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# Are banks' below-par own debt repurchases a cause for prudential concern?

**Abstract**

Leading up to the implementation of Basel III, European banks repurchased debt securities that traded below par. Banks are subjected to a prudential filter that excludes unrealized gains on liabilities from changes in own credit standing from the calculation of capital ratios. By repurchasing debt securities below par, unrealized gains become realized and increase Core Tier 1 capital. Using data of 720 European Liability Management Exercises (LMEs) conducted between April 2009 and December 2013, we show that poorly capitalized banks repurchased securities and lost about €9.1bn in premiums to compensate debt holders. Banks also repurchased the most loss-absorbing securities, for which they paid the highest premiums. These premiums increase with leverage and in times of stress. Hence debt repurchases are a cause for prudential concern.

Keywords: *banking, prudential filter, fair value option, below par, subordinated debt*.

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## Introduction

In the years 2009–2013, many European banks repurchased debt that traded below par with the purpose of increasing their Core Tier 1 capital ratio. In anticipation of the new capital requirements that would enter into force in 2014, banks repurchased these below-par debt securities to turn an unrealized fair value gain into a realized one.[1] Bank regulation excludes unrealized fair value gains on debt securities arising from a deterioration in banks' own credit standing from the calculation of regulatory capital by means of a prudential filter. Even if banks wanted to use the fair value option for liabilities, regulation prevented them from doing so to increase capital ratios. Banks thus had an incentive to engage in Liability Management Exercises (LMEs), i.e., buybacks of debt capital securities that trade below par, as the unrealized gain then becomes realized and is included in regulatory capital.[2] Using data of unprecedented detail, we examine the determinants of 720 European LMEs as well as their effects on solvency and liquidity. We also examine the determinants of the buyback premium as a measure of the inefficiency of an LME, and the types of instruments that were bought back.

In the years leading up to the implementation of Basel III in Europe (2009–2013), banks' demand for equity capital increased significantly. Whereas under Basel II rules banks could satisfy an 8% capital requirement with 2% common equity over risk-weighted assets, under Basel III, the Common Equity Tier 1 requirement can be as high as 14.5%. Many European banks could not satisfy these augmented capital requirements within relatively short notice through conventional methods. Issuing shares, for example, was not practically possible for cooperatives and state-owned banks and because of weak investor appetite. In addition, issuing shares dilutes existing shareholders, especially when share prices are low. Alternatively, retaining profits would entail cutting dividend payments, which would give a bad signal to investors. Moreover, retaining profits is only meaning-

[1] The unrealized gain is the difference between the accounting value of debt and the (lower) market value of debt.

[2] Regulatory adjustments applied to accounting equity to arrive at regulatory capital are often denoted with the term "prudential filters." Note that we use the term Liability Management Exercise, instead of "balance sheet management," given that this is a common term for these transactions (Slater, 2011).

ful for profitable banks, but profitable banks were often less pressed to meet the increased capital requirements. A third way to increase capital ratios would be to sell assets with high risk weights, namely by "de-risking." However, in the interest of small and medium-sized enterprises (SMEs), European supervisors actively discouraged banks from de-risking as this would reduce lending to SMEs (as evidenced by the EBA press release on the EBA recapitalization exercise and EBA's 2013 recommendation on the preservation of capital (EBA, 2011b, 2013b)).

In the absence of alternative viable means to increase capital, many European banks responded to the higher anticipated capital requirements by buying back debt that traded below par. These banks actively managed their liabilities to realize gains on liabilities that originated from a weak credit standing. To illustrate this, assume a bank faces a deteriorated credit standing. This results in a potential gain on a debt security because increases in credit risk result in decreases in debt value. In case the bank values the debt security at amortized cost, a repurchase at the lower market value would turn the potential gain into a realized gain.

In case the bank fair values the debt security, the bank will recognize an unrealized fair value gain when the credit standing deteriorates, that is, without having to buy back the security. This unrealized gain increases the bank's equity level and its Core Tier 1 ratio. However, this is where the prudential rules come into play. Banks are subject to a prudential filter that requires them to exclude, from the calculation of regulatory capital ratios, any unrealized gains or losses on their liabilities valued at fair value that are due to changes in their own credit standing (e.g. see Article 64(4) of EC (2006)).[3] In addition, IFRS imposes requirements on the use of the fair value option that support the prudential filter.

A bank can circumvent the prudential rules by repurchasing the debt security at the lower market value. This, of course, works well if the debt security is traded below par. The realized fair value gain is then included in the calculation of the Core Tier 1 ratio.

[3]The prudential filter that excludes gains and losses resulting from changes in own creditworthiness is symmetrical. Unrealized gains originating from a deteriorated own credit standing are not included in regulatory capital. Likewise, the loss on a debt security associated with an improved credit standing does not affect regulatory capital either. This rule thus aligns the measurement of fair-valued liabilities with that of liabilities accounted for at amortized cost.

Crédit Agricole offers an example of a typical LME. On April 1, 2009, it announced the buyback of an Upper Tier 2 debt capital security that traded significantly below par, namely at 52%. Crédit Agricole's motivation for the LME was to increase its solvency ratio.[4] Shortly after the announcement, Crédit Agricole exchanged £545m of this security at a price of 72%, thus paying the holders a 20% buyback premium (Crédit Agricole, 2011b,a). This LME would add £153m (€170m) to income, and would increase equity and Core Tier 1 capital by 5.03 basis points, at a time when Crédit Agricole's Core Tier 1 capital ratio was 8%.[5] Offsetting this gain is a reduction of total regulatory capital by £545m (€605m) due to the decrease in Upper Tier 2 capital. In addition, Crédit Agricole paid the debt security holders a cash premium of £114m (20% of £545m). If banks were free to recognize gains on liabilities, the total unrealized fair value gain could have been recognized as net income, which would increase common equity and Core Tier 1 capital without a decrease in total regulatory capital and a reduction in cash.

Most of the LMEs involve hybrid debt instruments that count towards a bank's regulatory capital.[6] Buying these instruments back is subject to rules, with particularly strict rules applying to debt capital instruments of the highest prudential quality, where the quality of capital instruments primarily relies on their capacity to absorb losses. The buyback restrictions ensure that instruments are available to absorb losses, for example by way of a write-down, a conversion into equity, or the cancellation or delay of coupon payments. At the same time, the higher loss-absorbing capacity of these instruments makes them more attractive buyback targets: it increases the likelihood of the instrument being written off or the bank skipping a coupon payment, which means that these instruments trade at deeper discounts when a bank's solvency ratio is low. As a consequence, buying back these instruments will result in the highest realized gains. However, buying back these instruments will also lead to a decrease in total regulatory capital and loss-absorbing capacity, as well as a reduction of liquidity.

[4]The Crédit Agricole invitation to offer mentions: "The Notes currently trade at a significant discount compared to their initial issue price. If the transaction is successful, it will result in a modest improvement in the Tier 1 solvency ratio of [Crédit Agricole]."

[5]Note that we used the April 9, 2009 GBPEUR exchange rate of 1.1103. The €170m is pre-tax. After tax, the amount would have contributed (even) less to Core Tier 1.

[6]From here on, we use the terms "security" and "instrument" interchangeably.

The Crédit Agricole example shows that the prevailing market conditions in combination with regulatory preferences that discouraged de-risking and excluded unrealized fair value gains and losses arising from changes in own credit standing from the calculation of regulatory capital resulted in significant unintended consequences. As the Crédit Agricole example shows, in exchange for a modest increase in the Core Tier 1 capital ratio, banks sacrificed cash to make debt holders part from their securities. The LMEs that banks executed were at the expense of their total capital ratios and their liquidity, neither of which are in the interest of a safe and sound banking system.

Surprisingly little research has been done into the (economic) effects of the prudential filter on unrealized gains and losses originating from changes in own credit standing. The requirement to exclude the unrealized fair value gain on a weakened credit standing creates an incentive to arbitrage. Option theory shows that the gain increases with leverage and at the same time, given the prudential filter, strengthens the incentive of a bank to realize the fair value gain through the execution of an LME. This incentive becomes even stronger when banks are pressured to increase their capital while having limited alternative opportunities to do so.

This paper analyzes 720 LMEs of banks from 16 European countries from April 2009 to December 2013. We have access to rich and detailed LME data. The comprehensive nature of the data allows us to examine the determinants of LMEs, as well their effects on solvency and liquidity. Our results show that repurchasing below-par debt securities comes at a cost: to compensate the debt holder for parting from his security, the bank pays a buyback premium. This buyback premium arises because, for a debt holder to be willing to sell his security, the buyback price should reflect the value of the debt *after* the buyback (Admati, DeMarzo, Hellwig, & Pfleiderer, 2017). Given that the buyback reduces the bank's default probability, the value of debt increases, leading to positive buyback premiums. The larger the buyback premium, the smaller the realized gain and the more cash the bank needs to spend on buying back the debt security. The literature on LMEs that are executed in the context of higher anticipated bank capital requirements is sparse. Therefore we present extensive descriptive evidence on which banks engaged in LMEs as well as on the cost and inefficiency of these LMEs. We then use regression analysis to examine the determinants of an

LME. The results show that the likelihood of an LME decreases (increases) with a bank's solvency ratio (leverage) and decreases with bank size. We also document that banks from Greece, Ireland, Italy, Portugal, and Spain, and listed banks were more likely to engage in an LME. The likelihood decreases with profitability and increases with the dividend pay-out ratio. In a next step, we examine the premium that banks paid to investors to part from their securities. Our results confirm that the premium increases with the loss-absorbing capacity of capital instruments, economy-wide financial stress measured by the CBOE Volatility Index, and leverage. In addition, the premium decreases with the size of a bank. We also investigate whether banks target instruments with a high capacity to absorb losses. We document a negative relation between bank solvency and the probability to buy back the most loss-absorbing instruments. In addition, banks repurchase these instruments more often in times of economic stress.

Our evidence shows that as a consequence of the interplay between prudential rules and a context that made it difficult for banks to increase capital through established ways such as raising capital, retaining profits or selling assets, mainly less resilient banks engaged in LMEs, during times of economic stress. In addition, banks bought back securities that were meant to contribute the most to the safety and soundness of the banking system as they repurchased the most loss-absorbing capital securities. The LMEs also resulted in a loss of liquidity and a reduction in total regulatory capital. In summary, our results show that banning banks from recognizing unrealized fair value gains originating from a change in own credit standing has no obvious positive effects on the safety and soundness of the banking system. To the contrary: in a context of economic uncertainty, poorly capitalized banks, for which cash conservation is paramount, engaged in the least efficient and least cash-conserving LMEs.

Our paper contributes to an emerging field of banking research that examines prudential filters. Existing research on prudential filters is sparse and limited to the filter for Available-for-Sale instruments (Bischof, Brüggemann, & Daske, 2014; Chircop & Novotny-Farkas, 2016; Barth, Gómez-Biscarri, Kasznik, & López-Espinosa, 2017; Dong & Zhang, 2017). Recent literature recognizes prudential filters as an area of future research (Beatty & Liao, 2014; BCBS, 2015), which is surpris-

ing given the attention prudential filters have attracted in the past. For example, the prudential filter on fair value gains and losses due to changes in own credit standing was the subject of controversy around the introduction of IFRS in 2005 (EC, 2005).

Whereas there is ample literature on the *level* of regulatory bank capital (Miller, 1995; Mehran & Thakor, 2011; Admati, DeMarzo, Hellwig, & Pfleiderer, 2016; Beltratti & Stulz, 2012; Berger & Bouwman, 2013; DeAngelo & Stulz, 2015; Jonghe & Öztekin, 2015; Firestone, Lorenc, & Ranish, 2017), papers that examine the *structure* of regulatory bank capital are sparse. Our results show that banks are willing to sacrifice total regulatory capital (i.e., hybrid Tier 1 and Tier 2 capital) for limited gains in Core Tier 1 regulatory capital.

We also contribute to the literature on fair valued liabilities: where Barth, Hodder, & Stubben (2008) show that gains on liabilities due to a weaker credit standing are more than offset by depressed asset values, we show that excluding these gains from bank capital does not prevent banks from finding (costly) ways to add these gains to Core Tier 1 capital. We thus highlight an unintended consequence of policies that aim to ban gains that some designate as counter-intuitive (ECB, 2001).

We also contribute to the understanding of the interaction between the *structure* and the *level* of bank capital: our paper lends support to Sommer's (2014) criticism on the narrow focus on equity of some academics. We confirm Sommer's view that not all liabilities are equal: Tier 1 instruments, for example, traded significantly below par during our sample period. The associated gains reveal that even without conversion, write-down or transaction, banks hold more equity "than we thought they did." (Sommer, 2014, p.28)

Our findings are relevant for policy makers and standard setters. It is illusory to ban banks form recognizing gains or losses resulting from a change in own credit standing. Such a ban can be arbitraged and introduces unintended consequences. Our analyses suggest that regulators should prevent banks from buying back the most loss-absorbing instruments, consistent with the argument made by Admati, DeMarzo, Hellwig, & Pfleiderer (2012) that if deleveraging is done inefficiently, regulators should limit banks' discretion.

## Literature, Regulation and Predictions

*Literature*

Early studies on LMEs rely on small samples, generally comprising multiple industries. For example, Johnson, Pari, & Rosenthal (1989) examine 42 insubstance defeasance transactions over the years 1980–1985. These transactions are similar to debt securitizations, where US accounting standards allowed firms to purchase US government securities to take risky debt off balance (FASB, 1983). The positive difference between the value of the securities and the value of debt could be recognized as income and added to retained earnings. Johnson et al. (1989) document that debt holders benefited from these transactions, and suggest earnings management as a motive for defeasing debt. Hand, Hughes, & Sefcik (1990) in another paper on insubstance defeasance transactions, show that these transactions are generally bad news. However, Hand et al. (1990) remain inconclusive on the motivation for insubstance defeasance transactions. Their sample firms defeased for various reasons: managing earnings, attempting to avoid violating restrictions in bond covenants, or using excess cash on hand.

More recent studies have used larger samples. For example, Mann & Powers (2007) uses a sample of 943 tender offers from US corporates where bonds trading at a premium dominate. They show that tender offers are more likely when credit spreads are tight. Vallée (2016), in a study highlighting the virtues of convertible capital instruments, documents a positive link between LMEs and profitability measured by return on assets (ROA). Vallée (2016) also suggests that the execution of an LME could potentially save a bank from having to engage in forced fires sales. However, we were not able to confirm Vallée's findings. For example, from our source data we learned that 82.6% of LMEs were motivated by the desire to augment capital, not profits or the prevention of forced fire sales. In addition, European banks struggle to make profits ever since the onset of the global financial crisis (Lautenschläger, 2016). LMEs, however, surged when banks needed more capital for prudential reasons. We focus in our study on the causes and immediate and direct consequences of LMEs. Post-performance of an LME measured by ROA could be the result of many factors, one of which is declining assets.

*Regulation*

*Introduction.* This section describes the relevant regulation that applies to bank debt instruments and their repurchases. It describes the accounting and solvency rules that were in effect during the period that led up to the entry into force of the EU Capital Requirements Regulation (CRR), the European implementation of Basel III. The description of the regulation shows that between April 2009 and December 2013, European regulators actively managed their expectations regarding the quantity and quality of regulatory bank capital. This led to an increased demand for Core Tier 1 capital. More importantly, the description shows that banks relied on LMEs to satisfy the increased demand for Core Tier 1 capital, as alternative ways to increase capital were not viable during this time period.

*The accounting rules and prudential filter.* The default treatment for liabilities under IFRS is to recognize them at fair value initially, and subsequently at amortized cost using the effective interest method (IAS 39 §47 and IFRS 9 Section 4.2.1). Under IAS 39 and IFRS 9, the fair value option allows firms to designate instruments as "at fair value through profit or loss." Banks can apply the fair value option under certain conditions. One such condition is that banks manage their instruments on a fair value basis. This implies that banks should be able to trade these instruments, which contradicts prudential rules that require instruments to be permanently available to absorb losses. European bank capital rules reinforce this condition by way of a prudential filter that requires the exclusion of any unrealized gains or losses on own liabilities valued at fair value that are due to changes in a banks' own credit standing (CEBS, 2004; EC, 2006).

In 2006, the Basel committee adopted the IAS 39 conditions for the use of the fair value option.[7] The committee also adopted the prudential filter that excludes gains and losses from changes in own credit risk as a result of applying the fair value option to financial liabilities. The committee did so because of the concern that, if a bank applies the option to its own debt, "it will recognise a gain and a resulting increase in its capital when its own creditworthiness deteriorates. Such an outcome would undermine the quality of capital measures and performance ratios" (BCBS, 2006b). The EBA

[7]The accounting rules in the United States (SFAS 159 and its successor Subtopic 825-10: Recognition and Measurement of Financial Assets and Financial Liabilities) do not mention this condition, nor do the US implementations of Basel II and Basel III (OCC, 2013).

supports this cautionary stance on the recognition of unrealized gains in their advice to the European Commission on unrealized gains (EBA, 2013a).

*EU capital requirements and bank capital structure.* Until the entry into force of the European implementation of Basel III in 2014, banks were subjected to the Capital Requirements Directive (CRD: EC (2006)). This directive reflects the (first) Basel accord and the Basel II Framework, which require that 8% of risk-weighted assets is backed by capital to absorb losses [Basel I: BCBS (1988), Basel II: BCBS (2006a)]. The CRD allowed banks to structure regulatory capital to minimize the use of equity. Banks could satisfy the 8% total capital requirement with a maximum of 50% Tier 2 capital. Table 1 gives an overview of the regulatory capital requirements and the loss-absorbing capacity of capital instruments.

[Table 1 about here]

To satisfy Tier 1 capital requirements under the CRD, banks could rely on hybrid capital, such as preferred shares and perpetual or permanent instruments. Banks could thus satisfy the 8% regulatory capital requirements with no or minimal amounts of equity capital.[8] As a response to the global financial crisis and to the G20 of April 2009, bank regulators vouched to improve the quality and quantity of regulatory capital (G20, 2009).

*The quality of capital.* The publication of Basel III in December 2010 presented a new definition of capital (BCBS, 2010). A new two-tier structure emphasized the importance of Common Equity Tier 1 (CET1), a new item of Tier 1 capital. CET1 is capital of the highest quality: equity capital after the deduction of specific items, such as goodwill and holdings in financial companies. Compared to Basel II, Basel III applies an increased number of deductions to capital. In addition, Basel III applies the deductions to equity (a subset of Tier 1 capital), whereas Basel II applied the deductions to total regulatory capital. These regulatory developments significantly increased the demand for equity capital.

[8]The formal definition of Tier 1 under CRD (EC, 2006) did not contain a common equity requirement, given that CRD covers listed companies as well as cooperatives, mutuals, and banks that issue certificates of shares. Although formally such institutions have no common equity in issue, the CRD included them in its scope.

*The quantity of capital.* Basel III requires banks to hold at least 4.5% of CET1 over risk-weighted assets, plus 2.5% CET1 in a capital conservation buffer. To mitigate procyclicality in the financial sector, Basel III introduces a 2.5% countercyclical buffer. On top of these requirements is a 1% to 5% capital surcharge for systematically important banks. The total CET1 requirement can thus stack up to 14.5% under the EU's implementation of Basel III, the Capital Requirements Regulation (CRR) (EC, 2013).

It is important to realize that even though Basel III would only enter into force in 2014, banks responded to these regulatory initiatives by issuing instruments that anticipated the upcoming requirements. They did not, however, issue substantial amounts of common equity. Marinova & van Veldhuizen (2014) show that the cumulative amount of equity issued in Europe during our sample period is less than €250m, which is significantly less than the typical nominal amount of an instrument involved in a single LME.

Pressure to satisfy the augmented capital requirements originated from regulators. For example, for the 2011 stress test, the EBA set a Core Tier 1 requirement of 5% of risk-weighted assets. After this stress test, the EBA rapidly raised expectations by setting that ratio to 9% for the 2012 EBA recapitalization exercise (EBA, 2012).[9] For the 2014 EU-wide stress test, the benchmark was even set at 8% Common Equity Tier 1 using the tighter Basel III definition of capital (ECB, 2013). Many European banks hence anticipated the entry into force of the CRR, either voluntarily or under pressure of their supervisors. In particular the EBA recapitalization exercise in 2012 stood out, because it required banks to meet a demanding capital requirement (Mésonnier & Monks, 2015).

*The motivation to execute LMEs.* Instead of issuing new shares to satisfy the elevated Core Tier 1 ratio requirements, banks could augment their capital of the highest quality in the following three ways: (i) retaining profits, (ii) selling assets with high risk weights in a process called "de-risking", and (iii) buying back debt with a low market value in an LME to realize a fair value gain.

[9] In setting such a high requirement, the EBA may have responded to the failed 2011 stress test, which did not prevent some banks from failing shortly after the results were published (Pignal & Jenkins, 2011).

The first two options were not always open to all banks. Retaining profits would entail cutting dividend payments, which would give a bad signal to investors (Lintner, 1956; Barnato, 2016). In addition, retaining profits is only meaningful for profitable banks, as without profits there is not much to retain. Regarding de-risking, European supervisors actively discouraged banks from selling assets with a high risk weight (EBA, 2011b, 2013b). Allowing banks to de-risk would lead them to "shrink" the denominator to increase capital ratios. In practice, this would mean that banks would cut back on lending to small and medium enterprises, as these are relatively risky borrowers, which in Europe is a politically sensitive issue (Chassany, Crowley, & Penty, 2012). Given these limitations, banks sought to increase capital through the execution of LMEs.

*Rules and conventions on LMEs.* The quality of capital instruments relies primarily on their loss-absorbing capacity. Banks should be able to impose losses on these instruments – for example, through a write-down or a conversion into equity. In addition, banks can impose losses on capital instruments by canceling coupon payments on Tier 1 and Upper Tier 2 instruments.

The loss-absorbing capacity of capital instruments increases with maturity.[10] However, bank regulation governing the maturity of capital instruments is ambiguous and somewhat inconsistent. In theory, regulatory capital instruments should be perpetual (or undated) and not callable. This to make sure the instruments are permanently available to absorb losses. Prudential regulation also prohibits banks from creating any expectations that the instrument will be bought back (BCBS, 2010; EC, 2006, 2013). In practice, however, European banks in particular redeem capital instruments at the first possible call date, which often is five years after issuance. For example, during the global financial crisis, Deutsche Bank did not honor the call for a Tier 2 instrument, after which the bank found it difficult and costly to access the market for new issuances of capital instruments.

Although premature redemptions violate the requirement that capital be permanently available to absorb losses, they are perfectly legal. The CRD allows banks to call, repurchase or redeem capital instruments after five years [Articles 63a(2) and 64(3) of CRD EC (2006)]. European banks

[10] An instrument with a short remaining maturity will be repaid in the foreseeable future. This prevents banks from imposing losses on that instrument, thus limiting the loss-absorbing capacity of the instrument.

generally do this, albeit that conditions apply, with stricter conditions applying to Tier 1 and Upper Tier 2 instruments than to Lower Tier 2 instruments. For example, Tier 1 and Upper Tier 2 instruments can generally be called if the bank replaces the instrument with an instrument of at least the same quality *or* if the solvency of the credit institution in question is not (unduly) affected.[11] In practice, the last requirement sets a low bar. The redemption should not lead a bank to breach minimum capital requirements and most banks operated above these requirements. On the other hand, buybacks of regulatory capital require supervisory approval, which creates some uncertainty. Not all supervisors grant permission equally swiftly, the rules on supervisory approval are ambiguous, although generally stricter for Tier 1 and Upper Tier 2 than for Lower Tier 2 capital.

### *Predictions*

The buyback premium is of particular prudential interest, as it reflects a loss of cash which affects liquidity and solvency. The premium arises because banks generally operate at high levels of leverage. When leverage is very high, the prospect of bankruptcy will negatively affect the value of the bank, its debt and equity.

An important consequence of a debt buyback is that the overall value of debt of a bank increases. Therefore, an investor who is willing to sell a debt instrument back to the bank faces a free-rider problem: *other* debt holders benefit from the investor's willingness to sell his instrument back to the bank. Consequently, the investor will only participate in a buyback transaction if he receives a premium. Bulow & Rogoff (1988) and Admati et al. (2017) predict that an investor will only participate in a buyback transaction if he receives a premium that increases the price to the value *after* the buyback. Appendix 1 outlines a theoretical model based on Merton (1974) that allows us to illustrate why debt holders demand the buyback premium and why this premium varies inversely with solvency. Consequently, we expect that less resilient banks pay higher premiums to make investors part from their instruments.

[11] This last requirement is meant to respect the seniority of Tier 1 and Upper Tier 2 instruments in case a bank is poorly capitalized. Buying these instruments back would impose losses on their holders, whereas the first and proportionately greatest share of losses should be imposed on equity holders.

Following the discussion on regulation in the previous section, we also expect that banks predominantly focus their LME efforts on debt instruments that count towards regulatory capital. The accounting rules and prudential regulation jointly work in such a way that, irrespective of the way they are accounted for, gains on these instruments can be realized only through a buyback. We also expect banks to opportunistically exploit the unpredictability of a buyback. Regulatory capital instruments are meant to be permanently available to absorb losses. The prospect of having to absorb losses therefore contributes to the depth of the discount and the related potential fair value gain in a LME. However, the discount and the related gain would disappear if investors anticipated a buyback.

A successful LME should therefore have an element of surprise. Thanks to the rule on buybacks that grant the initiative of a buyback to the issuer, banks were able to choose instruments with the deepest discounts. These were generally instruments that are least likely to be bought back – for example, instruments that are subject to more onerous buyback requirements, such as instruments that require permission and for which permission may perhaps not be granted, or instruments that were in issue less than five years.

We therefore expect permanent capital instruments (Tier 1 and Upper Tier 2 instruments) to show a larger discount and potential fair value gain than Lower Tier 2 instruments or senior unsecured debt. This is primarily because Tier 1 and Upper Tier 2 instruments are subject to requirements that make them more loss-absorbing than other instruments (see Table 1). In addition, these instruments are also the ones that investors may not expect to be bought back, given the more onerous buyback requirements. Moreover, Admati et al. (2017) and Sommer (2014) offer theoretical support for the idea that banks prefer to buy back the most junior instruments.

## Sample selection and data

We gathered data from European banks over the period April 2009 to December 2013. The period starts from the April G20 call for capital of higher quality and quantity and ends with the entry into force of the CRR, the implementation of this G20 call. We exclude Switzerland because this country is not bound by EU regulation. The reasons to study only EU banks are (i) EU prudential rules

require the exclusion of unrealized fair value gains or losses from changes in own credit standing for capital instruments, (ii) the availability of data: European banks engaged in LMEs much more often than US banks[12], and (iii) the quality of the data, as European LME transactions are all corroborated by the Debt Capital Market desks of three investment banks.

We analyzed the summary motivations provided by the investment banks for each transaction to infer the motives to engage in LMEs. From the 613 justifications provided, 506 (82.6%) indicate that the LME was executed to increase Core Tier 1 capital. The remaining justifications could not rule out that motive, but were more generic ("to manage the capital base of the bank") or described the process ("cash tender offer via reverse Dutch auction for up to €150m of its Upper Tier 2 subordinated callable step up notes"). We are therefore confident that increasing Core Tier 1 was the primary motivation to engage in LMEs.[13]

*Data levels*

We use the data for analyses on different levels. At bank level we compare LME banks against non-LME banks. This allows us to identify characteristics that may be typical for banks that execute LMEs. At bank-year level we analyze data of banks that executed LMEs during a fiscal year. This allows us to estimate the likelihood of an LME during a year.

To examine the consequences of buybacks and which instruments banks targeted, we focus on the most granular level: the instrument (or contract) level. Here we analyze particulars of individual instruments that took part in an LME, each of which is governed by a separate contract. At this level, we focus on LMEs of capital instruments: Tier 1, Upper Tier 2, and Lower Tier 2 instruments. However, to compare these LMEs against those that involved non-capital instruments, we also include LMEs of senior unsecured debt instruments. These instruments are closest to capital instruments in ranking and subordination, but not subject to capital adequacy rules. Moreover, they are similar in that they help bail out holders of financial liabilities in non-viability (Sommer, 2014).

[12] 720 LME transactions from 69 EU banks versus 86 from 37 US banks.

[13] We excluded debt-equity swaps because in banking (in particular during the aftermath of the financial crisis) a debt-equity swap in practice is a bail-in of bond-holders or creditors that occurs when a bank is in resolution or when the bank is unable to continue as a going concern. These swaps are likely not voluntarily decided or timed by bank managers, but by regulators, receivers, or administrators.

The three upper panels of Table 2 present an overview of the data at the different levels. Panel A shows that 69 of the 167 sample banks engaged in LMEs. We can compare characteristics of these banks to the 98 sample banks that did not engage in LMEs over the sample period. Most banks that executed LMEs bought back more than one instrument (57 out of 69 banks).

[Table 2 about here]

During the sample period (from April 1, 2009 to the end of 2013), the sample covers 787 bank-years, of which 330 (457) are from banks that executed one or more (respectively, zero) LMEs. Panel B shows that our sample includes 121 (666) bank-years with (without) LMEs.

Panel C reports the number of unique announcement dates as well as, at contract level, the total number of instruments that were bought back. The sample includes data from 185 announcement dates. Banks that executed LMEs generally visited the market more than once; they often targeted multiple instruments in one announcement. A total of 720 instruments was bought back.[14] Most buybacks involved Tier 1 and Lower Tier 2 instruments, which partly reflects the use of these instruments by banks.[15]

*Sample coverage*

We rely on both Bankscope and Datastream for consolidated bank data, as each of these databases offer incomplete and partial coverage of EU banks. The combined data that we use from both sources covers on average, per year, total bank assets worth €30.6tn, which is 88.3% of total EU consolidated banking assets reported by the ECB (see Panel D of Table 2).

For items that these databases do not cover, we rely on data from the EBA stress tests, the EBA recapitalization exercise, and ECB data of the 2014 asset quality review. Hand-collected data

[14] Of the 720 LMEs, 34 were bought back at a discount (negative premium) when trading at or over par at the announcement date. Except for three LMEs, all were announced jointly with other LMEs of the same bank on the same day. 28 of the 34 LMEs were announced after 2011 (i.e. in calmer times) and almost all of them were executed by Spanish banks as part of EU or State imposed reorganizations (FROB). It is likely that investors were aware for some time that these banks would execute an LME, thus driving the price at the announcement date up.

[15] It is nearly impossible under Basel II rules to assess details of individual capital instruments that any bank has in issue. Data kept by data vendors on regulatory capital instruments are often incomplete as banks are not required to disclose this information.

complements missing EBA and ECB data for the year 2009. Restricting hand collection of prudential data items to only EBA-covered banks should not lead to a loss of generalizability, given that EBA bank data cover more than 70% of the EU bank assets.[16]

Panel E of Table 2 shows that participation in LMEs differs across countries. For Denmark, for example, the sample has observations from 25 banks, of which one engaged in an LME, in 2011. Spain, on the other hand, reports 10 LMEs in 2012, whereas the number of sample banks is comparable to that of Denmark. The sample also reflects differences in market structures across Europe – with Denmark, France, Italy, Germany and Spain having many banks, and many other countries having fewer. Luxembourg has a low number of observations, likely because the banks operating in that country are predominantly subsidiaries of banks from other countries. Finland and Norway have no LME data.

*Announcement data*

Banks announce an LME generally via a press release. We use the announcement to retrieve the pre-announcement price. After completion of the LME, a bank publishes details for each instrument involved: the exchange price, notional offered amount, and notional accepted amount. We use this information and the information from the announcement to calculate for each instrument included in the LME the buyback premium as well as the realized fair value gain which increases the Core Tier 1 capital ratio. This realized gain is the difference between the nominal value of the underlying exchanged instrument and the associated paid amount, summed over the instruments involved in an LME.

We measure the cost of the LME by calculating the difference between the potential fair value gain that a bank could realize, based on the pre-announcement price of the nominal underlying exchanged instruments and the actual gain that the bank realized. This cost is equal to the buyback premium multiplied with the nominal value exchanged. The larger the buyback premium, the more the holder of the instrument gains and the less a bank can increase its Core Tier 1 capital ratio.

[16]The total assets covered by ECB's asset quality review (AQR) is over 82%, but it should be noted that the wider scope of the AQR is mainly the result of the inclusion of subsidiaries of banks covered by the EBA. To prevent double counting of subsidiary-owned assets and liabilities, we rely on EBA's consolidated scope.

## Research design and results

*Characteristics of LMEs*

Table 3 presents descriptive evidence on the characteristics of banks that engaged in LMEs versus those that did not during the sample period.

[Table 3 about here]

Panel A shows that banks that engaged in LMEs score poorly on many dimensions: profitability, solvency, regulatory capital ratios, liquidity (cash), and asset quality are much lower compared to non-LME banks. Untabulated results show that the relative shortfall of cash does not change for bank-years with LMEs. Density, measured by the ratio of risk-weighted assets over total assets and beta are also high for banks executing an LME – that is, LME banks appear to display a relatively high risk appetite, which the low market to book ratios confirm. The banks that did not engage in LMEs are relatively small compared to LME banks: the average total assets of LME banks is €326bn versus €107bn for non-LME banks.

An explanation for why larger banks executed LMEs is that they generally involve complex hybrid instruments which are subject to extensive regulation. There are economies of scale – for example, the nominal value of a typical capital instrument is €375m or more. Consequently, larger banks likely have more instruments in issue at the start of the sample period.[17] More importantly, the capacity needed to manage these instruments implies that larger banks are more successful in obtaining the required supervisory approval to execute an LME. This is in line with Ioannidou (2005), who shows that larger banks are less likely the subject of formal supervisory intervention.

Panel B of Table 3 reports dividend pay-out statistics of 121 bank-year observations with and 666 bank-year observations without LMEs. Banks that engaged in LMEs have higher pay-out ratios than non-LME banks in the year before the LME (44.9% versus 25.9%) and in the year of the LME (39.4% versus 23.5%). There is a drop in pay-out ratio after an LME, from 44.9% to 39.4%,

[17] See footnote 15.

however this drop is insignificant (untabulated $p$-value of 0.37). This suggests that banks generally avoid cutting dividends and revert to other (less efficient) ways of increasing capital.

*The buyback premium*

Table 4 reports descriptive statistics of the buyback premium, as well as the associated costs, gains and inefficiencies of LMEs. Panel A shows the distribution of the buyback premium for banks that engaged in an LME. The mean premium is relatively high when compared to other research. De Jong, Roosenboom, & Schramade (2009), for a wide sample of EU banks before the global financial crisis, for example, report an average (median) premium of 3.9% (1.2%) whereas we find an average (median) premium of 8.22% (5.06%). Mann & Powers (2007) report average (median) premiums of 5.55% (3.24%). A possible explanation for these differences is that our sample contains only banks, which are highly levered and for which buybacks are subject to supervisory permission. In addition, our sample period is situated after the onset of the financial crisis, which may have deepened the discounts.

[Table 4 about here]

The discount at which the instruments taking part in a LME trade is substantial, on average about a quarter of the nominal value with an inter-quartile range of two thirds of that value. The average potential fair value gain that a bank could realize in an LME is 20.0 bp of total assets (29.2 bp of risk-weighted assets). The average actual, or realized, gain however, is substantially lower: 14.3 bp of total assets (21.8 bp of risk-weighted assets). These gains may appear limited, however, when expressed in relation to equity, they are substantial: the mean (median) realized gain is 390 bp (97.4 bp).

The difference between potential and actual gains on LMEs reveals their cost. Although these costs are limited in comparison to total assets (5.66 bp on average), their effect on equity can be substantial: the mean (median) cost of a LME on equity holders is 115 bp (48.9 bp). However, their effect at the 99th percentile can be significantly larger: 1,355 bp.

Panel B shows the buyback premium as a percentage of the par value of the exchanged instrument by regulatory classification. It shows that holders of permanent instruments, namely Tier 1 and Upper Tier 2 instruments, command a higher buyback premium (11.32% and 9.87%) than holders of Lower Tier 2 instruments (5.59%) and non-regulatory instruments (2.48%). The differences in the premiums between regulatory classifications are also significantly different from zero, except for the difference in the premiums paid for Tier 1 and Upper Tier 2 instruments ($p$-value = 0.19). The next column in Panel B shows the amounts offered per instrument, which are comparable for capital instruments, but about twice as large for unsecured debt instruments.

Panel B also shows the inefficiency of LMEs. For example, the average Upper Tier 2 instrument would, in the absence of an LME, offer a 41.8% unrealized gain. However, this is deceptive: the average realized gain is only 31.9% (41.8% – 9.87%) as part of the potential gain (the premium) is transfered to the holders of the bought-back instruments. The rightmost column of Panel B measures this inefficiency. It measures which part of the potential buyback premium accrues to debt holders. This column shows that LMEs that involve the most loss-absorbing instruments are the least cash conserving: about a quarter of the potential gain goes to the debt holders. The transfer is lower for less loss-absorbing instruments.

The lower part of Panel B shows the mean amount exchanged per instrument as well as the loss of regulatory capital per exchanged instrument (in italics). The amounts are smaller for capital instruments than for unsecured debt. Note that not all instruments offered are exchanged: the success rate of an LME is about 53%.

Table 5 shows a breakdown of the premiums as well as the amounts involved per year and per country. The premiums vary by year, with 2009 (2010) reporting the highest (lowest) premiums. The observations of 2009 may reflect lingering uncertainty during the post-Lehman collapse period as untabulated results show a drop in premiums, from 11.9% for the first half of 2009 to 8.36% for the second half of 2009. The low premiums in 2010 coincide with a low number of exercises. The potential gain of the LMEs reaches a total of €41.6bn.

[Table 5 about here]

Panel A of Table 5 also shows that the actual, or realized, gains on LMEs are significantly lower than the potential gains. The difference is €9.1bn, which is about 22% of the potential gain. To put the amount of €9.1bn in perspective, it is 35% of the reported total capital shortfall of €25bn that the ECB reported for the 2014 EU asset quality review (ECB, 2014).

In addition, Panel A shows that in 2011 and 2012, the years of the controversial EBA stress test and the EBA recapitalization exercise, banks executed more LMEs than in other years. In these two years, banks offered a total nominal amount of €162.2bn, about 64% of the sample total. In the other years, banks offered significantly less. The number of banks engaging in LMEs is also high for these two years: 36 (2011) and 51 (2012), where in other years this number ranges from 13 to 25. The effect of the LMEs on total EU regulatory capital is a reduction of €110.9bn, with the largest reductions taking place in 2011 and 2012.

Lastly, the penultimate row of Panel A shows that the number of LMEs dropped in 2013. The mean premium value for this year is high due to the premium paid by the Eurobank of Greece. Excluding this bank would lead the mean premium value to drop to 3%, which helps explain the decrease in activity for 2013: the gains to be made in an LME dropped.

Panel B of Table 5 shows the transactions per country. France, Ireland, Italy, Spain and the UK were particularly active regarding LMEs. The countries with the lowest efficiency were Portugal and Spain, with Spanish banks transferring 48.2% of the potential gains to debt instrument holders. Cyprus and Ireland show a low discrepancy between potential and actual gains, as banks in these countries were obliged to impose losses on debt holders.

In the previous two sections, we presented descriptive evidence on the characteristics of banks that engaged in LMEs versus those that did not and on the inefficiency of LMEs. In the next section we investigate more formally the determinants of an LME using a multivariate regression model.

*The likelihood of an LME*

At bank level, we model the likelihood of an LME using the following probit model, henceforward referred to as the LME model:

$$LME_{[0,1]} = \beta_0 + \beta_1 Solvency + \beta_2 Size + \beta_3 Pay\text{-}out + \beta_4 ROA + \beta_5 GIIPS + \beta_6 Listed + \sum_{n=7}^{8} \beta_n Business\ model + \varepsilon \quad (1)$$

where *LME* is equal to one if a bank engages in an LME in a fiscal year, and zero otherwise.

*Solvency* is either Tier 1 capital divided by risk-weighted assets ($Solv_{\text{Tier 1}}$) or accounting equity divided by total assets ($Solv_{\text{Equity}}$). *Size* is the natural log of *total assets* in millions of euros. *Pay-out* is dividend as a proportion of net income. *ROA* is net income over total assets. *GIIPS* is an indicator for LMEs from Greece, Ireland, Italy, Portugal, and Spain. *Listed* indicates whether the bank is listed on a stock exchange. *Business model* is indicator variable for the following bank types: "retail-funded" or "trading" based on the average values for gross loans and interbank borrowing. Except for *GIIPS*, the regressors are lagged variables to respect the order of causality. The regression model relies on *p*-values that account for two-dimensional within-cluster correlation (Petersen, 2009).

We expect the coefficient on *Solvency* to be negative and the coefficient on *Size* to be positive. We control for dividend *Pay-out* as it may be associated with the probability of an LME for two reasons. First, dividends are sticky over time (Lintner, 1956). Therefore banks may choose to continue paying dividends, even if this is at the expense of retained earnings and additions to Core Tier 1 capital. Ceteris paribus, a dividend-paying bank will need to replenish equity capital sooner than a bank that does not pay dividends. Second, by paying debt holders a premium, banks that engage in LMEs give their non-equity capital instrument holders a preferential treatment over equity holders. To prevent unequal treatment of investors, debt contracts often contain clauses that are referred to as "pushers" and "stoppers." These clauses align the payment of dividends and coupons. The buyback of a debt instrument may therefore prompt a bank to continue paying dividends.

We control for profitability (*ROA*), of which the coefficient should be negative, as low profitability limits a bank that wishes to increase retained earnings and capital. We use an indicator variable to control for Greece, Ireland, Italy, Portugal, and Spain (*GIIPS*). These countries were singled out as risky debtor countries during our sample period and are therefore potentially less able to guarantee their national banks. This implies an expected positive coefficient on this indicator variable. We apply an additional control for listing status, as listed banks may operate in a different disclosure environment and may be subjected to different regulations – for example, MiFID (Directive 2004/39/EC) and exchange listing rules. Lastly, we control for a possible business model effect, as banks may issue debt instruments to distinct investor classes. For this control, we rely on Roengpitya, Tarashev, & Tsatsaronis (2014), who classify European banks into distinct business models. We use separate indicators for retail-funded and trading banks.

Table 6 shows the correlation matrix for the main regression variables. This table shows that the occurrence of an LME in a year negatively correlates with solvency and profitability, and positively with the other variables. The correlations are broadly consistent with our expectations.

[Table 6 about here]

Table 7 presents the results of the LME model. The dependent variable of the probit model is one if a bank engages in an LME during a fiscal year, and zero otherwise. The coefficients on *Solvency* are negative and significant, as expected: −5.55 for accounting solvency and −6.88 for regulatory solvency, both with $p$-values of 0.00. The likelihood of an LME thus increases as banks' solvency decreases. The coefficient on *Size* is positive and significant. The coefficient on *Pay-out* is positive, and the coefficient on *ROA* negative. These two coefficient values are as expected, albeit that the latter is not significant. Next, we find that banks in Greece, Ireland, Italy, Portugal, and Spain are more likely to execute an LME, as well as listed banks and banks that adopted a trading or a retail-funded business model.

[Table 7 about here]

Overall, the results of Table 7 show that the likelihood of an LME increases with leverage and size. The LME model thus shows that poorly capitalized banks engaged in LMEs, which is consistent with the idea that the unrealized gain on a debt instrument incentivizes banks to buy them back, but is inconsistent with prudential rules that prevent poorly capitalized banks from buying back capital instruments. The positive coefficients on size are in line with Ioannidou (2005) and likely reflect bargaining power or economies of scale, as larger banks are in a better position to manage the instruments that they choose to issue and later buy back: e.g. larger banks may obtain permission quicker than smaller banks. Other factors that increase the likelihood of an LME are location in one of the GIIPS countries, which likely reflects a higher perceived risk of bank failure.[18]

*Determinants of the buyback premium*

The main variable of interest in the second stage of the analysis is the buyback premium. This is the difference between the buyback price and the value of the instrument before the buyback announcement:

$$\pi = P_X - P_A, \tag{2}$$

where $P_X$ is the exchange price of the instrument expressed as a percentage of the nominal value of the instrument and $P_A$ is the pre-announcement price of the instrument, also expressed as a percentage of the nominal value of the instrument $(P_N)$. Instruments that are bought back in an LME generally trade below par at the announcement date $(P_A < P_N)$. The exchange price should therefore be higher than the price at the announcement and lower than the nominal value: $P_A < P_X < P_N$. The reason we focus on the buyback premium is because it is the part of the regulated gain that the bank loses in an LME.

[18] We ran this regression including a book-to-market variable of which the coefficient is positive but weakly significant only. This finding does not change our inferences. Moreover, it confirms Bhagat, Bolton, & Lu (2015), who show that leverage primarily drives risk.

The Premium model below allows us to examine the factors that affect the buyback premium for individual bought-back instruments:

$$\begin{aligned}\pi = &\beta_0 + \beta_1 \textit{Tier 1} + \beta_2 \textit{Upper Tier 2} + \beta_3 \textit{Lower Tier 2} + \beta_4 VIX + \beta_5 Solvency + \\ &\beta_6 Size + \beta_7 \textit{EBA Recap} + \beta_8 Mills' + \varepsilon \end{aligned} \tag{3}$$

where $\pi$ is the buyback premium for each individual bought-back instrument, expressed as a percentage of the nominal underlying value of the instrument, or the inverse hyperbolic sine of the premium: $\sinh^{-1}\pi$. The latter is a log transformation of the premium that is not restricted to only positive values.

*Tier 1* is an indicator variable that is set to one if the bought-back instrument counted towards Tier 1 capital, and zero otherwise. Likewise, *Upper (Lower) Tier 2* is an indicator variable for an Upper (Lower) Tier 2 instrument, where Table 1 shows the loss-absorbing capacity of these instruments. As the sample used for the regressions contains transactions where the exchanged instrument is a regulatory capital instrument or an unsecured debt instrument, the coefficient values for Tier 1, Upper Tier 2 and Lower Tier 2 are relative to those of unsecured debt instruments. As explained, we expect the coefficients on Tier 1 and Upper Tier 2 instruments to be positive and higher than the coefficient on Lower Tier 2 instruments because Tier 1 and Upper Tier 2 instruments are meant to be more loss-absorbent, and their buybacks are subjected to stricter rules. *Solvency* is either accounting equity divided by total assets ($Solv_{\text{Equity}}$) or Core Tier 1 capital divided by risk-weighted assets ($Solv_{\text{CoreTier 1}}$), where Core Tier 1 capital is Tier 1 capital net of hybrid Tier 1 capital instruments. We expect the coefficient for *Solvency* to be negative.

Given that this analysis uses intra-year data, we now include the CBOE Volatility Index (*VIX*) and EBA recapitalization exercise in this model. *VIX* is the closing value of the CBOE Volatility Index, standardized to values between zero and one. We expect the CBOE Volatility Index to be positively associated with the buyback premium, given that worse financial conditions are associated with higher correlations, higher volatilities, and higher spreads (Schwert, 2011; Opschoor, van

Dijk, & van der Wel, 2014). *EBA Recap* is an indicator variable that is equal to one for repurchases that took place from September to December 7, 2011, the time before the EBA announced the recapitalization exercise results (EBA, 2011a). The response to the EBA recapitalization exercise, which required banks to meet a fairly demanding capital requirement of 9% Core Tier 1, may have prompted banks without excess capital to announce an LME, which would imply a positive coefficient on this indicator variable. On the other hand, buybacks in these months may have alerted investors, who then may have responded by buying hybrid capital instruments in anticipation of an LME, which would imply a negative coefficient on the indicator. As a result, we have no expectations on this indicator variable. Next, we control for the size of banks, where we expect to find a negative coefficient. We include the inverse Mills ratio, obtained from the results of the LME model, to control for selection bias.

Table 8 presents the correlations between the variables included in the buyback premium model. The table shows that the buyback premium correlates positively with the most loss-absorbing instruments (Tier 1 and Upper Tier 2), the CBOE Volatility Index, and the EBA recapitalization exercise, albeit that the latter correlation is weak. The other correlation coefficients are negative, in particular the coefficients on solvency and size. Table 8 thus shows that most correlation coefficients are as expected.

[Table 8 about here]

The high and negative correlation coefficient between Tier 1 and Upper Tier 2 appears to indicate that these two instruments are substitutes and more similar to each other than to Lower Tier 2 instruments. The other high correlation coefficient is the one between the CBOE Volatility Index and the EBA recapitalization exercise.[19]

Table 9 shows the results of the buyback premium model. The first column presents the base-line regression results only, with minimal overlap of variables included in the LME model. Subsequent

[19]Note that, although Table 8 shows a high correlation between CBOE Volatility Index and the EBA recapitalization exercise, the variance inflation factors for these two variables are low (2.01 and 1.98) and for all variables they are well below 10. Therefore, multicollinearity is unlikely to affect the coefficient estimates.

columns include also size and solvency. The coefficients on the capital instruments are all positive and significant, which confirms that investors command a premium for redeeming capital instruments. The coefficients are significant for all three types of instruments: for Tier 1 hybrids the coefficient value is 1.46, for Upper Tier 2 instruments it is 1.13, and for Lower Tier 2 instruments it is 0.88, all with $p$-values of 0.00. As expected, the coefficient on *VIX* is positive and significant (2.47, $p$-value of 0.00). The coefficients on the two solvency variables are negative and significant: $-10.1$ ($p = 0.00$) for the coefficient on accounting solvency and $-11.2$ ($p = 0.00$) for Core Tier 1 ratio. These results confirm our expectation that less resilient banks pay higher premiums to make investors part from their instruments. The coefficient on size is also consistently negative: larger banks pay a lower premium, a result that can be attributed to either a better information environment or lower risk. Lastly, the coefficient on the EBA recapitalization exercise is negative throughout, though not always significant. This coefficient value is consistent with the interpretation that the EBA recapitalization exercise may have contributed to the information environment, and not consistent with the notion that the exercise forced banks to reveal more about their true solvency position than the two other measures of solvency did.

[Table 9 about here]

Moving to the last four columns, these present the coefficients of a linear regression model with the buyback premium ($\pi$) as dependent variable. These coefficients facilitate an assessment of the economic significance of the results. For example, the coefficient values on Tier 1 show that these instruments require a 6–10% higher premium than senior unsecured instruments. The coefficient values on solvency indicate that a drop of the solvency ratio by 1% point increases the buyback premium by 34 to 63%, which is economically significant. The coefficient on *VIX* has the potential to increase the premium by at least 10%, which too is economically significant. Although the coefficient values on Upper Tier 2 instruments are higher than the coefficients on Tier 1 instruments, the probabilities shown in the row below the intercept values indicate that we cannot reject the hypothesis that these coefficients are equal.

The results reported in Table 9 confirm our expectations that the buyback premiums paid in LMEs (i) increase with the loss-absorbing capacity of bought back instruments, (ii) increase with economy-wide financial stress measured by the *VIX*, (iii) decrease with solvency, and (iv) decrease with bank size. The results are relevant – for example, the results on loss-absorbing capacity and solvency reveal unintended consequences of the requirement to exclude unrealized fair value gains on debt instruments that are due to a change in credit standing from regulatory capital. The results on *VIX* show that supervisors' decisions to require banks to recapitalize in times of economic stress may have unintended consequences. On the other hand, the results on the EBA recapitalization exercise show that a coordinated recapitalization exercise may mitigate the adverse effects of LMEs.

*Determinants of instruments that banks target*

The models above do not distinguish between the types of instruments that banks bought back. To investigate whether banks use their discretion to target specific instruments, we run an ordered probit model at instrument level:

$$T_{[1..4]} = \beta_0 + \beta_1 Solvency + \beta_2 Discount + \beta_3 VIX + \beta_4 Size + \beta_5 Pay\text{-}out + \beta_6 ROA + \beta_7 GIIPS + \beta_8 EBA\ Recap + \beta_9 Listed + \sum_{n=10}^{11} \beta_n Business\ model + \beta_{12} Mills' + \varepsilon \quad (4)$$

where the dependent variable ($T$) is a categorical variable that increases with the loss-absorbing quality of the instrument. Its value is "4" for an LME involving a Tier 1 instrument, "3" for an Upper Tier 2 instrument, "2" for a Lower Tier 2 instrument, and "1" for senior unsecured debt. *Discount* is 1 minus the pre-announcement price expressed as a fraction of the face value of the bought-back instrument: $1 - P_A$. We include this variable as it is likely positively related to the loss-absorbing quality of the bought-back instrument. All other variables are as defined previously.

[Table 10 about here]

Consistent with our expectations, the correlations shown in the lower rows of Table 8, and with Admati et al. (2017), we find that lower solvency increases the likelihood of the repurchase of

a more loss-absorbing instrument. The discount variable also confirms expectations, with deeper discounts for more loss-absorbing instruments. Likewise, the coefficient on *VIX* shows that banks target more loss-absorbing instruments in times of higher economic uncertainty. The positive size coefficient likely indicates that larger banks may have more Tier 1 and Upper Tier 2 instruments in issue. The positive coefficient on ROA is probably a reflection of the supervisory approval process. Holding other factors constant, supervisors may grant permission earlier when profitability of a bank looks good.

### *Additional tests*

*Alternative motivations for LMEs.* Our paper relies on the motivations for LMEs mentioned in the offer documentation. Increasing regulatory capital is the first and foremost reason for engaging in an LME: 82.6% of the transactions were the result of a bank wanting to augment regulatory capital. Nevertheless, we investigated the following alternative motivations: $i$) earnings management, $ii$) tax, and $iii$) capital structure.

As for the earnings management motive, we examined whether a bank executing an LME would report a positive net income just because of the execution of the LME. We find only six bank-year observations, out of 330, where an LME helped a bank turn a negative net income number into a positive one. Using OLS we estimated a measure of abnormal loan loss provisioning to examine if banks with abnormal loan losses (an indication of earnings management) are more likely to engage in LMEs. We included the residual of our loan loss estimation model as a variable in our analyses. However, our measure of abnormal loan loss provisions is not significant in our regressions. This supports our finding that liability management is the prime driver for conducting LMEs, not earnings management.

Regarding the tax motive, it should be noted that tax deductibility is the primary reason for banks to issue non-equity capital instruments. A buyback would therefore be at the expense of tax savings. Still, a bank that accumulates losses may suffer less from the tax disadvantages of a buyback. We therefore examined whether banks with relatively high amounts of deferred tax assets (DTAs) are associated with the occurrence of an LME. Including a DTA variable in the regressions reported

in Tables 7 and 10 does not result in significant coefficients. From this we infer that tax reasons do not drive the decision to execute an LME or to target a specific instrument. On the other hand, including DTAs in the analyses of Table 9 gives positive coefficients that are significant for three out of the four full model specifications (i.e., the specifications including a solvency measure). The other coefficients remain unaffected. We infer from this that fixed income investors see the presence of DTAs as a factor that contributes to the vulnerability of banks, and thus allows them to require a higher compensation to part from their instruments. This pricing effect thus works against a tax motive: where accumulated losses potentially favor a buyback, it instead lowers the realized gain and it leads to an outflow of liquidity to compensate fixed income investors.

Regarding the capital structure motive, we find that 31% of the LMEs are exchanges, where a bank replaces an existing instrument by a new instrument at new terms. If purely deleveraging would motivate banks to engage in LMEs, we would observe differences between cash LMEs and exchanges. We therefore included in our analyses an indicator variable that is equal to one if the LME is a cash transaction, and zero otherwise. As this is a variable measured at LME contract level, we include it in the regressions reported in Tables 9 and 10. Our results show no show significant coefficients on this indicator variable.

We also examined annual changes of total assets and densities for bank-years with and without LMEs. We found no results that confirm significant differences between LME and non-LME bank-years for these variables.

We do find positive changes in the annual (Core) Tier 1 ratios for bank-years with LMEs ($p$-values of 0.084 for $\Delta$Tier 1 and 0.0124 for $\Delta$Core Tier 1, using multivariate analyses controlling for size, profitability, pay-out, solvency, business model, and GIIPS). These results lend additional support to our argumentation that augmenting capital is the main motive for banks to execute an LME, not altering a bank's capital structure.

*LMEs that involve senior unsecured instruments.* To assess differences between LMEs that involve capital instruments versus LMEs that do not involve such instruments, we separate out bank-years

that involve transactions in only senior unsecured instruments. Unfortunately, there are only nine such bank-years, which is insufficient to influence the results. From this we infer that banks include senior unsecured instruments in their offerings jointly with capital instruments, which makes it difficult to analyze them separately.

We also examine the proportion of cash LMEs versus LMEs that exchanged instruments for each of the four instrument types (Tier 1, Upper and Lower Tier 2 and Senior Unsecured). About 69% of the LMEs are cash LMEs, where that percentage is 76.5% for Tier 1 LMEs and 76.9% for senior unsecured LMEs.[20] From this we infer that banks include senior unsecured instruments in LMEs for the same reason as Tier 1 instruments.

*LME success rate and IFRS* Not all invitations to offer an instrument are successful – the success rate is 53%. We examine the effects of the success rate, but our inferences are unaffected. IFRS does not affect our results: from 2007 on, the EU implementation of IFRS requires firms whose debt securities are admitted on a regulated market of any Member State to apply IFRS EC (2002).

## Conclusion

European bank regulation requires banks to exclude, for the calculation of regulatory capital ratios, any unrealized gains or losses on their liabilities valued at fair value that are due to changes in their own credit standing. This is to safeguard the safety and soundness of the banking system. In the lead-up to the implementation of Basel III and as a response to the higher anticipated capital requirements, European banks repurchased instruments which traded at a discount from their holders in Liability Management Exercises (LMEs) to turn the unrealized gain into a realized one. The majority of LMEs involved hybrid debt instruments that counted as regulatory bank capital. These instruments were bought back, after which the gain, net of the buyback premium, contributed to the formation of additional Core Tier 1 capital.

Using highly detailed data, we investigate the determinants of 720 European LMEs from April 2009 to December 2013 as well as the effect on banks' solvency and liquidity. We also examine

[20] For Upper (Lower) Tier 2, these percentages are lower (68.4% and 60.4% respectively).

the determinants of the buyback premium, a measure of the inefficiency of the LME, and the types of instruments that were bought back. Our results show that the likelihood of an LME decreases with a bank's solvency. We also find that the buyback premium increases with (i) the loss-absorbing capacity of capital instruments, (ii) economy-wide financial stress, and (iii) leverage. The buyback premiums are at the expense of banks' liquidity and overall regulatory capital.

Altogether, these results indicate that the prevailing market conditions in combination with regulatory preferences that discouraged de-risking and excluded unrealized fair value gains and losses arising from changes in own credit standing from the calculation of regulatory capital resulted in significant unintended consequences. Namely, our results show that the most loss-absorbing instruments are the most attractive buyback targets. In addition, regulation allows buybacks of the most loss-absorbing instruments only if a bank is sufficiently solvent. However, our results provide evidence that the least solvent banks engaged in LMEs. Our results also show that the incentive to engage in an LME increases in times of economic stress. Our findings have several policy implications: contrary to the objectives of bank solvency rules, the prudential filter on unrealized fair value gains on debt instruments may not help the safety and soundness of the banking system. In a context of economic uncertainty, poorly capitalized banks, for which cash conservation is paramount, engaged in the least efficient and least cash conserving LMEs. This is precisely opposite to what the prudential filter aims to achieve.

It should be stressed that besides preserving and increasing regulatory capital, cash conservation is an important objective of bank supervisors. The Basel committee introduced many rules that preserve capital as well as liquidity. An example is the capital conservation buffer that forces banks to stop paying dividends when capital dips below a pre-specified ratio. Even today, supervisors remain firm on the preservation of both capital and liquidity. The EBA recently reaffirmed its stance on limiting distributions to investors (EBA, 2017). Lastly, at least one EU supervisor (DNB, the Netherlands) requires banks to apply for regulatory permission for dividend payments.

Returning to the question in the title of this paper, the answer is affirmative: below-par own debt repurchases should be a cause for prudential concern. In general, banks do not recognize unrealized

gains, because they are uncertain. However, once banks lose their resilience and in times of economic uncertainty the prudential rules that are the subject of our study become ineffective: banks will circumvent the rules that ban the recognition of unrealized gains originating from a weakened own credit standing. They then execute LMEs. In particular the least resilient banks will engage in LMEs when they are most vulnerable. Our analyses suggest that regulators should prevent banks from buying back the most loss-absorbing instruments, consistent with the argument made by Admati et al. (2012) that if deleveraging is done inefficiently, regulators should limit banks' discretion.

Our study is subject to a number of limitations. First, we focus on a specific industry and a specific time period, during which the incentives to engage in LMEs are very clear ex ante. The execution of the LMEs that we examine is a function of motive, opportunity, and ability. During our sample period, banks clearly had both a motive (i.e., increasing regulatory capital) and the opportunity (i.e., many capital instruments traded below par). The advantage is that in this almost experimental setting we can develop clear tests without a strong need to control for other confounding factors. The drawback is that our study does not give insights into why banks in general would repurchase their debt. Nevertheless, our results are generalizable outside our sample period: on 12 February 2016, Deutsche Bank, after a set-back of regulatory capital, engaged in just what our paper describes: it announced a buyback of debt worth $5.37bn, with predictable effects on capital and liquidity. On liquidity, the completion note reveals that Deutsche Bank had increased its purchase price "by 1.50-2.60 percentage points or respectively lower the spreads by 20-25 bps at which it accepts bonds within this tender offer," to "... provide liquidity to holders of the debt securities listed in the tender offer." A second limitation pertains to the ability of banks to buy back instruments. As explained in footnote 15, it is impossible to assess details of all capital instruments that any bank had in issue. As a result we rely on size as a measure of ability, as larger banks likely have more instruments in issue.

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**Table 1.** Regulatory capital and loss-absorbing capacity.

| **Basel II and CRD** | Item | Maturity | | Remarks | Requirement | |
|---|---|---|---|---|---|---|
| Capital of highest quality (book equity after deductions) | Core Tier 1 | Cannot be repaid outside liquidation | ⇓ Less loss absorbing | Tier 1 + Tier 2 ≥8% of RWA | $> \frac{1}{2}$ of Tier 1[3] | ⇑ Subordination |
| Hybrid instruments[1,2] | Tier 1 hybrids | Permanent, perpetual | | Coupon and instrument should absorb losses in going concern | $\leq \frac{1}{2}$ of Tier 1[3] | |
| Subordinated debt instruments[1,2] | Upper Tier 2 | Permanent, no maturity | | Coupon and instrument should absorb losses in going concern | Tier 2 ≤ Tier 1 | |
| Subordinated debt instruments[1] | Lower Tier 2 | Maturity ≥ 5 years and a 5-year gradual capital derecognition period | | | $\leq \frac{1}{2}$ of Tier 1 | |
| Senior unsecured debt | | | | Buyback without permission | | |
| **Basel III and CRR** | Item | Maturity | | Remarks | Requirement | |
| Capital of highest quality | Common equity Tier 1 (CET1) | Cannot be repaid outside liquidation | ⇓ Less loss absorbing | | ≥ 4.5% + buffers up to 10% of RWA | ⇑ Subordination |
| Hybrid instruments[1,4] | Additional Tier 1 (AT1) | Permanent, perpetual, preferential | | Subordinated to Tier 2; coupon may be cancelled | ≥ 1.5% of RWA | |
| Subordinated debt instruments[1,4] | Tier 2 | Maturity ≥ 5 years and then a 5-year linear capital derecognition period | | | ≥ 2% of RWA | |
| Senior unsecured debt | | | | Buyback without permission | | |

*Note:* The table outlines the loss-absorbing capacity of capital instruments, with the most loss-absorbing items at the top. The descriptions follow capital definitions of Basel II (BCBS, 2006a), the Basel press release on instruments eligible for inclusion in Tier 1 capital (BCBS, 1998), CRD (EC, 2006), Basel III (BCBS, 2010, 2011), and CRR (EC, 2013). CRR (Europe's Basel III implementation) entered into force on January 1, 2014. *Tier 1 hybrid* and *Additional Tier 1* instruments are senior in ranking to common stock and rank junior to depositors, general creditors and subordinated debt of the bank. *Upper Tier 2* instruments are undated, permanent instruments that are subordinated in full to non-subordinated creditors. *Lower Tier 2* instruments are dated instruments of which the principal is subordinated to non-subordinated creditors. *Tier 2* (Basel III) instruments are subordinated to depositors and general creditors of the bank. *RWA* is risk-weighted assets.

[1] These instruments are callable at the initiative of the issuer after a minimum of five years. Buybacks generally need supervisory approval, but CRD rules for Lower Tier 2 instruments are ambiguous (EC, 2006).

[2] Calls are generally allowed if the bank replaces the instrument with an instrument of at least the same quality, *or* if the financial and solvency conditions of the institution are not (unduly) affected (EC, 2006).

[3] Before CRD changed in 2011, the directive had no requirement regarding the amount of common equity, nor had it a definition of common equity.

[4] Under Basel III rules and under the EU bank recovery and resolution directive, all instruments shall be written off or converted into equity at the point that the viability of the bank is at risk (BCBS, 2011; EC, 2014). The CRR allows calling the instrument before maturity after prior supervisory approval and if the bank replaces the called instrument by an instrument of equal or higher quality at terms that are sustainable for the income capacity of the institution; or the bank demonstrates that its capital position is well above the minimum capital requirements after the call option is exercised.

**Table 2.** Sample coverage.

| ***Panel A: Bank level*** | | Banks |
|---|---|---|
| Total | | 167 |
| Banks executing an LME during 2009–2013 | | 69 |
| Of which, banks with | | |
| | a single LME | (12) |
| | more than one LME | (57) |
| Banks that did not execute an LME over the sample period | | 98 |

| ***Panel B: Bank-year level*** | | Bank-years |
|---|---|---|
| All bank-years | | 787 |
| Of which, bank-years with | LMEs | 121 |
| | no LME | 666 |

| ***Panel C: Instrument level*** | | Announcement dates | Instruments, Contracts |
|---|---|---|---|
| Total | | 185 | 720 |
| Of which | Tier 1 | 97 | 280 |
| | Upper Tier 2 | 50 | 97 |
| | Lower Tier 2 | 92 | 302 |
| | Unsecured debt | 11 | 41 |

| ***Panel D: Total bank assets (€ tn)*** | Average | 2013 | 2012 | 2011 | 2010 | 2009 |
|---|---|---|---|---|---|---|
| Sample | 30.6 | 29.4 | 32.6 | 33.0 | 31.4 | 26.5 |
| ECB | 34.7 | 32.4 | 35.5 | 35.9 | 34.6 | 34.8 |
| Coverage (%) | 88.3 | 90.7 | 91.9 | 91.8 | 90.7 | 76.2 |

| ***Panel E: Bank-years with, without LMEs*** | 2013 | | 2012 | | 2011 | | 2010 | | 2009 |
|---|---|---|---|---|---|---|---|---|---|
| Austria | 1 | 2 | 2 | 2 | | 2 | | 2 | 2 |
| Belgium | | 4 | 2 | 4 | | 4 | | 4 | 1 4 |
| Cyprus | | 3 | 1 | 3 | | 3 | | 3 | 3 |
| Denmark | | 24 | | 25 | 1 | 25 | | 25 | 25 |
| Finland | | 1 | | 1 | | 1 | | 1 | 1 |
| France | | 21 | 5 | 21 | 3 | 21 | | 21 | 2 21 |
| Germany | | 14 | | 14 | 1 | 15 | | 15 | 15 |
| Greece | 4 | 7 | 4 | 8 | | 8 | | 9 | 1 9 |
| Ireland | | 2 | | 3 | 3 | 3 | 2 | 4 | 3 4 |
| Italy | 3 | 19 | 7 | 20 | 4 | 19 | 1 | 19 | 2 19 |
| Luxembourg | 1 | 2 | | 2 | | 2 | | 1 | 1 |
| Netherlands | 1 | 7 | 1 | 7 | 4 | 7 | 1 | 7 | 2 7 |
| Norway | | 1 | | 1 | | 1 | | 1 | 1 |
| Portugal | | 5 | 1 | 5 | 4 | 5 | | 5 | 4 |
| Slovenia | | 2 | 2 | 4 | | 4 | | 4 | 4 |
| Spain | 1 | 19 | 10 | 19 | 6 | 26 | 4 | 25 | 5 20 |
| Sweden | | 4 | | 4 | | 4 | | 4 | 1 4 |
| United Kingdom | 4 | 13 | 7 | 13 | 5 | 13 | 4 | 13 | 4 11 |
| Total | 15 | 150 | 42 | 156 | 31 | 163 | 12 | 163 | 21 155 |

*Note.* The table describes the sample, which covers the period April 2009 to December 2013. Panel A reports observations of European banks that executed one or more LMEs during the sample period and those that did not execute an LME during the sample period. Panel B focuses on banks-years only. Panel C reports the number of instruments that were involved in LMEs – each number represents a contract governing an instrument. Panel D shows the coverage of the sample banks measured by consolidated total assets, compared to the total assets of consolidated banking data reported by the ECB. Panel E reports bank-years with complete accounting information. Of the column pairs, the left-hand number shows bank-years in which a bank did execute an LME; the right-hand number shows sample bank-years without an LME.

**Table 3.** Characteristics of sample banks 2009–2013.

| ***Panel A: Ever LME (no. of obs: 330)*** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Means | $p$ (diff) | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
| Net income (M€) | −92.2 | 0.01 | −10,811 | −4,211 | −461 | 82.0 | 640 | 3,590 | 6,271 |
| ROA (%) | −0.53 | 0.00 | −11.0 | −4.22 | −0.47 | 0.15 | 0.35 | 0.83 | 2.99 |
| Solvency (%) | 5.30 | 0.00 | 0.00 | 0.80 | 3.50 | 5.10 | 6.50 | 10.1 | 17.0 |
| Tier 1 ratio (% of RWA) | 10.3 | 0.00 | 0.00 | 6.65 | 8.30 | 10.1 | 12.5 | 15.5 | 18.3 |
| AQ (%) | 1.58 | 0.08 | 0.00 | 0.12 | 0.45 | 0.95 | 1.67 | 4.90 | 11.5 |
| Cash | 0.04 | 0.09 | -1.94 | -1.52 | -0.65 | -0.04 | 0.70 | 1.74 | 2.23 |
| Density ( $\frac{RWA}{TA}$ ) (%) | 49.7 | 0.04 | 19.7 | 23.7 | 33.5 | 49.5 | 61.2 | 82.7 | 91.3 |
| Beta | 0.98 | 0.00 | 0.24 | 0.33 | 0.76 | 0.92 | 1.25 | 1.55 | 1.90 |
| Market to Book | 0.64 | 0.11 | 0.00 | 0.16 | 0.38 | 0.61 | 0.85 | 1.31 | 2.31 |
| BIS ratio (%) | 12.8 | 0.00 | 0.20 | 9.32 | 11.0 | 12.8 | 14.4 | 17.1 | 19.0 |
| Equity (M€) | 14,760 | 0.00 | −2,463 | 320 | 1,748 | 5,971 | 17,440 | 66,308 | 85,886 |
| Total assets (M€) | 325,947 | 0.00 | 2,677 | 10,499 | 42,147 | 110,742 | 399,220 | 1,550,903 | 1,899,419 |
| ***Never LME (no. of obs: 457)*** | | | | | | | | | |
| | Means | | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
| Net income (M€) | 263 | | −1,800 | −299 | 1.33 | 31.2 | 203 | 2,310 | 4,973 |
| ROA (%) | −0.02 | | −10.4 | −2.60 | 0.08 | 0.32 | 0.70 | 1.27 | 3.22 |
| Solvency (%) | 8.80 | | 0.00 | 2.10 | 4.60 | 7.30 | 11.0 | 17.0 | 58.8 |
| Tier 1 ratio (% of RWA) | 11.9 | | 4.00 | 4.00 | 8.85 | 11.2 | 14.5 | 19.9 | 25.3 |
| AQ (%) | 1.42 | | 0.00 | 0.01 | 0.28 | 0.70 | 1.68 | 4.64 | 11.4 |
| Cash | 0.17 | | -2.10 | -1.65 | -0.55 | 0.11 | 0.92 | 2.03 | 3.89 |
| Density ( $\frac{RWA}{TA}$ ) (%) | 44.0 | | 14.0 | 17.7 | 24.8 | 36.1 | 49.4 | 136 | 268 |
| Beta | 0.49 | | 0.03 | 0.09 | 0.28 | 0.46 | 0.63 | 1.08 | 1.27 |
| Market to Book | 0.71 | | 0.00 | 0.04 | 0.14 | 0.54 | 0.95 | 2.13 | 3.43 |
| BIS ratio (%) | 15.1 | | 9.5 | 10.1 | 12.7 | 14.1 | 16.9 | 21.6 | 24.8 |
| Equity (M€) | 4,794 | | −0.19 | 25.7 | 150 | 1,026 | 2,794 | 18,263 | 87,981 |
| Total assets (M€) | 106,520 | | 122 | 236 | 1,407 | 11,833 | 77,049 | 1,899,419 | 1,933,861 |
| ***All (no. of obs: 787)*** | | | | | | | | | |
| | Mean | | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
| VIX | 19.1 | | 13.1 | 13.3 | 14.9 | 16.7 | 21.1 | 33.5 | 36.3 |

| ***Panel B: LME bank-year (no. of obs: 121)*** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Means | $p$ (diff) | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
| Pay-out (previous yr.) (%) | 44.9 | 0.00 | 0.00 | 0.00 | 16.1 | 46.7 | 64.9 | 100 | 100 |
| Pay-out (current yr.) (%) | 39.4 | 0.00 | 0.00 | 0.00 | 0.00 | 37.8 | 67.9 | 100 | 100 |
| ***Non-LME bank-year (no. of obs: 666)*** | | | | | | | | | |
| | Means | | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
| Pay-out (previous yr.) (%) | 25.9 | | 0.00 | 0.00 | 0.00 | 25.1 | 41.4 | 68.8 | 97 |
| Pay-out (current yr.) (%) | 23.5 | | 0.00 | 0.00 | 0.00 | 23.5 | 36.8 | 65.9 | 97 |

*Note.* The table reports descriptive statistics, separately for European banks that did (and did not) engage in LMEs, over the period April 2009–December 2013. *Ever LME (Never LME)* denotes banks that did (did not) engage in LMEs. The table reports 330 bank-year observations from 69 banks with, and 457 bank-year observations from 98 banks without LMEs. p1, p5, p25, p50, p75, p95, p99 indicate percentile values for percentiles 1, 5, 25, 75, 95, and 99 and the median (p50). *p (diff)* indicates the significance of the differences in means of variables reported in the upper and lower part of each panel. *Net income* is the income the bank realized over the fiscal year. *ROA* is net income over average total assets. *Solvency* is lagged accounting equity divided by lagged total assets. *Tier 1 ratio* is the lagged Tier 1 capital ratio. *AQ* is the asset quality of the bank, measured as the loan loss provision over the amount of net loans. *Cash* is net cash over Total assets, standardised. *Density* is the lagged ratio of risk-weighted assets over total assets. *Beta* is a bank's stock beta, estimated using 60 monthly observations of bank returns and the Datastream EU market index. *Market to Book* is the lagged ratio of the bank's market value over the value of book equity. *Equity* is common shareholders' equity. *Total assets* is the book value of total assets. *Pay-out* is the dividend pay-out ratio. *VIX* is the closing value of the CBOE Volatility Index.

**Table 4.** European Liability Management Exercises 2009–2013.

***Panel A: Descriptives of buyback premiums (no. of transactions: 720) and annual gains and costs (no. of bank-years: 121)***

| | Means | $p$-value | p1 | p5 | p25 | p50 | p75 | p95 | p99 |
|---|---|---|---|---|---|---|---|---|---|
| Buyback premium ($\pi$ in %) | 8.22 | 0.00 | −1.39 | −0.57 | 2.29 | 5.06 | 10.3 | 29.2 | 65.9 |
| Potential gain (in bp of assets) | 20.0 | 0.00 | 0.20 | 0.45 | 2.44 | 7.73 | 19.5 | 69.5 | 248 |
| Actual gain (in bp of assets) | 14.3 | 0.00 | 0.00 | 0.00 | 1.15 | 4.81 | 14.1 | 45.8 | 203 |
| Cost (in bp of assets) | 5.66 | 0.00 | −0.34 | 0.03 | 0.51 | 1.97 | 4.85 | 26.9 | 49.6 |
| Potential gain (in bp of RWA) | 29.2 | 0.00 | 0.03 | 0.53 | 4.50 | 16.0 | 33.7 | 107 | 334 |
| Actual gain (in bp of RWA) | 21.8 | 0.00 | −0.03 | 0.00 | 2.17 | 9.33 | 20.8 | 64.4 | 327 |
| Cost (in bp of RWA) | 7.35 | 0.00 | −0.64 | 0.05 | 1.11 | 3.70 | 8.20 | 31.0 | 52.8 |
| Potential gain (in bp of equity) | 505 | 0.00 | 0.46 | 6.20 | 40.2 | 148 | 395 | 1,816 | 9,747 |
| Actual gain (in bp of equity) | 390 | 0.00 | −0.49 | 0.00 | 19.5 | 97.4 | 279 | 1,288 | 9,548 |
| Cost (in bp of equity) | 115 | 0.00 | −17.2 | 0.14 | 11.8 | 48.9 | 93.6 | 528 | 1,355 |
| Discount | 0.28 | 0.00 | 0.78 | 0.70 | 0.48 | 0.26 | 0.07 | -0.00 | -0.03 |

***Panel B: Characteristics of LME transactions (no. of transactions: 720)***

| Eligibility | Premium ($\pi$) in % of nominal | $p$ (diff) ($p$-value) | Offered(M€) | Mean potential gain (%) | Inefficiency (%) $= \frac{Premium}{Potential\ gain}$ |
|---|---|---|---|---|---|
| Tier 1 | 11.32 | 0.19 | 373 | 44.9 | 25.2 |
| Upper Tier 2 | 9.87 | 0.00 | 301 | 41.8 | 23.6 |
| Lower Tier 2 | 5.59 | 0.02 | 366 | 28.0 | 20.0 |
| Unsecured debt | 2.48 | | 762 | 17.3 | 14.3 |
| Means | 8.22 | (0.00) | 383 | 35.8 | 23.0 |

| Eligibility | $\Delta$*Reg. cap.* Exchanged (M€) | Success rate (%) | # Instruments |
|---|---|---|---|
| Tier 1 | *187* | 54.0 | 280 |
| Upper Tier 2 | *161* | 53.5 | 97 |
| Lower Tier 2 | *179* | 52.8 | 302 |
| Unsecured debt | 392 | 51.0 | 41 |
| Means | 192 | 53.2 | 720 |

*Note.* The table shows descriptive statistics of 720 European LMEs over the period April 2009 to December 2013, involving 121 bank-years. p1, p5, p25, p50, p75, p95, p99 indicate percentile values for percentiles 1, 5, 25, 75, 95, and 99 and the median (p50). $\pi$ is the mean buyback premium: $P_X - P_A$, where $P_X$ is the exchange price of the instrument expressed as a percentage of the nominal value of the instrument; $P_A$ is the price of the instrument before the announcement, also expressed in a percentage of the nominal value of the instrument $(P_N)$. *Potential gain* is the potential fair value gain that a bank could realize in a LME, based on the pre-announcement price of the nominal amount exchanged. *Actual gain* is the pre-tax fair value gain that a bank realized in a LME, based on the exchange price of the nominal amount exchanged. *Discount* is 1 minus the pre-announcement price expressed as a fraction of the face value of the bought-back instrument: $1 - P_A$. *Cost* is the difference between potential gain and actual gain. The denominators *assets*, *risk weighted assets (RWA)*, and *equity* in Panel A are lagged. $p$ *(diff)* tests the difference between the two values reported to the left of this statistic. $p$-value tests the mean being 0. *Offered* is the mean amount the bank announces in the Liability Management Exercise. *Inefficiency* is the ratio of *cost* over *potential gain*. *Exchanged* is the mean nominal underlying the bank bought back in the Liability Management Exercise. $\Delta$*Reg. cap.*: the italic font denotes the mean loss of total regulatory capital resulting from the LME. *Success rate* is the mean of the ratio of exchanged over offered. *Instruments* is the number of instruments exchanged.

**Table 5.** European Liability Management Exercises years, countries.

***Panel A: Gains and losses per year (amounts in M€)***

| Year | π (%) | Potential gain | Actual gain | Cost | Inefficiency (%) | Offered | −Δ Reg. cap. | Bank-years |
|---|---|---|---|---|---|---|---|---|
| 2009 | 10.06 | 9,002 | 6,814 | 2,188 | 24.3 | 33,982 | 19,278 | 25 |
| 2010 | 5.23 | 8,928 | 7,816 | 1,112 | 12.5 | 39,996 | 21,019 | 13 |
| 2011 | 7.10 | 12,641 | 9,871 | 2,770 | 21.9 | 70,856 | 35,375 | 36 |
| 2012 | 9.16 | 10,120 | 7,504 | 2,616 | 25.8 | 91,305 | 29,960 | 51 |
| 2013 | 9.60 | 859 | 439 | 420 | 48.9 | 15,715 | 5,305 | 18 |
| Overall | 8.22 | 41,550 | 32,443 | 9,107 | 21.9 | 251,854 | 110,937 | 143 |

***Panel B: Gains and losses per country (amounts in M€)***

| Country | π (%) | Potential gain | Actual gain | Cost | Inefficiency (%) | Offered | −Δ Reg. cap. | Bank-years |
|---|---|---|---|---|---|---|---|---|
| Austria | 6.63 | 845 | 699 | 147 | 17.4 | 4,913 | 2,599 | 6 |
| Belgium | 15.67 | 969 | 735 | 235 | 24.3 | 2,126 | 1,775 | 3 |
| Cyprus | 3.00 | 151 | 141 | 9 | 6.0 | 413 | 314 | 1 |
| Denmark | 4.69 | 51 | 46 | 5 | 9.8 | 675 | 149 | 2 |
| France | 6.13 | 4,189 | 3,279 | 909 | 21.7 | 33,194 | 12,147 | 15 |
| Germany | 8.25 | 1,894 | 1,514 | 380 | 20.1 | 10,049 | 4,774 | 4 |
| Greece | 20.07 | 1,342 | 953 | 389 | 29.0 | 5,271 | 2,201 | 8 |
| Ireland | 4.34 | 11,109 | 10,083 | 1,025 | 9.2 | 28,573 | 18,024 | 11 |
| Italy | 4.23 | 3,815 | 2,961 | 853 | 22.4 | 60,159 | 14,723 | 17 |
| Luxembourg | 3.41 | 31 | 24 | 6 | 19.4 | 698 | 188 | 1 |
| Netherlands | 7.45 | 2,451 | 1,683 | 767 | 31.3 | 17,583 | 10,396 | 9 |
| Portugal | 22.67 | 1,493 | 911 | 582 | 39.0 | 5,951 | 2,119 | 6 |
| Slovenia | 7.43 | 1 | 1 | 0 | 0.0 | 100 | 1 | 1 |
| Spain | 10.93 | 3,478 | 1,800 | 1,678 | 48.2 | 35,305 | 14,282 | 31 |
| Sweden | 12.33 | 185 | 132 | 53 | 28.6 | 975 | 535 | 1 |
| United Kingdom | 6.94 | 9,548 | 7,480 | 2,068 | 21.7 | 45,869 | 26,711 | 27 |
| Aggregate | 8.22 | 41,550 | 32,443 | 9,107 | 21.9 | 251,854 | 110,937 | 143 |

*Note.* The table shows amounts involved in European LMEs over the period April 2009 to December 2013. π is the mean buyback premium: $P_X - P_A$, where $P_X$ is the exchange price of the instrument expressed as a percentage of the nominal value of the instrument; $P_A$ is the price of the instrument before the announcement, also expressed in a percentage of the nominal value of the instrument $(P_N)$. *Potential gain* is the maximum potential gain that a bank could realize in a LME, based on the pre-announcement price of the nominal amount exchanged, pre-tax. The *Actual gain* is the pre-tax gain that a bank realized in a LME, based on the exchange price of the nominal amount exchanged. *Cost* is the difference between *Actual gain* and *Potential gain*. This is a measure of the cost of the LME. *Inefficiency* is the ratio of *Cost* over *Potential gain*. *Offered* is the amount the bank announces in the buyback offer, in millions of €. $-\Delta$ *Reg. cap.* is the negative change in total regulatory capital resulting from the LME. *Bank-years* is the number of sample bank-year observations.

**Table 6.** Correlations for bank-years.

| **Bank-year obs.** ($n$ = 645) | LME | $Solv_{\text{Equity}}$ | $Solv_{\text{Tier 1}}$ | Size | Pay-out | ROA | GIIPS | Listed | Trading |
|---|---|---|---|---|---|---|---|---|---|
| $Solv_{\text{Equity}}$ | −0.20 | | | | | | | | |
| $Solv_{\text{Tier 1}}$ | −0.15 | 0.40 | | | | | | | |
| Size | 0.28 | −0.64 | −0.29 | | | | | | |
| Pay-out | 0.09 | −0.03 | −0.07 | 0.03 | | | | | |
| ROA | −0.05 | 0.11 | 0.07 | 0.01 | 0.03 | | | | |
| GIIPS | 0.19 | −0.06 | −0.24 | 0.11 | 0.14 | −0.20 | | | |
| Listed | 0.00 | 0.23 | 0.03 | −0.15 | 0.11 | 0.05 | −0.02 | | |
| Trading | 0.29 | −0.08 | −0.02 | 0.07 | −0.02 | 0.00 | 0.01 | −0.21 | |
| Retail | 0.39 | −0.09 | 0.00 | 0.07 | −0.04 | −0.11 | 0.03 | −0.33 | 0.23 |

*Note.* The table reports correlations of variables from European LME data over the period April 2009 to December 2013. *LME* is 1 if a bank engages in an LME during a fiscal year, else it is 0. $Solv_{Equity}$ is accounting equity divided by total assets. $Solv_{\text{Tier 1}}$ is Tier 1 capital divided by risk-weighted assets. *Size* is the natural log of *total assets* in millions of euros. *Pay-out* is dividend as a proportion of net income. *ROA* is net income over total assets. *GIIPS* is an indicator for LMEs from Greece, Ireland, Italy, Portugal, and Spain. *Listed* indicates whether the bank is listed on a stock exchange. Business model is either "*Retail-funded*" or "*Trading*" based on the average values for gross loans and interbank borrowing. Except for *GIIPS*, the variables are lagged variables.

**Table 7.** LME model (first stage)

| | β | $p$ | β | $p$ |
|---|---|---|---|---|
| $\text{Solv}_{\text{Equity}}$ $(-)$ | −5.55 | 0.00 | | |
| $\text{Solv}_{\text{Tier 1}}$ $(-)$ | | | −6.88 | 0.00 |
| Size $(+)$ | 0.25 | 0.00 | 0.28 | 0.00 |
| Pay-out $(+)$ | 0.17 | 0.00 | 0.19 | 0.00 |
| ROA $(-)$ | −0.21 | 0.24 | −0.19 | 0.24 |
| GIIPS $(+)$ | 0.73 | 0.00 | 0.62 | 0.00 |
| Listed | 1.31 | 0.00 | 1.25 | 0.00 |
| Trading | 2.99 | 0.00 | 3.08 | 0.00 |
| Retail | 2.92 | 0.00 | 3.07 | 0.00 |
| Intercept | −5.15 | 0.00 | −5.03 | 0.00 |
| Pseudo-$R^2$ | | 0.39 | | 0.38 |
| Wald $\chi^2$ | | 111 | | 138 |
| Prob. $> \chi$ | | 0.00 | | 0.00 |
| Correctly classified (%) | | 89.0 | | 87.3 |
| No. of obs. | | 762 | | 645 |

*Note.* The table reports results of a probit regression that relies on European LME data over the period April 2009 to December 2013. The dependent variable is 1 if a bank engages in an LME during a fiscal year, else the dependent variable is 0.

$$LME_{[0,1]} = \beta_0 + \beta_1 \textit{Solvency} + \beta_2 Size + \beta_3 \textit{Pay-out} + \beta_4 \textit{ROA} + \beta_5 GIIPS + \beta_6 Listed + \sum_{n=7}^{8} \beta_n \textit{Business model} + \varepsilon$$

$Solv_{\text{Equity}}$ is accounting equity divided by total assets. $Solv_{\text{Tier 1}}$ is Tier 1 capital divided by risk-weighted assets. *Size* is the natural log of *total assets* in millions of euros. *Pay-out* is dividend as a proportion of net income. *ROA* is net income over total assets. *GIIPS* is an indicator for Liability Management Exercises from Greece, Ireland, Italy, Portugal, and Spain. *Listed* indicates whether the bank is listed on a stock exchange. Business model is either "*Retail-funded*" or "*Trading*" based on the average values for gross loans and interbank borrowing. *Pseudo-*$R^2$ is McFadden's pseudo-$R^2$. Except for *GIIPS*, the regressors are lagged variables to respect the order of causality. The regression model relies on $p$-values that account for two-dimensional within-cluster correlation (Petersen, 2009).

**Table 8.** Correlations for LMEs at instrument level.

| **Individual LMEs** ($n = 493$) | π | Tier 1 | UT2 | LT2 | Unsecured | $VIX$ | $Solv_{\text{Eq}}$ | $Solv_{\text{CT1}}$ | Size | EBA Recap | Target | Discount | Pay-out | ROA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tier 1 | 0.27 | | | | | | | | | | | | | |
| Upper Tier 2 | 0.10 | −0.30 | | | | | | | | | | | | |
| Lower Tier 2 | −0.28 | −0.69 | −0.33 | | | | | | | | | | | |
| Unsecured | −0.11 | −0.20 | −0.09 | −0.21 | | | | | | | | | | |
| *VIX* | 0.25 | 0.19 | −0.03 | −0.11 | −0.12 | | | | | | | | | |
| $Solv_{\text{Equity}}$ | −0.21 | −0.22 | 0.03 | 0.14 | 0.13 | −0.23 | | | | | | | | |
| $Solv_{\text{Core Tier 1}}$ | −0.17 | −0.11 | 0.04 | 0.07 | 0.03 | −0.21 | 0.51 | | | | | | | |
| Size | −0.20 | 0.00 | 0.10 | −0.07 | 0.01 | 0.07 | −0.07 | 0.10 | | | | | | |
| EBA Recap | 0.10 | 0.12 | −0.09 | −0.02 | −0.10 | 0.73 | −0.22 | −0.08 | 0.20 | | | | | |
| Target[1] | 0.32 | 0.91 | 0.06 | −0.73 | −0.45 | 0.20 | −0.24 | −0.10 | 0.03 | 0.11 | | | | |
| Discount | 0.41 | 0.39 | 0.02 | −0.28 | −0.25 | 0.10 | −0.01 | 0.35 | −0.39 | 0.02 | 0.44 | | | |
| Pay-out | 0.11 | 0.01 | 0.01 | −0.02 | 0.01 | −0.01 | −0.20 | −0.13 | −0.16 | −0.08 | 0.01 | 0.06 | | |
| ROA | −0.07 | 0.09 | 0.06 | −0.15 | 0.05 | 0.10 | 0.07 | −0.02 | 0.40 | 0.15 | 0.10 | −0.34 | −0.07 | |
| GIIPS | 0.05 | −0.16 | −0.09 | 0.15 | 0.15 | −0.26 | 0.36 | 0.15 | −0.41 | −0.34 | −0.22 | 0.07 | 0.16 | −0.18 |

*Note.* The table reports correlations of variables from European LME data over the period April 2009 to December 2013. π is the buyback premium, namely the difference between the exchange price and its price three days before the buyback announcement, expressed in percent of the nominal underlying value of the instrument. *Tier 1* is an indicator variable for exchanged instruments that are undated, permanent, capital instruments that are senior in ranking to common stock and always rank junior to depositors, general creditors and subordinated debt of the bank. *Upper Tier 2* is an indicator variable for exchanged instruments that are undated, permanent, instruments that are subordinated in full to non-subordinated creditors. *Lower Tier 2* is an indicator variable for exchanged instruments that are dated instruments of which the principal is subordinated to non-subordinated creditors. *Unsecured* are senior unsecured debt instruments. *VIX* is the closing value of the CBOE Volatility Index, standardized to values between 0 and 1, measured at the announcement date. $Solv_{\text{Equity}}$ is accounting equity divided by total assets. $Solv_{\text{Core Tier 1}}$ is Core Tier 1 capital divided by risk-weighted assets, where Core Tier 1 capital is Tier 1 capital net of hybrid Tier 1 capital instruments. *Size* is the natural log of *total assets* in millions of euros. *EBA Recap* is an indicator for observations of repurchases that took place from September to 7 December 2011.

[1] These variables will the referred to in Table 10 below: *Target* is a categorical variable that increases with the loss-absorbing quality of the instrument. Its value is 4 for Tier 1, 3 for Upper Tier 2, 2 for Lower Tier 2, 1 for Senior unsecured debt *Discount* is 1 minus the pre-announcement price expressed as a fraction of the face value of the bought-back instrument: $1 - P_A$. *Pay-out* is dividend as a proportion of net income. *ROA* is net income over total assets. *GIIPS* is an indicator for Liability Management Exercises from Greece, Ireland, Italy, Portugal, and Spain.

**Table 9.** Premium model (second stage).

| Dependent variable: | $\sinh^{-1}\pi$ | | | | | | | | $\pi$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | *p* | β | *p* | β | *p* | β | *p* | β | *p* | β | *p* | β | *p* | β | *p* |
| Tier 1 (+) | 1.46 | 0.00 | 1.57 | 0.00 | 1.31 | 0.00 | 1.34 | 0.00 | 8.40 | 0.00 | 9.78 | 0.00 | 8.14 | 0.00 | 6.11 | 0.00 |
| Upper Tier 2 (+) | 1.13 | 0.01 | 1.33 | 0.00 | 1.12 | 0.01 | 1.08 | 0.01 | 7.63 | 0.01 | 10.1 | 0.00 | 8.74 | 0.00 | 6.73 | 0.00 |
| Lower Tier 2 (+) | 0.88 | 0.01 | 0.96 | 0.00 | 0.78 | 0.01 | 0.65 | 0.05 | 3.09 | 0.08 | 4.05 | 0.06 | 2.92 | 0.09 | 0.45 | 0.37 |
| *VIX* (+) | 2.47 | 0.00 | 2.23 | 0.00 | 2.15 | 0.00 | 1.85 | 0.00 | 15.7 | 0.00 | 12.9 | 0.00 | 12.4 | 0.00 | 10.6 | 0.00 |
| $Solv_{\text{Equity}}$ (−) | | | | | −10.1 | 0.00 | | | | | | | −63.3 | 0.01 | | |
| $Solv_{\text{Core Tier 1}}$ (−) | | | | | | | −11.2 | 0.00 | | | | | | | −33.7 | 0.03 |
| Size (−) | | | −0.20 | 0.00 | −0.20 | 0.00 | −0.19 | 0.01 | | | −2.44 | 0.00 | −2.44 | 0.00 | −1.86 | 0.00 |
| EBA Recap | −0.65 | 0.00 | −0.40 | 0.04 | −0.51 | 0.01 | −0.19 | 0.24 | −5.81 | 0.01 | −2.83 | 0.10 | −3.48 | 0.05 | −1.15 | 0.29 |
| Mills' | −0.20 | 0.15 | −0.26 | 0.07 | −0.09 | 0.30 | −0.39 | 0.01 | −3.14 | 0.09 | −3.90 | 0.03 | −2.88 | 0.06 | −2.15 | 0.04 |
| Intercept | 0.00 | 0.00 | 3.18 | 0.00 | 3.81 | 0.00 | 4.66 | 0.00 | 1.90 | 0.00 | 32.7 | 0.00 | 36.6 | 0.00 | 30.3 | 0.00 |
| *Prob* T1 = UT2 | | 0.30 | | 0.45 | | 0.55 | | 0.41 | | 0.73 | | 0.89 | | 0.78 | | 0.78 |
| $\overline{R}^2$ | | 0.15 | | 0.18 | | 0.21 | | 0.24 | | 0.12 | | 0.19 | | 0.21 | | 0.20 |
| Prob. $> F$ | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| # of obs. | | 593 | | 593 | | 593 | | 493 | | 593 | | 593 | | 593 | | 493 |

*Note.* The table reports results of a regression that relies on European LMEs over the period April 2009 to December 2013.

$$\pi = \beta_0 + \beta_1 \textit{Tier 1} + \beta_2 \textit{Upper Tier 2} + \beta_3 \textit{Lower Tier 2} + \beta_4 VIX + \beta_5 Solvency + \beta_6 Size + \beta_7 \textit{EBA Recap} + \beta_8 Mills' + \varepsilon$$

For each individual bought-back instrument, the dependent variable ($\pi$) is either the buyback premium, namely the difference between the exchange price and its price three days before the buyback announcement, expressed in percent of the nominal underlying value of the instrument, or the inverse hyperbolic sine of the premium: $\sinh^{-1}\pi$ or $\ln(\pi + \sqrt{1+\pi^2})$. As the sample used for the regressions contains transactions where the exchanged instrument is a regulatory capital instrument or an unsecured debt instrument, the coefficient values for Tier 1, Upper Tier 2 and Lower Tier 2 are relative to those of unsecured debt instruments. *Tier 1* is an indicator variable for exchanged instruments that are undated, permanent, capital instruments that are senior in ranking to common stock and always rank junior to depositors, general creditors and subordinated debt of the bank. *Upper Tier 2* is an indicator variable for exchanged instruments that are undated, permanent, instruments that are subordinated in full to non-subordinated creditors. *Lower Tier 2* is an indicator variable for exchanged instruments that are dated instruments of which the principal is subordinated to non-subordinated creditors. *VIX* is the closing value of the CBOE Volatility Index, standardized to values between 0 and 1, measured at the announcement date. $Solv_{\text{Equity}}$ is accounting equity divided by total assets. $Solv_{\text{Core Tier 1}}$ is Core Tier 1 capital divided by risk-weighted assets, where Core Tier 1 capital is Tier 1 capital net of hybrid Tier 1 capital instruments. *Size* is the natural log of *total assets* in millions of euros. *EBA Recap* is an indicator for observations of repurchases that took place from September to 7 December 2011. *Mills'* is the inverse Mills ratio. The regression model relies on *p*-values that account for two-dimensional within-cluster correlation (Petersen, 2009).

**Table 10.** Target instruments.

| | Clustered OLS | | | | Ordered Probit | | | |
|---|---|---|---|---|---|---|---|---|
| | β | $p$ | β | $p$ | β | $p$ | β | $p$ |
| $Solv_{\text{Equity}}$ $(-)$ | −7.89 | 0.01 | −7.90 | 0.01 | −15.0 | 0.00 | −15.0 | 0.00 |
| Discount $(+)$ | 2.10 | 0.00 | 2.11 | 0.00 | 2.99 | 0.00 | 2.99 | 0.00 |
| $VIX$ $(+)$ | 0.92 | 0.02 | 0.92 | 0.02 | 1.01 | 0.04 | 1.01 | 0.04 |
| Size | 0.08 | 0.03 | 0.08 | 0.08 | 0.10 | 0.05 | 0.10 | 0.07 |
| Pay-out | −0.03 | 0.51 | −0.03 | 0.58 | −0.08 | 0.23 | −0.08 | 0.32 |
| ROA | 11.6 | 0.00 | 11.6 | 0.00 | 18.4 | 0.01 | 18.4 | 0.01 |
| GIIPS | −0.20 | 0.06 | −0.19 | 0.15 | −0.22 | 0.22 | −0.22 | 0.31 |
| EBA Recap | −0.40 | 0.15 | −0.40 | 0.15 | −0.45 | 0.22 | −0.45 | 0.23 |
| Listed | −0.10 | 0.76 | −0.09 | 0.78 | −0.12 | 0.81 | −0.13 | 0.81 |
| Trading | −0.45 | 0.11 | −0.44 | 0.16 | −0.76 | 0.11 | −0.77 | 0.15 |
| Retail | −0.14 | 0.64 | −0.13 | 0.78 | −0.30 | 0.54 | −0.31 | 0.66 |
| Mills | | | 0.01 | 0.97 | | | −0.01 | 0.98 |
| Intercept | 1.66 | 0.00 | 1.62 | 0.14 | | | | |
| Cut 1 | | | | | −0.77 | 0.00 | −0.80 | 0.00 |
| Cut 2 | | | | | 1.17 | 0.00 | 1.13 | 0.00 |
| Cut 3 | | | | | 1.59 | 0.00 | 1.56 | 0.00 |
| $\overline{R}^2$, Pseudo-$R^2$ | | 0.32 | | 0.32 | | 0.18 | | 0.18 |
| Prob. $> F$ | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| No. of obs. | | 593 | | 593 | | 593 | | 593 |

*Note.* The table reports results of regression results from European LME data over the period April 2009 to December 2013. The dependent variable denotes the loss-absorbing quality of the repurchased instrument: 4 for Tier 1, 3 for Upper Tier 2, 2 for Lower Tier 2, 1 for Senior unsecured debt.

$$T_{[1..4]} = \beta_0 + \beta_1 \textit{Solvency} + \beta_2 \textit{Discount} + \beta_3 \textit{VIX} + \beta_4 Size + \beta_5 \textit{Pay-out} + \beta_6 \textit{ROA} + \beta_7 GIIPS + \beta_8 \textit{EBA Recap} + \beta_9 Listed + \sum_{n=10}^{11} \beta_n \textit{Business model} + \beta_{12} Mills' + \varepsilon$$

$Solv_{\text{Equity}}$ is accounting equity divided by total assets. *Discount* is 1 minus the pre-announcement price expressed as a fraction of the face value of the bought-back instrument: $1 - P_A$. *VIX* is the closing value of the CBOE Volatility Index, standardized to values between 0 and 1, measured at the announcement date. *Size* is the natural log of *total assets* in millions of euros. *Pay-out* is dividend as a proportion of net income. *ROA* is net income over total assets. *GIIPS* is an indicator for Liability Management Exercises from Greece, Ireland, Italy, Portugal, and Spain. *Listed* indicates whether the bank is listed on a stock exchange. Business model is either "*Retail-funded*" or "*Trading*" based on the average values for gross loans and interbank borrowing. *Pseudo-*$R^2$ is McFadden's pseudo-$R^2$. The clustered OLS model relies on $p$-values that account for two-dimensional within-cluster correlation (Petersen, 2009).

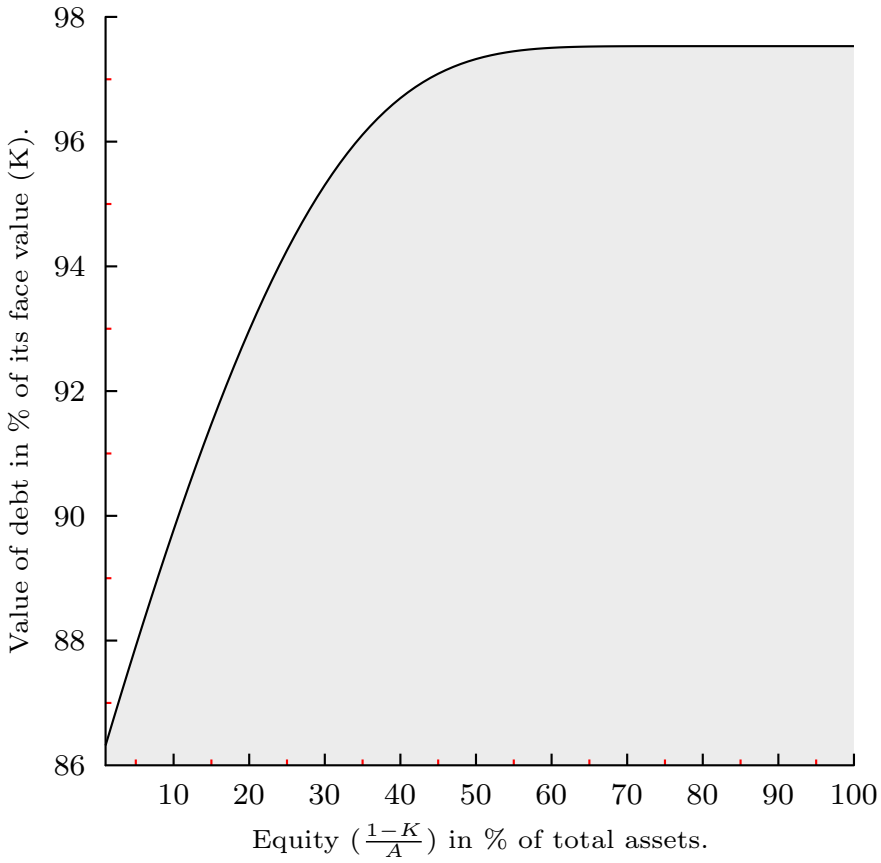


Figure 1: The value of debt: the graph follows the function $\frac{D}{K} = \frac{A}{K}N(-d_1) + e^{-rt}N(d_2)$, where $d_2 = d_1 - \sigma\sqrt{t}$, $d_1 = \frac{ln(\frac{A}{K}) + (r + \sigma^2/2)^t}{\sigma\sqrt{t}}$, $A$ is total assets, $K$ the face value of debt as a fraction of total assets times 100, $r$ the risk-free rate, and $t$ the duration of debt. $N(d)$ is the probability that a standard normal random variable will be less than or equal to $d$. The figure assumes the following parameter values: $t$ is 2.5 years – assuming average maturity of a 5-year Tier 2 hybrid capital security. The risk-free rate: $r = 1.0\%$, annual standard deviation $\sigma = 20.0\%$.

## Appendix 1

Merton (1974) allows us to illustrate why debt holders would command a premium for selling their instrument back to a bank by demonstrating that the value of debt (D) can be expressed as

$$D = AN(-d_1) + Ke^{-rt}N(d_2), \tag{5}$$

where $A$ is the asset value of the bank, $K$ the face value of debt, $r$ the risk-free rate, and $t$ the duration of debt. $N(d)$ is the probability that a standard normal random variable will be less than or equal to $d$:

$$d_1 = \frac{ln(\frac{A}{K}) + (r + \sigma^2/2)^t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}. \tag{6}$$

Dividing Equation (5) by the face value of debt ($K$) allows us to show the effect of deleveraging, see Figure 1. The graph in Figure 1 shows that debt reduction (a move along the graph to the right) leads to an increase in the value of the remaining debt relative to its face value.

[Figure 1 about here]

According to Admati et al. (2017), holders of bank debt will command a premium ($\pi$) to part from their instrument, where $\pi = P_X - P_A$. $P_X$ is the exchange price paid for the bought-back instrument, $P_A$ is its fair value before the buyback announcement. Aware of the post-buyback value of debt, holders of debt instruments will command a buyback premium that varies inversely with solvency, as demonstrated by the graph.