal\ time\ dt$;
$\sigma = Volatilty\ with\ regard\ to\ the\ time\ dt$;
$dz(t) = Random\ variable$.

The price will have a geometric Brownian motion and with regard to the random variable $dz(t)$, by changing the time *t*, the variable *z* will describe a series of random variables which will distribute as a normal characterized by mean equal to 0 and variance *dt*:

$$Z(t) \sim N\ (0, dt) \tag{40}$$

This process is defined the standard Brownian motion. It means there is a mean (a trend) at which it will be added the factor of distortion, which is the stochastic part.
The integral formula of the previous differential equation is:

$$S(t) = S(0)\ e^{\left(\mu - \frac{\sigma^2}{2}\right)(t)} + \sigma\ [Z(t) - Z(0)] \tag{41}$$

Where:
$S(t) = Value\ of\ the\ price\ which\ has\ to\ be\ estimated\ (unknown)$;
$S(0) = Strike\ Price\ (known)$;
$e^{\left(\mu - \frac{\sigma^2}{2}\right)(t)} = Drift$.

The price of the asset will have a log-normal distribution characterized by the following parameters:

$$S \sim \log N\left[\left(\mu - \frac{\sigma^2}{2}\right);\ (\sigma^2)(t)\right] \tag{42}$$

Where:

$\left(\mu - \frac{\sigma^2}{2}\right) = Mean;$

$(\sigma^2)(t) = Variance.$

The Black and Scholes model (Black and Scholes, 1973) has to be demonstrated through building a portfolio composed by a long position on an option and a short one on an asset:

$$\pi = V(S,t) - \Delta\, S \tag{43}$$

Where:

$V(S,t) = Long\ position;$

$-\Delta\, S = Short\ position.$

The portfolio has to be instructed in a way such that its return must be equal to the risk-free asset return (strategy to cover risks through diversification).

Considering the infinitesimal variation of the portfolio:

$$d\pi = dV - \Delta\, dS \tag{44}$$

Through the Ito's lemma it is possible to obtain the solution of the equation (Ito, 1944). In statistics, this identity is used to find the differential of a time-dependent function of a stochastic process (Oksendal, 2000). While in financial mathematics its best known application is in the derivation of the Black and Scholes equation for option values (Tavella, 2002).

Starting with the formula:

$$dV = \frac{dV}{dt}\, dt + \frac{dV}{dS}\, dS + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt \tag{45}$$

Including last formula in the $d\pi$ formula, replacing dV:

$$d\pi = \frac{dV}{dt}\, dt + \frac{dV}{dS}\, dS + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt - \Delta\, dS \tag{46}$$

It is equal to:

$$d\pi = \frac{dV}{dt}\, dt + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt + \left(\frac{dV}{dS} - \Delta\right) dS \tag{47}$$

Where:

$\frac{dV}{dt}\, dt + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt = dV;$

$\left(\frac{dV}{dS} - \Delta\right) dS = 0 = Random\ part\ (the\ risky\ one).$

Assuming $\Delta = \frac{dV}{dS}$ then it is possible to delete the risk and to delete the right hand side of the equation. Now the portfolio's return and its risk will be the same of a risk-free one. Thus, it is possible to write as:

$$d\pi = \pi\, r\, dt \tag{48}$$

Where:

$r = Risk - free\ return.$

Last formula is a simple capitalization, given an amount of capital *C* at an interest rate *i* for a limited time *t*. What is it possible to obtain capitalizing?

$$d\pi = C\ i\ t \tag{49}$$

The output is a simple capitalization. Going back to the risk-free $d\pi$, now:

$$\frac{dV}{dt}\, dt + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt = \pi\, r\, dt \tag{50}$$

Since at the beginning it was $\pi = V - \Delta\, S$, replacing π:

$$\frac{dV}{dt}\, dt + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt = (V - \Delta\, S)\, r\, dt \tag{51}$$

Since to delete the risk it was $\Delta = \frac{dV}{dS}$, then:

$$\frac{dV}{dt}\, dt + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2\, dt = (V - \frac{dV}{dS}\, S)\, r\, dt \tag{52}$$

Deleting dt:

$$\frac{dV}{dt} + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2 = r\, V - \frac{dV}{dS}\, r\, S \tag{53}$$

It is equal to the Black and Scholes' equation:

$$\frac{dV}{dt} + \frac{dV}{dS}\, r\, S + \frac{1}{2}\left(\frac{d^2V}{dS^2}\right)\sigma^2 S^2 - r\, V = 0 \tag{54}$$

Solving last equation the output are the formulas to price a call option and a put one. Assuming:

$$V(S,t) = MAX(S_t - E, 0) \tag{55}$$

The solution of the equation is:

$$C = S(0)N(d_1) - E(1+r)^{-T}N(d_2) \tag{56}$$

Where $N(d_1)$ and $N(d_2)$ are the distribution functions of a normal standardized one:

$$\begin{cases} d_1 = \frac{\log\left[\frac{S(0)}{E}\right] + (r + \frac{1}{2}\sigma^2)(t)}{\sigma\sqrt{t}} \\ d_2 = d_1 - \sigma\sqrt{t} \end{cases} \quad (57)$$

These formulas justify the concept of risk-neutral pricing in order to be solved, and through it the Black and Scholes equation is demonstrated, but, empirically, at the same time, this way of thinking is at the bottom of the speculative process of a levered bank or financial intermediary.

3.3. International bankruptcy.

The Basel committee has defined a framework for transnational banking operations that has allowed it to establish some uniform international banking system, so when a bank or a financial intermediary operates at an international level, its bailout or its liquidation will affect the global financial stability and each country will bear costs or benefits of the operation (Freixas, 2009). The territoriality problem will be faced when each country will tend to free ride on the home country and therefore large multinational banks will not be bailed out (Freixas, 2009). Only an ex ante commitment on clearly set rules for burden-sharing among countries could solve this type of problem (Goodhart, 2006). Moreover, with regard to the bankruptcy procedure, the international banks' bankruptcy laws make a liquidation process more complex, because countries could choose between two different perspectives on the different rights of their claimholders:

- Territoriality; where each country considers the assets and liabilities in its own country.
- Universality; where in each country assets and liabilities are jointly considered, independently of their country of origin.

These two ways of resolution create the problem which faces each country regulatory authority: has a country applying territoriality to cope with the bankruptcy of a foreign bank or financial intermediary from a country where universality is the role?
The former Bank of England Governor, Mervyn King, gave the answer regarding this issue:

"International banking is global in life, but national in death"

Moreover, according to Modigliani and Miller theorem (Modigliani and Miller, 1963), the price of the capital (in this case the price of the debt), which is mathematically equal to *i*, shows the risk taken by the management of the market agent and its internalization in the decision making. Due to

the concept that taxpayers are considered shareholders (because in case of an eventual financial bankruptcy of the market agent, at the end of the process if the bank or the financial intermediary will fail then taxpayers will pay for the bankruptcy) they have to be considered and taken into account in the decision making process of the market agent. Thus, during the formulation of the strategies and the decision making process it has to be considered and internalized the cost of an eventual bank or financial intermediary's bankruptcy paid by taxpayers.

The new mechanism of banking resolution, promoted by the European Union, is a new step to solve the problem. It fixes the protection of the territoriality through the payment of effects of an eventual bankruptcy by shareholders, creditors and depositors of the bank or the financial intermediary.

Countries no longer participate at the bailout of banking market agents if there will be a financial distress, banking market agents themselves will pay the crisis. When an agent is facing a liquidity problem or is facing a bankruptcy first payers will be shareholders, bondholders and creditors, then depositors will pay (but only the ones owning deposits in excess of 100,000€) (D'Alessio, 2014). In April 2014, the European Parliament approved the unique mechanism of banking resolution which faces the problem of banks' bankruptcy and rules problems as financial restructuring and settlements. At the bottom of the reasoning there is the concept of independence of the banking sector and in particular of the banking authorities: if a bank navigates dangerous waters only "technicians" will take right decisions and only who is participating at the business will do interests of the bank, while several countries would have preferred to assign to their Ministry of Finance a key role for core-business decisions and in the running of the bank resolution fund settled by the approved mechanism (in opposition to the concept of independence between fiscal policy and monetary policy). In this way there is no possibility to influence the banking sector for politicians and it is guaranteed a proper, fast and at lower cost policy to face a financial crisis.

4. Conclusions: Central Bank independence.

In order to improve the long term economic performance, over the past decade, it has been promoted the increasing of the independence of Central Banks as a way to guarantee the global financial stability. The concept of independence is defined as the Central Bank's operational and management independence from the government (Sullivan and Sheffrin, 2003).

A monetary authority which is too susceptible to political direction or pressure may encourage economic cycles (as the Political Business Cycle – see Tab 12), as politicians may be interested in improving economic activity before elections, to the detriment of the long term health of the economy and the country.

Tab 12 - Political Business Cycle.

It shows the behavior of politicians which have as unique objective the re-election for one more mandate. Their utility function is shown as following: $f(x) = E_1$. Where E_1 represents the probability of election at the time 1, and it is a value between 0 and 1 (binary), while E_0 represents the election at the time 0 (current time) and it has to be equal to 1.

It is studied that before elections politicians tend to maximize votes through the redistribution of resources to the electorate (by decreasing taxation or increasing public expenditure), while after elections politicians will increase taxation or they will decrease public expenditure in order to restore the public budget.

There are several types of Central Bank's independence[3], classified in:

- Legal Independence; each Central Bank's liability is at the same level of the government officials' liability. This kind of independence is enshrined in law and it is limited in a democratic country. Degrees of legal independence are defined but at the bottom the challenge is empirically: legislation provides framework within which government and the Central Bank work out their relationship, but their real relationship and real allocation of powers and liabilities are ambiguous.
- Goal independence; each Central Bank has the right to set its own policy objectives; whether control of the money supply, inflation targeting, and maintaining a fixed exchange rate. While this type of independence is widespread many Central Banks prefer to announce their policy objectives in partnership with the appropriate government departments, through increasing the level of transparency and credibility of the objectives chosen by providing assurance that they will not be changed without notice (deleting the time inconsistency problem – see Tab 13). This way of running is guaranteed by the positive correlation that links setting common objectives by the Central Bank and government with respect to avoid situations where monetary and fiscal policy are in conflict.
- Operational independence; each Central Bank has the right to determine the best way of achieving its policy objectives. It is the most common form of Central Bank independence.
- Management independence; each Central Bank has the authority to run its own operations without excessive involvement of the government. The other types of independence are not possible unless the Central Bank has a significant degree of management independence. In this field it is used a statistical indicator as a proxy for showing the Central Bank

[3] Global Central Banks Directory, International Business Publications, 2011

independence: the Turn-Over Rate of Central Bank Governors (the output is when a government is directly or indirectly allowed to appointing and replacing the governor frequently, then it has the capacity to micro-manage the Central Bank through its choice of governors).

An independent Central Bank can run a more credible monetary policy, making market expectations more responsive to signals from the Central Bank. Empirically, both the Bank of England and the European Central Bank have been made independent and follow a set of published inflation targets so that markets know what to expect. At the same time the People's Bank of China has been accorded great latitude due to the difficulty of problems it faces, though in the People's Republic of China the official role of the bank remains that of a national bank rather than a Central Bank, underlined by the official refusal to "unpeg" the yuan or to revalue it under pressure. The People's Bank of China's independence can thus be read more as independence from the US which rules the financial markets than from the Communist Party of China which rules the country (Batten, Hogan and Szilagyi, 2010).

Anyhow governments have some degree of influence over even "independent" Central Banks. The aim of independence is primarily to avoid short term interference and in order to follow it there are interconnections between Central Banks and governments as for example in the US the Board of Governors of the US Federal Reserve is nominated by the President of the US and confirmed by the Senate.

Tab 13 - Time Inconsistency.

It is a property in financial risk related to dynamic risk measures. The purpose of the time consistent property is to categorize the risk measures which satisfy the condition that if *portfolio A* is riskier than *portfolio B* at some time in the future, then it is guaranteed to be more risky at any time prior that point. This is an important property since if it were not to hold then there is an event (with probability of occurring greater than 0) such that *B* is riskier than *A* at time t although it is certain that *A* is riskier than *B* at time $t + 1$. As the name suggests a time inconsistent risk measure can lead to inconsistent behavior in financial risk management.

In contrast with these relationships between monetary authorities and fiscal authorities are the international organizations such as the International Monetary Fund and the World Bank, which are strong supporters of the Central Bank independence.

According to these institutions an increase in the level of independence (up to total independence of the Central Bank) means an increase in the level of transparency in the policy making process.

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