Leverage, Cost of capital and Bank valuation[*]

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Abstract

In this paper we presented a model that demonstrates the effect of debt on cost of capital and value for banks with risky assets. Using a static partial equilibrium setting, both in a steady state and steady growth scenario, we derive a bank-specific valuation metric which separately attributes value to assets and debt cash flows in the form of a liquidity premium and tax-shield. The asset side model proposed does not require the stable capital structure assumption, typical of the currently applied DCF equity side methods. Furthermore, the theoretical framework we present is helpful in reconciling asset and equity side approaches in banking.

Keywords: *bank valuation, capital structure, cost of capital, liquidity premium, taxes.*

JEL classification: *D58, G21, G31, G32*

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1. Introduction

Banks represent a particular case in valuation as they create value from both the assets and liabilities side of their balance sheet due to the liquid-claim production (De Angelo and Stulz, 2015; Hanson *et al.*, 2015). This peculiar and unique feature of banks has several important side effects on cost of capital and total value as a whole (Hanson *et al.*, 2011; Kashyap *et al.*, 2010).

Although the effect of the liquid-claim production has been widely acknowledged and investigated in the banking literature (among others, Diamond and Dybvig, 1983, Diamond and Rajan, 2001; Gorton, 2010; Gorton and Pennacchi, 1990, Holmstrom and Tirole, 2011), from a corporate finance perspective, there has still not been sufficient effort in formalizing a bank-specific DCF valuation model that is useful to highlight the effects of banks' debt on cost of capital and enterprise value.

This paper seeks to fill this gap by proposing a theoretical framework for banks valuation based on an adjusted present value model (APV), which allows to explain how assets and debt cash flows contribute to value creation and, moreover, how debt affects the cost of capital.

The most accredited view of bank valuation follows an equity-side approach, whereas asset-side models are the most used metric in the case of industrial firms (Barker, 1999; Imam *et al.*, 2008). This is because the liquidity premium banks hold on debt financial instruments has implications for valuation: specifically in terms of operating cash flows estimation and weighted average cost of capital interpretation (Copeland *et al.*, 2000, Damodaran, 2013, Massari *et al.*, 2014). The model proposed in this paper aims at overcoming such issues by moving toward an asset-side perspective.

In the asset-side approach, firm value is obtained using two alternatives: (a) discounting free cash flow from operations at the weighted average cost of capital (the aggregate model); or (b) discounting free cash flow from operations at the unlevered cost of equity, and adding, separately, the present value of tax savings (the disaggregate model), which can be identified with the APV approach (Myers, 1974) or the Capital Cash Flow method (CCF) (Ruback, 2002). The disaggregate model exploits the well-known debt-value relation proposed in the seminal works of Modigliani and Miller (1958, 1963; hereafter MM) and enables to clearly split the effect of investing and financing decisions on total value. In the case of banks, given the production of liquid-claims and the associated value creation on the liabilities side, a disaggregate model can be a useful solution for highlighting debt benefits and cost of capital implications. A similar disaggregate asset side view is not new in the banking literature. Bank and Lawrenz (2013), focusing on the optimal mix of bond and deposit financing, used a trade-off model in which the levered value of a bank is obtained by increasing and decreasing the bank unlevered value by the advantage and disadvantages on debt respectively. More recently Hanson *et al.* (2015) defined bank value as the sum between the actualized expected cash flows on assets and money-premium on deposits.

However, the main critical issue in dealing with in the application of a DCF disaggregate model into a banking context is its consistency with MM theories. First, the extension of the MM propositions is questioned due to the incompatibility of the assumptions underlying the theoretical framework of the theorems due to the role of banks in reducing information asymmetries in a MM world. Second, more technically, a formal restatement of the MM first and second propositions might be complicated owing to the criticalities in separating operating from financial management, both in terms of cash flows and cost of capital. In order to overcome these issues, firstly it is proposed a formal restatement of the

MM propositions for banking firms exploiting the segmented-markets model (Merton 1990; DeAngelo and Stulz, 2015) which permits the existence of banks in a perfect and complete financial market. Thereafter, using a static partial equilibrium model as in MM (1958), it is separated the contribution of assets from liabilities to bank enterprise value in line with the original framework of disaggregate models for non-financial firms.

In summary, the proposed model helps to directly and explicitly reveal the value creation determinants of banks by providing a more general leverage-cost of capital theory in the absence of distress costs.

The adoption of a disaggregate asset-side model for banks can help to overcome problems typical of DCF aggregate models and, in particular, cost of equity and weighted average cost of capital redetermination in function of leverage changes over time. Besides assuming a disaggregate view of value, the model provides a sort of binary approach to banks valuation which is useful in taking into account their specifics on the asset and liabilities side. On the one hand, the model assigns a portion of value to assets in relation to their risk declined both in terms of cash flows (which take into account provisioning and securities losses) and expected return. On the other hand, the disaggregate approach explicitly attributes a significant portion of value to banks' debt when they better manage financial structure in terms of composition and pricing.

A separated view of value allows to analyse also the cost of capital implications over banks' debt management strategies. The theoretical framework presented in this paper offers an explanation in terms of value on why banks hold an incentive to fund their assets through deposits or other marked-down financial instruments. The liquidity premium gained on such type of debt mitigates the effect of the cost of increasing leverage on cost of equity with direct effects in terms of valuation. Thus, in the presence of macroeconomic conditions for which banks preserve wide margins on mark-down management and in absence of distress costs, the higher the stock of marked-down debt, the greater the value creation. More generally, this paper contributes to the literature providing a theoretical framework for banks valuation which permits to choose between an asset or equity side valuation, thereby removing the drawbacks of the current applied DCF equity side models.

The reminder of the paper is organized as follows: the next section introduces the theoretical model; the third section introduce a banks valuation framework in a steady state and in a steady growth scenario with a discussion of cost of capital implications; section four is devoted to offering a comparison between equity and asset side methods in terms of banks' capital structure; section five concludes.

2. Capital structure and bank total value

The effect of leverage on firm value and cost of equity are usually analysed in the light of MM propositions. If the leverage irrelevance principle is valid for banking firms as predicted by the first proposition, a variation of financial leverage would imply a proportional variation of cost of equity, maintaining stable the overall cost of funding. The shared view of the literature is that MM theorems cannot be applied to banks in perfect and complete financial markets, because the absence of information asymmetries makes unnecessary the presence of financial intermediaries (Mehran and Thakor 2011). De Angelo and Stulz (2015) offer a viable solution for such alleged incompatibility introducing a segmented-markets model (Merton 1990) which assumes two financial markets with different level of information availability: a first perfect and complete financial market and a second financial market with frictions. In their model, banks act in the first market and extend loans to agents in the second financial market, maintaining their reducing information asymmetries role among agents according to MM assumptions.

With regard to investigating the effect of financial structure on value, MM requires a clear split between operating and financial cash flows. But such cash flow break-up is not easily achieved since financial management is part of the operating management in the case of banks. In order to overcome this problem, we reconsider the cash flows generation separating those coming from asset and liabilities. In asset cash flows, we take into account not only the positive components arising from loans and securities, but also of the negative components related to intermediation costs which depend on the bank's scale and size (De Angelo and Stulz 2015).

Combining the segmented financial market assumption and the distinction between asset and debt's cash flows, we exploit a static partial equilibrium model from which we are able to analyse the effect of leverage on bank value.

2.1 A static partial equilibrium model for banks

We consider two banks with the same class of risk and the same operating expected return (X) given by the net profit of the intermediation activity, before the deduction of financial expenses paid on debt. Both banks operate in the first perfect and complete financial market and intermediate to agents of the second imperfect and incomplete financial market. The first bank (1) is financed only by equity (S_1), while the second bank (2) has a financial structure composed by equity (S_2) and safe debt in the form of deposits (D_2). Bank 2 gains a liquid-claim premium (p), equal to the difference between the perfect and complete market interest rate (r_f) (that is the risk free) and the liquid financial claim interest rate (r_l). Specifically, the liquidity premium is reached paying debt at r_l rather then r_f, with $r_l < r_f$.

The existence of the two different interest rates in a frictionless market is justified by the presence of intermediation costs: they eliminate arbitrage across the two markets and, consequently, make possible a liquidity-claims rate lower than risk free rate. On this basis, according to the seminal work of MM (1958), we are able to demonstrate that for an agent operating in a first perfect and complete financial market, the "homemade leverage" and "mixed portfolio" strategies converge to the same result of a levered equity portfolio and unlevered equity portfolio respectively.

2.2 "Homemade leverage" strategy

If an investor holds a fraction α of bank 2 equity, its return Y_2 would be equal to:

$$Y_2 = \alpha(X - r_l D_2) \ (1)$$

The same investor could replicate the capital structure of bank 2 selling his stocks, borrowing on his own credit an amount of debt equal to αD_2 and purchasing on market an amount of equity of bank 1 equal to $\alpha(S_2 + D_2)$. Accordingly, he would acquire a percentage of equity equal to $\alpha(S_2 + D_2)/S_1$.

The return Y_1 for the so called "homemade leverage" strategy would be equal to:

$$Y_1 = \alpha \frac{V_2}{V_1} X - r_f \alpha D_2 \ (2)$$

where $S_2 + D_2$ is equal to V_2 and S_1 is equal to V_1, while r_f is the interest rate paid on debt by the investor himself in a perfect and complete market. The investor would have the incentive to sell his stocks of bank 2 and purchase stocks of bank 1 only when $Y_1 > Y_2$ and until the increase in bank 1 equity and the decrease in bank 2 equity make equal the return on bank 2 with the return on "homemade leverage" strategy ($Y_1 = Y_2$):

$$\alpha(X - r_l D_2) = \alpha \frac{V_2}{V_1} X - r_f \alpha D_2 \ (3)$$

2.3 "Mixed portfolio" strategy

If the investor holds a fraction α of bank 1 (unlevered) equity, its return Y_1 would be equal to:

$$Y_1 = \alpha X \ (4)$$

The investor can switch all his equity unlevered portfolio in a mixed portfolio (made of equity and debt) selling his stocks and acquiring a proportional amount of equity of bank 2 equal to $\frac{V_1 \alpha}{V_2} E_2$ and an amount of debt of $\frac{V_1 \alpha}{V_2} D_2$. As long as the investor acts in a perfect and complete financial market, he would be able to achieve an interest rate on debt equal to the risk free rate, rather than the lower interest rate obtained by agents of the imperfect and incomplete financial market. Therefore, the total return on the mixed portfolio (on equity and debt – Y_2) is:

$$Y_2 = \frac{V_1 \alpha}{V_2}(X - r_l D_2) + r_f \frac{V_1 \alpha}{V_2} D_2 \ (5)$$

The first term of (5) represents the yield on equity and the second term the yield on debt. The investor would have the incentive to sell his stocks in bank 1 and acquire stocks of bank 2 if $Y_2 > Y_1$ and until the increase of bank 2 equity and the decrease of bank 1 equity makes equal the return on bank 1 with the return on mixed portfolio strategy ($Y_1 = Y_2$):

$$\alpha X = \frac{V_1 \alpha}{V_2}(X - r_l D_2) + r_f \frac{V_1 \alpha}{V_2} D_2 \ (6)$$

Table 1

Different investors strategies: summary

This table resumes the pay-off strategies for investors. Firstly we reported the cost and pay-off associated with buying levered bank stocks and a "homemade leverage" strategy. Secondly, we reported the cost and pay-off of buying unlevered bank stocks and a "mixed portfolio" strategy. An investor can gain an equal premium with both strategies given by the spread between the market interest rate and interest rate on deposits (that is the liquidity premium banks earn on deposits). The wider the spread, the higher the value of levered compared to the unlevered bank. In the table *S* is equity, *D* is debt, *V* is value, *CF* is cash flow, *rf* is the market interest rate and *rl* is the cost of deposits.

Buy levered bank vs "homemade leverage" strategy

Strategies	Today you pay	Pay out in each period
Strategy 1: Buy levered bank's equity	S (=V levered-D)	Bank cash flow - D rl
Strategy 2: Buy unlevered bank's equity	V unlevered	Bank cash flow
and borrow a loan	- D	-D rf
	V levered - V unlevered	D (rf - rl)

Buy unlevered bank vs mixed portfolio strategy

Strategies	Today you pay	Pay out in each period
Strategy 1: Buy unlevered bank's equity	V unlevered	Bank cash flow
Strategy 2: Buy levered bank's equity	S (=V levered-D)	Bank cash flow - D rl
and buy bank's debt	D	D rf
	V unlevered - V levered	-D (rf - rl)

2.4 Leverage effect on bank value

Expressed in terms of V_2, (3) and (6) together lead to (7) in equilibrium:

$$V_2 = \frac{V_1}{X} D_2 \left(r_f - r_l\right) + V_1 \ (7)$$

We can now define V_1/X as the factor of proportionality $1/\rho_1$ or the inverse of expected rate of return, that is, the cost of equity for the unlevered bank associated with a specific class of risk. Hence, (7) is formally the MM first proposition when deposits are priced considering a liquidity premium $\left(r_f - r_l\right)$, in line with the view of Hanson et al. (2015) on traditional banks. Accordingly, the more a bank levers up, other things remaining equal, the higher the bank firm value. Note that if the bank does not gain a liquidity premium, the interest rate on debt is the same of the market rate ($r_f = r_l$). As a consequence, the enterprise value of the unlevered bank (bank 1) and levered bank (bank 2) are equivalent and the MM leverage irrelevance principle still holds true. On the contrary, if bank 2 issues debt at lower rates than the market rate ($r_f - r_l = p > 0$), then the enterprise value of the levered bank will be higher than the unlevered bank ($V_2 > V_1$). In this case, debt will be the preferred source of funding and, consequently, the leverage irrelevance principle does not hold true.

If (7) is re-expressed as a function of the unlevered cost of capital, the enterprise value of the bank would be equal to:

$$V_2 = D_2 \frac{\left(r_f - r_l\right)}{\rho_1} + \frac{X}{\rho_1} \ (8)$$

The first term of the equation is the Present Value of Liquidity Premium (PVLP), while the second term is the bank's asset cash flow discounted at the cost of capital of the unlevered bank in a steady state framework.

In a perfect and complete financial market banks can transform risky assets to riskless assets undertaking a hedging policy. On this basis, our model would converge to that of

DeAngelo and Stulz (2015) in which free cash flows to equity (and asset's cash flow as a consequence) are discounted at the risk free rate. However the bank's firm value does not only depend on its assets value, but also on the value created by other financial services such as investment banking and many other activities that banks typically undertake to increase their profits. The risk associated to such typology of businesses cannot be totally eliminated through hedging strategies and therefore the discount rate of these cash flows should be higher than the risk free rate.

Thus, in a similar manner to the MM application for non-financial firms, asset cash flows should be discounted at $\rho_1 > r_f$. The presence of risky assets implies a lower capacity of issuing safe debt. In facts, banks could lever up without losing the liquidity premium until debt is equal to the value of perfectly hedged assets and, as a consequence, less than 100% of its enterprise value. The same conclusion is reached by DeAngelo and Stulz (2015) when only an imperfect hedging strategy is possible, making capital requirements useful to cover unexpected losses.

3. Leverage, cost of capital and valuation for banking firms

In line with an asset-side disaggregate valuation model used for non-financial firms, the bank valuation scheme proposed in the previous section separates the unlevered bank value from debt benefits. Specifically, in the case of industrial firms, the asset-side disaggregate model determines the enterprise value as the sum between the unlevered firm and debt's tax benefits value. In the case of banks, as we previously discussed, debt creates value not only through the deductibility of interest expenses, but also by a liquidity premium on deposits.

In this section, we present the bank valuation model which takes into account both the tax and liquidity premium benefits in two configurations: the steady state and the steady growth scenario. In each, we make distinct assumptions on the discount rate for the benefits of debt. The approaches we introduce entail different implications in terms of weighted average cost of capital and cost of equity.

3.1 The steady state valuation

According to the MM propositions, we can choose to discount the fiscal and liquidity premium benefits at the unlevered cost of equity (MM 1958), or at the cost of debt (MM 1963). In the first case, both the debt benefits in the form of a liquidity premium and tax-shields are discounted at the cost of capital for the unlevered bank. Thus (8) becomes:

$$V_2 = PVLP + PVTS + V_1 = D_2 \frac{(r_f - r_l)}{\rho_1} + D_2 \tau \frac{r_l}{\rho_1} + \frac{X^\tau}{\rho_1} \quad (9)$$

where $PVLP$ is the Present Value of Liquidity Premium, $PVTS$ is the Present Value of Tax Shield, τ is the tax rate and X^τ is the net bank's assets cash flow before interests expenses. According to Hanson et al. (2015), the interest rate on liquid-claims is compounded as the interest rate on deposits divided by deposits. More synthetically, the (9) can be written as:

$$V_2 = PVDB + V_1 = D_2 \frac{[r_f - r_l(1-\tau)]}{\rho_1} + \frac{X^\tau}{\rho_1} \quad (10)$$

The first term on the right side of the equation stands for the Present Value of Debt Benefits ($PVDB$) (that is the sum of $PVLP$ and $PVTS$) on debt while the second term is the unlevered bank value. As we note, the valuation approach introduced provides a useful independent view of bank value, enabling us to understand the contribution of asset, liquidity premium and tax-shields to the enterprise value of a bank. However, as in the case of non-financial firms, such avvaluation model should be equivalent to an asset-side aggregate model in which free cash flows are discounted at the weighted average cost of capital (ρ_2) whereby debt benefits are included in the discount rate:

$$V_2 = \frac{X^\tau}{\rho_2} \ (11)$$

It has been demonstrated that the aggregate model leads to the same result as the disaggregate model when benefits from tax-shields are discounted at the unlevered cost of equity (Ruback 2002). Thus, adapting the traditional relation between weighted average cost of capital and unlevered cost of equity to the case of banking firms, the relation between ρ_2 and ρ_1 can be written as:

$$\rho_2 = \rho_1 - \frac{D_2}{V_2}\left[r_f - r_l(1-\tau)\right] \ (12)$$

Other things remaining equal, ρ_2 decreases when leverage increases more than proportionally according to the size of liquidity premium and taxes effect (Hanson et al. 2011; Kashyap et al. 2010). Our model is consistent also considering an equity-side model. In this case the value of a bank can be measured as:

$$S_2 = \frac{Y_2}{i_2} \ (13)$$

where i_2 is the cost of equity. Combining (12) with the traditional weighted average cost of capital formula (14):

$$\rho_2 = i_2 \frac{E_2}{V_2} + r_l(1-\tau)\frac{D_2}{V_2} \ (14)$$

we obtain the cost of equity i_2 consistent with the valuation approach proposed:

$$i_2 = \rho_1 + \left(\rho_1 - r_f\right)\frac{D_2}{S_2} \ (15)$$

Equation (15) is the second proposition of MM. As in case of non-financial firms, when bank debt benefits are discounted using the cost of unlevered firm, the cost of equity is not directly dependent on the tax rate and liquidity premium.

In the case of MM (1963) and in line with the original adjusted present value approach of Myers (1974), debt benefits are both discounted at the risk free rate (that is the cost of debt) and therefore equation (9) becomes:

$$V_2 = PVLP + PVTS + V_1 = D_2 \frac{(r_f - r_l)}{r_f} + D_2 \tau \frac{r_l}{r_f} + \frac{X^\tau}{\rho_1} \quad (16)$$

and the synthetic version of the valuation model (equation 10) becomes:

$$V_2 = PVDB + V_1 = D_2 \left[\frac{r_f - r_l(1-\tau)}{r_f} \right] + \frac{X^\tau}{\rho_1} (17)$$

The weighted average cost of capital and the cost of equity consistent with the use of cost of debt to discount tax benefits and liquidity premium are respectively:

$$\rho_2 = \rho_1 \left[1 - \frac{D_2}{V_2} \frac{r_f - r_l(1-\tau)}{r_f} \right] \quad (18)$$

$$i_2 = \rho_1 + (\rho_1 - r_f)(1-\tau) \frac{r_l}{r_f} \frac{D_2}{S_2} \quad (19)$$

where equation (19) is the reinterpretation of the MM with taxes integrated with the liquidity premium. All other things remaining equal, the larger the difference between the risk free rate and the pricing of deposits, the flatter the effect of leverage on cost of equity.

3.2 The steady growth valuation model

Also in the case of growth, we can assess banks' debt benefits by discounting either at the unlevered cost of equity (more recently, Dempsey 2013) or at the cost of debt (Massari et al. 2007).

Therefore considering a constant growth rate both for asset and debt, following Dempsey (2013), (9) becomes:

$$V_2 = PVLP + PVTS + V_1 = D_2 \frac{(r_f - r_l)}{\rho_1 - g} + D_2 \tau \frac{r_l}{\rho_1 - g} + \frac{X^\tau}{\rho_1 - g} \quad (20)$$

and (10) becomes:

$$V_2 = PVDB + V_1 = D_2 \frac{[r_f - r_l(1-\tau)]}{\rho_1 - g} + \frac{X^\tau}{\rho_1 - g} \quad (21)$$

Also in the steady growth scenario the model must be consistent both with the aggregate model and with the equity-side approach. In the case of the aggregate model, bank value is equal to:

$$V_2 = \frac{X^\tau}{\rho_2 - g} \quad (22)$$

The weighted average cost of capital making equal the value obtained through (21) with the one obtained through (22) is reached using the same formula of the steady state framework (Miles and Ezzell 1980; Dempsey 2013):

$$\rho_2 = \rho_1 - \frac{D_2}{V_2}\left[r_f - r_l(1-\tau)\right] \quad (23)$$

Thus when debt benefits are discounted at the unlevered cost of capital, growth does not affect the weighted average cost of capital.

Also for the equity-side approach, we can assess the value of equity discounting the expected free cash flow to equity at the difference between the cost of equity and the growth rate:

$$S_2 = \frac{Y_2}{i_2 - g} \quad (24)$$

As we note, the cost of equity in a growing scenario is calculated as MM in their second proposition without taxes:

$$i_2 = \rho_1 + \left(\rho_1 - r_f\right)\frac{D_2}{S_2} \quad (25)$$

Conversely, following Massari et al. (2007), our model becomes:

$$V_2 = D_2\frac{\left[r_f - r_l(1-\tau)\right]}{r_f - g} + \frac{X^\tau}{\rho_1 - g} \quad (26)$$

Accordingly, the weighted average cost of capital (18) and cost of equity (19) must be restated for the growth scenario. Combining (26) with (22), we find the relation between the weighted average cost of capital and the unlevered cost of capital:

$$\rho_2 = \rho_1 - \frac{\rho_1 - g}{r_f - g}\left[r_f - r_l(1-\tau)\right]\frac{D_2}{V_2} \quad (27)$$

while combining (27) with (23), we restate the cost of equity as:

$$i_2 = \rho_1 + \left(\rho_1 - r_f\right)\frac{D_2}{S_2}\left[\frac{r_l(1-\tau) - g}{r_f - g}\right] \quad (28)$$

In contrast with the previous model version, the weighted average cost of capital and the cost of equity are affected by taxes, liquidity premium and growth rate.

3.3. Choosing the appropriate discount rate for debt benefits

The debt benefits stand-alone valuation requires the choice of the appropriate discount rate for tax-shields and liquidity premium. In the case of fiscal benefits arising from debt, the literature on industrial firms recommends the usage of cost of debt in the steady state hypothesis (MM 1963; Myers 1974) and, conversely, the unlevered cost of capital in the steady growth hypothesis (Dempsey 2013). In the first case, when debt is kept fixed over time, MM (1963) justify the use of the cost of debt instead of the unlevered cost of capital, claiming the different risk profiles between firms' operating and tax-shield cash flows. The former are uncertain and dependent on the risk associated to assets, while the latter is the result of a determined stock of debt. In the second case, when the dynamic of debt is in line with that of the free cash flow from operations (and with the same expected growth rate), the literature discounts the tax benefits at the unlevered cost of capital (Cooper and Nyborg 2006; Dempsey 2013; Harris and Pringle 1985; Miles and Ezzell 1980; Ruback 2002). However, the choice depends on the assumption on the future debt policy. If we assume to maintain stable the debt value in the forecast period, then the discount rate should be equal to the cost of debt. Alternatively, assuming a constant debt-to-value ratio in the case of steady growth, the appropriate discount rate should be equal to that of asset cash flows.

With regards to banks, although there are no explicit references in the literature over a stand-alone valuation of debt benefits, empirical models used to investigate the effect of capital requirements on systematic risk implicitly take the cost of unlevered capital as the discount rate for debt benefits (Baker and Wurgler 2015, Miles et al 2013). This is because it is assumed that additional cash flows due to debt undergo the same risk as operating assets. Such valuation perspective is widely endorsed by the literature which considers bank debt as of an operating nature rather than financial (among others Massari et al. 2014). However such different view on banks' debt should not lead to treat it as working capital, but, rather, it should maintain its function as a stable source of funding even when it holds benefits in terms of value creation.

4. Comparing asset and equity cash flow method: the capital structure effect

Empirical evidence suggests a positive correlation between leverage and bank cost of equity, both in a systematic and specific risk framework. Among others, Kashyap et al. (2010) highlighted a negative relation between book equity to asset ratio and equity beta, while Miles et al. (2013) confirm the same results finding a similar relation using the inverse of price earning ratio as a measure of cost of equity. Moreover, the relation still holds valid using beta or equity standard deviation and both book and market leverage ratio (Rosenberg and Perry 1978).

Allowing that the empirical evidence shows that leverage has a significant effect on banks' cost of equity, the valuation approach should consider the dynamic of debt and equity in order to assess how the financial structure affects value in the absence of distress costs. The choice in terms of leverage is not negligible in banking because as well as affecting the cost of capital, leverage is strictly monitored by the Basel framework which sets specific limitations on the bank's ability to take on debt. Notwithstanding the regulation over capital requirements and leverage, banks operate with different financial structures choosing between setting their requirements beyond the regulation or keeping close to minimum requirements. Nevertheless, such relative small differences can have substantial effects in terms of valuation.

The asset cash flow method we introduce in this paper offers a potential solution for overcoming the hypothesis of constant debt to value ratio proper of DCF equity side metrics universally applied in banking valuation. In an infinite time horizon (with a terminal value) the assumption might represent a reliable estimation; in an explicit forecast period the capital structure can no longer be constant (Tagart 1991). The same problem arises if we implement an aggregate asset side valuation (WACC approach) since the discount rate is affected by the leverage ratio due to the presence of taxes and liquidity premium.

The cost of equity and weighted average cost of capital redetermination process requires a basic market leverage-cost of capital theory for banking firms, which we introduced in Section 3. Alternatively, the problem can be resolved applying directly the disaggregate asset cash flow method because it does not require the market leverage ratio as an input and is more appropriate when target leverage ratios are linked to regulatory measures. Thus, precise assumptions can be made about the dynamic of bank debt in the analytic forecast period (Inselbag and Kaufold 1997). More generally, if a leverage-consistent valuation for banks is required, our model allows us to move from an asset to equity side approach always considering the effects of changes in financial structure on cost of capital and value.

5. Conclusions

This paper presents a theoretical framework for bank valuation, reconciling asset and equity side approaches while explicitly taking into account the financial structure and the unique benefits banks hold through a liquidity premium. In particular, this paper formalizes a DCF disaggregate asset-side model showing the contribution of assets and debt to the enterprise value. Consistent with the original assumption of the MM propositions, it has been adopted the segmented markets model as in De Angelo and Stulz (2015), but differing in three main aspects. First, using the original MM arbitrage proof, it has been showed how to determine the equity value of a bank using an indirect approach to valuation (Hanson et al. 2015). In contrast with the most common applied valuation metrics, this has allowed to split value creation between assets and liabilities. Second, it has been considered the presence of risky assets rather than just hedged assets in order to take into account the riskiness of assets' cash flows that is more consistent and realistic in a context of valuation. Third, it has been derived the cost of capital implications when the liquidity premium and taxes come into play showing how the mark-down spread mitigates the effect of increasing leverage on the cost of equity.

On this basis, it might be concluded that MM irrelevance principle is not valid for banks owing to the liquidity premium banks gain on marked-down financial instruments, which make the choices on financial structure relevant in terms of value. Accordingly, as in the MM first proposition with taxes, the total bank value is the sum of the stand-alone asset value and debt advantages (Miller, 1995). In addition, the cost of capital implications are in line with the partial MM off-set that can be highlighted empirically. These conclusions lay the foundation for a leverage-bank cost of capital theory and for a bank-specific valuation scheme based on asset and debt cash flows in which the total value is a function of the present value of cash flows from asset, tax benefits and the liquidity premium, similarly to the Adjusted Present Value of Myers (1974) and the Capital Cash Flows of Ruback (2002) applied in the valuation of industrial firms. Additionally, we contributed to this literature by highlighting the application of the model in a steady state and steady growth scenario, providing a reconciliation equation that equates the results of the aggregate asset-side model and of the equity DCF methods.

The model is helpful in seeking to analyse how macroeconomic conditions affect banks value through interest rates. Lower interest rates reduce the value created by marked-down debt together with fiscal benefits. The more the liquidity premium moves close to zero and the fiscal effect becomes neutral, in the absence of distress costs, the more the choice between equity and debt is made irrelevant. However, in the presence of distress costs, increasing regulatory capital in the form of equity becomes the more appropriate source of funding for reducing such costs (Allen et al. 2015; Admati and Hellwig 2013). Equity can generate value because the decrease in debt benefits is more than compensated by the decrease in the present value of distress costs. Empirical evidence highlights a positive correlation between bank value and equity capital in the cross-section owing to the lower probability of being closed (Mehran and Thakor, 2011).

The theoretical framework presented in this paper has useful application in bank valuation. First, compared to the DCF equity-side models currently applied in practice, the disaggregate perspective to valuation helps to better explain where the value of a bank is generated among asset and liabilities. Other equity-side methods lack such useful information, providing only a synthetic view of value creation. More specifically, the minimum regulatory requirements that banks must comply with do not negate the need to analyse the effects of financial structure on value, as banks can create value not only by choosing between equity and debt, but also by choosing between the several types of debt financial instruments that are available for each special category of firm, from which depends the size of the liquidity premium. Second, the disaggregate model does not require the assumptions typical of the DCF equity side methods, namely the distribution of the excess capital, the adjustments for such capital distribution, a stable capital structure in the forecast period and the assumption on the level of distributable earnings.

It might be observed that the main limitation of the model is that it is not taken into account the present value of distress costs. Future research is called for to introduce this effect in the bank valuation scheme, formalizing a trade-off between debt advantages (liquidity premium and tax-shields) and disadvantages in term of distress costs.

Appendix A – Systematic risk and leverage: determining the cost of unlevered bank

A separate determination of bank unlevered value requires the use of the unlevered cost of equity (ρ_1) to discount the asset cash flows. The cost of equity for the unlevered firm is generally unobservable due to the presence of levered firms in the financial market. Assuming a perfectly diversified investor, we can express ρ_1 through the CAPM relation:

$$\rho_1 = r_f + \beta_U\left(r_m - r_f\right) \; (A1)$$

where β_U is the beta of the unlevered bank, and where r_m is the return of the market portfolio. Allowing the CAPM, the problem shifts to the calculation of the unlevered beta.

Hamada (1972) introduced a model to determine an unlevered (or asset) beta combining MM's second proposition and the CAPM. Assuming that the beta of debt is zero (in line with prior studies that analysed the effect of leverage on bank overall cost of capital) and debt benefits are discounted at the unlevered cost of capital, we can establish the relation between levered and unlevered beta as:

$$\beta_E = \beta_U\left(1 + \frac{D}{E}\right) \; (A2)$$

Alternatively, when debt is fixed and debt benefits are discounted at the cost of debt (risk free rate), equation (30) becomes:

$$\beta_E = \beta_U \left[1 + (1 - \tau)\frac{r_l}{r_f}\frac{D}{E}\right] \ (A3)$$

Independently of whether debt benefits are discounted at the cost of unlevered capital, the Hamada equation is the same of the case of non-financial firms. In contrast, equity betas are affected by taxes and by the difference between the risk-free rate and the cost of core deposits. Inverting the two relations, we reach the unlevered beta in the two different basic assumptions, respectively:

$$\beta_U = \frac{\beta_E}{\left(1 + \frac{D}{E}\right)} \ (A4)$$

$$\beta_U = \frac{\beta_E}{\left[1 + (1 - \tau)\frac{r_l}{r_f}\frac{D}{E}\right]} \ (A5)$$

Appendix B – A comparison between the asset cash flow method and flow to equity model

The following example provides a comparison in terms of application of the asset cash flow method and flow to equity model. The example aims to demonstrate that if the cost of equity is not consistently determined over time, significant mistakes in valuation can occur. We assume the absence of taxes and growth in the terminal value and require an increasing level of capital requirement (Tier 1) covered by equity.

Table B1

Balance sheet and financial market data

Value, expected return and risk of assets are maintained fixed. After time 4 we adopted a steady state scenario. The main hypotheses is a progressively replacement of debt with equity, according to an expected growth of Tier 1 ratio from 12% to 15%. As a consequence, there are expected some repayments of debt through shareholder capital. FCFA are free cash flows from assets.

Data in €	1	2	3	4	oo
Book value of assets	1,000,000,000	1,000,000,000	1,000,000,000	1,000,000,000	1,000,000,000
Risk weight assets density	50%	50%	50%	50%	50%
Target Tier 1 ratio	12%	13%	14%	15%	15%
Target book value of equity	60,000,000	65,000,000	70,000,000	75,000,000	75,000,000
Target debt	940,000,000	935,000,000	930,000,000	925,000,000	925,000,000
FCFA	29,500,000	29,500,000	29,500,000	29,500,000	29,500,000
Expected return on asset	3.42%	3.42%	3.42%	3.42%	3.42%
Risk free rate	3.00%	3.00%	3.00%	3.00%	3.00%
Cost of debt	2.50%	2.50%	2.50%	2.50%	2.50%

Applying the asset cash flow method, the bank unlevered value is:

$$V_1 = \frac{FCFA}{(1+\rho_1)} + \frac{FCFA}{(1+\rho_1)^2} + \frac{FCFA}{(1+\rho_1)^3} + \frac{FCFA}{(1+\rho_1)^4} + \frac{FCFA}{\rho_1}\frac{1}{(1+\rho_1)^4}$$
$$= \frac{29{,}500}{(1+3.42\%)} + \frac{29{,}500}{(1+3.42\%)^2} + \frac{29{,}500}{(1+3.42\%)^3} + \frac{29{,}500}{(1+3.42\%)^4}$$
$$+ \frac{29{,}500}{3.42\%}\frac{1}{(1+3.42\%)^4} = 862{,}573$$

The present value of debt benefits (in this case represented by a liquidity premium since we are assuming the absence of taxes) is:

$$PVDB = D_0\frac{r_f - r_l}{(1+\rho_1)} + D_1\frac{r_f - r_l}{(1+\rho_1)^2} + D_2\frac{r_f - r_l}{(1+\rho_1)^3} + D_3\frac{r_f - r_l}{(1+\rho_1)^4}$$
$$+ D_4\frac{r_f - r_l}{\rho_1}\frac{1}{(1+\rho_1)^4}$$
$$= 940{,}000\frac{3\% - 2.50\%}{(1+3.42\%)} + 940{,}000\frac{3\% - 2.50\%}{(1+3.42\%)^2}$$
$$+ 935{,}000\frac{3\% - 2.50\%}{(1+3.42\%)^3} + 930{,}000\frac{3\% - 2.50\%}{(1+3.42\%)^4}$$
$$+ 925{,}000\frac{3\% - 2.50\%}{3.42\%}\frac{1}{(1+3.42\%)^4} = 135{,}444$$

The bank firm value is:

$$V_2 = V_1 + PVDB = 862{,}573 + 135{,}444 = 998{,}017$$

while value of equity is:

$$S_2 = V_2 - D_2 = 998{,}017 - 940{,}000 = 58{,}017$$

Moving toward a flow to equity method, we calculate first the cost of equity and then the equity value.

$$i_2 = \rho_1 + (\rho_1 - r_f)\frac{D_2}{S_2} = 3.42\% + (3.42\% - 3\%)\frac{940{,}000}{58{,}017} = 10.22\%$$

In order to directly reach the value of equity, we need to know the free cash flow to equity. In Table 2 we provide a synthetic cash flow statement.

Table B2

Cash flow statement

In the absence of taxes, the free cash flow to equity is given by netting free cash flow from assets of interest expenses and debt repayments. Interest expenses are calculated on the debt at the beginning of the year using the cost of debt.

Data in €	1	2	3	4	oo
FCFA	29,500,000	29,500,000	29,500,000	29,500,000	29,500,000
Interest expenses	23,500,000	23,500,000	23,375,000	23,250,000	23,125,000
Debt repayment	-	- 5,000,000	- 5,000,000	- 5,000,000	-
FCFE	6,000,000	1,000,000	1,125,000	1,250,000	6,375,000

The equity value is determined as:

$$S_2 = \frac{FCFE_1}{(1+i_2)} + \frac{FCFE_2}{(1+i_2)^2} + \frac{FCFE_3}{(1+i_2)^3} + \frac{FCFE_4}{(1+i_2)^4} + \frac{FCFE_4}{i_2}\frac{1}{(1+i_2)^4}$$
$$= \frac{6{,}000}{(1+10.22\%)} + \frac{1{,}000}{(1+10.22\%)^2} + \frac{1{,}125}{(1+10.22\%)^3} + \frac{1{,}250}{(1+10.22\%)^4} + \frac{6{,}375}{10.22\%}\frac{1}{(1+10.22\%)^4} = 50{,}217$$

As we note, without restating the cost of equity consistently with leverage changes, the result of the flow to equity model is misleading. In Table B3, we report the dynamic of leverage ratio and the consistent changes in cost of equity.

Table B3

Leverage and cost of equity dynamic

The present value of debt benefits is calculated using the liquidity premium applied to debt at the beginning of the year and discounted at the expected return of assets.

Data in €	1	2	3	4	oo
Bank unlevered value	862,573,099	862,573,099	862,573,099	862,573,099	862,573,099
Present value of debt benefits	135,443,615	135,375,787	135,305,639	135,258,091	135,233,918
Bank firm value	998,016,714	997,948,886	997,878,738	997,831,191	997,807,018
Present value of debt (t-1)	940,000,000	940,000,000	935,000,000	930,000,000	925,000,000
Equity	58,016,714	57,948,886	62,878,738	67,831,191	72,807,018
D/E	16.20	16.22	14.87	13.71	12.70
Cost of equity	10.22%	10.23%	9.67%	9.18%	8.76%

Using the correct cost of equity for each year, we arrive at an equity value consistent with that of the asset cash flow model:

$$S_2 = \frac{FCFE_1}{(1+i_{2,1})} + \frac{FCFE_2}{(1+i_{2,1})(1+i_{2,2})} + \frac{FCFE_3}{(1+i_{2,1})(1+i_{2,2})(1+i_{2,3})}$$
$$+ \frac{FCFE_4}{(1+i_{2,1})(1+i_{2,2})(1+i_{2,3})(1+i_{2,4})}$$
$$+ \frac{FCFE_4}{i_{2,\infty}} \frac{1}{(1+i_{2,1})(1+i_{2,2})(1+i_{2,3})(1+i_{2,4})}$$
$$= \frac{6{,}000}{(1+10.22\%)} + \frac{1{,}000}{(1+10.22\%)(1+10.23\%)}$$
$$+ \frac{1{,}125}{(1+10.22\%)(1+10.23\%)(1+9.67\%)}$$
$$+ \frac{1{,}250}{(1+10.22\%)(1+10.23\%)(1+9.67\%)(1+9.18\%)}$$
$$+ \frac{6{,}375}{8.76\%} \frac{1}{(1+10.22\%)(1+10.23\%)(1+9.67\%)(1+9.18\%)} = 58{,}017$$

References

Allen, F., Carletti, E., and Marquez, R., ‘Credit market competition and capital regulation’, *Review of Financial Studies*, Vol. 24, No. 4 , 2011, pp. 983-1018.

Allen, F., Carletti, E., and Marquez, R., ‘Deposits and bank capital structure’, *Journal of Financial Economics*, Vol. 118, No. 3, 2015, pp. 601-619.

Admati, A. and Hellwig, M., *The bankers' new clothes: What's wrong with banking and what to do about it* (Princeton: Princeton University Press, 2013).

Baker, M. and Wurgler, J., ‘Do strict capital requirements raise the cost of capital? Bank regulation, capital structure, and the low risk anomaly’, *The American Economic Review*, Vol. 105, No. 5, 2015, pp. 315–320.

Bank, M and Lawrenz, J., ‘Deposit Finance as a Commitment Device and the Optimal Debt Structure of Commercial Banks’, *European Financial Management*, Vol. 19, No. 1, 2013, pp. 14–44.

Barker, R. G. ‘Survey and Market-based Evidence of Industry-dependence in Analysts’ Preferences Between the Dividend Yield and Price-earnings Ratio Valuation Models’, *Journal of Business Finance & Accounting* Vol. 26, No 3-4, 1999, pp. 393–418.

Cooper, I. A. and Nyborg, K. G., ‘The value of tax shield is equal to the present value of tax shields’, *Journal of Financial Economics*, Vol. 81, No. 1, 2006, pp. 215–25.

Copeland, T., Koller, T. and Murrin, J., *Valuation Measuring and Managing the Value of Companies* (New York: John Wiley & Sons, 2000).

Damodaran, A., 'Valuing financial service firms', *Journal of Financial Perspectives,* Vol. 1, No. 1, 2013, pp. 1–16.

DeAngelo, H. and Stulz, R. M., 'Liquid-claim production, risk management, and bank capital structure: Why high leverage is optimal for banks', *Journal of Financial Economics,* Vol. 116, No. 2, 2015, pp. 219–236.

Dempsey, M. 'Consistent Cash Flow Valuation with Tax- Deductible Debt: a Clarification', *European Financial Management,* Vol. 19, No. 4, 2013, pp. 830–836.

Diamond, D. W. and Dybvig P. H., 'Bank runs, deposit insurance, and liquidity', *The journal of political economy,* Vol. 91, No. 3, 1983, pp. 401–419.

Diamond, D. W. and Rajan, R. G., 'Banks and liquidity', *The American Economic Review,* Vol. 91, No. 2, 2001, pp. 422–425.

Gorton, G., *Slapped by the Invisible Hand: The Panic of 2007* (Oxford: Oxford University Press, 2010).

Gorton, G. and Pennacchi G., 'Financial intermediaries and liquidity creation', *The Journal of Finance,* Vol. 45, No.1, 1990, pp. 49–71.

Hanson, S.G., Kashyap, A.K. and Stein, J.C. (2011), "A macroprudential approach to financial regulation", *The journal of economic perspectives*, Vol. 25, No. 1, pp. 3–28.

Hanson, S. G., Shleifer, A., Stein, J. C. and Vishny, R. W., 'Bank as patient fixed-income investors', *Journal of Financial Economics,* Vol. 117, No. 3, 2015, pp. 449–469.

Hamada, R. S., 'The effect of the firm's capital structure on the systematic risk of common stocks', *The Journal of Finance*, Vol.3, No. 2, 1972, pp. 435–452.

Harris, R. and Pringle, J., 'Risk adjusted discount rates – extension from the average risk case', *Journal of Financial Research*, Vol. 8, no. 3, 1985, 237–44.

Holmstrom, B. and Tirole, J., 'Financial Intermediation, Loanable Funds, and the Real Sector', *Quarterly Journal of Economics*, Vol. 112, No. 3,, 1997, pp. 663-691.

Holmström, B. and Tirole, J., *Inside and Outside Equity* (Cambridge: MIT Press, 2011).

Imam, S., Barker, R. and Clubb, C., 'The use of valuation models by UK investment analysts', *European Accounting Review,* Vol. 17, No. 3, 2008, pp. 503–535.

Inselbag, I., and Kaufold, H., 'Two DCF approaches for valuing companies under alternative financing strategies (and how to choose between them)', *Journal of Applied Corporate Finance*, Vol. 10, No.1, 1997, pp. 114-122.

Kashyap, A., K., Stein, J. C. Hanson, S., 'An analysis of the impact of 'substantially heightened'capital requirements on large financial institutions', Working paper

(*Booth School of Business University of Chicago* 2010).

Massari, M., Gianfrate, G. and Zanetti, L., *The Valuation of Financial Companies: Tools and Techniques to Measure the Value of Banks, Insurance Companies and Other Financial Institutions* (New York: John Wiley & Sons, 2014).

Massari, M., Roncaglio, F. and Zanetti, L., 'On the equivalence between the APV and the WACC approach in a growing leveraged firm', *European Financial Management*, Vol. 14, No. 1, 2007, pp. 152–62.

Mehran, H. and Thakor. A., 'Bank capital and value in the cross-section', *Review of Financial Studies*, Vol. 24, No. 4, 2011, pp. 1019–1067.

Merton, R., *Continuous-Time Finance*, (Oxford: Blackwell Publishing Ltd., 1990).

Miles, D., Yang, J. and Marcheggiano, G., 'Optimal bank capital', *The Economic Journal*, Vol. 123, No. 567, 2013, pp. 1–37.

Miles, J. and Ezzell, J., 'The weighted average cost of capital, perfect capital markets and project life: a clarification', *Journal of Financial and Quantitative Analysis*, Vol. 15, no. 5, 1980, pp. 719–30.

Miller, M. H., 'Do the M & M propositions apply to banks?', *Journal of Banking & Finance*, Vol. 19, No. 3, 1995, pp. 483–489.

Modigliani, F. and Miller, M.H., 'The cost of capital, corporation finance and the theory of investment', *The American Economic Review*, Vol. 48, No. 3, 1958, pp. 261–97.

Modigliani, F. and Miller, M.H., 'Corporate income taxes and cost of capital', *The American Economic Review*, Vol. 53, No. 3 1963, pp. 433–43.

Myers, S., 'Interactions of corporate financing and investment decisions – implications for capital budgeting', *The Journal of Finance*, Vol. 29, no. 1, 1974, pp. 1–25.

Rosenberg, B., and Perry, P. R., 'The fundamental determinants of risk in banking', Working paper (NBER no. 265, 1978).

Ruback, R.S., 'Capital cash flow: a simple approach to valuing risky cash flows', *Financial Management*, Vol. 31, No. 2, 2002, pp. 53–70.

Taggart, R. A., 'Consistent valuation and cost of capital expressions with corporate and personal taxes', *Financial Management*, Vol. 20, No. 3, 1991, pp. 8–20.