Optimal capital structure of a bank: the role of asymmetry of information and Equityzation of Debt.

Francesco Giuliani

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Abstract

Past literature has focussed on bankruptcy costs, tax benefits and agency costs as key factors to derive an optimal capital structure policy.

In this paper we argue that asymmetry of information is crucial to explain why Equity and Debt are not just substitutes in the balance sheet of a bank: the uncertainty in evaluating its Assets is reflected in the market by a number of banks whose Market to Book Ratios are well below 100%. In order to face such uncertainty the bondholder requires, when facing new Debt issuance, an Equity buffer capable of preserving the value of the Debt from a drop in the Assets value.

If the Equity of the bank is not well sized for the volatility of the Assets, then Debt issuance is not welcomed by the market, as the current financial crisis testifies. Debt then prices yields proper of Equity, a phenomenon which we will refer to as "Equityzation of Debt".

On the contrary, if banks stabilize in their market share, then their Assets are meant to grow proportionally with GDP and so are their liabilities. A Steady State for a bank is a combination of Profit, Debt and Equity whereby the Debt issuance is proportional to GDP growth and Equity grows fuelled by Profits net of dividends. Such Equity growth, obtained through endogenous Profit generation, and not through Rights issuance, preserves the composition of shareholders and ultimately the stability of Management.

One conclusion is that optimal capital structure would not lead to set a level of Equity equal to the minimum set by regulators. The optimal level of Equity depends on the volatility of the Assets and minimizes the volatility of the Debt, so that new issuance of the latter may take place with a pricing consistent with long term Profits, in the sense of the Steady State mentioned above. Optimal level of Equity is then associated with optimal leverage, as one of the factor to control volatility of the Assets.

In the second part of this paper we present empirical evidence of Debt Equityzation and we aim at proposing a measure of the latter obtained from market data

This paper represents a strong departure form the current state of the literature and provides a unifying frame to give theoretical and empirical explanations to phenomena such as

- Deleverage
- Rights Issuance
- Prevalent covered bond issuance as opposed to Senior unsecured issuance
- Redesign of subordinated Debt.

Decomposition of Capital Structure and assumptions on costs

In this paper we will simplify the liabilities of a Bank by assuming that they are composed by 3 elements: Equity (S), Bonds (B) and short term liabilities (D). Deposits will be included in the short term liabilities: D also includes the liabilities when the bank enters financing by using elegible collateral for the purpose of mitigating the credit risk. Such short term financing is typically referred to as "repo" and its cost is equal to an overnight parameter quoted in the market: eonia. For this reason we will assume that the component of Short term liabilities will produce a cost equal to Eonia.
The bond issuance, in spite of the variety of bonds issued by the bank, will be assumed bearing a cost equal to Euribor + CDS, where CDS is the credit default swap quoted by the market when the bank issues further debt.
The return of equity is the return of assets after covering for interest from short term liabilities, Bonds and some other internal costs. Such return for equity is the objective function for the management, aiming at maximizing value for shareholders. In this paper the variable under the management control is indeed the capital structure, i.e. the composition of the liabilities across Bonds and short term liabilities. Management also chooses the leverage to implement for the asset side of the balance sheet, after acknowledging that a choice on leverage has implications on the costs to issue Debt.
Whereas the variables so far contemplated (leverage, debt issuance and short term liabilities) represent simply an asset liabilities management, a more strategic variable is under management's control: the amount of equity. Management could decide for a Capital Increase, with the purpose of reducing the leverage or to accommodate future growth. Rights issuance is a strategic choice, since it may change the composition of shareholders; hence it may change the strength of the support for the management. We will see that such variable is contemplated only when the First Order conditions in the maximization can no longer be met.

Assumptions on the asset side of the Balance Sheet

As anticipated in the abstract, the lack of transparency of the composition of the banking book entails a difficulty from the market in estimating the actual value of a bank, since its assets are marked at cost on the Loan and Receivable Book (the majority of the assets, in a commercial bank, mainly credit granted to their own clients, does not reflect the evaluation of the market).
On the contrary, although the bond issuance in most cases is not marked to market, the CDS market makes it easy to estimate the value of the issued bonds and more importantly the cost to be bore on future issuance.
In other words, markets participants may have a better understanding of the liability side of a bank rather than the asset side. We will denote the value of the assets with A, although that value may be well different from the Balance sheet amount. A is the theoretical value of the asset side following a market approach. By definition the credit in the asset side of a balance sheet is an illiquid portfolio, hence a market evaluation reflects the information asymmetry existing between the management of the bank and the market. The value of A is then the best estimate the market can make of the asset side of a bank. In the remaining sections of this paper we will give further hints on how such estimate may take place (in summary the market will pick

observable securities in the market which may be deemed closely related to the composition of the banking book portfolio).
For the purpose of this paper what matters is not so much the actual value of the assets, but the volatility of such aggregate. The rationale is that the higher the volatility, the more a high leverage run by the bank will make it likely that a drop in the mark to market of the assets will make the bank run on zero equity: in the scenario of a drop of value making the actual equity equal to zero any further loss will be borne by the Debt. Hence the volatility of the assets is crucial to determine what leverage is low enough to make sure that the market may not fear that the debt issued is not protected by a sizeable equity.
In the empirical section of this paper we will point at a portfolio of securities (in the format of indices) which may approximate the composition of a banking book of a Bank. Under this simplifying approach we will estimate the volatility of the latter and show its degree of correlation with the magnitude of the CDS of various issuers.

General Equilibrium.

In this section we will consider the interaction between market and management. The first one analyzes the balance sheet with limited information in the sense mentioned above. Management is left with determining the variables in the balance sheet that represent the optimal reaction to the market values. Management therefore chooses the leverage to implement, in the understanding that higher amounts of leverage make, ceteris paribus, the debt holder require a higher amount of yield when rolling the debt.

In particular the debt holder compares the yield of the safest asset with the payout from the financial (risky) debt.

General Equilibrium: the bond holder.

In case of non default the Bond holder receives (assuming an average duration of debt of 5 years, which is also the most liquid maturity for a CDS)

- Redemption amount at maturity
- Yield of the Risky Bond (which we will assume equal to Swap rate with tenor 5 years + CDS with tenor 5 years.

In case of default the Bond holder receives the recovery value of the bond. Given the time it usually takes for bankruptcy procedures to determine recovery values and to liquidate it, we assume that such amount is paid at legal maturity of the defaulted bond.

With this simplified approach, then the equation of indifference between the 2 investments (free risk and risky bond) must hold: by denoting P as the probability of the event of default,

$$100\% *(1-P) + P* Rec + (1-P) * (Swap+CDS)*CF= 100\% + Yield*CF$$

where

i. Rec is the recovery value in case of default and is meant to be a percentage between 0 and 100%
ii. CF is the capitalization factor that compounds to maturity the flows paid in the 5 years of life of the investment
iii. P, once again , is the probability of default, in the sense that we will better specify in a section below
iv. Yield is the risk free bond return for a tenor of 5 years (matching the tenor of maturity of the CDS). Although the approach is general enough, in the empirical section we will focus on issuers Euro and Sterling denominated. Hence, for the purpose of the empirical section, we will consider the yield of German and British government bonds for a maturity of 5 years.

When analyzing the bond issuance of a bank, we will assume that, in spite of the variety of bonds to be issued, we may consider a representative bond with tenor equal to the average duration of the bonds to be issued. The yield to be offered when issuing such bond (as subscription conditions accepted by the market) is

Swap(T) + CDS(T)

Swap(T) is the swap rate quoted by the interest rate swap market for an interest swap with tenor identical to the maturity of the bond.

From the equation above we obtain that the value of CDS is equal to a function of Swap rates, Probability of Default, recovery values and governement yields:

- $CDS = f(P, Yield,\ Rec) - Swap(T)$

Where

$$f(P, Yield,\ Rec) = \frac{P*(1-Rec) + Yield*CF}{CF*(1-P)}$$

In a general equilibrium approach this will represent the equation of bond subscription where the most relevant variable will be soon shown to be P, i.e. the probability of Default, an event not yet thoroughly defined.

From such equation we deduce that the market has to estimate a probability of default in order to determine the risk premium to associate to the bond issuance. This is exactly the point where asymmetry of information plays a central role.

Market inference on a probability of default: general considerations.

Most of the academic literature defines default as a drop in the asset value of the bank, where the latter drops below the value of the liabilities. Such approach implicitly assumes that the value of the asset is observable and liquid. As a matter of fact the banking book is subject to accounting mechanics which very rarely are similar to the logic of mark to market. The asset values of the Loan Book are reduced typically when some arrear payments are actually realized. It is rare that the loan book is impaired when the default risk is perceived higher for a degeneration of the economic environment.

As a result, it is extremely difficult to make any inference on the value of the loan book of a bank, regardless of the nature performing or not performing of loans. The accounting methods admissible for the balance sheet evaluation of such items may strongly differ from a market evaluation of the latter.

On the liability side, instead, there is a much higher level of transparency: Issuance, redemptions and coupons are easily identifiable. Liabilities are typically evaluated at cost, although some financial institutions may elect a regime of mark to market for some of them. We obtain a financial reading of the banks' liabilities with a higher degree of transparency than the available estimate of the assets. The first implication is that stated Equity may strongly differ from what is quoted in the stock exchange. Ultimately it is a problem of information asymmetry and this explains why most of the banks experience a Price to Book ratio well below 100%: accounting differs from Market estimates.

On the other hand regulators have defined criteria of solvency by defining capital ratios and by introducing a definition of regulatory capital. Once more, although useful as a first measure of assessment of the health of a financial institution, they base themselves on accounting measures which, during stress periods may significantly differ from the solvency perceived from the markets.

The main implication is that the equity as measured by market may be critically low although the capital in the regulatory and balance sheet sense may be sound enough. In this occasion regulators would not deem necessary to intervene and the bank may face a spiralling cost of debt.

This long digression justifies why a definition of default as the value of assets falling below the liabilities is not easy to adopt, simply because such value of the assets is not observable, but only object of estimate.

The total notional of assets composing the asset side of a balance sheet is known and here we consider the banks with a liquid stock price. The market aims at estimating what amount of depreciation is enough to wipe out the existing equity.
Hence the market has to determine the probability that the assets may be subject to a drop in value such that the actual equity be zero or lower, even with a positive value of stated equity. This is the event where the bondholder should expect a haircut, hence technically an insolvency event is a return (x) on the value of the assets (A) such that

$$A\,(1+x) < B+D$$

$$x < -1 + (B+D)/A$$

From such equation it is evident to see that the more the assets depreciate even from a mere Mark to market perspective, the smaller is the negative return which suffices for annihilating the equity of a bank. During crisis period the numerator may be deemed

constant in a very short amount of time, whereas the denominator will be estimated as losing value very quickly due to observable widening[1] of the main credit indices.

If we define A as a multiple, or leverage (λ) of the equity as measured by the market, $A = \lambda S$; hence we obtain that the yield of the assets making the bank run on zero equity is

$$x < -1 + (A-S)/A$$
$$x < -S/A$$
$$x < -1/\lambda$$

which is easy to interpret. With no leverage, $\lambda = 1$, the assets should drop in value by 100% in order to wipe out all the available equity. With very high levels of leverage, instead a minimum drop in the value is enough to make the equity worth zero.

The market is then called to estimate a probability of return of the assets contained in the balance sheet of the bank. The market estimates the cumulative probability

$$P(-1/\lambda)$$

The crucial role of such estimate explains why during crisis times both market analysts and regulators have emphasized the importance of leverage. Describing the assets as a leverage of the equity (in a linear format) may turn out to be quite misleading. A reduction in the value of the assets is not translated into an equal reduction of equity: with a drop in value of the assets the leverage grows since the liabilities are fixed payments due. Banks are institutions endogenously increasing the amount of leverage the more they approach financial stress. We will explore this point with a more appropriate analytical framework in a section below.

From now on the probability of insolvency will be

$$P\ \{-1 + (B+D)/A\}$$

and we have shown the importance of this probability in determining the CDS level of a certain issuer. Not only will such probability depend from the leverage of the bank, but also from the volatility of the underlying assets. It is also clear now that banks are subject to a self feeding mechanism since an unexpected turbulence in the markets is typically associated with the widening of the main credit indices and with an increase in volatility. Hence

a. the probability of default grows from an intrinsic viewpoint due to a drop in the asset values (Credit market deteriorates).
b. Also such probability increases due to a higher volatility, which makes the CDS level increase, thus making the future profitability drop (second negative effect for equity). During volatile times, exactly when banks need more equity, the endogenous generation of such equity weakens. As a reaction the new assets need to generate a higher yield or the leverage needs to be increased to guarantee profitability in line with the risk of equity. An increase in leverage generates a further increase of the CDS market which in its turn makes the

[1] By "widening" in the credit market and in this paper we mean the generic worsening of the credit conditions: CDS gap to higher levels, indices drop to lower levels, making the yield of credit higher.

credit indices widen even more. Hence the value of the assets is marked down by the estimate of the market and equity values drop.

From this simple intuition relating to the importance of volatility in Credit we derive the importance of the banking system in the propagation or the isolation of volatility shocks in the economy. Hence ideally the leverage should be as low as possible during volatile times so that the probability in the formula above does not experience a dramatic increase. A bank is short volatility: in this sense future research should study the optimal design of the capital structure to reduce this structural short position on volatility.
One candidate for reducing the volatility of leverage is the design of subordinated debt with volatility dependent calls, by linking redemption to observable levels of volatility and credit spreads of liquid indices below certain thresholds levels.

Inference on the value of the asset side of a Bank

As mentioned the inference on the value of the assets leads as well to an inference on the level of equity, an estimate on the leverage and on the CDS. Ultimately the market determines sustainability of a capital structure by looking at the return of the overall firm. Profits aligned with ROE of the sector testify that there is production of value, net of the liabilities cost. The importance on capital structure drops when firms prove capable to affirm a competitive advantage. Their value then cannot be inferred from the balance sheet, but from the repeatability of profits (and their growth).

The current financial crisis has emphasized the weaknesses of the financial institutions, with Return on tangible equity sometimes even below the cost of debt (a phenomenon we will explore in depth during this paper). CDS have registered levels discounting a probability of default which is at odds with the belief that issuers are still in a "going concern" context.

In evaluating the sustainability of debt, profits registered during this financial crisis do not longer fuel (in most cases) a growth of equity consistent with the variability of the latter. The strength and resilience of the issuer is to be evaluated versus the equity available and no longer on the future profitability. Issuers whose equity price discounts only a fraction (below 1) of the book are very frequent: the market is shifting from discounting the future (firms trading at a certain multiplier of the expected profit) to capitalizing the past (firms are worth the equity generated in the past and they stand against the burden of the debt with the strength of the balance sheet shaped in the past years). When the capital structure is composed mainly of debt, the equity evaluations are relevant to have an estimate of the maximum tolerable loss before the debt is at risk. The two main components of the capital structure, equity and debt are then to be fine tuned so that debt may improve the ROE by making leverage feasible and equity may provide the guarantee that such debt is sustainable (by providing an adequate buffer to loss). From this long premise and simple reasoning we may already derive the main conclusions of this paper:

1. There is an optimal mix between equity and debt which challenges the irrelevance of the capital structure composition as maintained in some research

2. Such optimal structure has the purpose to maximize the return on Equity: the results of such maximization are crucially determined by the cost of debt, in its turn affected by the information asimmetry
3. The opportunity cost of such information asymmetry is in the extra leverage that could be implemented if the assets could be evaluated appropriately, thus resulting into an extra profitability.
4. When such optimal capital structure is not met/ implemented, there may be no endogenous process that makes it converge towards the optimal points. Information asymmetry has always been the main academic factor causing failure in the market, meaning, among other things, that the market no longer allocates resources efficiently. Capital structures with a suboptimal combination produce a similar result. We will consider one specific example: the so called "Equityzation of debt".
5. The main conclusion and inception point for future research is the importance of information asymmetry and volatility on the value of a bank. The design of subordinated debt needs to address these 2 issues making them less relevant in the long term equilibrium that a financial institution should achieve.

The assumptions on modelling the assets and liabilities of a Bank.

Most of the literature has modelled the assets of a bank as a generic stochastic process. Such an assumptions, in the attempt to be as generic as possible, does not reflect a pragmatic (although maybe too narrow) view the the quality of the Bank assets are driven primarily by the Credit Market. Banks buy Credit from their retail (borrower), sometime backed by a residential asset, sometimes by a commercial project, whose profitability should be enough to pay for Interests and compensate for the entrepreneurial risk.

The bank will be assumed to run an aggregate portfolio, with no (or negligible) interest rate risk[2], with a certain duration. Its assets will be very diversified, although ultimately driven by the credit conditions in place at the moment of composing such portfolio. The accounting treatment of such portfolio is aligned with the long term nature of the investment. Determining a mark to market would be unpractical and unfeasible. Yet the market, when estimating the probability of default, must produce an estimate of such portfolio or on the variation of its value. Being such portfolio the only guarantee of profitability and solvency of the bank, its value is crucial to understand the sustainability and solvency with respect of the liabilities.

As mentioned until this point, the liabilities will be assumed composed of Deposits, producing an interest of Eonia, and bonds, producing an interest equal to the sum of Euribor 6m and a spread. Such spread is the CDS quoted by the market when the bond is issued.

By CS01 we will refer to the value of 1 basis point for the remaining life of the asset (or liability). CS01 stands for Credit spread of 1 Basis point and it changes depending on the maturities under scrutiny.

[2] The efficiency of the Interest Rates Swap market makes this assumption quite realistic, since the duration risk can easily be removed from the balance sheet (or, viceversa, increased) by entering one or more interest rates swap.

In this oversimplification of the Bank balance sheet the assets will have a certain average maturity, for the sake of example, 10 years. The liabilities will have typically a much shorter duration, which is observable since the statistics and debt distribution, sorted by maturity and amounts,are well known.

The value of the assets will be then assumed to evolve from one period to another as

$$A_t = A_{t-1} * [1 + CS01_A * (Spread_{t-1} - Spread_t)]$$

Similarly, for the liabilities

$$B_t = B_{t-1} * [1 + CS01_B * (CDS_{t-1} - CDS_t)]$$

CS01(A) and CS01(B) are the Net present value of a change of 1 basis point, computed respectively for the maturity of the assets or the liabilities. Bonds are issued with a variety of maturities and analysts refer to a debt distribution. When dealing with a representative bond for the entire issuance we consider the average duration in the assumption that the issuance activity will contribute to roll the existing debt without changing dramatically the current debt distribution.

By Spread(t) we denote the fair average asset swap level of the stock of credit purchased (originated) by a bank: it essentially the yield converted into Euribor + spread so that the evolution of the value of credit is not affected by a change in interest rates.

These very simple equations are worth considering for analyzing the impact of strong change in the Credit conditions. A higher CS01 on the asset side (with respect to the liability side) corresponds to a profitability of the assets not as reactive to the increase in cost on the liability side. For this simple reason, among others, one can justify the drastic fall in profitability of the banks. The widening (increase) of CDS has made the cost of liabilities adapt more quickly to the current credit market than the asset side. CS01 can be read as a measure of reactivity and inversely related to the speed of turnover of the portfolio (be it a liability portfolio or an asset portfolio).

Every year, in a steady state, the bank rolls a portion of assets and liabilities, namely 1/CS01. Presumably CS01(B) < CS01(A), given that the legal maturity of the liabilities is typically shorter than the one of the assets. Hence the asset liability management entails that the amounts of bond issued at new market conditions is higher than the credit purchased at market conditions. In extreme cases of drop of confidence, the CS01(B) has fallen to a point where most banks have experienced an authentic funding crisis and the European central bank has supported the market with so called “full allotment tender”. Traditionally and in stable markets banks have monetized a CS01(A) > CS01(B), since the conditions to roll 1/CS01(B) every year were extremely advantageous (due to the low level of CDS). The liability side of the bank is now more reactive to the variation of CDS since long dated issuance is no longer feasible and, on an aggregated basis, liabilities have a lower CS01.

One significant implication for the capital structure of the bank is the following. A balance sheet reading overestimates the amount of equity (especially) during crisis

time (i.e. increasing CDS level scenarios) since the CDS levels can jump to levels higher than the spread over euribor representing the profitability of assets. A scenario where assets yield less than liabilities would not be detectable in a balance sheet. An asset whose balance sheet value is 100 versus a corresponding liability whose balance sheet value is 100, jointly seem to produce a difference of zero. This is true only if the interest on the asset is equal or higher than the interest on the liability (the bank also has operational, staff and many other costs). If instead the issuance levels make the yield of liabilities higher than the one of the assets, such issuance is destroying equity although no actual equity reduction is realized accounting wise. This example not only testifies the difficulty in assessing the actual value of equity from reading a balance sheet, but it is a collateral effect of a deleverage in a scenario of increasing CDS. By definition of Deleverage, the amount of assets is reduced and therefore the high levels of CDS cannot be monetized by purchasing new assets. Simultaneously, liabilities have to be rolled and bonds are issued according to new levels of CDS. New issuance then destroys equity since the just issued liabilities are more expensive than the yield deriving from assets purchased in the past. Yet liabilities are issued and written at 100, historical assets are registered at 100 and equity is invariant in the balance sheet representation. This phenomenon is not only a theoretical example, but is currently ongoing in financial markets. When CDS of financial issuers are higher than corporate issuers (for a given rating) then corporates borrow money at cheaper rates than banks. Hence financial issuers need to worsen the quality of borrowers not to incur losses. Again, this is financially reducing equity, since by lowering the rating, default probability increases and future losses may be realized, thus affecting equity.

We find that this very simple representation of assets and liabilities is quite powerful in showing the main challenges when managing assets liabilities during volatile credit times. It also well reflects that the profitability deriving from a mismatch of duration has implications in terms of average turnover periods, which is quite relevant when the credit market widens (CDS increase), strongly reducing profitability and viceversa.

Until this point this paper shows intuitive and simple ways to interpret the consequences on the bank balance sheet structure of the CDS movements. It also shows the limits of a balance sheet representation of a bank, and the limits deriving from information asymmetry when assessing the value of assets and equity.

We will avail ourselves of the same balance sheet representation when considering, in the next section, the Return on Equity maximization problem of the management.

General Equilibrium: the management.

Management simply maximizes the shareholders return: in the constraint of the functioning of the CDS market, representing the cost of debt issuance, management is left with the choice of debt issuance, short term liabilities, and the choice of leverage. They also have one variable to activate: the capital increase. This is a variable which is activated only quite rarely as it has strong consequences in terms of, among other things

i. Likely change in the composition of the shareholders
ii. Dilution effect for the past shareholders

The maximization of return for shareholders can be expressed as

Max A* (Euribor + spread) – D*eonia –B*(Euribor + CDS) –C

Where C is an aggregate of operational costs that, for the purpose of this paper, are not directly linked to the capital structure of the bank and therefore will be considered a constant for the purpose of the optimization (the change in capital structure will not determine a change in C).

The maximization has to comply with the following constraints

a) The increase in assets needs an identical increase in liabilities (distributed among Debt, Deposits or, in extraordinary circumstances, Equity)
b) An increase in assets causes a different ratio of P {-1 + (B+D)/A}, hence a change in CDS level.
c) A, D and B reflect variables that derive from past years and therefore the actual choice in the maximization is in the variation of such variables with the constraints mentioned above.
d) Regulatory constraints: these include the expansion of assets over certain limits and the financing of assets in terms of short term liabilities (according to our terminology Deposits). Such regulatory constraints should also include the ones deriving from moral suasion. Especially during crisis times, with CDS levels making debt issuance particularly costly, management has incentives in increasing the assets monetizing very high credit spread, by financing such positions with short term debt. This increases the mismatch in duration especially during volatile times, strongly relying on the capability to roll on short maturity liabilities. The new Basel 3 rules also limit such incentives, by the introduction of some liquidity ratios. This will be a binding constraint even in the maximization below, as we will write in more detail.

We will rewrite the maximization by dividing every term in the sum by the level of equity. We might consider it a problem of maximization of Return on Tangible Equity, although S does reflect the value of equity given by the market and therefore it may differ from the tangible equity which is an accounting measure.

By defining

$$\lambda = \frac{A}{S};\ d = \frac{D}{S};\ b = \frac{B}{S}$$

and imposing that λ-b-d = 1, we may rewrite the maximization as

Max λ * (Euribor + spread) – d*eonia – (λ -1-d) *(Euribor + CDS) – c

Which gives two first order conditions, which represent in essence the capital structure equilibrium of a bank :

Eonia= euribor + CDS (Short term financing condition)

And

Spread = CDS + (λ -1 – d) * δCDS/δλ (No equity destruction condition)

We will derive below a closed formula for δCDS/δλ (derivative of the CDS with respect to the leverage parameter). For the purpose of a first set of qualitative conclusions we anticipate that δCDS/δλ is a positive number.

Such first order conditions describe the optimal capital structure in a specific moment, whereas the actual capital structure evolves every day according to the market quotes. In this sense we rewrite the interaction management – market not only giving the market the role to quote the CDS pricing the riskiness of the capital structure selected by the management; but also by determining the evolution of the capital structure driven by the evolution of the asset side of the balance sheet. Intuition suggests that if the assets drop in value then equity should drop by an identical amount, whereas Debt and Bond Issuance should stay stable within the period. Hence all ratios λ, b and d should increase in value.

Hence, in the understanding that the asset side of a bank is mainly composed by credit granted to the economy, we avail ourselves of the framework described in the above section, by writing (replacing Spread(t), for ease of notation, with s(t)):

$$A_t = A_{t-1} * [1 + CS01_A * (s_{t-1} - s_t)]$$

As mentioned a drop in the value of the assets will cause a decrease in the value of equity by an identical amount (ceteris paribus), which allows to write that

$$S_t = S_{t-1} + A_{t-1} * [CS01_A * (s_{t-1} - s_t)]$$

$$S_t = S_{t-1} * [1 + \lambda(t-1) * CS01_A * (s_{t-1} - s_t)]$$

If we assume that in the meanwhile the amount of bond issuance and deposit has not changed, then b(t) = B(t-1) / S(t), which gives

$$b(t) = \frac{B_{t-1}}{S(t-1) * [1 + \lambda_{t-1} * CS01_A * (s_{t-1} - s_t)]}$$

Hence

$$b(t) = \frac{b_{t-1}}{1 + \lambda_{t-1} * CS01_A * (s_{t-1} - s_t)}$$

Similarly we obtain that

$$\lambda(t) = \frac{\lambda_{t-1} * \left[1 + CS01_A * [s_{t-1} - s_t]\right]}{1 + \lambda_{t-1} * CS01_A * (s_{t-1} - s_t)}$$

These formulas of evolution of the capital structure through time show the relevance of the change in credit market conditions on the bank's capital structure. Most importantly they show that if management selects (and implements) an optimal capital structure at (t-1), then the market moves it away depending on the evolution of the credit market.

We will analyze in detail and comment on the extraordinary explanatory power on the current crisis of such conditions. For the moment it is important to notice that if a

bank has reached a steady state, then it satisfies the first order conditions above; as a result of steady state the bank produces a profit (to be measured as a percentage of equity) which is also the speed of growth of the assets: hence the assets grow at the same speed of equity and the leverage stays unchanged (hence λ, d and b are unchanged through time).

It would be too cumbersome to complete formally such general equilibrium approach, since it would require to model two crucial inputs in the profit and loss statement of the banks: internal costs and and non performing loans charges.

Few considerations on the results so far obtained

a) The choice in λ (leverage) ultimately depends on the sensitivity of CDS ($\delta CDS/\delta\lambda$) which in its turn depends on the probability of default. Such probability of default depends, among other things, from the volatility of assets. Hence the first intuition of this paper (optimal capital structure depends, among other things, from volatility of the assets) is confirmed and we will revisit this statement below on many occasions.
b) If a steady state is interrupted by a sudden shock on volatility the first order conditions will be immediately broken, since the probability of default will increase and the optimal leverage decrease. There are only 2 tools to satisfy again the first order conditions: reduce the assets or increase the capital (right issuance). We will see that both are difficult to implement; especially the second will take place when the survival of the bank is to be achieved by a strong decrease in the CDS level

Short term financing condition:

If no conditions on short term financing were imposed by the regulator, the management would converge towards a financing of the bank towards the short term, certainly cheaper than the long term financing by bond issuance (the latter implying a cost of Euribor + CDS). Clearly liabilities with a short term maturity expose the bank to risks of withdrawal or to the scenario of impossibility to roll such liabilities; such event may not be accommodated by sale of assets to pay for what due upon withdrawals. Ultimately the risk is systemic: a financial institution not capable of managing its liabilities spreads a panic well documented in literature as “run to the counter”. Furthermore the weaker the bank, the higher the incentive to be inclined towards short term financing, the weaker the financial equilibrium thus reached.

The financial crisis has witnessed a systemic attempt to finance with short term horizon: the unsecured deposit market was characterized by no offer of funds during the crisis. For this reason the European central bank had to intervene by introducing the full allotment tender (in the attempt to restore trust that the system would not collapse on a liquidity crunch). In that period the asset side of the central banks spiked to levels where (what in literature was deemed to be) the lender of last resort in practice was the only lender.
Hence the short term financing condition is meant to be satisfied with the restrictions imposed by regulators. The latter are the so called liquidity ratios, imposed exactly

after the difficulties of the current crisis, in the attempt to reduce the systemic impact of banks that may select very short term maturities when managing debt.

No equity destruction condition:

In the simple frame of this maximization, management should limit the increase of the assets up to the point where the yield earned from such asset is paid as cost on the bond issuance. Before that point it is worth expanding the assets since the liabilities are cheaper and after that point equity is destroyed since such costs of financing will not be paid for by the assets. Hence in this latter case of excess of Assets the equity holder will see through time a cost of bond issuance higher than the yield of the assets; such difference will be deducted from the return on equity. This paper does not consider the political constraint that a bank has to accept to expand the credit simply to facilitate the transmission of an accommodative political economy aiming at a growth of GDP rather than Bank's profit maximization.

As a matter of fact the CDS rise during a crisis time would lead to a massive asset reduction or at least to no growth at all according to this condition. This indeed would have been the logical and economical outcome if the banks had not been persuaded not to exacerbate the financial crisis by selecting a reduction on their asset side.

The topic of the equity distruction will be mentioned again in a section below, in the context of the difficulty of estimating key balance sheet variables when it comes to pinning down the actual amount of equity of a bank. We will mention various reasons why the latter amount is overestimated.

Probability of default.

So far we have treated P as a generic probability of default and we have dealt with the general equilibrium without specifying a parametrical assumption on P.

We will once more adopt the asset value representation of

$$A_t = A_{t-1} * [1 + CS01_A * (s_{t-1} - s_t)]$$

Adopting an infinitesimal approach, then the evolution of the asset may be rewritten as

$$dA_t = A_t * CS01_A * d[Spread_t]$$

We will assume that Spread (t) is normally distributed with mean equal to Spread(s) and variance σ*(t-s), for t>s. This leads to write

$$A_t = A_0 * \exp(-0.5 * t * (\sigma * CS01)^2 + \sigma * CS01 * s_t)$$

Condition of default is

$$A_t < B_t + D_t$$

By defining θ = CS01(A) *σ and L= [B(t) + D(t)] / A(0)

$$A_0 * exp(-t/2 * \theta^2 + \theta * s_t) < B_t + D_t$$

$$s_t < Ln(L)/\theta + \theta * t/2$$

Hence, by imposing some parametrical assumptions, we have derived an expression (which will lead to a close formula) for the generic condition above of

x< -1 + (B+D)/A

Where x was the generic return of the Asset.

The next assumption relates to L= [B(t) + D(t)] / A(0). If we assume that no particular changes will affect the sum of liabilities from time 0 to time t, hence B(t) +D(t) = B(0)+D(0) (i.e. we are simply assuming the Bond issuance is rolled on or converted into short term liabilities), then

[B(t) + D(t)] / A(0) = [b(0) + d(0)] / λ (0)

Hence

$$s_t < 1/\theta * Ln(\frac{b+d}{\lambda}) + \theta * t/2$$

Hence the probability of default is

$$P = \phi\left[\left(\frac{1}{\theta\sqrt{t}}\right) * Ln\left(\frac{b+d}{\lambda}\right) + \frac{\theta}{2}\sqrt{t}\right]$$

Where Φ(.) is the cumulative normal distribution of a Normal random variable with mean 0 and variance 1. When commenting the "No equity destruction condition", we have claimed that δCDS/δλ is a positive number. Indeed

δCDS/δλ= δCDS/δP * δP/δλ = δf/δP * δ Φ /δλ

δ Φ /δλ = p(.) * λ/ (b+d) * δ((λ-1)/ λ) / δ λ

where every factor is positive (p(.) is the density function of the normal random variable with zero mean and unit variance).

Both in the abstract of this article and in a section below we claim that volatility of the asset is crucial to explain the capital structure of a bank. Indeed by taking the derivative of the probability of default with respect to the volatility we obtain a positive number, which leads to the (logic) conclusion that the P (θ) is an increasing function.

$$\frac{\delta P}{\delta\theta} = p(.) * [0.5 * \sqrt{t} - Ln\left(\frac{b+d}{\lambda}\right) * \frac{1}{\theta^2\sqrt{t}}$$

Since (b+d)/ λ is a ratio lower than 1 , then its logarithm is negative. Hence the probability of default is an increasing function in the argument θ.

Hence the conditions describing the general equilibrium are

1. No equity destruction condition,
2. Market condition for determining the level of CDS
3. Parametrical assumptions of the Probability of default.

Respectively:

$$Spread = CDS + (\lambda - 1 - d) * \delta CDS/\delta\lambda$$

$$CDS = f(P, Yield, Rec) - Swap(T)$$

$$P = \phi\left[\left(\frac{1}{\theta\sqrt{t}}\right) * Ln\left(\frac{b+d}{\lambda}\right) + \frac{\theta}{2}\sqrt{t}\right]$$

Asymmetry of information: how much does it matter in the Debt space? A study on correlations

So far we have analyzed under many viewpoints the difficulty to estimate the assets value of a bank and therefore the consequences on the capital structure of the choice from management. In this section we want to provide an immediate consequence (and further confirmation) of the relevance of the asymmetry of information in the functioning of capital markets. If the market had a diversified approach, collecting and embedding into prices the specific information of the bank under scrutiny, then we would expect that level of CDS of different banks would not be very correlated, in light of their differences.

We find out instead that especially during crisis times the correlation spikes, almost signalling the difficulty of the market to estimate the value of the assets and to notice any difference across banks. If we run a linear regression analysis and we try to interpret the evolution of one CDS using as explaining variable the CDS of another bank, then the regressor does have explanatory power: we interpret the coefficients as adjustments for the different capital structure.
We then deduce the magnitude of the so called systemic risk. Banks CDS behave very similarly especially during volatile times: the market cannot tell the difference between one institution and another. This particular behaviour of prices generates a moral hazard mechanism that I will define "Global Consolidation". We will only give hints to this particular form of moral hazard and leave a more in depth analysis for future research.

In a more analytical framework the reasoning above translates into proving that we may deduce a probability of default from liquid indices quoted in the market: i.e. the level of such indices has a strong explanatory power on the probabilities of default derived from the CDS market. Therefore, according to the theoretical model above

$$CDS = f(P, Yield, Rec) - Swap(T)$$

(the market approach)

According to the parametrical assumptions introduced, then we have derived that such probability is to be determined as

$$P = \phi\left[\left(\frac{1}{\theta\sqrt{t}}\right) * Ln\left(\frac{b+d}{\lambda}\right) + \frac{\theta}{2}\sqrt{t}\right]$$

(

the balance sheet approach)

The expression for the probability of default has inputs which are bank specific, in terms of its capital structure, (b, d and λ), and the volatility of its assets, θ. If we show that such inputs can be replaced with market data, thus replacing such bank specific parameters, then we may conclude that the market cannot evaluate the specific balance sheet parameters with accuracy: it estimates them by considering liquid indices that approximate the evolution and the quality of the bank's balance sheet.

In particular we will consider the indices published by Markit iBoxx Data Services, and judge the explanatory power that such indices may have on the argument

$$\left(\frac{1}{\theta\sqrt{t}}\right) * Ln\left(\frac{b+d}{\lambda}\right) + \frac{\theta}{2}\sqrt{t}$$

If the probabilities obtained through the market approach can be explained in terms of

$$\phi[\alpha_i + \beta \quad * Index(t) + \gamma \quad \sigma_{Index}]$$

then we may conclude that the market is acting on a strong information asymmetry with respect to the management and that, for the purpose of estimating the evolution of the assets of the bank it adopts as proxies some publicly available liquid indices (by Vol(Index) we denote the standard deviation of the variable Index)

The asymmetry in information will be confirmed if, for different banks, we may approximate the CDS implied probabilities through the same liquid index.

From Information asymmetry typically we should expect an outcome where the market, acting in an uncertain environment, makes a very prudential and conservative evaluation of the assets. We will show that empirically the probability implicit in the CDS market may be obtained from the evolution of the Iboxx Index BBB 7-10, through the formula in [**], where the parameters α, β and γ are bank specific.

The reader may argue that a liquid index with a BBB rating is quite punitive when approximating the value of the assets: nevertheless we obtain R squared measures that do suggest the statistical significance of the Iboxx BBB index (and its volatility) in explaining the probabilities obtained from the market quotes of the CDS.

The phenomenon of lack of transparent information and the significance of the liquid indices in explaining the market quotes of CDS is not a sporadic phenomenon realized only for few banks. It is common to all banks in the sample (Italian, French and British): for all of them (restricting the sample to banks whose CDS is actively traded), we find that the probabilities implicit in the CDS can be computed from the value of the Index Iboxx, by means of Φ (α + β*Index +γ*Vol(Index)).

A first comment on such results is that the capital structure and the leverage of a bank depend daily upon the evolution of the credit market: Lack of bank specific information is such that the market estimates the evolution of the assets by adopting certain proxies which may reveal very poor estimators of the banking book value.

It is also interesting to analyze the coefficients that in the formula
Φ (α + β*Index +γ*Vol(Index)) approximate the probabilities expressed by the CDS market. High amounts of the coefficients mean a high sensitivity of the Bank to the evolution of the credit market.

A high Beta means that the leverage adopted is quite high and that movements in the credit market are not absorbed by the equity buffer of the bank.

Even more important is the magnitude of gamma, which will be crucial in analyzing how close the bank is from the phase of Debt Equityzation described below.

In this empirical section, we are implicitly proposing a new scheme to evaluate banks. Whereas analysts communicate to the market balance sheet ratios, we are here proposing a reading by means of coefficients that link the liabilities to the evolution of the credit market. The higher such coefficients, the more the bank transmits inputs from the credit market to its liabilities. More importantly balance sheet ratios are static whereas the coefficients estimated here have a signalling power on how much the equity of the bank will react when markets turn particularly volatile.

We will clarify below why the most important coefficient is gamma: intuitively, the more a bank is sensitive to the volatility of liquid indices, the more its equity is deemed depleted to provide a buffer against shocks on the credit market. Given the relevance of the so called SIFI (systematically important financial institutions), a strong dependence to the volatility makes the bank a vehicle of transmission of such volatility to the whole economy. Hence if regulators need to evaluate which banks require a higher capital, then the dependence of the default probabilities to the increase in volatility of liquid indices should matter and should provide a more accurate guidance than balance sheet ratios.

Before analyzing such values, it is important to notice that this data reflects the quotes of a market which (at least for the Italian banks) has witnessed a strong and aggregate deleverage by rights issuance (during the current year Intesa, Monte and Banco and in 2009 Unicredito have increased their capital). In spite of this change in capital structure, which is clearly not reflected in the values of the Iboxx indices, the relationship between Iboxx and capital structure of each bank is quite strong. The relationship is more accurate when we exclude the data of 2011.

Description of the Data

In order to assess the validity of the model we have used a sample of daily data, from April 2006 until May 2011. The choice of this sample relates to investigating the market behaviour during the current financial crisis.

For each issuer the database contains the daily closing value of the CDS Senior with maturity 5 years. We also have determined with daily frequency the yield of the German and UK government bonds with hypothetical maturity 5 years (by linear combination of bonds maturing around the 5y horizon); we also dispose of the swap rate for maturity 5 years in Euro and Sterling. All this data is obtained from Bloomberg. The series of IBoxx indices BBB 7-10 is instead provided by access to the Markit Database.

Empirical Evidence

We will briefly summarize the empirical results obtained from a sample of banks; The empirical section will continue also throughout other sections of the paper; the composition of the Iboxx Indices at particular dates is described in the appendix.

We estimate α, β and γ that minimize the sum of square differences between the inverse of the probability implicit in the CDS daily level and the linear expression
$\alpha + \beta * \text{Index} + \gamma * \text{Vol(Index)}$.

The inverse probability is determined by considering a cumulative normal distribution with mean zero and variance equal to 1.

The sample of data is chosen to avoid market events when the capital structure of the banking system undergoes a major change. For example, in United Kingdom there was a subscription of a relevant equity stake by the public sector in 2008. That is why the sample is cut to avoid data where the capital structure of an entire banking system was exogenously altered by public intervention.

Although we will explore such data in depth we immediately emphasize the importance of the multiplier gamma, which hints towards the issuers whose capital structure is weakest. If our theory is robust enough then we would expect a drop in gamma after the capital increase (or simply by extending the sample including the data both prior and after the capital increase).

A high gamma also signals the need of a recapitalization. The higher the R squared of the regression, the more robust the reasoning can be applied to the specific issuer.

We like to emphasize that the in all regressions the value of the R squared is particularly high for all issuers when the data is analyzed prior to the recapitalization event. After the value of gamma should theoretically be close to zero if the capital injection was welcomed as appropriate from the CDS market.

The table below is the picture of a sample of Banks just before entering a phase of recapitalization. The sample of Italian banks is therefore analyzed excluding 2011. The UK sample is then interrupted on the 13th of October 2008[3]. The French banks are analyzed instead without truncating the sample, since the French banking system has not experience yet a global recapitalization.

Issuer	Alpha	Beta	Gamma	R square	Start Sample	End Sample	Observations
Unicredit	-2.19357	22.22	4.6476	78.28%	11-Apr-06	31-Dec-10	1234
Intesa	-2.20338	20.6275	8.24567	70.953%	11-Apr-06	31-Dec-10	1234
Monte dei Paschi	-2.154	20.5508	9.25115	61.864%	11-Apr-06	31-Dec-10	1234
Banco	-2.11269	36.679	6.74594	74.469%	11-Apr-06	31-Dec-10	1234
BNP	-2.19357	19.2313	7.92333	67.057%	11-Apr-06	06-May-11	1311
Credite Agricole	-2.17033	20.9041	8.94146	64.627%	11-Apr-06	06-May-11	1311
Santander	-2.15194	21.8349	9.71465	63.127%	11-Apr-06	06-May-11	1311
Societe' Generale	-2.19029	21.7758	7.47993	68.557%	11-Apr-06	06-May-11	1311
Lloyds	-2.29854	32.13	12.316	88.345%	05-May-06	13-Oct-08	619
Royal Bank of Scotland	-2.32272	36.3226	16.9599	88.832%	05-May-06	13-Oct-08	619
Barclays	-2.03381	17.8421	0.08	73.115%	05-May-06	13-Oct-08	619
HBOS	-2.36416	44.1687	0.939653	90.928%	05-May-06	13-Oct-08	540
HSBC	-2.25352	29.1425	13.1887	83.197%	05-May-06	13-Oct-08	619
Abbey National	-2.28521	32.7213	9.78544	85.275%	05-May-06	13-Oct-08	619
Standard Chartered	-2.224	28.45	25.22	84.440%	05-May-06	13-Oct-08	619

[3] Monday October 13 (from the BBC web site):
"The government is to pump billions of pounds of taxpayers money into three UK banks in one of the UK's biggest nationalisations. Royal Bank of Scotland (RBS), Lloyds TSB and HBOS will have a total of £37bn injected into them".

The table above groups some of the major financial institutions with a strong commercial banking division before the wave of new capital injection, no matter if public or private (the latter through access to the equity market). Very high R squared do confirm the explanatory power of the Iboxx index on the probability of default implicit in the CDS market data.

If the theory and the empirical evidence here presented are consistent with the market reaction, a global capital structure change should cause a variation in both Beta and Gamma. We will analyze such reduction of coefficients after exploring in further depth the importance of gamma.

We also see that the market does unify the banks of one nation, since the coefficients are quite similar within the same region. We also conclude that this coefficients are a powerful measure of the systemic risk: it is easy to quantify the urgency to recapitalize the banking system. Such a measure of urgency is strongly understated by the standard ratios. This is particularly evident in the case of the United Kingdom. The coefficients in the regression are very high and significantly higher than the ones estimated for other banks (belonging to different regions). We would therefore deduce that a public intervention was strongly required; unfortunately ordinary balance sheet ratios would hardly suggest any particular need to rush for a recapitalization. In fact according to the the Tier 1 ratios and to the return on tangible Equity (estimated by the analyst community) a superficial reader would deduce a healthy UK banking system.

This is summarized in the table below:

Issuer	Alpha	Beta	Gamma	Price/Tangible Book	Stated Tier 1 ratio	Return on tangible equity	Date
Unicredit	-2.19357	22.22	4.6476	80.00%	9.60%	5.20%	31-Dec-10
Intesa SanPaolo	-2.20338	20.6275	8.24567	98.000%	9.00%	8.00%	31-Dec-10
Monte dei Paschi	-2.154	20.5508	9.25115	70.000%	8.50%	5.30%	31-Dec-10
Banco Popolare	-2.11269	36.679	6.74594	42.000%	8.00%	2.00%	31-Dec-10
BNP Paribas	-2.19357	19.2313	7.92333	122.000%	8.80%	14.90%	06-May-11
Credit Agricole	-2.17033	20.9041	8.94146	101.000%	7.20%	9.90%	06-May-11
Societe' Generale	-2.19029	21.7758	7.47993	110.000%	9.50%	12.80%	06-May-11
Santander	-2.15194	21.8349	9.71465	123.100%	8.30%	23.7	06-May-11
Barclays	-2.29689	35.3311	12.3903	82.000%	9.70%	20.10%	13-Oct-08
HBOS	-2.36416	44.1687	0.939653	32.000%	8.70%	15.40%	13-Oct-08
HSBC	-2.25352	29.1425	13.1887	174.000%	9.20%	17.80%	13-Oct-08
Lloyds	-2.29854	32.13	12.316	120.000%	8.70%	32.20%	13-Oct-08
Royal Bank of Scotland	-2.32272	36.3226	16.9599	41.000%	9.10%	6.70%	13-Oct-08
Standard Chartered	-2.224	28.45	25.22	170.000%	9.10%	22.60%	13-Oct-08

Beta and Gamma may be interpreted under different viewpoints:

i. An analyst and a regulator should prefer a reading as sensitivity of the capital structure to credit risk. Beta signals how much leverage is not protected by the equity buffer and is reflected into a worsening of default probabilities. Gamma instead speaks a language of shocks: the impact of volatility on the probabilities of default. Empirical analysis shows that once beta reaches a certain value, then gamma kicks in and makes the volatility a progressively more explanatory variable.

ii. From a trading prospective we may read the gamma also as the speed of acceleration of the leverage in a negative credit market environment. It may be compared to the gamma of an option (with inverted sign). This recalls the analogy of the bond holder being short a call (versus the equity holder being

long a call) on the value of the assets. The more the call approaches the " At the money" area , but still below 50% probability, the more the gamma increases and a shock on volatility is more relevant.

It is evident from the numbers above that United Kingdom was under a systemic risk (in October 2008) that resulted in a nationalization plan of the banking system (or part of it). The peculiarity of such intervention is that the support was injected directly by an entity rated AAA (the public sector), with the visible incentive of preserving the orderly functioning of the economy. Such a move was a signal to markets that anything necessary would have been enacted to preserve the stability of the banking system: it is to be expected then that the bailed out banks will lose after the nationalization date the dependence from the global market conditions, being effectively implicitly guaranteed by a AAA entity. Indeed, in line with expectations, R squared for such entities drop to zero.

The economy thus decreased the systemic risk, which shows on the coefficients of the banks who, although not bailed out, did have a benefit from the public sector intervention. We will consider the coefficients before and after the public sector intervention. For HSBC and Standard Chartered (where the R squared decreases, after October 2008 but still denoting meaningful relationships) the data provides these estimates of beta and gamma:

Issuer	Alpha	Beta	Gamma	R square	Sample	Standard Error Beta	Standard Error Gamma
HSBC	-2.25352	29.1425	13.1887	83.197%	Before October 2008	0.731053	3.05802
HSBC	-1.792	7.43226	-1.58658	60.493%	After October 2008	0.245159	0.790592
Standard Chartered	-2.224	28.45	25.22	84.440%	Before October 2008	0.727536	3.07929
Standard Chartered	-1.447343	14.8647	0.3145	80.194%	After October 2008	0.311933	1.0072

Global Consolidation

Global consolidation can be seen as one consequence of the correlation just explained above. As a matter of facts banks cannot be considered autonomous firms: it is impossible to isolate one default since they involve a systemic risk dealing with public deposit and potentially hampering global trust. Hence an analyst willing to assess the soundness of a bank should not look at its balance sheet but compose a global consolidation of all banks that present a high level of correlation. This is why the banks of one country should all be consolidated (improperly) to assess the average leverage and the average amount of equity. A consequence of such global consolidation is that from the point of view of an investor, he may be more subject to adverse Mark to Market movements, but in selecting the riskier debt (higher CDS) the actual default of one bank will be very likely to trigger a default for all banks in the system. In order to avoid this domino effect the intervention of the regulators in their moral suasion of merging good banks with lower quality banks will be one of the tool to isolate the danger represented by weaker banks. If the central bank is the lender of last resort, the public sector will become the equity buyer of last resort, thus guaranteeing a transitory solution to a capital structure when the latter is off its optimal point. This further role of the public sector suggests that in this improper global consolidation not only all banks should be consolidated, but also the public debt should be included. Equity, financial debt and public debt should represent a

unique side of a balance sheet because, although legally different, the mechanisms of transmission simply transfer the burden from one to the other. Further development of this reasoning goes well beyond the scope of this paper, but this section simply offers a reason why correlation across financial institution and public sector is increasingly more important. It also explains why financial crisis and public debt crisis are two faces of the same coin. It should not be a surprise at this stage that empirically , especially in times of stress, financial CDS of different issuers can be explained with a linear relation with a good level of approximation, even when the analysis is made on daily data. This theoretical framework and the empirical section above offer a valid explanation of such phenomenon.

The path off the first order conditions: endogenous capital structure and Equityzation of debt.

General equilibrium models typically explain an equilibrium where a system converges with subsequent adjustments. When Moral hazard and information asymmetry are introduced in the system, then the convergence to a general equilibrium is no longer guaranteed. In the financial system described so far banks have an incentive to tap into the short term financing (D in our notation) in order to use a higher leverage without paying for the bond issuance (Euribor + CDS), thus making the remaining economy bear the risk of a more likely default. Lack of transparency gives incentive to evaluate the banking book, from an accounting viewpoint, to higher levels with respect to the market estimate. This is confirmed by the empirical evidence that the market frequently estimates the equity of a bank less than its "Tangible equity", i.e. the accounting value obtained deducting from the accounting measure of equity the intangible assets.

With asymmetry of information and moral hazard playing such a key role, we should not expect the system's capability to converge towards the equilibrium described by first order conditions. The purpose of this section is to comment on what happens when the system is shocked from a steady state by a financial crisis.

In spite of its simplicity the model is robust enough to have a good explanatory power of the main consequences when a steady state is shocked.

A rise in Credit spreads (in our notation s(t)) is immediately observed by the market by means of liquid indices; hence a drop in the estimated value A immediately takes place. By adopting the same logical steps described above, CDS increases, volatility increases, profitability and equity drop. At this stage, the amount of leverage is excessive and the first order conditions suggest a reduction in leverage. Reducing leverage may mean

i. Asset disposal
ii. Rights issuance

Instead banks, when positioned in a point not satisfying the "No equity destruction condition" have an incentive in not adjusting their capital structure towards the optimal point by adopting the optimal leverage reduction. In particular

i. Asset disposal: during CDS widening times, the price of Credit (meant as asset class) tends to drop (due to high correlation across all issuers). As a result, if banks sold some of their portfolio when required so by the first order conditions, they would crystallize a loss given the accounting treatment of the banking book (assets are not marked to market when held in the Loan&receivable book). Although the rationale is only driven by a mere accounting approach, banks tend to sell only if the mark to market of certain assets is higher than the balance sheet price. This clearly holds when banks are called to optimal adjustments and not when banks have to sell for liquidity reasons (banks not in a forced selling status). It is also not a coincidence that during the actual financial crisis some banks have sold their "non core"

assets: certainly a way to reduce their leverage without affecting their core activity.

ii. Rights issuance: in a nutshell, if an asset disposal forces the bank to crystallize a loss, then a capital increase forces the shareholder to crystallize a loss. Analysts refer to "shareholders dilution" and actually they mean something more. Price/Book lower than 1 means that the market does not believe the accounting value and determines the equity value of the bank by an autonomous estimate of the assets. For the point above, it is immediate to see why the value of the assets estimated by the market should be inferior to the book value. Chances are that the estimate of the assets is very cautious due to lack of transparency. In a way the market marks down the value of the banks in the generic widening of credit, without the possibility to have an "ad hoc" assessment. The haircut of equity with respect to its "Tangible value" sometimes is substantial (price to book ratio well below 100%). In that case it is evident that a right issuance means, for existing shareholders to give up a substantial possibility of recovery in the asset value. The new shareholder buys the bank at cheap levels in the sense that participates to the upside when the market has expressed quite punitive estimates of the assets during crisis times. Such upside is subtracted (partially) to the old shareholders who clearly influence management to make sure that the optimal deleverage may not happen by means of right issuance. Not to mention incentives in opposing a rights issuance when such a move may mean change in the control of the bank.

The reasoning above well justifies that a deleverage may not happen although optimal. It is not rare then that banks may drift away from first order conditions rather than converge towards them. Suboptimal equilibria are then very common thus entailing increasing CDS levels. In this paper, although informally, I will even state that banks, once off from the first order conditions and when unable to reinstate a deleverage program, have strong incentives in moving even further away from an optimal capital structure equilibrium. With a rise in CDS level, their profitability jeopardizes the growth of equity and return on equity decreases. Their typical reaction is then to increase (rather than decrease) the leverage by purchasing only assets ECB deliverable for the purpose of financing (thus increasing D and not B). This generates the phenomenon analysts refer to as "Carry trades", to boost profitability which otherwise would be quite poor. The most common ECB deliverable assets are government bonds and a testimony may be retrieved by analyzing the ratios between government bonds and equity prior and after the crisis.

CDS levels on such a drift away from first order conditions rise so much that the profitability of the bank would be negative if the entire bond issuance had to be rolled at the new levels expressed by the market in such suboptimal equilibrium. Hence banks react by segregating certain assets and by ring fencing them to guarantee only new bond issuance. In other words, in order to cheapen the cost of the new issuance, necessary to finance the assets when some of the liabilities expire, banks subtract the generic guarantee (represented by the asset side of the balance sheet) to the old bond holders, who face a dramatic decrease of recovery value should the bank run into default by the time the old bonds expire. Such guarantee is the new specific collateral

(ad hoc assets) on which the new issuance has priority of call in case of default. This is the explanation of what the market calls "Covered Bonds", certainly the most frequent format of bond issuance during recent crises times.

So far the capital structure is assumed as if decided by the management in a maximization on Return of equity problem. We have distinguished so far between equity (S), Bond Issuance (B) and short terms maturities (D). With these 3 categories we have decomposed the whole liability side of the bank and have determined the optimal capital structure as satisfying certain first order conditions. I would like to claim that these categories are very rigid and that they are quite realistic only if the bank equilibrium is in a proximity of the first order conditions. When the bank drifts away from first order conditions equilibrium instead the interpretation of the capital structure should not be seen as static but quite dynamic. The writer is strongly inclined to believe that capital structure(when away from the equilibrium) is endogenous rather than decided by management. What the industry calls debt or equity is only a legal framework. In these crises times equity may become debt, in the sense that the actual enterprise risk is subscribed by bond holders (consciously or unconsciously). I will refer to this theory or particular state of the capital structure as "Equityzation of Debt", surely the most important intuition I mean to convey by writing this paper.

Equityzation of debt is the state of a bank running almost on zero profitability, with a rising level of CDS, a depressed price to book ratio and, more importantly a yield on Bond issuance superior to the return on tangible equity: in other words bond holders earn more from their holding than equity holders (carry wise, without considering the loss from the drop in equity prices). We are quite far away from an optimal capital structure and eventually the capital structure has evolved to a point where the actual risk of the bank is all absorbed by the bond holders who, for this reason, earn a yield higher than equity holders. The equity is not yet zero and the actual upside in equity is a rapid increase in the assets of the bank (benign general conditions in credit). The buffer offered by the (actual, i.e. not determined through accounting records) equity is so low that an event of default would see a severe haircut (low recovery value) on the bonds. In practice Equityzation of debt is evident especially when even covered bonds offer a higher yield than equity. Being the return on equity so low, dividends may not be distributed (or they will be negligible anyway). A further spike in volatility and CDS levels would cause the bank to reduce its equity: at that stage the management, even when satisfying the minimum capitalization criteria cannot ignore the message from the market and must announce a rights issuance. If it did not proceed this way, the bank would, upon a further shock, enter the negative profitability territory and gradually destroy its equity, making it fully Bond financed and capitalized.

Equityzation of debt is the last step of distance from the optimal capital structure. When it happens and the bank still operates a sustainable core activity it usually triggers the announcement of a rights issuance, since such capital structure would not be sustanaible for long.

If instead the core activity of the bank has turned quite poor, then the lack of appetite in subscribing further equity makes it impossible to announce a rights issuance. Hence the debate turns on the debt and on the necessity to impose a haircut of the latter in order to impose an orderly default. The debate on the debt of troubled banks (Ireland

could be an example) can be considered in this fashion: in the acknowledgment that the debt was the actual equity, then a haircut or (with similar effect) a tender on the subordinated debt well below its nominal value is nothing more than a debt reduction as if we were dealing with equity.

A formal framework describing the phase of Equityzation of Debt

Driven by the intuition described above, the phase of Debt Equityzation is a departure from the first order conditions: the leverage perceived (or estimated, in light of the information asymmetry) by the market is so high that the ratio (b+d)/ λ is very close to 1. By analyzing the market conditions and disregarding the "no equity destruction condition" (we are assuming that we are off the optimal leverage point), then in the phase of Debt Equityzation the following conditions hold:

$$CDS = f(P, Yield, Rec) - Swap(T)$$

$$P = \phi\left[\left(\frac{1}{\theta\sqrt{t}}\right) * Ln\left(\frac{b+d}{\lambda}\right) + \frac{\theta}{2}\sqrt{t}\right]$$

The second equation may be rewritten, for a large value of λ (λ = b+d+1), as

$$P = \phi\left[-\varepsilon + \frac{\theta}{2}\sqrt{t}\right]$$

where ε is a arbitrarily small.

Although the result just obtained heavily depends upon a parametrical assumption and is clearly an extreme example, it conveys a crucial intuition: poorly capitalized banks have a cost of bond issuance driven mainly by the volatility of assets. The latter cannot be estimated by the market if not by estimate from liquid indices adopted as proxies. More importantly, when probabilities of default reflect a distress status (over 50%, since the capital structure offer no longer any protection), the only relevant input is volatility.

Such formula also explains why a short positions on poorly capitalized banks are a recurrent trade to gain in market environment of rising systemic volatility. By short position on poorly capitalized banks we mean a position where a market player buys protection on a default of a poorly capitalized bank. Ceteris paribus a raise in volatility will make the CDS increase its market level and therefore that will translate into a Mark to Market profit for the protection buyer. Such market behaviour exacerbates the problem up to the point that some governments have introduced restrictions on short positions.

Being the target of protection buyers and with limited supply of protection in the market, the levels of CDS for the banks in the phase of Debt Equityzation is subject to a sharp rise. The bank then can no longer issue Debt at a sustainable cost and one of the solutions left to management is a leverage reduction by approving a capital increase.

Clearly we are describing a limit scenario, since probability of defaults determined as Φ (θ /2) are probabilities over 50%, hence signalling a strong distress on the market.

This limit case though explains why it is important to distinguish between issuers whose probability of default finds an explanatory power in terms of volatility of liquid indices and other issuers where volatility does not play a significant role. We will then conclude that the first have a weaker capital structure with respect to the latter and have a smaller distance from the point of Debt Equityzation. Whereas analysts and regulators focus on balance sheet ratios, statistical evidence gives importance to how a bank is acting as transmission mechanism for volatility and leverage (respectively gamma and beta in the analysis above.

We derive that poorly capitalized banks have a capital structure (or, more simply a cost of Bond issuance) extremely sensitive to volatility and therefore an optimal move from management should be to hedge such short volatility position. Such hedging may take place by issuance of subordinated debt whose performance is linked to the volatility of the main indices of credit and/ or equity. The idea is further discussed in a section below.

Although not modelled in this paper it is evident that the systemic interdependence of banks operating within the same environment (or economy) generates a correlation in the CDS movements driven, in volatile markets, mainly by the weakest banks, who prove to be the most reactive to worsening credit conditions and volatile markets.

It is hard to derive formally such intuition from the framework adopted, but at this stage we simply convey the intuition that Debt Equityzation is not a phase concerning only the bank with excessive leverage, but is a concern for the whole economy, since the correlation across institutions generates worsening credit conditions globally.

In a way, the capitalization wave that we are witnessing reflects the attempt to move the economy farther away from a point of Debt Equityzation. Basel 3 has taken the strategic choice to see banks recapitalized mainly through equity issuance. In this particular moment of the market such issuance has proved to be very difficult and value destroying, in some cases, for the existing shareholders. As mentioned above, it may be worth considering the design of subordinated debt whose payments/ redemptions are linked to the volatility realized in the market.

Debt equityzation has a strong explanatory power on the evolution we are witnessing in these days on many CDS levels. The relevance of detecting when an issuer is approaching a phase of Debt Equityzation is in acknowledging that such bank operates as transmission vehicles of volatility through the economy. The market deems that the balance sheet simply does not have enough equity for the amount of debt issued and given the estimate of the value of the assets.

From a mere statistical point of view, detecting if a bank is in a phase of Debt Equityzation requires that the market does quote CDS having as underlying that particular Issuer. If this is a case, then during a phase of Debt Equityzation, the volatility of the main liquid indices has a strong explanatory power on the probabilities of default implied by the CDS.

It is important to emphasize that this paper is not pointing at any bank by stating that they are running on a poor capital base, nor they are experiencing a phase of Debt Equityzation. We are simply looking at certain distressed moments of the financial

markets when banks may be closest in their history to the phase of Debt Equityzation. This concept is also translated by numbers which prove consistent with the intuitions and are validated by high levels of R squared.

Let us then consider the period just before the capital increase the closest point to the Debt Equityzation; then the sample including all data points should show lower estimated parameters if compared to the ones estimated only prior to the capital increase. This is the case for the Italian banks (considering the entire sample and afterwards dropping all observations in the year 2011). Once we consider the entire sample, then we notice a reduction in the gamma coefficients. Such reduction although numerically minute, is quite relevant, since the portion of sample including data after the capital increase is less than 10% of the entire sample. Hence the reduction of the gamma once the empirical analysis is extended to all data is quite meaningful.

Issuer	Alpha	Beta	Gamma	R square	Start	End	Observations
Intesa SanPaolo	-2.20338	20.6275	8.24567	70.953%	11-Apr-06	31-Dec-10	1234
Intesa SanPaolo	-2.1953	21.1804	7.55011	68.378%	11-Apr-06	06-May-11	1324
Monte dei Paschi	-2.154	20.5508	9.25115	61.864%	11-Apr-06	31-Dec-10	1234
Monte dei Paschi	-2.14506	21.3665	8.95066	58.732%	11-Apr-06	06-May-11	1324
Banco Popolare	-2.11269	36.679	6.74594	74.469%	11-Apr-06	31-Dec-10	1234
Banco Popolare	-2.10035	24.18	6.07702	70.853%	11-Apr-06	06-May-11	1324
Unicredit	-2.17056	22.22	4.6476	78.28%	11-Apr-06	31-Dec-10	1234
Unicredit	-2.16226	22.1254	2.90543	77.12%	11-Apr-06	06-May-11	1324

This data is to be paired with the data presented above when describing the UK economy and the capital injection of 2008. In that case the sample has sufficient observations after and prior to the recapitalization event, hence we compare the parameters across different samples rather than estimating them on the entire set of data.

It is worth noting that gamma decreases even for the bank that has not (yet) communicated any capital increase: Unicredit. A further confirmation that a capital increase is an event for the economy and not only for the single bank.

The coefficients derived through this empirical section catch this peculiar aspect which, instead, ordinary balance sheet ratios cannot explain.

Running on zero equity and actual default: when asymmetry of information makes these events different. The relevance of Goodwill

In most academic literature the event of default is described as the value of Assets dropping below the value of the liabilities. The relevance of asymmetry in information is such that it is impossible to observe such an event, therefore the default itself is driven by an estimate of the market. Defaulting entities are no longer given trust from the market and there is no price to roll their liabilities. If no other mechanism may kick in to redeem the debt due, then the financial institution defaults primarily for a stress on liquidity conditions. Hence if a financial institution is robust enough not to be dependent from the institutional market, then there is a logical possibility that it may preserve an ongoing concern although running on zero (or negative) equity.

Hence there is a logical possibility whereby published ratios of a bank may be compliant with the minima imposed by regulators, the actual value of equity close to zero, the institutional market unavailable to roll any of the liabilities, yet the bank would be preserving the amounts of liabilities by tapping into the local retail market. When such event takes place CDS levels are very high and the assumption of this paper where the liabilities have to offer a yield of Euribor + CDS is no longer valid.

Clearly this is an extreme and provocative example, but explains why most of the issuers have turned primarily to their local clients to roll their liabilities rather than facing the much higher costs imposed by the institutional market.

If we consider that most of the issuers do not have a traded CDS and that the smallest banks roll their liabilities only in the retail market, the provocation of running on zero equity may be a widespread fact with no possibility from an ordinary investor to be detected.

Only regulators have the power to inspect the consistencies of the asset side of a balance sheet and deem if it is solid enough to make the institution solvent given the outstanding liabilities.

These few considerations lead to reconsider the value of immaterial assets like goodwill. Any analyst would subtract the goodwill since it cannot be monetized in the event of liquidation; its amount merely derives, in most cases, from accounting considerations from the past acquisitions of the bank.

Goodwill does then have a value and is the one we would derive if we applied the cost of Euribor + CDS to the whole bond issuance versus the actual cost of such liabilities. The difference of the 2 amounts is the annual contribution of Goodwill to the results of the year. By forecasting the cost of Euribor + CDS on the entire bond issuance, we could be concluding that the bank would run on constant loss and we would then conclude that the bank is therefore running on zero equity. This is the power of information asymmetry, which is the main inspiring theme of this paper. What we deem a solvent institution may be instead running on zero equity. When CDS are quoted, an institutional market will professionally run an estimate on the value of the assets, and high level of CDS will signal that such estimate is quite punitive with

respect to the published accounting values. It is a strong signal for management to intervene in restoring a higher level of transparency, changing leverage, increasing capital.

Design of the new generation Subordinated Debt and comparison across ratios

In this paper we have adopted the simplifying approach of assuming the liability side of a balance sheet composed only of 3 main building blocks: deposits, Bonds and equity. Such a design of the capital structure is quite consistent with the target of the new rules designed by regulators. Banks will be mainly equity measured when it comes to measuring their robustness for regulatory purposes and the role of subordinated debt will be downplayed if compared to the past. Yet, such criteria and ratios base themselves on a pure accounting approach and by a measure of risk known as Risk Weighted Assets. On the other hand market seems to measure the strength of a bank by its resilience to credit market fluctuations. In this paper we have summarized such a resilience by means of 2 parameters, where the starting point was market data rather than balance sheet data. We have also concluded that such parameters do change when significant events like capital increases take place. This market approach, more importantly, proves consistent even when built on daily data.

Although a capital increase is the best tool aiming at a deleverage of a bank, market appetite is a strong constraint making such tool very expensive. That is why we believe that the role of subordinated debt, although of poor relevance from a mere regulatory viewpoint, may be engineered to reduce the dependence of the capital structure from the volatility of the credit market.

In particular, some subordinated debt may be issued with a clause that automatically reschedules the maturity if the level of volatility rises above a certain threshold. This particular category of Debt would provide an automatic rollover of liabilities, thus preventing that a lack of trust due to volatile conditions may jeopardize the roll of liabilities when most needed. This would generate implicitly a demand for options on credit spreads and the price for such volatility could transfer the risk of shocks on credit on other market players less systemically relevant. In this particular stage, credit market shocks are absorbed by the Equity of the banks or to the next market player mostly correlated with banks (we have maintained above that such market player in most cases is the government), depending on the size of equity available.

This automatic transmission also generates the particular form of Moral Hazard named in this paper “Global Consolidation”. Such a design of subordinated debt may weaken this transmission and generate a liquid market for volatility on the credit market. The market of volatility on CDS exists, but a big demand does not converge on the market due to a lack of regulatory incentives which may acknowledge the benefit for implementing these strategic trades.

Also, similar liabilities would be preferred to the digital risk of “Loss absorption” currently required by the new generation of subordinated securities. Not only such loss is typically determined by accounting measurements, but the necessary yield for

placing such securities is estimated sometimes even higher than the Return on Tangible Equity, i.e. the return for shareholders.

Developing in further depth the topic of new contractual terms of subordinated debt is not in the purposes of this paper. Certainly it is of interest to make a comparison from the most common ratios published within balance sheets and analysts at the end of sample and the parameters derived in terms of this model. We have presented this evidence above and have concluded that balance sheet ratios have a limited signalling power.

Conclusions

In this paper we propose a general equilibrium model where the management of a bank chooses the optimal capital structure by maximizing the Return on Equity. Market instead determines the cost of such capital structure by quoting the level of CDS, thus determining the cost of the Bond Issuance.

We argue that management acts in a context of information asymmetry, in the extent that it can observe the value of the assets and the volatility, whereas the market can only make an educated guess on such values. Hence the market determines estimates which may be structurally and permanently different from the values reported in the audited financials.

The problem of information asymmetry exacerbates when the general equilibrium is shocked and an optimal deleverage cannot be implemented: management does not have any accounting or regulatory incentive to accomodate an optimal deleverage, since that would entail some losses from an accounting viewpoint which would signal to the market a reduced profitability.

We then enter a phase where the equity of the bank is overstated with respect to the value estimated by the market. Price to Book ratios below 100% do signal this phase. A suboptimal capital structure makes the bank more vulnerable to adverse credit conditions and its cost of liabilities excessive if compared to the profitability of the assets. We consider this phase as a breach of the first order conditions. The bank therefore enters a phase where it gradually and endogenously erodes its equity, due to the rising cost of liabilities.

The equity then offers little protection to the bondholders and the CDS quotes in the market imply a probability of default that may be explained in terms of

- Movement of liquid credit indices
- Volatility of the latter.

What systemically is more relevant is that when the volatility of the credit market is a good explanatory power for the probability of default, then banks approach a phase called Debt Equityzation where debt holders are actually bearing the risk of the firm, as if they were equity holders.

Empirically we notice that prior to a major recapitalization effort, all banks in the sample show a dependence on the volatility of the Iboxx indices. They reduce such dependence after the capital increase. In the empirical section we conclude that the parameters showing the degree of dependence of default probabilities from the credit market have more informative power than standard balance sheet ratios.

The role of volatility in the capital structure may trigger a new role of subordinated debt making the bank less volatility dependent.

Appendix

The rules of composition, update, drop out of single elements of the Iboxx indices are summarized on the web site http://www.markit.com and will not be reported here. We will report the composition of the indices on the last observation of the sample or subsample considered

Composition of the Iboxx EURO 5-7 Index overall BBB on the date 31st of December 2010.

Issuer	Ticker	Coupon	Maturity Broad	Security Description	Issue Level 1	Issue Level 3
DEUTSCHE TELEKOM INT FIN	DT	6.625	29-Mar-2018	DT 6 5/8 03/29/18	Corporate: Non- Financials	Telecommunications
COMPAGNIE FIN ET INDUS	VINCI	5.25	30-Apr-2018	VINCI 5 1/4 04/30/18	Corporate: Non- Financials	Industrial Goods & Services
NATIONAL GRID PLC	NGGLN	5	02-Jul-2018	NGGLN 5 07/02/18	Corporate: Non- Financials	Utilities
FINMECCANICA FINANCE	FNCIM	5.75	12-Dec-2018	FNCIM 5 3/4 12/12/18	Corporate: Non- Financials	Industrial Goods & Services
TELECOM ITALIA SPA	TITIM	5.375	29-Jan-2019	TITIM 5 3/8 01/29/19	Corporate: Non- Financials	Telecommunications
REPUBLIC OF HUNGARY	REPHUN	3.875	24-Feb-2020	REPHUN 3 7/8 02/24/20	Sub-Sovereigns	Foreign Sovereign
NATIONAL GRID PLC	NGGLN	4.375	10-Mar-2020	NGGLN 4 3/8 03/10/20	Corporate: Non- Financials	Utilities
BARCLAYS BANK PLC	BACR	4.75	--	BACR 4 3/4 03/29/49	Corporate: Financials	Banks
LAFARGE SA	LGFP	4.75	23-Mar-2020	LGFP 4 3/4 03/23/20	Corporate: Non- Financials	Construction & Materials
ABERTIS INFRAESTRUCTURAS	ABESM	4.375	30-Mar-2020	ABESM 4 3/8 03/30/20	Corporate: Non- Financials	Industrial Goods & Services
BOUYGUES SA	BOUY	4.25	22-Jul-2020	BOUY 4 1/4 07/22/20	Corporate: Non- Financials	Construction & Materials
GAZPROM (GAZ CAPITAL SA)	GAZPRU	6.605	13-Feb-2018	GAZPRU 6.605 02/13/18	Corporate: Non- Financials	Oil & Gas
SOCIETE GENERALE	SOCGEN	6.999	--	SOCGEN 6.999 12/29/49	Corporate: Financials	Banks
UBS AG JERSEY BRANCH	UBS	7.152	--	UBS 7.152 12/29/49	Corporate: Financials	Banks
SKANDINAVISKA ENSKILDA	SEB	7.092	--	SEB 7.0922 12/29/49	Corporate: Financials	Banks
ROYAL BK OF SCOTLAND PLC	RBS	6.934	09-Apr-2018	RBS 6.934 04/09/18	Corporate: Financials	Banks
WOLTERS KLUWER NV	WKLNA	6.375	10-Apr-2018	WKLNA 6 3/8 04/10/18	Corporate: Non- Financials	Media
DB CONT CAP TRUST IV	DB	8	--	DB 8 05/29/49	Corporate: Financials	Banks
AVIVA PLC	AVLN	6.875	22-May-2038	AVLN 6 7/8 05/22/38	Corporate: Financials	Insurance
UNICREDIT SPA	UCGIM	6.7	05-Jun-2018	UCGIM 6.7 06/05/18	Corporate: Financials	Banks
REPUBLIC OF HUNGARY	REPHUN	5.75	11-Jun-2018	REPHUN 5 3/4 06/11/18	Sub-Sovereigns	Foreign Sovereign
DAA FINANCE PLC	DAAFIN	6.587	09-Jul-2018	DAAFIN 6.5872 07/09/18	Corporate: Non- Financials	Industrial Goods & Services
KONINKLIJKE KPN NV	KPN	7.5	04-Feb-2019	KPN 7 1/2 02/04/19	Corporate: Non- Financials	Telecommunications
ASF	VINCI	7.375	20-Mar-2019	VINCI 7 3/8 03/20/19	Corporate: Non- Financials	Industrial Goods & Services
STATKRAFT AS	STATK	6.625	02-Apr-2019	STATK 6 5/8 04/02/19	Corporate: Non- Financials	Utilities
DONG ENERGY A/S	DANGAS	6.5	07-May-2019	DANGAS 6 1/2 05/07/19	Corporate: Non- Financials	Utilities
GAS NATURAL CAPITAL	GASSM	6.375	09-Jul-2019	GASSM 6 3/8 07/09/19	Corporate: Non- Financials	Utilities
SOCIETE GENERALE	SOCGEN	9.375	--	SOCGEN 9 3/8 09/29/49	Corporate: Financials	Banks
GROUPAMA SA	CCAMA	7.875	27-Oct-2039	CCAMA 7 7/8 10/27/39	Corporate: Financials	Insurance
AREVA SA	CEIFP	4.375	06-Nov-2019	CEIFP 4 3/8 11/06/19	Corporate: Non- Financials	Industrial Goods & Services
PORTUGAL TELECOM INT FIN	PORTEL	5	04-Nov-2019	PORTEL 5 11/04/19	Corporate: Non- Financials	Telecommunications
VIVENDI SA	VIVFP	4.875	02-Dec-2019	VIVFP 4 7/8 12/02/19	Corporate: Non- Financials	Telecommunications
UNICREDIT INTL BANK	UCGIM	8.125	--	UCGIM 8 1/8 12/29/49	Corporate: Financials	Banks
HERA SPA	HERIM	4.5	03-Dec-2019	HERIM 4 1/2 12/03/19	Corporate: Non- Financials	Utilities
LAFARGE SA	LGFP	5.5	16-Dec-2019	LGFP 5 1/2 12/16/19	Corporate: Non- Financials	Construction & Materials
GAS NATURAL CAPITAL	GASSM	4.5	27-Jan-2020	GASSM 4 1/2 01/27/20	Corporate: Non- Financials	Utilities
GAS NATURAL CAPITAL	GASSM	4.125	26-Jan-2018	GASSM 4 1/8 01/26/18	Corporate: Non- Financials	Utilities
EXPERIAN FINANCE PLC	EXPNLN	4.75	04-Feb-2020	EXPNLN 4 3/4 02/04/20	Corporate: Non- Financials	Industrial Goods & Services
BOUYGUES SA	BOUY	4	12-Feb-2018	BOUY 4 02/12/18	Corporate: Non- Financials	Construction & Materials
SES SA	SESGLX	4.625	09-Mar-2020	SESGLX 4 5/8 03/09/20	Corporate: Non- Financials	Media
DEUTSCHE TELEKOM INT FIN	DT	4.25	16-Mar-2020	DT 4 1/4 03/16/20	Corporate: Non- Financials	Telecommunications
ALSTOM	ALOFP	4.5	18-Mar-2020	ALOFP 4 1/2 03/18/20	Corporate: Non- Financials	Industrial Goods & Services
ITALCEMENTI FINANCE	ITCIT	5.375	19-Mar-2020	ITCIT 5 3/8 03/19/20	Corporate: Non- Financials	Construction & Materials
LLOYDS TSB BANK PLC	LLOYDS	6.5	24-Mar-2020	LLOYDS 6 1/2 03/24/20	Corporate: Financials	Banks
MERCK FIN SERVICES GMBH	MRKGR	4.5	24-Mar-2020	MRKGR 4 1/2 03/24/20	Corporate: Non- Financials	Health Care
VALE SA	VALEBZ	4.375	24-Mar-2018	VALEBZ 4 3/8 03/24/18	Corporate: Non- Financials	Basic Resources
AUTOROUTES DU SUD DE LA	VINCI	4.125	13-Apr-2020	VINCI 4 1/8 04/13/20	Corporate: Non- Financials	Industrial Goods & Services
LAFARGE SA	LGFP	5	13-Apr-2018	LGFP 5 04/13/18	Corporate: Non- Financials	Construction & Materials
MONTE DEI PASCHI SIENA	MONTE	5	21-Apr-2020	MONTE 5 04/21/20	Corporate: Financials	Banks
AXA SA	AXASA	5.25	16-Apr-2040	AXASA 5 1/4 04/16/40	Corporate: Financials	Insurance
ANHEUSER-BUSCH INBEV SA	ABIBB	4	26-Apr-2018	ABIBB 4 04/26/18	Corporate: Non- Financials	Food & Beverage
CASINO GUICHARD PERRACH	COFP	4.481	12-Nov-2018	COFP 4.481 11/12/18	Corporate: Non- Financials	Retail
BAT HOLDINGS BV	BATSLN	4	07-Jul-2020	BATSLN 4 07/07/20	Corporate: Non- Financials	Personal & Household Goods
NATIONWIDE BLDG SOCIETY	NWIDE	6.75	22-Jul-2020	NWIDE 6 3/4 07/22/20	Corporate: Financials	Banks
UNICREDIT SPA	UCGIM	9.375	--	UCGIM 9 3/8 07/29/49	Corporate: Financials	Banks
MONTE DEI PASCHI SIENA	MONTE	5.6	09-Sep-2020	MONTE 5.6 09/09/20	Corporate: Financials	Banks
KONINKLIJKE KPN NV	KPN	3.75	21-Sep-2020	KPN 3 3/4 09/21/20	Corporate: Non- Financials	Telecommunications
ALSTOM	ALOFP	3.625	05-Oct-2018	ALOFP 3 5/8 10/05/18	Corporate: Non- Financials	Industrial Goods & Services
KINGDOM OF MOROCCO	MOROC	4.5	05-Oct-2020	MOROC 4 1/2 10/05/20	Sub-Sovereigns	Foreign Sovereign
COMPAGNIE DE ST GOBAIN	SGOFP	4	08-Oct-2018	SGOFP 4 10/08/18	Corporate: Non- Financials	Construction & Materials
CORIO NV	CORANA	4.625	22-Jan-2018	CORANA 4 5/8 01/22/18	Corporate: Financials	Financial Services
EUROGRID GMBH	EUROGR	3.875	22-Oct-2020	EUROGR 3 7/8 10/22/20	Corporate: Non- Financials	Utilities
SNS BANK NV	SNSSNS	6.25	26-Oct-2020	SNSSNS 6 1/4 10/26/20	Corporate: Financials	Banks
SOCIETA INIZ AUTOSTRADAL	SISIM	4.5	26-Oct-2020	SISIM 4 1/2 10/26/20	Corporate: Non- Financials	Industrial Goods & Services
BANCO POPOLARE SC	BPIM	6	05-Nov-2020	BPIM 6 11/05/20	Corporate: Financials	Banks
LAFARGE SA	LGFP	5.375	29-Nov-2018	LGFP 5 3/8 11/29/18	Corporate: Non- Financials	Construction & Materials

Composition of the Iboxx EURO 5-7 Index overall BBB on the date 6th of May 2011.

Issuer	Ticker	Coupon	Maturity Broad	Security Description	Issue Level 1	Issue Level 3
COMPAGNIE FIN ET INDUS	VINCI	5.25	30-Apr-2018	VINCI 5 1/4 04/30/18	Corporate: Non- Financials	Industrial Goods & Services
NATIONAL GRID PLC	NGGLN	5	02-Jul-2018	NGGLN 5 07/02/18	Corporate: Non- Financials	Utilities
FINMECCANICA FINANCE	FNCIM	5.75	12-Dec-2018	FNCIM 5 3/4 12/12/18	Corporate: Non- Financials	Industrial Goods & Services
TELECOM ITALIA SPA	TITIM	5.375	29-Jan-2019	TITIM 5 3/8 01/29/19	Corporate: Non- Financials	Telecommunications
TREASURY 4 1/2% 2020	IRISH	4.5	18-Apr-2020	IRISH 4 1/2 04/18/20	Sovereign	Domestic
REPUBLIC OF HUNGARY	REPHUN	3.875	24-Feb-2020	REPHUN 3 7/8 02/24/20	Sub-Sovereigns	Foreign Sovereign
OBRIGACOES DO TESOURO	PGB	3.85	15-Apr-2021	PGB 3.85 04/15/21	Sovereign	Domestic
NATIONAL GRID PLC	NGGLN	4.375	10-Mar-2020	NGGLN 4 3/8 03/10/20	Corporate: Non- Financials	Utilities
BARCLAYS BANK PLC	BACR	4.75	--	BACR 4 3/4 03/29/49	Corporate: Financials	Banks
LAFARGE SA	LGFP	4.75	23-Mar-2020	LGFP 4 3/4 03/23/20	Corporate: Non- Financials	Construction & Materials
ABERTIS INFRAESTRUCTURAS	ABESM	4.375	30-Mar-2020	ABESM 4 3/8 03/30/20	Corporate: Non- Financials	Industrial Goods & Services
BOUYGUES SA	BOUY	4.25	22-Jul-2020	BOUY 4 1/4 07/22/20	Corporate: Non- Financials	Construction & Materials
TREASURY 4 1/2% 2018	IRISH	4.5	18-Oct-2018	IRISH 4 1/2 10/18/18	Sovereign	Domestic
OBRIGACOES DO TESOURO	PGB	4.45	15-Jun-2018	PGB 4.45 06/15/18	Sovereign	Domestic
TREASURY 4.4% 2019	IRISH	4.4	18-Jun-2019	IRISH 4.4 06/18/19	Sovereign	Domestic
DB CONT CAP TRUST IV	DB	8	--	DB 8 05/29/49	Corporate: Financials	Banks
AVIVA PLC	AVLN	6.875	22-May-2038	AVLN 6 7/8 05/22/38	Corporate: Financials	Insurance
AMERICAN INTL GROUP	AIG	8	22-May-2038	AIG 8 05/22/38	Corporate: Financials	Insurance
UNICREDIT SPA	UCGIM	6.7	05-Jun-2018	UCGIM 6.7 06/05/18	Corporate: Financials	Banks
REPUBLIC OF HUNGARY	REPHUN	5.75	11-Jun-2018	REPHUN 5 3/4 06/11/18	Sub-Sovereigns	Foreign Sovereign
DAA FINANCE PLC	DAAFIN	6.587	09-Jul-2018	DAAFIN 6.5872 07/09/18	Corporate: Non- Financials	Industrial Goods & Services
KONINKLIJKE KPN NV	KPN	7.5	04-Feb-2019	KPN 7 1/2 02/04/19	Corporate: Non- Financials	Telecommunications
OBRIGACOES DO TESOURO	PGB	4.75	14-Jun-2019	PGB 4 3/4 06/14/19	Sovereign	Domestic
ASF	VINCI	7.375	20-Mar-2019	VINCI 7 3/8 03/20/19	Corporate: Non- Financials	Industrial Goods & Services
STATKRAFT AS	STATK	6.625	02-Apr-2019	STATK 6 5/8 04/02/19	Corporate: Non- Financials	Utilities
DONG ENERGY A/S	DANGAS	6.5	07-May-2019	DANGAS 6 1/2 05/07/19	Corporate: Non- Financials	Utilities
TREASURY 5.9% 2019	IRISH	5.9	18-Oct-2019	IRISH 5.9 10/18/19	Sovereign	Domestic
GAS NATURAL CAPITAL	GASSM	6.375	09-Jul-2019	GASSM 6 3/8 07/09/19	Corporate: Non- Financials	Utilities
SOCIETE GENERALE	SOCGEN	9.375	--	SOCGEN 9 3/8 09/29/49	Corporate: Financials	Banks
GROUPAMA SA	CCAMA	7.875	27-Oct-2039	CCAMA 7 7/8 10/27/39	Corporate: Financials	Insurance
AREVA SA	CEIFP	4.375	06-Nov-2019	CEIFP 4 3/8 11/06/19	Corporate: Non- Financials	Industrial Goods & Services
PORTUGAL TELECOM INT FIN	PORTEL	5	04-Nov-2019	PORTEL 5 11/04/19	Corporate: Non- Financials	Telecommunications
BAT INTL FINANCE PLC	BATSLN	4.875	24-Feb-2021	BATSLN 4 7/8 02/24/21	Corporate: Non- Financials	Personal & Household Goods
VIVENDI SA	VIVFP	4.875	02-Dec-2019	VIVFP 4 7/8 12/02/19	Corporate: Non- Financials	Telecommunications
UNICREDIT INTL BANK	UCGIM	8.125	--	UCGIM 8 1/8 12/29/49	Corporate: Financials	Banks
HERA SPA	HERIM	4.5	03-Dec-2019	HERIM 4 1/2 12/03/19	Corporate: Non- Financials	Utilities
LAFARGE SA	LGFP	5.5	16-Dec-2019	LGFP 5 1/2 12/16/19	Corporate: Non- Financials	Construction & Materials
GAS NATURAL CAPITAL	GASSM	4.5	27-Jan-2020	GASSM 4 1/2 01/27/20	Corporate: Non- Financials	Utilities
TREASURY 5% 2020	IRISH	5	18-Oct-2020	IRISH 5 10/18/20	Sovereign	Domestic
EXPERIAN FINANCE PLC	EXPNLN	4.75	04-Feb-2020	EXPNLN 4 3/4 02/04/20	Corporate: Non- Financials	Industrial Goods & Services
OBRIGACOES DO TESOURO	PGB	4.8	15-Jun-2020	PGB 4.8 06/15/20	Sovereign	Domestic
SES SA	SESGLX	4.625	09-Mar-2020	SESGLX 4 5/8 03/09/20	Corporate: Non- Financials	Media
DEUTSCHE TELEKOM INT FIN	DT	4.25	16-Mar-2020	DT 4 1/4 03/16/20	Corporate: Non- Financials	Telecommunications
ALSTOM	ALOFP	4.5	18-Mar-2020	ALOFP 4 1/2 03/18/20	Corporate: Non- Financials	Industrial Goods & Services
ITALCEMENTI FINANCE	ITCIT	5.375	19-Mar-2020	ITCIT 5 3/8 03/19/20	Corporate: Non- Financials	Construction & Materials
MERCK FIN SERVICES GMBH	MRKGR	4.5	24-Mar-2020	MRKGR 4 1/2 03/24/20	Corporate: Non- Financials	Health Care
CARREFOUR SA	CAFP	4	09-Apr-2020	CAFP 4 04/09/20	Corporate: Non- Financials	Retail
AUTOROUTES DU SUD DE LA	VINCI	4.125	13-Apr-2020	VINCI 4 1/8 04/13/20	Corporate: Non- Financials	Industrial Goods & Services
MONTE DEI PASCHI SIENA	MONTE	5	21-Apr-2020	MONTE 5 04/21/20	Corporate: Financials	Banks
AXA SA	AXASA	5.25	16-Apr-2040	AXASA 5 1/4 04/16/40	Corporate: Financials	Insurance
CASINO GUICHARD PERRACH	COFP	4.481	12-Nov-2018	COFP 4.481 11/12/18	Corporate: Non- Financials	Retail
BAT HOLDINGS BV	BATSLN	4	07-Jul-2020	BATSLN 4 07/07/20	Corporate: Non- Financials	Personal & Household Goods
NATIONWIDE BLDG SOCIETY	NWIDE	6.75	22-Jul-2020	NWIDE 6 3/4 07/22/20	Corporate: Financials	Banks
UNICREDIT SPA	UCGIM	9.375	--	UCGIM 9 3/8 07/29/49	Corporate: Financials	Banks
CARREFOUR SA	CAFP	3.875	25-Apr-2021	CAFP 3 7/8 04/25/21	Corporate: Non- Financials	Retail
MONTE DEI PASCHI SIENA	MONTE	5.6	09-Sep-2020	MONTE 5.6 09/09/20	Corporate: Financials	Banks
AREVA SA	CEIFP	3.5	22-Mar-2021	CEIFP 3 1/2 03/22/21	Corporate: Non- Financials	Industrial Goods & Services
KONINKLIJKE KPN NV	KPN	3.75	21-Sep-2020	KPN 3 3/4 09/21/20	Corporate: Non- Financials	Telecommunications
ALSTOM	ALOFP	3.625	05-Oct-2018	ALOFP 3 5/8 10/05/18	Corporate: Non- Financials	Industrial Goods & Services
KINGDOM OF MOROCCO	MOROC	4.5	05-Oct-2020	MOROC 4 1/2 10/05/20	Sub-Sovereigns	Foreign Sovereign
COMPAGNIE DE ST GOBAIN	SGOFP	4	08-Oct-2018	SGOFP 4 10/08/18	Corporate: Non- Financials	Construction & Materials
EUROGRID GMBH	EUROGR	3.875	22-Oct-2020	EUROGR 3 7/8 10/22/20	Corporate: Non- Financials	Utilities
SNS BANK NV	SNSSNS	6.25	26-Oct-2020	SNSSNS 6 1/4 10/26/20	Corporate: Financials	Banks
SOCIETA INIZ AUTOSTRADAL	SISIM	4.5	26-Oct-2020	SISIM 4 1/2 10/26/20	Corporate: Non- Financials	Industrial Goods & Services
BOUYGUES SA	BOUY	3.641	29-Oct-2019	BOUY 3.641 10/29/19	Corporate: Non- Financials	Construction & Materials
BANCO POPOLARE SC	BPIM	6	05-Nov-2020	BPIM 6 11/05/20	Corporate: Financials	Banks
LAFARGE SA	LGFP	5.375	29-Nov-2018	LGFP 5 3/8 11/29/18	Corporate: Non- Financials	Construction & Materials
SES SA	SESGLX	4.75	11-Mar-2021	SESGLX 4 3/4 03/11/21	Corporate: Non- Financials	Media
AMCOR LTD	AMCOR	4.625	16-Apr-2019	AMCOR 4 5/8 04/16/19	Corporate: Non- Financials	Industrial Goods & Services
COMMERZBANK AG	CMZB	7.75	16-Mar-2021	CMZB 7 3/4 03/16/21	Corporate: Financials	Banks
COMMERZBANK AG	CMZB	6.375	22-Mar-2019	CMZB 6 3/8 03/22/19	Corporate: Financials	Banks

Composition of the Iboxx GBP 5-7 Index overall BBB on the date 13th of October 2008.

Issuer	Ticker	Coupon	Maturity Broad	Security Description	Issue Level 1	Issue Level 3
HUTCHISON PORTS FINANCE	HUWHY	6.75	07-Dec-2015	HUWHY 6 3/4 12/07/15	Corporate: Non- Financials	Industrial Goods & Services
SMITHS GROUP PLC	SMINLN	7.25	30-Jun-2016	SMINLN 7 1/4 06/30/16	Corporate: Non- Financials	Industrial Goods & Services
LINDE FINANCE BV	LINGR	6.5	29-Jan-2016	LINGR 6 1/2 01/29/16	--	--
BRITISH TELECOM PLC	BRITEL	8	07-Dec-2016	BRITEL 7 1/2 12/07/16	Corporate: Non- Financials	Telecommunications
AGGREGATE INDUSTRIES PLC	HOLZSW	7.25	31-May-2016	HOLZSW 7 1/4 05/31/16	Corporate: Non- Financials	Construction & Materials
NORTHUMBRIAN WATER FIN	NWGLN	6	11-Oct-2017	NWGLN 6 10/11/17	Corporate: Non- Financials	Utilities
SAFEWAY LTD	MRWLN	6	10-Jan-2017	MRWLN 6 01/10/17	Corporate: Non- Financials	Retail
AHOLD FINANCE USA INC	AHOLD	6.5	14-Mar-2017	AHOLD 6 1/2 03/14/17	Corporate: Non- Financials	Retail
UPM-KYMMENE CORP	UPMKYM	6.625	23-Jan-2017	UPMKYM 6 5/8 01/23/17	Corporate: Non- Financials	Basic Resources
TALISMAN ENERGY INC	TLM	6.625	05-Dec-2017	TLM 6 5/8 12/05/17	Corporate: Non- Financials	Oil & Gas
LAFARGE	LGFP	6.625	29-Nov-2017	LGFP 6 5/8 11/29/17	Corporate: Non- Financials	Construction & Materials
ACQUEDOTTO PUGLIESE SPA	ACQUED	6.92	29-Jun-2018	ACQUED 6.92 06/29/18	Corporate: Non- Financials	Utilities
ANGLIAN WATER SERV FIN	AWLN	5.5	10-Oct-2040	AWLN 5 1/2 10/10/40	Collateralised	Securitized
TELECOM ITALIA SPA	TITIM	5.625	29-Dec-2015	TITIM 5 5/8 12/29/15	Corporate: Non- Financials	Telecommunications
BRITANNIA BLDG SOCIETY	BRITNA	5.556	--	BRITNA 5.5555 12/29/49	Corporate: Financials	Banks
BRIXTON PLC	BXTN	5.25	21-Oct-2015	BXTN 5 1/4 10/21/15	Corporate: Financials	Financial Services
BSKYB FINANCE UK PLC	BSY	5.75	20-Oct-2017	BSY 5 3/4 10/20/17	Corporate: Non- Financials	Media
RL FINANCE BONDS PLC	RLMI	6.125	--	RLMI 6 1/8 12/29/49	Corporate: Financials	Insurance
HAMMERSON PLC	HMSOLN	5.25	15-Dec-2016	HMSOLN 5 1/4 12/15/16	Corporate: Financials	Financial Services
TELEFONICA EMISIONES SAU	TELEFO	5.375	02-Feb-2018	TELEFO 5 3/8 02/02/18	Corporate: Non- Financials	Telecommunications
BAT HOLDINGS BV	BATSLN	5.5	15-Sep-2016	BATSLN 5 1/2 09/15/16	Corporate: Non- Financials	Personal & Household Goods
KONINKLIJKE KPN NV	KPN	5.75	18-Mar-2016	KPN 5 3/4 03/18/16	Corporate: Non- Financials	Telecommunications
RENTOKIL INITIAL PLC	RENTKL	5.75	31-Mar-2016	RENTKL 5 3/4 03/31/16	Corporate: Non- Financials	Industrial Goods & Services
DERBYSHIRE BUILDING SOC	DERBS	6	--	DERBS 6 03/29/49	Corporate: Financials	Banks
AMLIN PLC	AMLIN	6.5	19-Dec-2026	AMLIN 6 1/2 12/19/26	Corporate: Financials	Insurance
RSA INSURANCE GROUP PLC	RSA	6.701	--	RSA 6.701 05/29/49	Corporate: Financials	Insurance
COVENTRY BLDG SOCIETY	COVBS	6.092	--	COVBS 6.092 06/29/49	Corporate: Financials	Banks
LONDON STOCK EXCHANGE PL	LSELN	6.375	07-Jul-2016	LSELN 5 7/8 07/07/16	Corporate: Financials	Financial Services
LINDE FINANCE BV	LINGR	8.125	14-Jul-2066	LINGR 8 1/8 07/14/66	Corporate: Non- Financials	Chemicals
QBE CAPITAL FUNDING LP	QBE	6.857	--	QBE 6.857 07/29/49	Corporate: Financials	Insurance
NEXT PLC	NXT	5.875	12-Oct-2016	NXT 5 7/8 10/12/16	Corporate: Non- Financials	Retail
BEAZLEY GROUP PLC	BEZLN	7.25	17-Oct-2026	BEZLN 7 1/4 10/17/26	Corporate: Financials	Insurance
NBOG FUNDING LIMITED	ETEGA	6.289	--	ETEGA 6.2889 11/29/49	Corporate: Financials	Banks
COMPAGNIE DE ST GOBAIN	SGOFP	5.625	15-Dec-2016	SGOFP 5 5/8 12/15/16	Corporate: Non- Financials	Construction & Materials
IMPERIAL TOBACCO FINANCE	IMTLN	5.5	22-Nov-2016	IMTLN 5 1/2 11/22/16	Corporate: Non- Financials	Personal & Household Goods
INVESTEC FINANCE PLC	INVES	6.25	--	INVES 6 1/4 01/29/49	Corporate: Financials	Financial Services
AMERICAN INTL GROUP	AIG	5.75	15-Mar-2067	AIG 5 3/4 03/15/67	Corporate: Financials	Insurance
WPP GROUP PLC	WPPLN	6	04-Apr-2017	WPPLN 6 04/04/17	Corporate: Non- Financials	Media
BRITISH TELECOM PLC	BRITEL	6.625	23-Jun-2017	BRITEL 6 5/8 06/23/17	Corporate: Non- Financials	Telecommunications
CATTLES PLC	CATTLE	7.125	05-Jul-2017	CATTLE 7 1/8 07/05/17	Corporate: Financials	Financial Services
THAMES WATER UTIL CAYMAN	THAMES	7.241	09-Apr-2058	THAMES 7.241 04/09/58	Corporate: Non- Financials	Utilities
AMERICAN INTL GROUP	AIG	8.625	22-May-2038	AIG 8 5/8 05/22/38	Corporate: Financials	Insurance
GOODMAN AUSTRALIA FIN	GMGAU	9.75	16-Jul-2018	GMGAU 9 3/4 07/16/18	Corporate: Financials	Financial Services
CADBURY SCHWEPPES FIN	CBRYLN	7.25	18-Jul-2018	CBRYLN 7 1/4 07/18/18	Corporate: Non- Financials	Food & Beverage
TNT N.V.	TNTNA	7.5	14-Aug-2018	TNTNA 7 1/2 08/14/18	Corporate: Non- Financials	Industrial Goods & Services
FIRSTGROUP PLC	FGPLN	8.125	19-Sep-2018	FGPLN 8 1/8 09/19/18	Corporate: Non- Financials	Travel & Leisure

Composition of the Iboxx GBP 5-7 Index overall BBB on the date 8th of July 2011.

Issuer	Ticker	Coupon	Maturity Broad	Security Description	Issue Level 1	Issue Level 3
COMMERZBANK AG	CMZB	6.625	30-Aug-2019	CMZB 6 5/8 08/30/19	Corporate: Financials	Banks
HIGHBURY FINANCE BV	HIGHB	7.017	20-Mar-2023	HIGHB 7.017 03/20/23	Collateralised	Mortgage Backed
HAMMERSON PLC	HMSOLN	6.875	31-Mar-2020	HMSOLN 6 7/8 03/31/20	Corporate: Financials	Financial Services
BRITISH TELECOM PLC	BRITEL	8.625	26-Mar-2020	BRITEL 8 5/8 03/26/20	Corporate: Non- Financials	Telecommunications
WESTERN POWER DISTRIBUT	PPL	9.25	09-Nov-2020	PPL 9 1/4 11/09/20	Corporate: Non- Financials	Utilities
TEXTRON INC	TXT	6.625	07-Apr-2020	TXT 6 5/8 04/07/20	Corporate: Non- Financials	Industrial Goods & Services
AXA SA	AXASA	7.125	15-Dec-2020	AXASA 7 1/8 12/15/20	Corporate: Financials	Insurance
BIRMINGHAM AIRPORT PLC	BIRMIN	6.25	22-Feb-2021	BIRMIN 6 1/4 02/22/21	Corporate: Non- Financials	Industrial Goods & Services
DEUTSCHE TELEKOM INT FIN	DT	7.375	04-Dec-2019	DT 7 3/8 12/04/19	Corporate: Non- Financials	Telecommunications
PUNCH TAVERNS FINANCE B	PUNTAV	5.943	30-Dec-2024	PUNTAV 5.943 12/30/24	Collateralised	Securitized
DANSKE BANK A/S	DANBNK	5.375	29-Sep-2021	DANBNK 5 3/8 09/29/21	Corporate: Financials	Banks
IMPERIAL TOBACCO FINANCE	IMTLN	6.25	04-Dec-2018	IMTLN 6 1/4 12/04/18	Corporate: Non- Financials	Personal & Household Goods
FRIENDS PROVIDENT GROUP	FRIPRO	6.875	--	FRIPRO 6 7/8 11/29/49	Corporate: Financials	Insurance
BAT INTL FINANCE PLC	BATSLN	6.375	12-Dec-2019	BATSLN 6 3/8 12/12/19	Corporate: Non- Financials	Personal & Household Goods
FIRSTGROUP PLC	FGPLN	6.125	18-Jan-2019	FGPLN 6 1/8 01/18/19	Corporate: Non- Financials	Travel & Leisure
CO-OPERATIVE BANK PLC	COOPWH	5.75	02-Dec-2024	COOPWH 5 3/4 12/02/24	Corporate: Financials	Banks
LEGAL & GENERAL GROUP	LGEN	5.875	--	LGEN 5 7/8 03/29/49	Corporate: Financials	Insurance
TELECOM ITALIA SPA	TITIM	6.375	24-Jun-2019	TITIM 6 3/8 06/24/19	Corporate: Non- Financials	Telecommunications
SOUTH EAST WATER FIN LTD	SEWLTD	5.658	30-Sep-2019	SEWLTD 5.6577 09/30/19	Collateralised	Securitized
STANDARD LIFE PLC	STALIF	6.546	--	STALIF 6.546 01/29/49	Corporate: Financials	Insurance
AVIVA PLC	AVLN	5.902	--	AVLN 5.9021 11/29/49	Corporate: Financials	Insurance
BUPA FINANCE PLC	BUPA	6.125	--	BUPA 6 1/8 09/29/49	Corporate: Financials	Insurance
GREENE KING FINANCE PLC	GNKLN	5.702	15-Dec-2034	GNKLN 5.702 12/15/34	Collateralised	Asset Backed
OLD MUTUAL PLC	OLDMUT	6.376	--	OLDMUT 6.376 03/29/49	Corporate: Financials	Insurance
PUNCH TAVERNS FINANCE B	PUNTAV	4.767	30-Jun-2033	PUNTAV 4.767 06/30/33	Collateralised	Securitized
MARSTONS ISSUER PLC	MARSLN	5.641	15-Jul-2035	MARSLN 5.641 07/15/35	Collateralised	Securitized
SOUTHERN GAS NETWORK PLC	SGN	4.875	21-Dec-2020	SGN 4 7/8 12/21/20	Corporate: Financials	Insurance-wrapped
GLENCORE FINANCE EUROPE	GLEINT	6.5	27-Feb-2019	GLEINT 6 1/2 02/27/19	Corporate: Non- Financials	Basic Resources
ELM BV (SWISS REIN CO)	RUKNVX	6.302	--	RUKNVX 6.3024 03/29/49	Corporate: Financials	Insurance
KONINKLIJKE KPN NV	KPN	6	29-May-2019	KPN 6 05/29/19	Corporate: Non- Financials	Telecommunications
AXA SA	AXASA	6.772	--	AXASA 6.772 10/29/49	Corporate: Financials	Insurance
WPP FINANCE SA	WPPLN	6.375	06-Nov-2020	WPPLN 6 3/8 11/06/20	Corporate: Non- Financials	Media
VECTOR LTD	VCTNZ	7.625	14-Jan-2019	VCTNZ 7 5/8 01/14/19	Corporate: Non- Financials	Utilities
XSTRATA CANADA FIN CORP	XTALN	7.375	27-May-2020	XTALN 7 3/8 05/27/20	Corporate: Non- Financials	Basic Resources
GOODMAN AUSTRALIA FIN	GMGAU	9.75	16-Jul-2018	GMGAU 9 3/4 07/16/18	Corporate: Financials	Financial Services
KRAFT FOODS INC	KFT	7.25	18-Jul-2018	KFT 7 1/4 07/18/18	Corporate: Non- Financials	Food & Beverage
POSTNL	PNLNA	7.5	14-Aug-2018	PNLNA 7 1/2 08/14/18	Corporate: Non- Financials	Industrial Goods & Services
FIRSTGROUP PLC	FGPLN	8.125	19-Sep-2018	FGPLN 8 1/8 09/19/18	Corporate: Non- Financials	Travel & Leisure
FIRSTGROUP PLC	FGPLN	8.75	08-Apr-2021	FGPLN 8 3/4 04/08/21	Corporate: Non- Financials	Travel & Leisure
FINMECCANICA FINANCE	FNCIM	8	16-Dec-2019	FNCIM 8 12/16/19	Corporate: Non- Financials	Industrial Goods & Services
G4S PLC	GFSPLN	7.75	13-May-2019	GFSPLN 7 3/4 05/13/19	Corporate: Non- Financials	Industrial Goods & Services
RSA INSURANCE GROUP PLC	RSALN	9.375	20-May-2039	RSALN 9 3/8 05/20/39	Corporate: Financials	Insurance
FRIENDS PROVIDENT GROUP	FRIPRO	12	21-May-2021	FRIPRO 12 05/21/21	Corporate: Financials	Insurance
LONDON STOCK EXCHANGE PL	LSELN	9.125	18-Oct-2019	LSELN 9 1/8 10/18/19	Corporate: Financials	Financial Services
IMPERIAL TOBACCO FINANCE	IMTLN	7.75	24-Jun-2019	IMTLN 7 3/4 06/24/19	Corporate: Non- Financials	Personal & Household Goods
NORTHERN GAS NETWORKS	NGN	5.875	08-Jul-2019	NGN 5 7/8 07/08/19	Corporate: Non- Financials	Utilities
PROVIDENT FINANCIAL PLC	PFGLN	8	23-Oct-2019	PFGLN 8 10/23/19	Corporate: Financials	Financial Services
SOUTHERN GAS NETWORK PLC	SGN	5.125	02-Nov-2018	SGN 5 1/8 11/02/18	Corporate: Non- Financials	Utilities
TATE & LYLE INTL FIN PLC	TATELN	6.75	25-Nov-2019	TATELN 6 3/4 11/25/19	Corporate: Non- Financials	Food & Beverage
MARKS & SPENCER PLC	MKS	6.125	02-Dec-2019	MKS 6 1/8 12/02/19	Corporate: Non- Financials	Retail
ESB FINANCE LIMITED	ESBIRE	6.5	05-Mar-2020	ESBIRE 6 1/2 03/05/20	Corporate: Non- Financials	Utilities
WALES & WEST UTL FIN PLC	WWUF	6.75	17-Dec-2036	WWUF 6 3/4 12/17/36	Collateralised	Securitized
PORTERBROOK RAIL FIN LTD	PORTER	6.5	20-Oct-2020	PORTER 6 1/2 10/20/20	Collateralised	Asset Backed
NATIONAL EXPRESS GROUP P	NEXLN	6.625	17-Jun-2020	NEXLN 6 5/8 06/17/20	Corporate: Non- Financials	Travel & Leisure
GREAT ROLLING STOCK PLC	GRSCL	6.25	27-Jul-2020	GRSCL 6 1/4 07/27/20	Collateralised	Asset Backed
BAA FUNDING LTD	BAA	6.25	10-Sep-2018	BAA 6 1/4 09/10/18	Collateralised	Securitized
FIDELITY INTERNATIONAL L	FIDINT	6.75	19-Oct-2020	FIDINT 6 3/4 10/19/20	Corporate: Financials	Financial Services
EVERSHOLT FUNDING PLC	EVEHOL	5.831	02-Dec-2020	EVEHOL 5.831 12/02/20	Collateralised	Asset Backed
EXPERIAN FINANCE PLC	EXPNLN	4.75	23-Nov-2018	EXPNLN 4 3/4 11/23/18	Corporate: Non- Financials	Industrial Goods & Services
VIRGIN MEDIA SECURED FIN	VMED	5.5	15-Jan-2021	VMED 5 1/2 01/15/21	Corporate: Non- Financials	Telecommunications
CO-OPERATIVE BANK PLC	COOPWH	9.25	28-Apr-2021	COOPWH 9 1/4 04/28/21	Corporate: Financials	Banks
CO-OPERATIVE GROUP LTD	COOPWH	5.625	08-Jul-2020	COOPWH 5 5/8 07/08/20	Corporate: Non- Financials	Retail
QBE CAP FUNDING II LP	QBEAU	7.5	24-May-2041	QBEAU 7 1/2 05/24/41	Corporate: Financials	Insurance
AVIVA PLC	AVLN	6.625	03-Jun-2041	AVLN 6 5/8 06/03/41	Corporate: Financials	Insurance
OLD MUTUAL PLC	OLDMUT	8	03-Jun-2021	OLDMUT 8 06/03/21	Corporate: Financials	Insurance
PORTERBROOK RAIL FIN LTD	PORTER	5.5	20-Apr-2019	PORTER 5 1/2 04/20/19	Collateralised	Asset Backed

References

Ashcraft, A. (2008) Does the market discipline bank? New evidence from regulatory capital mix, Journal of Financial Intermediation 17, 543–561.
Berger, A., DeYoung, R., Flannery, M., Lee, D. and O¨ ztekin, O¨ . (2008) How do large banking organizations manage their capital ratios? Journal of Financial Services Research 34, 123–149.
Berger, A., Herring, R. and Szeg¨o, G. (1995) The role of capital in financial institutions, Journal of Banking and Finance 19, 393–430.
Brewer, E., Kaufman, G. andWall, L. (2008) Bank capital ratios across countries:Why do they vary? Journal of Financial Services Research 34, 177–201.
THE DETERMINANTS OF BANK CAPITAL STRUCTURE 621
Caballero, R. and Engel, E. (2004) Adjustment is much slower than you think, unpublished working paper, MIT and Yale University.
Diamond, D. and Rajan, R. (2000) A theory of bank capital, Journal of Finance 55, 2431–2465.
Flannery, M., Kwan, S. and Nimalendran, M. (2004) Market Evidence on the opaqueness of banking firms' assets, Journal of Financial Economics 71, 419–460.
Flannery, M. and Rangan, K. (2006) Partial adjustment toward target capital structures, Journal of Financial Economics 79, 469–506.
Flannery, M. and Sorescu, S. (1996) Evidence of bank market discipline on subordinated debenture yields: 1983–1991, Journal of Finance 51, 1347–1377.
Frank, M. and Goyal, V. (2004) Capital structure decisions: Which factors are reliably important? Financial Management forthcoming.
Gropp, R. (2004) Bank market discipline and indicators of banking system risk: The European evidence, in: C. Borio, W. Hunter, G. Kaufman and K. Tsatsaronis (eds.), Market Discipline across Countries and Industries, MIT Press, Cambridge, MA, pp. 101–117.
Harris, M. and Raviv, A. (1991) The theory of capital structure, Journal of Finance 46, 297–356.
Miller, M. (1995) Do the M&M propositions apply to banks? Journal of Banking and Finance 19,483–489.Mishkin, F. (2000) The Economics of Money, Banking and Financial Markets, 6th edition, Addison Wesley, New York.
Modigliani, F. and Miller, M. (1958) The cost of capital, corporation finance and the theory ofinvestment, American Economic Review 48, 261–297.
Peura, S. and Keppo, J. (2006) Optimal bank capital with costly recapitalization, Journal of Business 79, 2162–2201.
Rauh, J. and Sufi, A. (2008) Capital structure and debt structure, unpublished working paper, University of Chicago.
Santos, J. (2001) Bank capital regulation in contemporary banking theory: A review of the literature,Financial Markets, Institutions & Instruments 10, 41–84.
Titman, S. and Wessels (1988) The determinants of capital structure choice, Journal of Finance 43,1–19