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Modigliani-Miller Doesn't Hold in a "Bailinable" World:

A New Capital Structure to Reduce the Banks' Funding Cost

Angelo Baglioni* - Marcello Esposito**

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Abstract. *To protect retail investors from the bail-in rule, we propose that banks should issue subordinated "contractual bail-in instruments", as defined in the BRRD, for an amount (together with Tier1 capital) at least equal to 8% of their liabilities. We support our argument by means of a theoretical model, where retail investors are uncertainty averse, due to their lack of information about the new "bailinable" regime. To the contrary, institutional investors are better informed. Within this framework, a bank is able to reduce the cost of debt by splitting it into a junior and a senior tranche, sold to institutional and retail investors respectively. This result is a deviation from the Modigliani – Miller theorem. We also provide some estimates of the amounts of contractual bail-in instruments that European banks should issue in order to reach the 8% target level. Such amounts are considerable, implying that the solution proposed here should be implemented gradually over a transition period.*

Keywords: banks, capital structure, bail-in, resolution, regulation.

JEL Codes: G21, G28.

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Introduction

The "Bank Recovery and Resolution Directive"[1], BRRD, has introduced a regime for European banks where any support, either from the Government or from the Resolution Fund, triggers a resolution procedure where at least 8% of bank liabilities must be hit by the bail-in rule.[2] The application of this rule to outstanding bank's liabilities, held by retail savers, has turned out to be very problematic: retail banks' customers are not familiar with the new regime, and they are not able to have a clear assessment of the risks they incur when they buy a bank bond or deposit money on a current account.

To protect retail investors, we propose here that banks should issue "contractual bail-in instruments", as defined in the BRRD, for an amount (together with Tier1 capital) at least equal to the 8% of their liabilities. Contractual bail-in instruments, which in our view should be sold to institutional investors only, are liabilities that are hit before other senior liabilities in case of bail-in. They are de facto a new kind of junior (subordinated) bonds, with the specific purpose of bearing losses before other claimholders (with the exception of equity-holders and subordinated bonds, of course) in case of a resolution procedure triggering a bail-in. As far as we know, instruments of this type have been introduced only in France so far. In that

[1] Directive 2014/59/EU
[2] The resolution procedures are regulated by the Single Resolution Mechanism (SRM) that became fully operational on 1 January 2016. For details, see Baglioni (2016).

country, banks can issue “senior un-preferred” debt to meet the MREL requirement: such securities rank between subordinated debt and preferred senior debt.

The protection of retail savers from the bail-in, triggered by state aids to banks, is a target that should be pursued by policy-makers not only for political and social reasons but also for economic and financial reasons. In a perfect information framework, the additional cost on the junior debt (contractual bail-in instruments) is exactly compensated by a lower cost on the residual senior debt. But if the information is far from perfect, so that many bond-holders and depositors are not able to estimate their exposure to the bail-in risk, the proposal made here would contribute to make clear the distribution of losses in case of state aid, leading to an overall decrease in the cost of bank funding.

We support our argument by means of a theoretical model, where retail investors are supposed to be uncertainty averse: they do not have an additive probability distribution over their payoffs, including the state of nature where the bank might be resolved by applying the bail-in rule. To the contrary, institutional investors are better informed, and they are able to assess the additive probability distribution over their payoffs. Within this framework, a bank is able to reduce the cost of its own debt by splitting it into a junior and a senior tranche, sold to institutional and to retail investors respectively. This result is a deviation from the well-known Modigliani – Miller theorem, stating that the structure of liabilities is irrelevant as far as the cost of funding and the value of the firm are concerned.

We also provide some estimates of the amounts of contractual bail-in instruments that European banks should issue in order to reach the 8% target level. Such amounts are considerable, implying that the solution proposed here should necessarily be implemented gradually through a transition period of several years. Moreover, the new financial instruments are supposed to (partially) substitute outstanding bank securities, either at maturity or through buy-back deals. That solution might be imposed by the Resolution authorities, exploiting their power of setting a Minimum Requirement of own funds and Eligible Liabilities (MREL), following the BRRD procedures. As an alternative, it might be implemented by banks in their own interest, to reduce the cost of funding and to avoid the instability created by the bail-in regime.

The plan of the paper is the following. In section 1 we discuss the literature related to the issues addressed in our paper. In section 2 we illustrate the theoretical model showing how the liability structure can modify the cost of funding for a bank in a world of imperfect information. In section 3 we make our proposal of introducing the new contractual bail-in instruments through the MREL. In section 4 we simulate the impact of our proposal on the European banking system. Section 5 summarizes and provides some concluding remarks.

1. Resolution, MREL, and related literature

The BRRD has introduced a new regime in the management of banking crises. This regime is designed so as to minimize the impact of banking crises on public finances. One of the key features of this new regime is the requirement that, before any public support is given within a resolution procedure (either from the resolution fund or from government intervention) at least 8% of bank liabilities are hit by the bail-in, through haircuts and/or debt-to-equity conversion. On one hand, this requirement is able to significantly reduce the burden of bank distress for the public sector. For example, Benczur et al. (2016) find that the bail-in rule is able to reduce the impact of a financial crisis, similar to the recent one, from 3.7% of EU GDP to 1.4%; however, they acknowledge that their analysis is focused on the direct link between bank and the public sector, without considering the indirect link going through the macroeconomic impact of a bank crisis. On the other hand, this new regime has turned out to be harmful on political and social grounds, particularly when it hits outstanding bank liabilities (issued before 1/1/2016) held by retail investors. Moreover, the potential instability created by the new regulatory framework, also due to a lack of

transparency, was underestimated by policymakers and scholars in the debate taking place before the entry into force of BRRD .

One way of dealing with the new regime is provided by the regulation itself, and it is the Minimum Requirement of own funds and Eligible Liabilities (MREL): this is the minimum ratio between "bailinable" liabilities (including own funds) and total liabilities. By the end of 2016, the resolution authorities have to set a threshold for this ratio, which is going to be applied to all banks in the EU. In the euro area in particular, the Single Resolution Board (SRB) is responsible for setting the MREL requirement for significant and cross-border banks (143 financial groups), while the national resolution authorities (NRAs) are responsible for all the other banks. The MREL requirement basically mirrors the Total Loss Absorption Capacity (TLAC) requirement, set by the Financial Stability Board for the Globally Systemic Institutions (G-SIBs) and becoming effective as of 1/1/2019.

In this paper, we propose that banks should issue subordinated bonds for an amount (together with Tier1 and Tier2 capital) at least equal to the 8% of their liabilities, which should be sold to institutional investors only. In our view, this financial structure would enable banks to reduce their cost of funding, by making clear which are the bank stakeholders that are going to be hit by the bail-in in case of a resolution procedure using some kinds of public support. The need for transparency has been advocated by other sources, including the authorities themselves. For example, Deutsche Bundesbank (2016, page 71) states that "Transparency regarding the insolvency ranking and the balance sheet classification of TLAC instruments ensures that their risks can be priced appropriately". EBA (2016, page 9) asks bank stakeholders to give their views on the disclosure needs in the areas of MREL requirements and statutory creditor hierarchies.

We also provide some estimates of the amounts of new subordinated bonds that should be issued in order to comply with an 8% MREL requirement of the kind that we propose here. As we shall see, the amounts are huge, similarly to those obtained by other studies: see EBA (2016) and Morgan Stanley (2016). However, as suggested in the Morgan Stanley paper, the issuing needs look much less challenging by considering that the new securities can be issued as long as other senior bonds mature: this roll-over strategy could take 3-4 years, a time span such that large amounts of outstanding bonds come to maturity.

This issue of subordination is strictly related to the problem addressed in this paper. A reason for identifying a set of "MREL liabilities", additional to our argument, derives from the "No Creditor Worse Off" rule introduced by the BRRD (art. 73). This states that a bank stakeholder cannot be treated worse in a resolution procedure than in a standard liquidation. Therefore, if a bond can be hit by the bail-in before another class of liabilities, the former should be junior to the latter also outside resolution. [3]

Unfortunately, this issue has been addressed in different ways across the European countries. France has introduced the "un-preferred senior" bonds (named "Tier3"), with an intermediate seniority between outstanding subordinated bonds and senior bonds: those securities seem to implement the "contractual bail-in instruments" that we refer to below. Spain and the Netherlands are likely to follow the French way, by introducing Tier 3 instruments. In Germany, the insolvency law has been amended so that (as of 1/1/2017) the holders of debt securities are junior relative to other ordinary creditors (including derivative creditors). In Italy, the "extended depositor preference" rule makes all deposits preferred to senior securities, which rank *pari passu* with all the other senior liabilities (including derivatives). In the UK, major banks have been encouraged to make their non-operating holding companies issue new unsecured debt, implying a "structural subordination" of such liabilities, since their holders have only a residual claim on the

[3] In general, subordination of a certain instrument with respect to other liabilities can be obtained by law ("statutory subordination") or by contract ("contractual subordination") or by the fact that it is issued by the parent holding company of a financial group ("structural subordination").

assets of the operating companies. Obviously, this fragmented approach might minimize the amount of new type of liabilities to be issued but it creates segmentation in the market for bank securities and it represents an obstacle to the "harmonized application" of MREL and to regulatory convergence in Europe. Eventually, as we will show, the cost of financing depends on uncertainty aversion. A transparent and clear solution to the MREL problem, such as the new Tier3 bonds, has a cost for the banks in the short run, in terms of issuance of new type of mandatory subordinated liabilities. But it will have significant advantages in the long run in terms of a lower average funding cost and a higher level of financial stability. Moreover, MREL harmonization across Europe should minimize a potential source of confusion with the FSB regulation of TLAC-eligible instruments that for example require subordination and excludes sight-deposits or liabilities arising from derivatives.

2. The theoretical model: Modigliani - Miller does not hold under uncertainty aversion

This section shows that, if some investors in bank securities are averse to uncertainty, a bank is able to reduce the cost of its own debt by splitting it into a junior and a senior tranche. This result is a deviation from the well-known Modigliani – Miller theorem, stating that the structure of liabilities is irrelevant as far as the cost of funding and the value of the firm is concerned.

Before focusing on our topic, let us briefly remind the reader the concept of uncertainty aversion. The underlying idea is that a lack of information prevents people from having a clear understanding of the risks they incur by investing in some assets. As a consequence, they are unable to formulate a probability distribution over the possible outcomes of their investment decisions. This idea goes back to Knight (1921), who introduced the distinction between *risk*, namely a situation where the odds of the possible events are known, and *uncertainty*, where to the contrary people do not know the probability distribution of events. This idea has been revived more recently by the theory of decision. In particular, Gilboa and Schmeidler (1989) model the choice of an individual facing "ambiguous lotteries", i.e. situations where the exact probability distribution over outcomes is not kwon, so that a decision-maker has a set of probabilities distributions. In this framework the traditional expected utility maximization is replaced by the "maximin" criterion: the individual evaluates the minimum expected utility over his set of probability distribution. This behavior has become known as "uncertainty aversion" (which should not be confused with risk aversion, deriving from decreasing marginal utility). On technical grounds, using the maximin criterion is equivalent to computing the expected outcome of lotteries by using the so-called "Choquet integral" (that will be introduced below).

The concept of uncertainty turns out to be extremely useful to examine a situation like the one created by the introduction of the bail-in tool by the BRRD. The application of the bail-in rule to existing contracts, the complexity of the new regulatory framework, the lack of information provided by banks and regulators to investors, have produced a situation where retail bank customers are not able to have a clear assessment of the risks they incur when they buy a bank bond, or even when they put their money in a bank deposit.

In what follows, we will assume that there are two categories of bank customers: retail and institutional. The former are supposed to be uncertainty averse: they have a set of probability distributions over the outcomes of their investment, and they act by using the maximin criterion. To the contrary, institutional/professional investors are supposed to have a unique probability distribution over the outcomes of their investment, under the assumption that they enjoy a more accurate information of the (possible) application of the bail-in rule. We will show that, by allocating senior debt to retail investors and junior debt to institutional investors, a bank is able to reduce the cost of its own debt. In doing that, we will abstract from the technical details related to the application of the bail-in regime, since they are not essential to make our point and they would add unnecessary complications to the model.

Let us focus on a bank, and assume that its asset value is a random variable *V*, taking either value V_H or value V_L. The bank issues zero coupon debt with nominal value $D = D_R + D_I$, where D_R and D_I are the securities held by retail and institutional investors respectively. Of course, we focus on the interesting case where $V_L < D < V_H$. All investors are supposed to be risk-neutral, so they are willing to buy the bank debt at a price equal to the expected value of their return. Since the debt is zero coupon, the cost of debt for the bank is given by the difference between the face value *D*, to be repaid at maturity, and the price at which it is able to sell its securities in the market.

Let us momentarily assume that all investors, retail and institutional, share the same information. In particular, they know that the probability distribution over V_H and V_L is given by: π_H and π_L respectively, with $\pi_H + \pi_L = 1$. In this full information framework, uncertainty aversion plays no role, and it is easy to see that the Modigliani – Miller theorem applies. To do that, let us first compute the price of the securities sold to retail and institutional investors respectively, under the assumption that they have the same priority (*pari passu*). They can be computed as follows:

$$E(D_R) = r[V_L + \pi_H(D - V_L)] \quad (1)$$

$$E(D_I) = i[V_L + \pi_H(D - V_L)] \quad (2)$$

where $E(D_R)$ and $E(D_I)$ are the expected payoffs of the retail and institutional investors respectively, and $r = \frac{D_R}{D}$ and $i = \frac{D_I}{D}$. It can be noticed that the expectation has been computed by using the Choquet integral, which in the discrete case amounts to summing the lower possible outcome with the additional return that can be obtained in the high state of nature, multiplied by its own probability. Absent uncertainty aversion, this way of computing the expected value of a lottery is equivalent to the standard one (where each possible outcome is weighted by its own probability), as it can be easily verified. We use the Choquet integral here only to be consistent with what follows below, but this choice has no consequence for the moment. The total price of the bank debt is trivially given by the sum:

$$E(D) = E(D_R) + E(D_I) = V_L + \pi_H(D - V_L) \quad (3)$$

Now, imagine that the bank decides to give a preferential treatment to retail investors: let the securities sold to retail investors (D_R) be *senior* and those sold to institutional investors (D_I) be *junior*. To compute the expected payoffs of the two classes of lenders, we have to distinguish between two cases: either $D_R \geq V_L$ or $D_R < V_L$:

i) $D_R \geq V_L$: $E(D_R) = V_L + \pi_H(D_R - V_L)$ and $E(D_I) = \pi_H D_I$

ii) $D_R < V_L$: $E(D_R) = D_R$ and $E(D_I) = (V_L - D_R) + \pi_H[D_I - (V_L - D_R)]$

In both cases, it is still true that $E(D) = E(D_R) + E(D_I) = V_L + \pi_H(D - V_L)$: the total price of bank debt is unaffected. In other words, the Modigliani – Miller theorem applies: the bank is unable to alter the overall price of its own debt by altering its composition, in particular by splitting it into a junior and a senior tranches.

We now turn to the more interesting case, where retail investors have poor information about their payoffs. More precisely, they do not have a clear assessment of the probability distribution over *V*. As a consequence, they face a decision problem under uncertainty. We use the simple parametrization of uncertainty aversion introduced by Dow and Werlang (1992), assuming a constant uncertainty aversion. The probability distribution employed by retail investors is denoted by p_H and p_L, defined as follows: $p_H = (1 - c)\pi_H$ and $p_L = (1 - c)\pi_L$, where $c \in [0,1]$ is the parameter measuring uncertainty aversion. This definition implies that $p_H + p_L < 1$: the probability mass left unassigned (named "subadditivity" of their probability measure) is a consequence of the fact that retail investors do not have a clear assessment of the risk they incur. In fact, this is equivalent to assuming that they have a full set of probability

distributions over *V*. To explain this point, let us focus on the case where retail investors have the same priority as institutional ones (*pari passu*). Their payoffs are either D_R (in state *H*) or rV_L (in state *L*). Their expected payoff can be computed by referring to their full set of probability measures, so they have a set of expectations defined by:

$$\gamma D_R + (1-\gamma) rV_L : \gamma \in [\, p_H, 1-p_L] \tag{4}$$

The maximin criterion implies that the retail investors face this choice under uncertainty by taking the minimum value within the above set of expectations, namely:

$$E(D_R) = min\{\gamma D_R + (1-\gamma) rV_L : \gamma \in [\, p_H, 1-p_L]\} =$$

$$= p_H D_R + (1-p_H) rV_L =$$

$$= r[V_L + \, p_H(D - V_L)] \tag{5}$$

where the last expression is the Choquet integral. In this case, where $p_H < 1 - p_L$, this way of computing the expected payoff is not neutral: it represents the preferences of uncertainty averse individuals.[4]

As far as institutional investors are concerned, we will keep assuming that they do not face uncertainty, since they are supposed to have a more accurate understanding of the risk they face, even under the new regime introduced by the BRRD and, in particular, by the bail-in rule. Therefore, they compute their expected payoff by using the above probabilities: π_H and π_L, with $\pi_H + \pi_L = 1$. Under the *pari passu* scenario, the price of the securities held by institutional investors is still given by equation (2). By summing up the values given in equations (5) and (2), we get the overall price of the bank debt:

$$E(D) = E(D_R) + E(D_I) = V_L + (rp_H + i\pi_H)(D - V_L) \tag{6}$$

Notice that the expression in equation (6) is lower than that given in equation (3): the presence of uncertainty aversion by some investors lowers the market value of the bank debt.

Let us now examine again the impact of giving a preferential treatment to retail investors: the securities sold to retail investors (D_R) are *senior* and those sold to institutional investors (D_I) are *junior*. As we did before, we have to distinguish between two cases in computing the expected payoffs of lenders: either $D_R \geq V_L$ or $D_R < V_L$:

i) $D_R \geq V_L$: $E(D_R) = V_L + \, p_H(D_R - V_L)$ and $E(D_I) = \, \pi_H D_I$
ii) $D_R < V_L$: $E(D_R) = D_R$ and $E(D_I) = (V_L - D_R) + \, \pi_H[D_I - (V_L - D_R)]$

Easy computation shows that in the two cases above the total price of bank debt is given respectively by:

i) $D_R \geq V_L : E(D) = E(D_R) + E(D_I) = V_L + (rp_H + i\pi_H)D - p_H V_L$ (7)
ii) $D_R < V_L : E(D) = E(D_R) + E(D_I) = V_L + \, \pi_H(D - V_L)$ (8)

The relevant result is that both the expressions in equations (7) and (8) are larger than that given in equation (6), as it can be immediately verified by comparing those expressions. This means that the bank is able to increase the overall price of its own debt – or equivalently to reduce its cost of funding – by splitting it into a junior and a senior tranche. In other words, in presence of uncertainty aversion the Modigliani – Miller theorem does not hold anymore. The intuition behind this result is the following. Those (retail) investors who are averse to uncertainty apply the maximin criterion, so they give a relatively higher weight to the low state of nature than the other (institutional) investors, who apply the expected utility criterion. Therefore, if the retail investors are given a seniority, increasing their payoff in the low state at the expense

[4] As we said above, the Choquet integral boils down to the standard expected utility criterion when $c = 0$ and $p_H = 1 - p_L$.

of other investors, the benefit they get more than offsets the reduction in expected return suffered by the institutional investors.

3. Contractual bail-in instruments and MREL

The BRRD has introduced a regime for banks where any support, either from the government (art.37) or from the resolution fund (art. 44), triggers a resolution procedure where at least 8% of bank liabilities must be hit by the bail-in rule before public intervention. The application of this rule to outstanding bank liabilities, held by retail savers, has turned out to be very problematic: retail bank customers are not familiar with the new regime, and they are not able to have a clear assessment of the risks they incur when they buy a bank bond or deposit money on a current account.

Protecting retail savers from the application of the bail-in rule is in the interest not only of savers, for obvious reasons, but also of banks, for the following reason. It is reasonable to assume that institutional investors have a rather clear understanding of the risks implied by the new regime introduced by the BRRD, while retail savers do not. Therefore, a bank should be able to reduce its overall cost of funding by issuing specific bonds, that should be hit before other bonds in a resolution procedure, and sell them to institutional investors only. While senior bonds held by retail investors would retain their seniority, the new contractual bail-in instruments would be subordinated in a resolution procedure as well as in case of insolvency: the latter provision is needed to meet the "no-creditor-worse-off" principle.[5] By applying the theoretical result obtained in the previous section, under the assumption that retail investors are uncertainty averse while institutional investors are not, we can conclude that the total cost of bank funding should decline: the higher return required on junior bonds would be more than offset by the lower return paid on senior liabilities.

It is interesting to note that such a new kind of junior bonds are already present in the regulatory framework. Following art. 45 of the BRRD, the resolution authorities should set a Minimum Requirement for own funds and Eligible Liabilities (MREL), which is defined as:

$$\textbf{MREL} = \frac{\textbf{own funds} + \textbf{eligible liabilities}}{\textbf{own funds} + \textbf{total liabilities}} \qquad (9)$$

where the "eligible liabilities" are those that can be hit in a resolution procedure, through either write-down or debt-equity conversion. For each bank, the authorities should set a minimum threshold value for the MREL ratio. They can also decide that the MREL requirement should be met (at least partially) by "contractual bail-in instruments": these are liabilities that are hit before other liabilities in case of bail-in, and accordingly they are repaid after other liabilities in case of insolvency. They are de facto a new kind of junior (subordinated) bonds, with the specific purpose of bearing losses before other claimholders (with the exception of equity-holders, of course) in case of a resolution procedure triggering a bail-in.

Building on the above rule introduced by the BRRD, the resolution authorities (i.e. the Single Resolution Board for the significant and cross-border institutions, and the national authorities for other banks) might use their power to impose that at least 8% of bank liabilities are made up of own funds plus contractual bail-in instruments, which should be sold only to institutional investors, not to retail savers. The requirement should be as follows:

$$\frac{\textbf{own funds} + \textit{\textbf{contractual bail-in instruments}}}{\textbf{own funds} + \textbf{total liabilities}} \geq 8\% \qquad (10)$$

It is true that imposing such a requirement would put a severe regulatory pressure on banks: as we shall see in the next section, the amounts of contractual bail-in instruments to be issued to reach the 8% target level would be quite large. For this reason, we believe that the supervisory authorities will not impose such

[5] This principle states that a claimholder cannot be treated worse under resolution than under a normal insolvency procedure.

a requirement as a general rule. Actually, the SRB has stated that the 8% threshold for MREL is a target level, but it retains the flexibility of setting the MREL on a case-by-case basis, within the process of designing the resolution plans of significant and cross-border banks in the euro area[6]. EBA's view[7] is even more radical. The best option for the EBA is that the reference base of MREL should be changed to Risk Weighted Assets (RWA), complemented with a leverage ratio requirement[8] backstop. This is the approach followed by the Financial Stability Board (FSB) in setting the Total Loss-Absorbing Capacity (TLAC) for Global Sistemically Important Banks (G-SIBs).[9] The issue of harmonizing TLAC with MREL is not secondary because in the EU there are 13 G-SIBs. Moreover, MREL should be calibrated to the different business models, because they can affect the single banks' resolution strategies.

As far as significant institutions are concerned, the delegated regulation, issued by the EU Commission (23.5.2016), provides that the resolution authorities shall take into account the requirements set out in art. 44 of the BRRD: this is the article stating that a bank cannot access financing from the resolution fund unless 8% of its own liabilities have contributed to loss absorption. Thus the 8% target level is in the regulation, albeit with some flexibility and only for significant banks. Our model suggests that, independently of regulatory requirements, it is in the interest of banks to introduce gradually the new contractual bail-in instruments into their capital structure, with the aim of reaching the 8% target level in a reasonable time span, i.e. a few years. For example, they could roll over some old liabilities into new junior bonds as long as they come to maturity through time. By doing so, they would be able to lower their total cost of funding.

Let us explain the above point by means of a numerical example, which applies the simple model introduced in the previous section. It is a very stylized case, made only for expositional purposes. Consider a bank, with asset value represented by a random variable *V*, taking either value $V_H = 110$ or value $V_L = 90$ (with probabilities : $\pi_H = 0.8$ and $\pi_L = 0.2$ respectively). The bank gets funding by issuing a zero-coupon debt with face value $D = 100$. So the cost of debt is easily represented by the price of bonds: the higher the price, the lower the cost. In addition, suppose that in the low state the bank goes through a resolution procedure, supported by a contribution by the resolution fund or by the government. The application of the bail-in rule implies that 8% of the outstanding bonds are written off (the alternative is their conversion into equity, that we do not consider here for simplicity). This is equivalent to setting the lower value of bank assets to $V_L = 92$, as far as debt-holders are concerned. Assuming risk neutrality of investors, it is easy to see that the market price of debt is $E(D) = V_L + \pi_H(D - V_L) = 98.4$. This computation implicitly assumes that the 8% loss, due to the bail-in, is evenly spread across the bond-holders, who are perfectly aware of this.

In this scenario, if the bonds are split into a senior and a junior tranches, say with face value $D_R = 92$ and $D_I = 8$ respectively, where D_R is allocated to retail investors and D_I to institutional investors, the cost of funding remains unchanged. Since $D_R = V_L$, the retail bonds are risk-free and their market value is $E(D_R) = 92$. To the contrary, institutional investors bear the whole bail-in burden in the low state, so $E(D_I) = \pi_H D_I = 6.4$. The total market price of bank debt is still $E(D) = E(D_R) + E(D_I) = 98.4$. The

[6] See SRB (2016).

[7] See EBA (2016)

[8] The leverage ratio requirement is a non-risk based measure conceived to constrain financial leverage and build a safeguard against model risk and measurement error in the statistical models of financial risk management. It has been introduced in Basel III and it substitutes the Capital/RWA ratio with Capital/TA ratio.

[9] In this case, TLAC should be at least equal to 18% of RWA with a leverage ratio backstop of 6.75%. Just to understand how the interaction between capital and leverage ratios work, let's work the math in a simplified example. If TLAC has to be at least 6.75% of Total Assets and 18% of RWA, this implies that RWA have to be at least equal to 37.5% of Total Assets. If Tier1 capital has to be greater than or equal to 12% of RWA (and the previous TLAC rule implies that RWA have to be at least equal to 37,5% of Total assets), the leverage ratio backstop for regulatory capital is equal to 4,5% (Tier1/TA = Tier1/RWA*RWA/TA >= 12%*37.5%).

Modigliani – Miller theorem applies here: a change in the financial structure of the bank, introduced by splitting its debt into junior and senior bonds, would not alter the overall market value of its liabilities. Therefore, the cost of funding would not be affected: the higher cost of issuing junior bonds would be exactly offset by the lower cost of senior bonds. As we have seen in the more general model, this result holds under the assumption that information is perfect: all bond-holders know their payoffs, and the associated probabilities, in case of bank resolution.

However, a more realistic assumption is that retail investors do not have a clear assessment of their exposure to the bail-in risk. This can be formalized by assuming that their decisions are based on the following probability distribution over outcomes: $p_H = (1-c)\pi_H = 0.72$ and $p_L = (1-c)\pi_L = 0.18$, where $c = 0.1$ is the parameter value measuring their uncertainty aversion. If retail and institutional investors share the same priority (*pari passu*), the market price of the bonds held by institutional and retail investors can be computed by applying equations (2) and (5) respectively, which provides the following values: $E(D_I) = 7.872$ and $E(D_R) = 89.9392$. The total market value of the bank debt turns out to be: $E(D) = E(D_R) + E(D_I) = 97.8112$. If, instead, the bonds sold to institutional investors are junior and those sold to retail investors are senior, the latter would be safe and their market value would go up to $E(D_R) = 92$; to the contrary, the value of bonds sold to institutional investors would decline to $E(D_I) = \pi_H D_I = 6.4$, since they would be worthless in case of resolution. The important result is that the total market value of the bank debt would increase from 97.8112 to $E(D) = E(D_R) + E(D_I) = 98.4$. Therefore the Modigliani – Miller theorem does not apply anymore. This stylized example shows that, by introducing a specific class of junior bonds (contractual bail-in instruments) and by making clear, through an adequate communication strategy, that all the other (senior) bonds are outside the scope of application of the bail-in rule, a bank would be able to increase the market value of its own debt; the cost of funding would be reduced accordingly.

The cost for the banks of a contractual bail-in instrument is higher than that of a senior bond. However, we see no need to use the same terms as in a Contingent Convertible or other type of subordinated bonds eligible for the regulatory capital. In the sense that it is not necessary that these instruments comply with the Tier1 or Tier2 definition. They could behave exactly as senior bonds during “normal” times (i.e. no coupon payments’ suspension or capital haircuts). However, in the case of bank resolution or insolvency, they would be junior to senior bonds. If this is the case, the funding cost of contractual bail-in instruments could be not far from that of the "old" perpetual bonds, issued before the 2008 financial crisis hit the international financial system. The higher marginal cost of this new funding tool would be more than offset by the lower cost that the bank would pay on the senior bonds and bank deposits. The statement that the bail-in will never affect senior bondholders and big depositors requires in fact credibility. Since the bail-in is a source of systemic instability and risk, possibly triggering self-fulfilling expectations, we believe that the total cost of bank funding would be reduced from the current situation.

4. Simulations for the European Banking System

Under our proposal, each financial institution should issue an amount of contractual bail-in instruments up to 8% (together with existing regulatory capital) of its own total liabilities. In this way, senior bonds and large deposits could be considered implicitly “guaranteed” by the government. Our model shows that the overall impact of this solution on the cost of funding for banks should be beneficial. Moreover, it is reasonable to believe that the “bank run” risk could be greatly limited. However, the difficulties related to the transition period, during which banks should issue the new junior securities, must be carefully considered. As we are going to show in this section, the amounts to be issued are quite large. Therefore, in order to reduce the market impact, the above mentioned 8% target should be reached through time, either by a gradual phase-in of the MREL requirement or by an autonomous decision of banks’ management. For

example, the issuance effort could be diluted over a period of three years, i.e. up to 2019, when Basel 3 becomes fully enforced. Moreover, the TLAC implementation for G-SIBs is set for 2019 and 2021. MREL implementation should follow a similar path at least for O-SII[10], if the EU does not want to alter the relative competitiveness between G-SIB and O-SII. The new financial instruments are supposed to (partially) substitute outstanding bank securities, either at maturity or through buy-back deals.

The amount of contractual bail-in instruments to be issued is difficult to estimate. First, the general calculation formula is still to be defined. The EBA is for example suggesting to use a formula based on RWA and a leverage ratio backstop. Second, the MREL includes necessarily bank-specific considerations concerning the resolution process. Third, it is not clear if there will be an harmonization of MREL rules across European countries. At the moment the legal form of MREL-qualifying liabilities subordination can be contractual (our preferred solution), statutory or structural. Keeping in mind these limitations, we can use different approaches in order to have a rough estimate of what could be the issuance effort required to the European banking system.
The first approach is to estimate MREL shortfalls at the level of national banking systems using the ECB Data Warehouse. A methodological note is necessary. There are two major types of "banking" data in the official statistics. The traditional one is designed mainly for monetary policy purposes, and then refers to Monetary Financial Institutions (MFI), i.e. credit institutions and other institutions with liabilities included in the broad definition of money (central banks themselves, money markets funds, government agencies). The other type of statistics is designed instead for supervisory purposes and it is inside the so-called Financial Reporting (FINREP) framework. In the latter case, the national aggregated data refer essentially to supervised credit institutions, i.e. banks. Given our purposes, we will use the last type of statistics on consolidated Banking data.

According to the Statistical Data Warehouse of the ECB[11], the consolidated amount of Total Liabilities of the EU banking system(s) is equal to almost 40 trillion euro (as of 2015 Q4) while the consolidated amount of Own Capital is equal to 2,8 trillion euro. The sum of Total Liabilities and Own Funds, TLOF, is equal to 42,6 trillion euro. Since the 8% of the TLOF is equal to 3,3 trillion euro and applying (9)-(10), we can estimate in 627 billion the potential shortfall of contractual bail-in instruments to be issued if we want to satisfy MREL with a new type of subordinated debt. If we limit the analysis just to the countries adopting the euro, the estimated shortfall is equal 418 billion euro.
However, if the goal of the MREL regulation is not only the one of minimizing the State intervention but also to avoid the involvement of retail investors in a bail-in process, we should consider that in many countries subordinated bank debt has been sold also to retail investors.[12] As the experience of the first bail-in processes teaches[13], it would be sensible to substitute old subordinated debt in the hands of retail investors with new Tier3 instruments sold to institutional investors.
For this reason, we calculate in Table 1 the potential shortfall of MREL with and without considering Tier 2 bonds eligible. The maximum shortfall (the "Max" column of Table 1) is obtained under the assumption that Tier 2 bank liabilities have to be entirely replaced by the new contractual bail-in instruments. The minimum shortfall (the "Min" column) is instead obtained under the assumption that existing Tier 2 bonds have not be replaced.

INSERT TABLE 1 HERE

[10] Other Systemically Important Institutions.
[11] http://sdw.ecb.europa.eu/browse.do?node=9689685
[12] For example, for many months during 2016 the Italian government insisted in ruling out any bail-in of subordinated bondholders of Banca Monte dei Paschi di Siena.
[13] In Italy, for example, one of the biggest issue in the recapitalization plan of Monte dei Paschi di Siena, the third largest Italian bank by assets, is the degree of burden sharing, if any, to impose on retail holders of subordinated debt. The experience of four small regional banks, resolved in November 2015, showed that a systemic confidence crisis can arise also from subordinated debt bail-in.

Table 1 shows a potential shortfall of MREL in the range of 1,052 and 627 billion euro for the entire EU banking system. For the countries adopting the euro as a currency, the range reduces to 671 and 418 billion euro. The difference between the EU and the Euro Area is accounted for by mainly the UK.

These results are quite similar to those obtained by the EBA (2016), which estimates an additional financing need up to 790 billion in case of an integral application of the MREL formula and in case senior unsecured debt were excluded from MREL-eligible instruments. [14]

The potential amount of new Tier3 instruments to be issued is large but, as noted also by Morgan Stanley (2016), manageable. First, one needs to take into account that in the next three years (2017-2019) there will be 550 billion euro of bank's senior debt maturing. Second, there are clear signals from the European authorities to adopt a flexible approach in the phasing-in of the MREL regulation. EBA (2016) notes that the MREL shortfall might be reduced to 340 billion from 790 billion if it were possible not to follow literally the BBRD's formula and the amount of MREL be calibrated banks by banks with less demanding recapitalization scenarios. We need to remember that MREL ideally is the result of two components: a loss absorption amount and a recapitalization amount. The recapitalization amount can be calculated in different ways, depending if the authorities want that the bank be immediately fully recapitalized or if they accept that it can start its new life with the minimum amount of regulatory capital. Similar results are obtained by Morgan Stanley (2016) where the aggregate shortfall is estimated in a range of 434 and 697 billion euro.

In table 1, one can immediately note the anomaly of the French banking system: the potential shortfall of contingent bail-in instruments, 168 billion euro, is by far the highest in the Euro area. Obviously, a lower number does not imply that a bank or a system is safer. The quality of the protection offered by the capital buffer depends on the quality of the assets. The case of the Non-Performing Loans (NPL) afflicting the Italian banking system is just an example.

After France, Germany presents the second highest shortfall of the Euro area. If we enlarge the analysis to the entire European Union, it is the UK that stands out with a potential shortfall of 148 billion euro, which is second only to the French one. Many countries, especially the smallest ones, present a zero potential shortfall. Once again this has not to be interpreted as a signal of a safe and sound banking system. Greece and Cyprus for example are among these countries, whereas Portugal has a very small potential shortfall.

EBA (2016) and Morgan Stanley (2016) simulations follow a different statistical approach with respect to Table 1, referring to a sample of 114 major banks (as of June 2015). This is reductive with respect to consolidated data referring to the national banking systems, but allows for a more detailed analysis.

4.1. Focus on major European banks

We can then shed some further light complementing a "top-down" approach with a "bottom-up" analysis. In other words, we can estimate the potential shortfall from the single banks' balance-sheet, instead of using consolidated national data as we did in Table 1.

We will restrict the analysis to the major European banks listed on the European Union's Stock Exchanges so that we can access more detailed data and we can calculate bottom-up the potential amount of new contractual bail-in instruments.[15] The results are illustrated in Table 2.

[14] See EBA (2016).

[15] HSBC HOLDINGS PLC , BNP PARIBAS , DEUTSCHE BANK AG-REGISTERED , CREDIT AGRICOLE SA , SOCIETE GENERALE SA , BANCO SANTANDER SA , BARCLAYS PLC , ROYAL BANK OF SCOTLAND GROUP , LLOYDS BANKING GROUP PLC , UNICREDIT SPA , ING GROEP NV , BANCO BILBAO VIZCAYA ARGENTA , STANDARD CHARTERED PLC , COOPERATIEVE RABOBANK UA , INTESA SANPAOLO , COMMERZBANK AG , NATIXIS , DANSKE BANK A/S , ABN AMRO GROUP NV-CVA , CAIXABANK S.A , SVENSKA HANDELSBANKEN-A SHS , SKANDINAVISKA ENSKILDA BAN-A , KBC GROEP NV , SWEDBANK

INSERT TABLE 2 HERE

As one can see, under both the pessimistic and optimistic scenarios, 80% of the potential MREL shortfall in the EU is accounted for by the first 17 financial institutions by Total Liabilities. Quite interestingly, for example, EBA (2016) finds that 95% of the additional funding requirement (in order to reach the 8% MREL target) is concentrated on the systemically important institutions.

If we focus on the optimistic scenario (the "Min" column), which is also the most realistic, it is evident that the shortfall looks huge for some financial institutions. For example, BNP Paribas has a shortfall of 72 billion euro, which is however not far from the estimate of 53 billion obtained by Morgan Stanley (2016) under a less demanding scenario.[16] In general, our estimates are more pessimistic than the Morgan Stanley ones with the notable exception of the Italian banks. In our case, Intesa Sanpaolo, for example, should have a shortfall of 7 billion whereas for Morgan Stanley (2016) the shortfall is 14 billion.
The data of Table 2 can be aggregated by country, in order to compare the top-down simulations of Table 1 with the bottom-up results of Table 2.

INSERT TABLE 3 HERE

One of the most interesting things to note is the fact that in some countries the sub-sample of the big banks has higher MREL shortfalls with respect to the full sample. Whereas in other countries the opposite is true. For example, in France, Italy, and Spain big listed banks seem to be characterized by lower capitalization levels and higher leverage ratios with respect to the small and medium banks. This implies a higher MREL shortfall for the sub-sample of the big banks (Table 2) with respect to the entire sample (Table 1). On the contrary, in Germany, UK, and the Netherlands, the maximum MREL shortfall is higher for the full sample than for the sub-sample.

5. Concluding remarks

The BRRD has introduced a regime for banks where any support, either from the government or from the resolution fund, triggers a resolution procedure where at least 8% of bank liabilities must be hit by the bail-in. The application of this rule to outstanding bank liabilities, held by retail savers, has turned out to be very problematic. To address this issue, we propose here that banks should issue subordinated bonds for an amount (together with Tier1 and Tier2 capital) at least equal to the 8% of their liabilities, which should be sold to institutional investors only. In our view, this financial structure would enable banks to reduce their cost of funding, by making clear which are the bank stakeholders that are going to be hit by the bail-in in case of a resolution procedure using some kinds of public support. Actually, France has already introduced the "un-preferred senior" bonds (named "Tier3"), with an intermediate seniority between outstanding subordinated bonds and senior bonds: those securities seem to implement the "contractual bail-in instruments" that we support in this paper.

AB - A SHARES , BANCO DE SABADELL SA , BANKIA SA , ERSTE GROUP BANK AG , BANCA MONTE DEI PASCHI SIENA , BANCO POPULAR ESPANOL , BANK OF IRELAND , BANCO POPOLARE SC , UBI BANCA SPA , RAIFFEISEN BANK INTERNATIONA , NATIONAL BANK OF GREECE , PIRAEUS BANK S.A , JYSKE BANK-REG , EUROBANK ERGASIAS SA , NORDEA BANK AB , ALPHA BANK AE , BANCA POPOL EMILIA ROMAGNA , BANKINTER SA , AAREAL BANK AG , MEDIOBANCA SPA , BANCA POPOLARE DI MILANO , BANCA MEDIOLANUM SPA , CYBG PLC , CREDITO EMILIANO SPA , BANCA POPOLARE DI SONDRIO , AGRICULTURAL BANK OF GREECE , KOMERCNI BANKA AS , BANCA CARIGE SPA , CREDITO VALTELLINESE SCARL , FINECOBANK SPA , SYDBANK A/S , OBERBANK AG , OLDENBURGISCHE LANDESBANK AG , BANCO DESIO E DELLA BRIANZA , BANCA IFIS SPA , BANCA GENERALI SPA .

[16] It is called scenario 3 in Morgan Stanley (2016, Exhibit 2). It is based on the approach that EBA (2016) is trying to advocate and that is less demanding than the literal interpretation of the BRRD.

We support our argument by means of a theoretical model, where retail investors are supposed to be uncertainty averse and institutional investors are not. Within this framework, a bank is able to reduce the cost of its own debt by splitting it into a junior and a senior tranche, sold to institutional and to retail investors respectively.

We have also provided some estimates of the amounts of contractual bail-in instruments that European banks should issue in order to reach the 8% target level for MREL. Such amounts are considerable: depending on the class of outstanding liabilities to be replaced, the MREL shortfall ranges between 1,052 and 627 billion euro for the entire EU banking system; for the countries adopting the euro as a currency, the range reduces to 671 and 418 billion euro. Therefore, the solution proposed here should be implemented gradually through a transition period of several years, by replacing existing securities as long as they come to maturity. If one considers the large amounts of bank bonds due to expire in the next few years, the amounts of new "MREL liabilities" to be issued is not so challenging. Our estimates also show that the MREL shortfall is very concentrated on the largest banks: 80% of the potential MREL shortfall in the EU is accounted for by the first 17 financial institutions by total Liabilities. The countries showing the largest aggregate shortfalls are France, Germany and the UK.

REFERENCES

Baglioni A. (2016), *The European Banking Union. A Critical Assessment*, Palgrave Macmillan.

Benczur P., et al. (2016), Evaluating the effectiveness of the new EU bank regulatory framework: a farewell to bail-out?, *Journal of Financial Stability*, available on-line ahead of publication.

Deutsche Bundesbank (2016), Bank recovery and resolution – the new TLAC and MREL minimum requirements, *Monthly Report*, July.

Dow J., and S. Werlang (1992), Uncertainty aversion, risk aversion, and the optimal choice of portfolio*, Econometrica*, 60(1), 197-204.

European Banking Authority (2015), *Regulatory Technical Standards, draft* July.

European Banking Authority (2016), *Interim Report on MREL*, July.

Gilboa I., and D. Schmeidler (1989), Maxmin expected utility with non-unique prior, *Journal of Mathematical Economics*, 18, 141-153.

Knight F.H. (1921), *Risk, Uncertainty and Profit*, New York, Houghton Miffin.

Morgan Stanley (2016), *The potential for MREL*, MS Research, September.

Single Resolution Board (2016), *Second Industry Dialogue*, January.

Table 1. Simulation amount of new contractual bail-in instruments to be issued to clear the risk of involving retail investors in the bail-in. Top down: ECB country-level aggregated data (million euro)

Country	Total Liabilities, TL (*)	Own Funds, OF (**)	Tier 1 Capital, T1 (***)	TLOF (TL+OF)	8% TLOF	Shortfall of Contractual bail-in instruments (****)	
						max	min
FRANCE	6,538,033	385,874	324,686	6,923,907	553,913	229,227	168,039
GERMANY	6,580,088	469,728	404,796	7,049,816	563,985	159,189	94,257
SPAIN	3,397,254	243,029	212,591	3,640,283	291,223	78,632	48,194
ITALY	2,515,946	201,166	167,190	2,717,111	217,369	50,179	16,203
NETHERLANDS	2,386,836	159,013	127,742	2,545,849	203,668	75,925	44,655
AUSTRIA	978,586	87,123	68,481	1,065,709	85,257	16,776	-
BELGIUM	904,472	64,557	55,158	969,029	77,522	22,364	12,966
LUXEMBOURG	750,909	47,942	46,241	798,851	63,908	17,667	15,966
FINLAND	518,595	27,824	26,205	546,420	43,714	17,509	15,889
IRELAND	420,463	63,780	58,528	484,242	38,739	-	-
PORTUGAL	375,139	31,116	29,394	406,256	32,500	3,106	1,384
GREECE	318,199	35,139	34,841	353,338	28,267	-	-
CYPRUS	66,370	6,705	6,472	73,075	5,846	-	-
SLOVAKIA	59,862	5,586	5,191	65,448	5,236	45	-
MALTA	43,789	2,877	2,540	46,666	3,733	1,193	856
SLOVENIA	35,829	4,233	4,083	40,062	3,205	-	-
LATVIA	28,834	3,195	2,776	32,028	2,562	-	-
LITHUANIA	20,845	2,319	2,267	23,164	1,853	-	-
ESTONIA	20,320	2,583	2,544	22,903	1,832	-	-
Area Euro	**25,960,370**	**1,843,788**	**1,581,727**	**27,804,158**	**2,076,830**	**671,812**	**418,408**
UNITED KINGDOM	10,753,162	773,697	619,832	11,526,859	922,149	302,317	148,452
SWEDEN	1,536,246	84,482	73,694	1,620,728	129,658	55,964	45,176
DENMARK	819,022	54,820	48,780	873,843	69,907	21,127	15,087
POLAND	335,379	37,519	34,426	372,898	29,832	-	-
CZECH REPUBLIC	178,813	15,979	15,613	194,792	15,583	-	-
HUNGARY	93,525	8,917	7,307	102,442	8,195	889	-
ROMANIA	75,914	7,894	6,834	83,807	6,705	-	-
CROATIA (local name: Hrva	50,354	7,238	6,668	57,592	4,607	-	-
BULGARIA	39,567	5,652	5,212	45,219	3,618	-	-
EU ex- euro area	**13,881,983**	**996,198**	**818,366**	**14,878,181**	**1,190,254**	**380,297**	**208,714**
European Union	**39,842,353**	**2,839,987**	**2,400,094**	**42,682,339**	**3,267,084**	**1,052,109**	**627,123**

Table 2. Single banks amount of new contractual bail-in instruments to be issued to clear the risk of involving retail investors in the bail-in. Bottom-up: only major, listed banking groups (million euro) (million euro)

Credit Institution	Country	Total Liabilities	Own Funds	Tier 1	TLOF	8 % TLOF	Shortfall of Contractual bail-in instruments *	
							max	min
HSBC HOLDINGS PLC	BRITAIN	2,486,222 €	213,353 €	172,297 €	2,699,575 €	215,966 €	43,669 €	2,613 €
BNP PARIBAS	FRANCE	1,894,116 €	85,920 €	76,854 €	1,980,036 €	158,403 €	81,549 €	72,483 €
DEUTSCHE BANK AG-REGISTERED	GERMANY	1,561,506 €	64,522 €	58,222 €	1,626,028 €	130,082 €	71,860 €	65,560 €
CREDIT AGRICOLE SA	FRANCE	1,469,859 €	54,700 €	41,800 €	1,524,559 €	121,965 €	80,165 €	67,265 €
SOCIETE GENERALE SA	FRANCE	1,271,716 €	58,100 €	48,100 €	1,329,816 €	106,385 €	58,285 €	48,285 €
BANCO SANTANDER SA	SPAIN	1,241,507 €	84,346 €	73,478 €	1,325,853 €	106,068 €	32,590 €	21,722 €
BARCLAYS PLC	BRITAIN	1,184,757 €	74,770 €	59,155 €	1,259,527 €	100,762 €	41,607 €	25,992 €
ROYAL BANK OF SCOTLAND GROUP	BRITAIN	855,581 €	67,395 €	52,088 €	922,976 €	73,838 €	21,750 €	6,443 €
LLOYDS BANKING GROUP PLC	BRITAIN	853,836 €	53,943 €	41,072 €	907,779 €	72,622 €	31,550 €	18,680 €
UNICREDIT SPA	ITALY	806,948 €	55,579 €	44,920 €	862,527 €	69,002 €	24,082 €	13,423 €
ING GROEP NV	NETHERLANDS	793,299 €	54,325 €	46,412 €	847,624 €	67,810 €	21,398 €	13,485 €
BANCO BILBAO VIZCAYA ARGENTA	SPAIN	694,638 €	60,185 €	48,539 €	754,823 €	60,386 €	11,847 €	201 €
STANDARD CHARTERED PLC	BRITAIN	665,316 €	66,334 €	48,073 €	731,650 €	58,532 €	10,459 €	- €
COOPERATIEVE RABOBANK UA	NETHERLANDS	629,093 €	49,455 €	35,052 €	678,548 €	54,284 €	19,232 €	4,829 €
INTESA SANPAOLO	ITALY	627,903 €	47,299 €	39,210 €	675,202 €	54,016 €	14,806 €	6,717 €
COMMERZBANK AG	GERMANY	502,234 €	32,803 €	27,303 €	535,037 €	42,803 €	15,500 €	10,000 €
NATIXIS	FRANCE	479,757 €	16,245 €	13,733 €	496,002 €	39,680 €	25,947 €	23,435 €
DANSKE BANK A/S	DENMARK	420,947 €	23,538 €	20,768 €	444,486 €	35,559 €	14,791 €	12,021 €
ABN AMRO GROUP NV-CVA	NETHERLANDS	372,732 €	23,431 €	18,226 €	396,163 €	31,693 €	13,467 €	8,262 €
CAIXABANK S.A	SPAIN	319,051 €	22,827 €	18,485 €	341,878 €	27,350 €	8,865 €	4,523 €
SVENSKA HANDELSBANKEN-A SHS	SWEDEN	246,592 €	13,379 €	11,585 €	259,971 €	20,798 €	9,212 €	7,418 €
SKANDINAVISKA ENSKILDA BAN-A	SWEDEN	242,400 €	13,987 €	12,504 €	256,387 €	20,511 €	8,006 €	6,524 €
KBC GROEP NV	BELGIUM	236,545 €	16,936 €	14,647 €	253,481 €	20,278 €	5,631 €	3,342 €
SWEDBANK AB - A SHARES	SWEDEN	208,648 €	12,137 €	10,770 €	220,785 €	17,663 €	6,893 €	5,526 €
BANCO DE SABADELL SA	SPAIN	195,860 €	11,417 €	10,209 €	207,277 €	16,582 €	6,373 €	5,165 €
BANKIA SA	SPAIN	194,274 €	11,575 €	10,541 €	205,848 €	16,468 €	5,927 €	4,893 €
ERSTE GROUP BANK AG	AUSTRIA	184,936 €	17,284 €	12,136 €	202,220 €	16,178 €	4,042 €	- €
BANCA MONTE DEI PASCHI SIENA	ITALY	159,389 €	11,298 €	9,101 €	170,687 €	13,655 €	4,554 €	2,357 €
BANCO POPULAR ESPANOL	SPAIN	146,135 €	10,521 €	9,975 €	156,656 €	12,532 €	2,558 €	2,012 €
BANK OF IRELAND	IRELAND	121,847 €	9,576 €	7,897 €	131,423 €	10,514 €	2,617 €	938 €
BANCO POPOLARE SC	ITALY	111,963 €	7,121 €	5,885 €	119,084 €	9,527 €	3,641 €	2,406 €
UBI BANCA SPA	ITALY	106,683 €	8,545 €	7,409 €	115,228 €	9,218 €	1,809 €	673 €
RAIFFEISEN BANK INTERNATIONA	AUSTRIA	105,926 €	10,987 €	7,671 €	116,913 €	9,353 €	1,682 €	- €
NATIONAL BANK OF GREECE	GREECE	101,408 €	5,884 €	5,884 €	107,292 €	8,583 €	2,700 €	2,700 €
PIRAEUS BANK S.A	GREECE	77,508 €	9,449 €	9,449 €	86,957 €	6,957 €	- €	- €
JYSKE BANK-REG	DENMARK	68,995 €	4,044 €	3,926 €	73,039 €	5,843 €	1,917 €	1,799 €
EUROBANK ERGASIAS SA	GREECE	66,421 €	6,785 €	6,623 €	73,206 €	5,856 €	- €	- €
NORDEA BANK AB	SWEDEN	63,437 €	3,183 €	2,731 €	66,620 €	5,330 €	2,598 €	2,147 €
ALPHA BANK AE	GREECE	60,242 €	8,763 €	8,699 €	69,005 €	5,520 €	- €	- €
BANCA POPOL EMILIA ROMAGNA	ITALY	55,609 €	5,012 €	4,549 €	60,621 €	4,850 €	301 €	- €
BANKINTER SA	SPAIN	54,862 €	3,467 €	3,207 €	58,329 €	4,666 €	1,460 €	1,199 €
AAREAL BANK AG	GERMANY	48,904 €	3,977 €	2,882 €	52,881 €	4,230 €	1,348 €	253 €
MEDIOBANCA SPA	ITALY	47,428 €	8,883 €	7,137 €	56,311 €	4,505 €	- €	- €
BANCA POPOLARE DI MILANO	ITALY	45,556 €	5,021 €	4,225 €	50,577 €	4,046 €	- €	- €
BANCA MEDIOLANUM SPA	ITALY	42,640 €	1,506 €	1,500 €	44,146 €	3,532 €	2,031 €	2,026 €
CYBG PLC	BRITAIN	39,631 €	3,881 €	3,209 €	43,512 €	3,481 €	272 €	- €
CREDITO EMILIANO SPA	ITALY	34,976 €	1,955 €	1,791 €	36,930 €	2,954 €	1,163 €	1,000 €
BANCA POPOLARE DI SONDRIO	ITALY	32,888 €	3,126 €	2,441 €	36,014 €	2,881 €	440 €	- €
AGRICULTURAL BANK OF GREECE	GREECE	30,471 €	928 €	793 €	31,400 €	2,512 €	1,719 €	1,584 €
KOMERCNI BANKA AS	CZECH	29,057 €	2,464 €	2,464 €	31,522 €	2,522 €	57 €	57 €
BANCA CARIGE SPA	ITALY	27,810 €	2,970 €	2,548 €	30,780 €	2,462 €	- €	- €
CREDITO VALTELLINESE SCARL	ITALY	24,714 €	2,345 €	2,034 €	27,059 €	2,165 €	130 €	- €
FINECOBANK SPA	ITALY	17,695 €	394 €	391 €	18,089 €	1,447 €	1,056 €	1,053 €
SYDBANK A/S	DENMARK	17,649 €	1,611 €	1,455 €	19,259 €	1,541 €	86 €	- €
OBERBANK AG	AUSTRIA	16,318 €	2,158 €	1,733 €	18,476 €	1,478 €	- €	- €
OLDENBURGISCHE LANDESBANK AG	GERMANY	12,988 €	596 €	586 €	13,585 €	1,087 €	501 €	491 €
BANCO DESIO E DELLA BRIANZA	ITALY	11,326 €	1,106 €	860 €	12,432 €	995 €	134 €	- €
BANCA IFIS SPA	ITALY	6,384 €	502 €	479 €	6,886 €	551 €	72 €	49 €
BANCA GENERALI SPA	ITALY	5,479 €	428 €	384 €	5,907 €	473 €	88 €	45 €

Table 3. Country aggregated amount of new contractual bail-in instruments to be issued to clear the risk of involving retail investors in the bail-in. Bottom-up: only major, listed banking groups (million euro)

Major listed banks	TLOF	Own Funds	8 % TLOF	Shortfall of Contractual bail-in instruments *	
Country				**max**	**min**
AUSTRIA	€ 337,609	€ 30,429	€ 27,009	€ 5,723	€ -
BRITAIN	€ 6,565,018	€ 479,675	€ 525,201	€ 149,307	€ 53,728
CZECK	€ -	€ -	€ -	€ -	€ -
DENMARK	€ 536,784	€ 29,193	€ 42,943	€ 16,794	€ 13,820
FRANCE	€ 5,330,413	€ 214,965	€ 426,433	€ 245,946	€ 211,468
GERMANY	€ 2,227,531	€ 101,898	€ 178,202	€ 89,210	€ 76,304
GREECE	€ 367,859	€ 31,810	€ 29,429	€ 4,419	€ 4,283
IRELAND	€ 131,423	€ 9,576	€ 10,514	€ 2,617	€ 938
ITALY	€ 2,328,479	€ 163,087	€ 186,278	€ 54,309	€ 29,749
NETHERLANDS	€ 1,922,335	€ 127,211	€ 153,787	€ 54,097	€ 26,576
SPAIN	€ 3,050,665	€ 204,338	€ 244,053	€ 69,619	€ 39,715
SWEDEN	€ 803,763	€ 42,686	€ 64,301	€ 26,710	€ 21,615
Total	€ 25,524,988	€ 1,291,529	€ 2,041,999	€ 759,531	€ 492,386

Source: Bloomberg data and published banks' balance sheet (end 2015), for major listed European banks

(*) "max" is max [(8% TLOF – OF), 0], "min" is max [(8% TLOF – Tier1 capital, 0]

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