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Bank Valuation

with an Application to the Implicit Duration of non-Maturing Deposits

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Abstract

The purpose of the *tutorial* paper is to present a model to value banks. Three traditional models are summarized briefly first. Next, a 'fundamental' bank valuation model is introduced. Based on sound economics and finance principles, it allows to identify the various sources of value and to derive managerial implications such as the measurement of interest rate risk on non-maturing deposits. A first contribution includes the breakdown of the value of equity into two parts: a liquidation value and a franchise value. A second contribution is to call the attention to the corporate bond market, instead of the equity market, to find adequate risk premium to value banks. The valuation model concerns on-balance sheet banking business, such as deposit taking and lending. Off-balance sheet business, such as advisory services, can be valued with standard corporate finance tools.

Surprisingly, few papers and books have discussed the valuation of banks. Many papers have conducted event-type studies, analysing, for example, how changes in deposit rate regulation or unexpected changes of interest rate in the case of maturity mismatch were affecting realized return on bank stocks. Other papers have analysed the impact of changes of interest rates on the profitability of banks and on the value of equity.[1] But, papers addressing the determinants of the market value of a bank are few. In a best selling book on the valuation of companies written by three consultants (Koller *et al.*, 2005), there is one chapter on bank valuation. One can read: 'Valuing banks is conceptually difficult'. The purpose of the *tutorial* paper is to present a framework that will help to identify the various sources of value for a bank. The tutorial is addressed first to corporate finance students and bankers who, on numerous occasions, have asked how do standard valuation finance tools apply to banks. It is also addressed to central bankers, regulators, antitrust specialists who have to deal with bank restructuring. A first contribution of the paper is to break explicitly the value of a bank into two components: liquidation value and franchise value. A second contribution is to call the attention to the corporate bond market, instead of the equity market, to find relevant risk premium to value banks. Finally, it is shown that the valuation model allows to discuss various managerial decisions, such as the measurement of interest rate risk on the banking book. In Pillar 2 of the Basel II capital regulation, bank supervisors are invited to evaluate the degree of duration mismatch between deposits and assets. The method to calculate the effective duration of non-maturing retail deposits, such as demand or savings deposits, is left to the bank or to the regulator. The valuation model proposes an explicit methodology to evaluate the duration of these accounts.

There are, to the best of the author's knowledge, four approaches to value banks:

1. Applications of market multiples, such as Price-to-Earnings or Market-to-Book Value ratios.
2. Discounted value of future dividends
3. Discounted value of future economic profits
4. 'Fundamental' valuation formula

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[1]Smirlock (1984) deals with deposit rate deregulation. Flannery and James (1984) and Yourougou (1990) deal with unexpected changes of interest rates on banks' stock returns. Flannery (1981) looks at accounting returns. Samuelson (1945) focuses on the market value of equity and on the duration mismatch between assets and liabilities. That paper falls short of calculating the duration of non-maturing deposits. A complete survey of studies on interest rate risk is available in Staikouras (2003).

These will be presented successively. As the first three approaches are not specific to banks, they are reviewed rapidly with references given to comprehensive publications. The emphasis is on the fourth approach, the ‘fundamental’ valuation model. We call it ‘fundamental’ because, not only does it present a clear transparent framework to value banks, it also helps greatly to discuss managerial issues such as fund transfer pricing, capital management, pricing loans and deposits, loan-loss provisioning, or the measurement of interest rate risk on the banking book. The last application calls for the estimation of the duration of non-maturing deposits. It is discussed at the end of the paper.

1. Market Multiples

The market multiple approach is the simplest way to value a bank. A common multiple used by bank analysts is the Price-Earnings ratio (P/E).

P/E Multiple

One proceeds in three steps.

Step1: Evaluate the Market P/E for Comparable Banks Listed on an Exchange

In the first step, one searches for comparable, similar banks listed on the stock market, and one computes for each the ratio of the stock price to the earnings-per-share. This is the P/E ratio. The share price refers to the most recent trading price. The earnings-per-share could be the last published earnings-per-share (*historical P/E*) or an average of the forecasted earnings per share by analysts (*forward P/E*). One then computes the average P/E for the set of comparables. The choice of comparables will include banks with similar growth and risk profile. Damodaran (2006) is a comprehensive reference on valuation which calls the attention to the choice of relevant comparables. In banking, besides growth and risk, one will be careful to choose banks with similar business mix across retail banking, private banking, corporate and investment banking, and trading activities. In the OECD countries, the P/E ratio for the commercial banking sector was around 11 in early 2007. It went down by 50% during the US subprime crisis.

Step 2 Forecast the Bank’s Earnings-per-Share (EPS)

The second step entails a forecast of the bank’s earnings-per-share. It could be an extrapolation based on last year's realized earnings, or on any information about the likely earnings in the future.

Step 3 Valuation

In the third step, it is assumed that the stock market will value the earnings of the bank in the same way it is valuing the earnings of comparable banks:

$$\text{Value}_{\text{bank}} = \text{P/E}_{\text{ comparables}} \text{ x forecasted EPS}_{\text{bank}}$$

Although very much used by analysts in many industries, this approach faces a specific problem in banking. As banks take sometimes large provisions for credit losses, they can report a very low profit in a specific year. As the market understands that the very low earnings is temporary and will return back to normal in the following years, the P/E ratio (the price divided by exceptionally low earnings) goes up substantially. In other words, the timing of a one-time provision for credit losses can create large volatility in the P/E ratio of banks. As a consequence, one would like to find more stable market multiples. In banking, the market-to-book value ratio (MBV ratio), the ratio of the market value of shares to the book value of equity, is a much more stable figure.

MBV Multiple

One proceeds in two steps:

Step1: Evaluate the Market-to-Book Value ratio (MBV) for Comparable Banks

In the first step, one searches for comparable, similar banks listed on a stock market, and one computes for each the ratio of the market value of shares to the accounting book value of equity. This is the market-to-book value ratio. The share price refers to the most recent trading price. The accounting value of equity is the shareholders' equity reported in the financial accounts. One then computes the average MBV of the banking sector. In the OECD countries, the average MBV ratio for the banking sector was around 2 in early 2007, one of the highest ratio observed in the past twenty years. As stated above, it went down by 50% during the US subprime crisis. The MBV ratio is close to or above 3 for banks located in emerging markets. In Table 1, we report the market-to-book value ratio and P/E of banks in a few countries. Data are reported in April 2008, ten months into the subprime crisis:

Table 1. Market to Book Value Ratio (P/E)	
United Kingdom	
Barclays	1.32 (6.9)
Lloyds-TSB	2.06 (8.5)
Royal Bank of Scotland	0.66 (6.7)
Standard Chartered	2.42 (15.1)
USA	
Merrill Lynch	1.87 (31.7)
Citicorp	1.25 (42.3)
Goldman Sachs	1.84 (11.5)
Germany-Switzerland	
Deutsche Bank	1.04 (8.92)
Commerzbank	1.00 (8.7)
Crédit Suisse	1.33 (10.28)
UBS	1.99 (-)
Brazil - Russia	
Banco Itau	3.63 (12.2)
Rosbank	4.58 (25)

Source: Thompson One Banker Analytics (29 April 2008)

In the United Kingdom, one observes that one bank, Royal Bank of Scotland, is trading at below book value. This is due in part to exposure to US subprimes but also to the acquisition of part of the Dutch bank ABN-AMRO. High valuations observed in emerging *new* markets (Brazil, Russia) reflect expectations about high growth prospects. The P/E ratios observed in April 2008 display the unwelcome volatility mentioned earlier. For examples, the very large P/E of 31.7 for Merrill Lynch or 42.3 for Citicorp are caused mainly by very low earnings resulting from heavy provisioning.

Step 2 Pricing

In the second step, it is assumed that the stock market will value the equity of the bank in the same way it is valuing the equity of other banks:

$$\text{Value of equity}_{\text{bank}} = \text{MBV}_{\text{comparables}} \times \text{Book Value of Equity}_{\text{bank}}$$

As was the case with the P/E ratio, differences in profitable growth opportunities, risk profile, or business mix will affect the MBV ratio of a specific bank. Similarly, the provisioning policy for non-performing assets or the accounting rule used at the time of a merger can affect the reported book value of equity. These characteristics must be taken into account, whenever relevant.

The multiple approach is very much used by bank analysts. Opponents to this approach recommend to focus, not on accounting figures such as earnings or book value of equity, but on the reality of future cash flows generated by the bank. A second problem with the market multiple approach is the implicit assumption that the stock market values correctly the shares of banks. This might often be true in efficient markets. Still, it might be useful to understand the economic/business assumptions which justify the current valuation figures. One can then exercise judgment and decide whether one is comfortable with that set of assumptions. We will turn to a cash flow-based approach next. But, the market multiple approach should not be dismissed, as it provides a useful benchmark, the current valuation by the stock market. One would need strong arguments to deviate substantially from current market valuation.

2. Discounting Future Dividends

The second approach to value a bank recognizes that the owners of shares, the shareholders, are likely to receive dividends in the future. One therefore forecast and discount the dividend stream expected from this equity investment. In practice, one starts with a detailed forecast of annual profits, a forecast of the part of earnings that needs to be retained to grow the equity (needed to finance the growth of the bank), to arrive at a forecast of dividends. Detailed dividend forecast can be for up to five years, after which one assumes simply that dividends will grow in perpetuity at a constant rate, *g*. Here is an example:

	Year 1	Year 2	Year 3	Year 4	Year 5......
Earnings	15,000	16,125	17,334.38	18,634.5	19,333.3
Dividends paid at end of Year	7,500	8,062.5	8,667.2	13,975.8	14,499.9
Retained earnings	7,500	8,062.5	8,667.2	4,658.6	4,833.3
Equity at start of year	100,000	107,500	115,562.5	124,229.7	128,888

In the above example, we provide a dividend forecast for the next four years, assuming constant perpetual growth thereafter. The dividend payout ratio, the part of profit paid as a dividend, is 50% in the first 3 years and, because of limited growth opportunities, of 75% thereafter. With a constant ROE of 15% (ROE = 15,000/100,000 in Year 1), dividends grow by 7.5% in the first 3 years[2], and after the increase in dividend payout ratio in Year 4, by 3.75% forever.
We discount the first three dividends, and we recognise that, starting in Year 4 , we have a constant growth perpetuity, with a first cash flow of 13,975.8 in Year 4 growing by 3.75% thereafter. Dividends are risky, and it is not a surprise that shareholders will use a higher risk-adjusted rate to discount these cash flows. The higher rate is justified by the risk aversion of investors who need to be compensated for taking some risk. The risk-adjusted discount rate to value shares, R_s is the risk-free rate on government bonds plus a risk premium. In banking, one uses a risk premium of around 5% to value bank shares (Dermine and Bissada, 2007).[3]

$$Value = \frac{D_1}{1+R_s} + \frac{D_2}{(1+R_s)^2} + \frac{D_3}{(1+R_s)^3} + \frac{\frac{D_4}{R_s - g}}{(1+R_s)^3}$$

$$Value = \frac{7{,}500}{1.1} + \frac{8{,}062.5}{(1.1)^2} + \frac{8{,}667.2}{(1.1)^3} + \frac{\frac{13{,}975.8}{0.1-0.0375}(=223{,}610)}{(1.1)^3} = 188{,}000$$

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[2]In the case of a constant ROE, it can be shown that the rate of growth of dividends is equal to the plow-back ratio x ROE = (1 - 50%) x 15% = 7.5%. See the proof at end of Appendix A.

[3]Remember that the discount rate represents the opportunity return available to shareholders. Instead of buying the shares from the bank, shareholders could buy other bank shares with similar risk. Historical studies show that buying bank shares, one earns, on average, an extra return of 5% over the risk-free government bond rate. This historical extra return is used to estimate the risk premium. It is consistent with theoretical asset pricing models, such as the Capital Asset Pricing Model (CAPM).

The last term in the numerator, the value of the future stream of dividend with constant growth in perpetuity (223,610), estimated at the end of Year 3, is referred to as the *Terminal Value*. That is, one discounts a series of yearly dividends over a certain period, plus a terminal value which captures the value of dividends beyond that initial period. A question raised frequently is what is a reasonable perpetual growth rate for dividends and is the estimated terminal value “reasonable”? The growth rate is often related to the nominal growth of GNP in a country, that is real growth plus inflation. Indeed, the growth of a banking system often parallels the growth in GNP. An *ad hoc* sanity check on the reasonableness of the terminal value is to divide the terminal value estimated at beginning of Year 4 (223,610) by the book value of equity at that time (124,230). This gives an implicit MBV (1.8 in the numerical example), and one can check whether or not it is a reasonable figure.

A specialist in corporate finance will notice a significant difference in the way one values non-financial corporations, and in the way one values banks. In standard corporate finance, one often forecast first the value of free cash flows, the cash flow available to meet financial obligations such as debt or equity. These free cash flows are discounted at a weighted average cost of capital (debt and equity), so as to compute the value of the assets of a company. One then deducts the debt to obtain the value of equity. In banking, one focuses directly on the value of equity and a forecast of dividends (after payment of interest). The reason is that the management of the debt (paying eventually low interest rate on some types of deposits) is a source of value creation in a bank. As it can fluctuate with growth of deposits and changes in competition and margins, there is no simple concept of a constant weighted average cost of capital. The focus is on forecasting dividends which will take into account the growth of deposits and eventual changes in margins.

The dividend method is obviously a sound method to value banks. One, however, has to be careful of not extrapolating simply short term earnings to forecast future earnings. A trivial and classical example is the case of an upward sloping interest rate curve, with the funding of long term fixed-rate loan with short term funds. Due to the slope of the curve, this produces a positive interest margin in the short term, but, as an upward sloping curve implies expectations of rising interest rates, the expected interest margin will turn negative at a later time when the refinancing of the short term debt at a higher rate is taking place. Assumptions about drivers of future earnings must be carefully spelled out.

3. Present Value of Future Economic Profits

As discussed previously, the market value of shares is equal to the present value of future dividends, discounted at the opportunity return on shares (R_s):

$$Market\ Value\ of\ Shares = \frac{D_1}{1+R_s} + \frac{D_2}{(1+R_s)^2} + \ldots$$

An alternative approach in corporate finance, fully consistent with the present value of dividends, is to relate the share price to the so-called Economic Profit (EP) of the bank, that is the value created by the bank on top of the opportunity cost of shareholders' equity (Mc Taggart *et al.* 1994, Schroder Salomon Smith Barney, 2002):

$$\text{Economic Profit}_t = EP_t = \text{Profit}_t - (\text{Equity}_t \text{ x Cost of Equity})$$
$$\text{Profit}_t - (\text{Equity}_t \text{ x } R_s).$$

Economic Profit is an intuitive concept. It recognizes that shareholders can invest in stocks yielding an expected return R_s. Value is creating during a year when the profit exceeds this opportunity revenue.[4]

One can show (see Appendix A) that the market value of equity today is equal to current equity, E_0, plus the present value of future economic profits:

$$Market\ Value\ of\ Equity_0 = Equity_0 + \sum_{i=1} (\Pr ofit_i - Cost\ of\ Equity_i)$$

$$Equity_0 + \sum_{i=0} (ROE_i x Equity_i - Equity_i x R_s)$$

[4]While banks measure performances with economic profits, standard corporate firms measure economic value added. Economic value added is the difference between operating profits (measured before interest expenses) and the weighted average cost of capital. Deposit gathering being an essential part of banking activities, the measure of performance in banking centers on a profit concept which is net of interest expenses. Pitfalls in measuring relevant profit figures for standard corporate firms are discussed in a comprehensive book by Young and O'Byrne (2000).

A special case is when equity, dividends, and economic profits are growing forever at a constant rate *g* (with *g* smaller than R_s).[5] Applying the financial mathematics for the case of a constant-growth perpetuity, we have:

$$MarketValue_0 = E_0 + \frac{(ROE - R_s)xE_0}{R_s - g}$$

For this special case of perpetual growth, the formula gives intuitive insights into the market to book value ratio:

$$\frac{MV_0}{E_0} = \frac{ROE - R_s}{R_s - g} + 1$$

One recognizes that the market-to-book value ratio is driven by the ROE and growth in earnings.

For example, for a cost of equity R_s of 10%, a ROE of 15%, and a growth rate of 5%, we have:

$$\frac{MV}{E} = \frac{15\% - 10\%}{10\% - 5\%} + 1 = 2$$

As was the case with the flow-of-dividend method, the valuation of future economic profits is a sound method to value banks. One, however, has to be careful of not extrapolating simply short term earnings to forecast future earnings. Assumptions about drivers of future earnings must be carefully spelled out.

4. 'Fundamental' Valuation Formula, No Corporate Taxes, no Risk

The first three methods to value banks -market multiples, value of dividends, value of economic profits- are not specific to banks, but can be applied to the valuation of any corporation. The fourth method that is presented, the fundamental valuation formula, is specific to banks. It is important for

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[5]As discussed at end of Appendix A, in the case of constant ROE and constant dividend payout ratio *p*, the growth rate is equal to : g = (1-p) x ROE.

two reasons. First, it provides a transparent framework to analyze the sources of value of banks. Second, it allows to discuss, in an integrated manner, several bank managerial decisions, such as fund transfer pricing, capital management, loan and deposit pricing, and the measurement of interest rate risk on the banking book.
For the ease of presentation, we will ignore corporate taxes and risk in a first step. These will be introduced in the second step. Let us start with a simple example. It encompasses most of the intuition beyond our approach. More general formulas will follow.

Valuing a bank, an example (no corporate taxes - no risk).

We consider a bank funded with deposits of 95 and equity of 5. Funds are invested in 1-Year fixed rate government bonds. They were purchased at a time when the fixed-coupon rate was 6%. Today, similar bonds yield a 9% return. Short-term maturity deposits yield 7%, the current rate available on new short-term deposits. The bonds are recorded at their historical book value of 100. One might wonder why depositors would accept a return of 7% when the current bond rate is 9%. Lack of competition among banks, ignorance of some depositors, or convenience can explain why some depositors will invest in 7% deposits.

To keep the example simple, we assume that this bank is going to live for 2 years, with the same deposit base of 95. There is no risk, so that the risk premium is 0%, and dividends will be discounted at the current risk-free bond rate of 9%. At the end, a liquidating dividend will be paid to shareholders. Finally, let us ignore for the moment operating (non-interest) expenses. Here is the balance sheet:

Assets (6 %) : 100	Deposits (7 %) : 95
(risk- free bonds)	Equity: 5

- Asset: Risk-free government bond with a maturity of 1 year and a coupon of 6%
- Short Term Deposits
- Current (risk free) Interest Rate on Asset : 9 %
- Current Interest Rate on Deposits : 7 %
- Bank Closed in Two Years

One can forecast the annual profit of this bank over the next two years:

$\text{Profit}_{\text{Year 1}} = (6\ \%\ \text{x}\ 100 - 7\ \%\ \text{x}\ 95) = -\ 0.65$

$\text{Profit}_{\text{Year 2}} = (9\ \%\ \text{x}\ 100 - 7\ \%\ \text{x}\ 95 - 9\ \%\ \text{x}\ 0.65) = 2.29$

In Year 1, the bank is losing money (0.65), and the bank takes a small loan on the market to finance that loss,[6] 0.65, paying the current market rate of 9%. In Year 2, the old 6%-coupon bond matures, and the proceeds are reinvested at the current bond rate of 9%.

Looking at this simple example, one can argue that there are three concepts for the value of equity:

Concept 1. The Book Value of Equity

This is the easiest concept. The book value of equity is the difference between the accounting value of assets and that of debt, 100 - 95 = 5. One will likely argue that this concept is not very meaningful because it does not take into account the fair value of the asset, a risk-free bond that yields only 6%, at a time when the current market rate is 9%.

Concept 2. The Liquidation Value

The liquidation value is the difference between the current value of the assets and that of deposits.

$$\textit{Value of Asset} = \frac{106}{1.09} = 97.25$$

The value of short term deposits will be equal to the book value, 95.

Liquidation Value = Value of Assets - Value of Deposits = 97.25 - 95 = 2.25

Concept 3. Present Value of Future Dividends

The third concept of value is to compute the present value of dividends paid to shareholders over the two years. Since, in our example, the bank is losing money in the first year, no dividend is paid in Year 1. A liquidating dividend is paid in Year 2. It includes the profit of the year (2.29) plus the principal on the asset (100) minus the reimbursement of the debt, deposits and the small additional debt raised to finance the loss of the first year (95 + 0.65).

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[6] An alternative way to finance the loss of 0.65 would have been to sell part of the bond portfolio. The 'additional borrowing' approach has been chosen for ease of exposition.

$$MV\ of\ Equity = PV\ of\ Dividends = \frac{0}{1.09} + \frac{2.29 + 100 - 95 - 0.65}{1.09^2} = 5.59$$

If one can dismiss the accounting book value of 5 because the assets were not marked-to-market, we end up with two relevant concepts of the value of equity, the liquidation value and the present value of future dividends. The liquidation value representing the value accruing to shareholders if one closes/liquidates the bank immediately. Ignoring transactions costs, bonds can be sold at 97.25. After reimbursement of the short term debt of 95, shareholders receive a liquidation value of 2.25.

The second calculation, the present value of future dividends, represents a different concept. This is the value of the equity of a company as a *going concern*, that is the value of the equity of a company that is going to live for 2 years.

In this example the going concern value of 5.59 is larger than the liquidation value of 2.25. It raises an interesting question as to what is driving the wedge between the liquidation value and the going concern value . The single key-assumption that explains the wedge, in our example, is that we have assumed that the bank can finance itself at a low interest rate of 7% when the market rate is 9%. The low cost deposits are, intuitively, the source of value creation. This can be shown mathematically. One can prove (see Appendix B) that the present value of future dividends can be decomposed into two terms: the *liquidation value* (value if we close the bank today) and an additional component, the *franchise value*, that is the present value of the profits on low cost deposits:

$$MV\ of\ Equity = PV\ of\ Dividends = \frac{0}{1.09} + \frac{2.29 + 100 - 95 - 0.65}{1.09^2} = 5.59$$

$$MV\ of\ Equity = [\frac{106}{1.09} - \frac{95x1.07}{1.07}] + [\frac{(9\% - 7\%)x95}{1.09} + \frac{(9\% - 7\%)x95}{1.09^2}]$$

$$MV\ of\ Equity = Liquidation\ Value + Franchise Value = 2.25 + 3.34 = 5.59.$$

There are two comments to make. In the liquidation value, assets and deposits have to be evaluated at their own current rate. That is, bonds are discounted at the current rate prevailing on the bond market,9%, while deposits are discounted at the rate prevailing on new deposits, 7%. This is consistent with fair valuation accounting rules which demand to evaluate assets and liabilities at their

own current rates. The value of 95 for deposits represents the amount of money depositors should be willing to receive, in case of liquidation, because they can invest money in an other bank at an identical rate of 7%.
Secondly, one observes that the franchise value[7] over 2 years is the margin between the current market rate of 9 % and the rate paid on deposits of 7%. The franchise value represents the value created by the bank as a going concern. For two years, it is able to raise deposits at a cost below the market rate. Notice that already in Year 1, the margin is computed vis-a-vis the current market rate of 9%, even if the government bond is only yielding 6%. The reason is that the low interest of 6% has already been taken into account in the liquidation value of the bonds.

This simple example is at the core of our valuation methodology. It proposes to evaluate the equity of banks in two steps. First, focussing on the current balance sheet of the bank, there will be a need to move from accounting book value figures to current liquidation values. Secondly, one will assess the franchise value with a forecast of future deposits and margins.

This approach also helps to understand some recent policy debates. In the 1980s in the USA under the Chairmanship of Paul Volker at the Federal Reserve, long term bond rates went up, precipitating a fall in the fair value of fixed rate mortgages. On a liquidation value basis, the equity of many American savings banks, the Savings and Loan Associations (S&Ls), was clearly negative. But, they were kept open by regulators with the hope that future franchise value would more than compensate for the negative liquidation value. Bad luck, the franchise value did not fully materialise as increased competition and financial innovations, such as money market funds, reduced substantially the margins on deposits and the franchise value. It resulted in large losses by many S&Ls and a massive bailout at a cost of $300 billion financed by US tax payers.

The simple numerical example was useful to introduce the intuition beyond the fundamental valuation model. We now proceed to introduce formally the fundamental valuation model. Two steps are needed. First, valuation in a risk-free and no tax world. This is followed in the next section by the introduction of corporate taxes and risk.

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[7] The word franchise arises from the fact that banks have received from central banks a bank license, the authorization to collect deposits (or grant loans), giving them access to a banking *franchise*.

Valuing a bank, no tax-no risk

In this step, we generalize the simple example. The representative balance sheet of the bank is given below :

Loans L(l)	Deposits D(d)
Bonds B (b)	Equity E (b^*)
Fixed assets	

Balance Sheet

Bank assets consist of three types: loans, bonds and fixed assets. Funding is coming from two sources: deposits and equity. Loans, bonds and deposits are recorded at their historical book value. That is, a loan of 1 Million granted two years ago is booked at 1 Million. This is often referred to as 'accrual' accounting. In practical applications, there will be several categories of loans, and several types of deposits. Some will be recorded at historical book value. Others could be marked-to-market. The model can accommodate all this. To introduce the valuation model, we simplify and concentrate on the essentials.

At this point, it is essential to distinguish between the contractual, *historical* interest rates applicable on the assets and deposits, and the *current* interest rates that would be applicable on new assets or deposits of identical maturity. For example, b is the historical return on the bond purchased a few years ago. b^* denotes the return on a new bond, with maturity identical to that remaining for the bond in the book. With reference to the previous example, the historical return was 6%, while the return on a new bond with 1-Year maturity was 9%.

So, let us denote *historical, contractual* return on loans, bonds and deposits as: l, b and d. And let us denote *current* return as: l^*, b^* and d^*.

Notice that in some cases, for example in the case of short term deposits or short term loans, the historical return will be identical to that of a current return. In the absence of risk, the discount rate to value share, the opportunity investment return available to shareholders will be the current risk-free rate b^*.

There can be many reasons as to why we observe an interest rate differential between assets and liabilities. The longer maturity of assets may command a risk premium and, with deposits withdrawable at short notice, the posted deposit rate does not include the extra cost of refinancing the bank in the case of deposit withdrawals. However, this does not explain the differential in the model. We have assumed that the return and cost, l^* and d^*, are net of the price for risk, and we postulate that it is imperfect competition, imperfect information, or regulation on some markets which creates the interest rate differentials. Barriers to entry or regulation (such as regulations on interest rate paid on demand deposits) prevent the creation of perfect substitutes which would erase the interest rate differentials. The relevance of imperfect competition can be questioned in a period of global deregulation, but it would seem that market concentration due to bank mergers or asymmetric information can create imperfections in at least some markets. In any case, the model is quite general as perfect competition will appear as a special case.

The market value of equity is equal to the present value of future dividends:

Market Value of Equity = Present Value of Future Dividends

It can be shown (proof in Appendix B), that the market value of equity can be decomposed into two terms: the liquidation value and a franchise value:

Market Value of Equity = Liquidation Value + Franchise Value
= Current Value of Assets- Current Value of Deposits
+ Franchise Value

$$\begin{aligned}
MV\ of\ Equity_0 = {} & L^*_0 + B^*_0 - D^*_0 \\
& + \frac{(b^*_1 - d^*_1) x D^*_1}{1 + b^*_1} + \frac{(b^*_2 - d^*_2) x D^*_2}{(1 + b^*_1) x (1 + b^*_2)} + \ldots \\
& + \frac{(l^*_1 - b^*_1) x L^*_1}{(1 + b^*_1)} + \frac{(l^*_2 - b^*_2) x L^*_2}{(1 + b^*_1) x (1 + b^*_2)} + \ldots \\
& - \frac{Oper.Expenses_1}{(1 + b^*_1)} - \frac{Oper.\ Exp._2}{(1 + b^*_1) x (1 + b^*_2)} - \ldots
\end{aligned}$$

with:

D^*_I = Value of Deposits in Year I, discounted at current deposit rate d_I^*
L^*_I = Value of Loans in Year I, discounted at current loan rate l_I^*
B^*_I = Value of Bonds in Year I, discounted at current bond rate b_I^*.

The value of equity is the sum of the four parts. Each represents something specific. Let us look at each part sequentially.

Part 1: Liquidation value

$$Liquidation\ value = L^*_0 + B^*_0 - D^*_0$$

As in the case of our example, the liquidation value is the current value of the assets net of the current value of debt, each item being discounted at its current rate. This deserves some interpretation. Discounting a loan at its current loan rate, what does the present value represent ? It represents the amount of money a borrower would be willing to pay back immediately, in case of liquidation, if that borrower is able to borrow a new loan at the current rate l^*. A similar reasoning apply to deposits. This is the amount of money a depositor is willing to receive if she can invest the money at a new rate d^* . These current values are identical to the *fair* value of financial instruments reported by US banks (SFAS 107 on "Disclosures about Fair Value of Financial Instruments").
The liquidation value represents the amount of money available to shareholders in case of liquidation, closure of the bank. Notice that the fixed assets do not appear in this liquidation value concept. This will be explained hereafter.

Franchise on Deposits

The second term is the franchise on deposits.

$$Franchise\ on\ Deposits. + \frac{(b^*_1 - d^*_1)xD^*_1}{1 + b^*_1} + \frac{(b^*_2 - d^*_2)xD^*_2}{(1 + b^*_1)x(1 + b^*_2)} + \ldots$$

The franchise value on deposits represents the discounted value of the future profits made in collecting deposits in the future. Notice that, for each year, the margin refers to the difference between the deposit rate paid in that year and the rate on the bond market available in that year. Notice also that, for each year, we take into account the current value of the book of deposits available in that year. They can include deposits from the past or new deposits collected during that year. Estimate of a franchise on deposits require therefore an estimate of the growth of deposits overtime, and of the margin likely to be obtained over time. The term representing the franchise value is identical to that of the example discussed earlier. There was a constant deposit base of 95 over 2 years, a rate on deposit of 7%, and a rate on bond of 9%. The third and fourth terms were not present in the simple example.

Franchise on Loans

The third term is the franchise on loans.

$$Franchise\,on\,Loans = \frac{(l^*_1 - b^*_1) x L^*_1}{(1+b^*_1)} + \frac{(l^*_2 - b^*_2) x L^*_2}{(1+b^*_1) x (1+b^*_2)} + \ldots$$

The franchise on loans represent the present value of future profit on loans, again evaluated vis-a-vis the current bond rate. Notice that this term did not exist in the previous example because the bank was not lending money ; it was only holding government bonds. Again, an estimate of the franchise value on loans requires a forecast of growth in loan portfolio and of margins made on these loans.

Present Value of Operating (non-interest) Expenses

Finally, the last term affects negatively the market value of equity of the bank. This is the present value of operating (non-interest) expenses.

$$Value\ of\ Operating(non-\text{int}erest)\ Expenses = -\frac{Oper.Expenses_1}{(1+b^*_1)} - \frac{Oper.Exp._2}{(1+b^*_1) x (1+b^*_2)} - \ldots$$

Again, this fourth and last term was not present in the simple example, because we had ignored operating expenses. Since the franchise value on deposits and loans had included margins, before operating expenses, we need to deduct the discounted value of cash operating expenses. This would include, when relevant, the capital expenditures, such as technological infrastructure, needed to sustain the growth of the bank.

To complete the discussion of the fundamental valuation formula, we will make three additional observations:

1. Fixed assets: one observes that fixed assets, such as headquarter buildings in prime location do not show up in the formula. The reason is that we are valuing a bank as a *going concern*. If it does not sell its fixed assets, no cash flow being realized, they do not affect the valuation formula. However, some have argued correctly that fixed assets would be sold in the case of a liquidation, generating a cash flow in that situation. Therefore, if one wants, one could include the value of fixed assets to get a true liquidation value, and take it back from the franchise value to recognize that fixed assets would be needed to run the bank as a going concern. So, we would obtain in that case:

$$
\begin{aligned}
MV\ of\ Equity_0 = {} & L^*_0 + B^*_0 - D^*_0 + FA^*_0 \\
& + \frac{(b^*_1 - d^*_1)xD^*_1}{1+b^*_1} + \frac{(b^*_2 - d^*_2)xD^*_2}{(1+b^*_1)x(1+b^*_2)} + \ldots \\
& + \frac{(l^*_1 - b^*_1)xL^*_1}{(1+b^*_1)} + \frac{(l^*_2 - b^*_2)xL^*_2}{(1+b^*_1)x(1+b^*_2)} + \ldots \\
& - \frac{Oper.Expenses_1}{(1+b^*_1)} - \frac{Oper.Exp._2}{(1+b^*_1)x(1+b^*_2)} - \ldots \\
& - FA^*_0
\end{aligned}
$$

In what follows, we will ignore fixed assets, assuming that they are not sold.[8]

2. No franchise on bonds. One observes that, in both the example and in the formula , there is no franchise on government bonds. The reason is that the bank does not create value in holding bonds, since shareholders can buy bonds themselves.

[8]One could also discuss *sale and lease back* agreement, with an initial cash flow linked to the sale of the asset, followed by the flow of after-tax rental expenses.

3. Fee-based Income

The model has focussed exclusively on valuing on-balance sheet businesses, such as loans and deposits. No value has been attached to off balance-sheet activities, such as asset management, corporate advisory services on M & As or trading desk. Of course, these off-balance sheet activities generate additional sources of value. As methods to value these activities are directly inspired by standard corporate valuation approaches, such as those found in the *Valuation* book mentioned earlier (Koller *et al.*, 2005 ; Brealey *et al.*, 2006), they will not be discussed in this paper. In real-life applications, we would suggest to split the activities of a bank into two parts: on-balance sheet activities for which the fundamental valuation model applies, and off-balance sheet activities for which standard valuation approaches apply.

The fundamental valuation formula framework allows to disentangle the sources of value: liquidation value of the current balance sheet, franchise on deposits, franchise on loans, and operating expenses. The liquidation value is the value of the current balance sheet $(L_0^* + B_0^* - D_0^*)$, while the going concern value entails a second term, the value of the franchise, i.e. the ability of the bank to earn rents in the future. Rents can be created on loans but also in collecting low cost deposits.[9] Solvency of banks must be evaluated as the greater of the *liquidation* and *going concern* values. This was already noted by Paul Samuelson many years ago (1945, p24): "It should not be necessary to argue before economists that the banking system is a going concern and should be treated as such".

In anticipation of the discussion on interest rate risk at the end of the paper, one can see that the market value of equity of a bank will be affected not only by changes in the liquidation value of assets and liabilities, but also by the impact of interest rate on the franchise value.

Corporate taxes and risk have been ignored so far. They are introduced next.

5. 'Fundamental' Valuation Formula, Corporate Taxes and Risk

In our step by step presentation, we had ignored corporate taxes and risk. In this section, we present the complete framework, taxes and risk included. A numerical example to build intuition will be

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[9] This is a major difference with non-financial firms. These create value on assets when the net present value of investment is positive (as is the case for banks with loans), but they do not create value in the funding because it is assumed that they must pay the market rate on their debt.

followed by formulas.

Value of a loan , an example

Let us consider a loan of 100 funded exclusively with equity. Again, this extreme example is chosen only to facilitate the introduction to corporate taxes and risk.

Loan = 100 (8 %) Equity = 100

This risky loan yields an expected interest revenue *l* (net of expected loan losses) of 8%. To ease the mathematics, we shall use the case of a perpetual loan, paying this expected revenue *l* of 8% every year. The loan is funded exclusively with equity. The expected return on a new loan l^* is 11%. The differential between the expected contractual return, l = 8%, and the return on a new loan, l^* = 11%, could be caused by the fact that fixed interest rates have increased in the country. The corporate tax rate *t* is 40%. Finally, since these are risky cash flows, we will discount at a risk-adjusted rate b^{**} of 10%, that is a risk-free rate b^* plus a risk premium. Comments on the estimation of the risk premium applied to loans will follow.

So, one has to consider three different interest rates:

The expected contractual return on the loan: l = 8%
The expected return on a new loan: l* = 11%
A shareholders risk-adjusted discount rate: b^{**} = 10%.

$$\text{Market Value of Equity} = \frac{(1-40\%)x8}{1.1} + \frac{(1-40\%)x8}{1.1^2} + \ldots = \frac{(1-40\%)x8}{0.1}$$

$$= 48$$

The value of the equity of the bank is the present value of dividends, the after tax corporate tax profit paid every year in perpetuity to shareholders.

In the spirit of the fundamental valuation formula, we can express the value of the loan in a different manner:[10]

$$MarketValue\ of\ Equity = \frac{annual\ dividend}{discount\ rate} = \frac{(1-40\%)x8}{0.1} = 48$$

$$= \frac{(1-40\%)x8}{(1-40\%)x0.11} + \frac{(1-40\%)x(11\% - 10\%)x72.7}{0.1} - \frac{40\%x0.1x72.7}{0.1}$$

$$= 72.7 + 4.4 - 29.1 = 48$$

The market value of equity is the sum of three terms. As in the model with no tax, we find the current liquidation value of the loan (72.7) and the franchise on loans (4.4). Now, a third term, the last one, has been added. Let us comment on each of these three terms:

After-tax liquidation value: 72.7. One notices that one must discount the after-tax contractual cash flows on the loans by an after-tax current rate on new loans. In the special case of a perpetuity, the tax factor (1-t) at the numerator and denominator would cancel out, but not in the case of loans with finite maturities.

After-tax franchise value: 4.4. It will not be a surprise that the franchise value must be calculated after-tax. The margin is now the difference between the current expected return on loan and the shareholders' risk-adjusted opportunity return, the cost of equity (to be discussed hereafter).

Tax penalty (-29.1). The third term, a negative figure, represents a *tax penalty*. At the numerator we find the tax rate t multiplied by the return on the loan. Corporate finance specialists should be familiar with this term. It is well known, since Modigliani and Miller, that debt creates value because the cost of debt, the interest expenses, is tax-deductible. Corporate debt allows to reduce corporate tax payments. Our case is just the reverse of the Modiglinai-Miller interest expenses tax shield. The bank does not have debt, but, holding a financial asset, it has to pay corporate tax on the interest income earned on the asset. So what is an interest tax shield in the case of debt, becomes a corporate tax

[10] See the proof in Appendix C for a 1-year maturity asset.

penalty in the case of an asset. We refer to the third term as the corporate tax penalty.
Notice, in this example that the tax penalty is very large. This is because the loan is funded exclusively with equity. There is no interest tax shield on debt. No surprise, bankers have lobbied very hard to be allowed to finance loans with a maximum amount of debt, with tax-deductible interest expenses, and a minimum amount of equity.

Before we generalize this example with the introduction of holdings of bonds and funding with deposits, and present the general fundamental formula to value banks, let us have a discussion of the risk-adjusted cost of equity, the discount rate needed to value dividends.

Risk-adjusted discount rate to value loans

The framework has ignored the discussion of risk and the difficulty of choosing a *risk-adjusted* discount rate to value assets and liabilities. Standard corporate finance theory suggests discounting dividends at the cost of equity, the opportunity expected return on the stock market. This one is calculated as the expected return on the bank share, which can be estimated with a standard CAPM, a discounted dividend model, or a multi-factor model (Lajeri and Dermine, 1999 ; Brealey *et al.*, 2006). The opportunity return on the stock market includes the overall risk premium for a bank. Whenever the risk of specific assets is different from that of the average bank risk, the standard corporate finance textbook recommends finding in the stock market shares of firms with similar risk as the one analyzed. For instance, in the case of a conglomerate firm with businesses in the chemical sector and in other sectors, one recommends using, as the cost of equity to evaluate projects in the chemical sector, the expected return on shares of companies specialized in the chemical sector. In principle, with a bank having assets with different types of risk, from very safe to very risky, one could be tempted to make a similar recommendation. Specialist banks, also called monolines, such as credit card providers (e.g., Capital One, MBNA[11]), global custodians (e.g., State Street, Bank of New York), or private banks (Vontobel in Switzerland) can help to estimate a risk premium specific to some activities of a universal bank. However, the standard 'corporate finance' recommendation is very unlikely to work for bank lending, for the reason that, on the stock market, specialized banks lending to just one business sector one are not easy to find. Banks diversify their credit risk, in lending to many different industries. It is for this reason, the absence of specialized banks listed on the stock market,

[11]MBNA was bought by Bank of America in 2005, reducing further the number of specialized financial institutions listed on an exchange.

that banks often use a single average cost of equity to evaluate different activities, the expected return on the bank's own shares (Zaik *et al.*, 1996). In this section, we propose a methodology to take into account specific risk-adjusted discount rates.

We argue that, rather than searching for banks specialized in lending to a single business sector to recover the *beta* of their shares and the relevant equity risk premium, an alternative would be to use the *expected return on corporate bonds of similar risk* as an opportunity cost for the banks' shareholders. Indeed, shareholders holding the equity of the bank used to finance a loan can find an alternative similar-risk opportunity investment by investing in a corporate bond of similar risk as that of a loan. For instance, a very safe loan can be compared as the holding of AAA-rated asset. So, unlike the corporate finance literature which advocates to use information on risk premium from the equity markets, we advocate to use information on risk premium available on the corporate bond and credit derivative markets.

Although the availability of data on expected return on corporate bonds is currently not as widely available as data on expected return on shares, one can expect that, with the growth of corporate bonds, asset-backed securities markets, and credit derivatives, more information will be available on the expected return on corporate bonds. For instance, a study by Kaplan and Stein (1990) for the junk bond markets or by Delianedis and Santa Clara (1999) for the investment grade bond markets provide the following realized excess premium, the difference between realized returns on corporate bonds of different grades and return on federal risk-free bonds. These are reported in Table 2.

AAA	27bp
AA	48 bp
A	69 bp
BBB	83 bp
Junk	200 bp
Equity	500 bp

Table 2. Excess return (realized return on corporate bonds – return on US federal bonds)

One observes a reasonable range from a low 27bp risk premium for holding AAA bonds to 200bp for holding higher risk junk bonds. For reference, the risk premium for the overall stock market is around 500bp. More recent evidence on risk premium on corporate credit risk is derived by comparing the risk neutral probability of default observed in credit default swaps to actual probability of default coming out of Moodys KMV (Amato, 2005, Berndt et al. 2005). They observe on average a risk premium of 35bp for a portfolio of 125 entities with credit ratings ranging from A to BBB^-, and that the risk premium exhibits large variation over time.[12]

One will observe that the margin in the loan franchise is the difference between the return on the loan (l^*) and the return on an opportunity similar-risk asset (b^{**}). This meets intuition. A loan will create a positive franchise when the expected return on that loan exceeds the expected return on a similar risk corporate bond[13] which the treasury of the bank can buy as an alternative investment.
We can now generalize the example of the value of equity invested in a loan.

Value of equity invested in a loan

Let us consider the equity of a bank invested into loans. We focus on one asset for expository convenience and further assumes that it is a perpetual loan. The single asset approach is generalized next.

We define:
L = loan (perpetuity)
l = expected return on loan
t = corporate tax rate
l^* = expected return on new loan
b^{**}= shareholders' opportunity rate

The balance sheet of this position is as follows :

[12]It must be noted that the empirical evidence on bond risk premium was estimated before the subprime crisis.

[13]As an alternative to the expected return on corporate bonds, one could attempt to estimate a beta with reference to CAPM theory : $\text{beta}_I = \text{Cov}(R_i, R_M)/\sigma^2_M$). In the absence of empirical evidence from bank shares, the covariance can be estimated with the correlation between the accounting income or cash flow of a specific business and the market return. The key difference with our approach is that the expected return on corporate bonds can be estimated directly from market data, while the alternative 'beta' approach makes the strong implicit assumption that the CAPM holds.

Loan L(l) Equity (b^{**})

We have argued that, rather than searching for banks specialized in lending to a single business sector to recover the *beta* of their shares and the relevant risk premium, an alternative would be to use the *expected return on corporate bonds of similar risk* as an opportunity cost for the banks' shareholders. In other words, to value a loan to a particular business sector with a specific credit grade, one could use information from the corporate bond and credit derivative markets.

We are now equipped to value the equity of this bank. It is the present value of the (perpetual) flows of dividends discounted at the shareholders' opportunity rate :

$$MV of\ Equity = PV of\ dividends = \frac{l x (1-t) x L}{b^{*}}$$

It can be shown to be equal to[14] :

$$Market\ Value of\ Equity = \frac{(1-t) l L}{(1-t) l^{*}} + \frac{(1-t)(l^{*} - b^{**}) L^{*}}{b^{**}} - \frac{t b^{**} L^{*}}{b^{**}}$$

$$= L^{*} + \frac{(1-t)(l^{*} - b^{**}) L^{*}}{b^{**}} - \frac{t b^{**} L^{*}}{b^{**}}$$

The value of the equity is the sum of three terms: the value of the loan after-tax cash flows discounted at the loan after-tax current rate, the after-tax value of the franchise, and the Modigliani-Miller tax penalty. The valuation formula highlights that the relevant opportunity rate to calculate the franchise loans should be the expected rate on a corporate bond with similar risk as the loan (b^{**}).

If one repeats the same approach for bonds and deposits, one can obtain the valuation formula to value the equity of a bank.

Value of Equity, with Corporate Taxes and Risk.

In the above discussion, we discussed the case of equity exclusively invested in loans. In general,

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[14]See the proof in Appendix C for a 1-year to maturity asset.

equity of a bank is a (long) position in loans and bonds, and a (short) position in debt (principle of value additivity of Modigliani and Miller, 1958). One can apply the above framework to each component to obtain the value of equity of the bank. So let us consider the balance sheet of the bank:

Loans (l)	Deposits (d)
Bonds (b)	Equity
Fixed assets	

The contractual rate on these assets and deposits are respectively l, b, d, while the current expected return are l^*, b^*, and d^*.

The market value of equity of the bank is the risk-adjusted value of future dividends, discounted at the cost of equity. The alternative is to use our framework to obtain a fundamental valuation formula. The intuition is that the single dividend flow can be decomposed into the cash flows linked to loans, bonds, or debt. Equity is seen as a portfolio of long positions in assets and short positions in debt. Applying the decomposition framework discussed above to loans, bonds and deposits and adding up, one obtains:

$$
\begin{aligned}
\textit{Market Value of Equity}_0 = {} & [L^*_0 + B^*_0 - D^*_0] \\
& + \frac{(1-t)x(b^*_1 - d^{**}_1)xD^*_1}{(1+b^{**}_1)} + \frac{(1-t)x(b^*_2 - d^{**}_2)xD^*_2}{(1+b^{**}_1)x(1+b^{**}_2)} + \ldots \\
& + \frac{(1-t)x(l^*_1 - b^{**}_1)xL^*_1}{(1+b^{**}_1)} + \frac{(1-t)x(l_2^{\ *} - b_2^{\ **})xL^*_2}{(1+b^{**}_1)x(1+b^{**}_2)} + \ldots \\
& - \frac{(1-t)\,x\,Oper..Expenses_1}{(1+b^{**}_1)} - \frac{(1-t)xOper.\,Expenses_2}{(1+b^{**}_1)x(1+b^{**}_2)} - \ldots. \\
& - \frac{t\,xb^{**}_1\,x(L^*_1 + B^*_1 - D^*_1)}{(1+b^{**}_1)} - \frac{t\,xb^{**}_2\,x(L^*_2 + B^*_2 - D^*_2)}{(1+b^{**}_1)x(1+b^{**}_2)} - \ldots
\end{aligned}
$$

The valuation formula includes five terms:

Liquidation value. The first term is the current value with each asset and debt being the value of after-tax expected cash flows discounted at after-tax expected rate on new asset/debt ($(1\text{-t}) \times l^*$, $(1 - t) \times b^*$, $(1 - t) \times d^*$). An alternative discussed in Dermine (1987) is to discount the before-tax cash flows at the before-tax rate and to add a tax adjustment for the any delayed taxation of capital gains/loss (Samuelson, 1964).

Franchise on deposits. This is the after-tax franchise on deposits, evaluated vis a vis a risk-adjusted rate. In the formula, we are using , for simplicity, one single risk-adjusted rate, b^{**}, but, in theory, they should be one specific for each asset and liability.[15]

Franchise on loans. The after-tax franchise on loans is evaluated vis-vis similar risk corporate bonds. An indirect implication of the valuation model is that a credit risk-adjusted transfer price to evaluate a loan should be, as the franchise value indicate, the expected return on corporate bonds with similar risk as that of the loan. This is very different from the current market practice which relies on a single transfer price, the interbank market rate.[16]

Present value of operating expenses. As the volatility of operating expenses is similar to that of deposits, one could discount at the risk-adjusted rate applied to deposits.

Modigliani-Miller tax penalty. The last term capture the tax effect. Note that there will be a tax penalty on the asset , but a tax shelter on the debt. As banks are usually net holder of financial assets, the net tax effect is likely to be negative.[17] Again, in this framework, there is no need to calculate the retained earnings needed to finance the grow of the bank. They are implicitly taken into account in the calculation of the franchise value.

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[15]The risk-adjusted rate for deposits should be lower than the risk-adjusted rate for loans. Depositors are protected by the equity of shareholders who will absorb part of the losses.

[16]The use of risk premium on corporate bonds to price loans and evaluate performances are discussed in Dermine (2009).

[17]The approach is fundamentally similar to the adjusted present value (APV) approach used in standard corporate finance. In that approach, the asset is evaluated first as if it was fully funded with equity. One values the assets with an unlevered cost of equity. One then adds the present value of tax savings caused by debt financing. In our approach, we value the loans as if they were funded exclusively by equity, and the unlevered discount rate is the expected return on corporate bonds with similar risk. One then adds a term to incorporate the impact of taxes.

To complete the discussion on bank valuation, two additional issues are discussed. One is the value derived from the limited liability of bank's shareholders. The second is the valuation impact of a maturity mismatch.

In the valuation formula, we have ignored the risk of default and the option given to bank shareholders to default on their obligations. This is equivalent to a put option, the ability of shareholders to sell the assets of the bank to depositors at a price equal to the liability. One way to interpret the fundamental valuation model is either to assume that the risk of default is very small so that value of the put is small, or that the benefit of the put option is passed on to depositors or borrowers through better terms (Merton (1977), Ronn and Verma (1986), and Dermine and Lajéri, (2001)).

The second question is the impact of a duration mismatch on the value of a bank. In perfect markets with fully informed shareholders, maturity mismatches create no value. That is, a long term fixed rate asset funded with a short term debt on perfectly competitive market creates no value. The intuition, in the spirit of Modigliani-Miller, is that perfectly informed shareholders can undo the mismatch by taking a reverse position. However, one can argue that a severe mismatch can create a risk of financial distress with depositors and the franchise running away.[18] A pragmatic approach would be to multiply the franchise value by some probability factor.

A final comment on the fundamental valuation model is that it does not attempt to model explicitly the complex intricacies of bank behavior. For example, we take as given the positioning of bank on the loan market with particular expected margins. This is the result of a complex market mechanism with an interplay of competition and borrower's behavior (Boyd and De Nicolo, 2005). Although parsimonious with a much simplified representation of the complex reality of a bank, the model hopes to capture the main cash flows characteristics driving the value of a bank.

6. Bank Valuation and Managerial Decisions, the Case of Interest Rate Risk on Non-Maturing Deposits

In this final section, we show that the fundamental bank valuation model can be used to evaluate the interest rate risk faced by a bank on their *banking* book. Banks are often funded with deposits with

[18]Note that, if depositors are not informed of the position, the risk of distress created by the mismatch would increase the value of the put option.

undefined maturities, such as demand and savings deposits. On contractual terms, these deposits have a short maturity. But, effectively, many of these deposits have an effective longer maturity, as they are stable. One calls them *core* deposits. In managing the interest rate risk of a commercial bank, a practical question concerns the effective maturity or duration of these deposits. For example, Pillar 2 of the forthcoming Basel II capital adequacy regulation recommends to evaluate the impact of a shift of 2% on the economic value of a bank. It should not exceed 20% the sum of Tier 1 and Tier 2 capital. To estimate the impact of an interest change on the economic value of a bank, one needs to define the effective maturity of non-maturing retail bank deposits. It is shown how the fundamental valuation formula can provide an answer to this specific question.

A change of value of an asset is given by the well known Macaulay duration formula:

$$\Delta\, Value\, of\, asset = -\, Value\, of\, asset\ x\ \frac{Duration}{1+R}\ x\, \Delta R$$

where duration is the average maturity of the assets, the cash flows being weighted by the present value of the cash flow received in that year.

Which duration should be applied to the deposits of a commercial bank: the short contractual one or a longer effective one, and which one ?
Our valuation framework allows to answer this question.[19] We define the duration of deposits indirectly. The duration of deposits is equal to the duration of bonds needed to neutralize to zero the impact of a change of interest rate on the value of a bank. Ignoring operating expenses, let us consider the following balance sheet, with deposits D^*_0 invested in bonds:

Bonds B^*_0	Deposits D^*_0

The value of equity is equal to:[20]

[19]This approach generalizes the results of Dermine (1985).

[20]There is no tax penalty as financial assets are equal to financial liabilities.

$$Market\,Value\,of\,Equity_0 = [B^*_0 - D^*_0] + \frac{(1-t)x(b^*_1 - d^{***}_1)xD^*_1}{(1+b^{***}_1)} + \frac{(1-t)x(b^*_2 - d^{***}_2)xD^*_2}{(1+b^{***}_1)x(1+b^{***}_2)} + \ldots$$

The first term is the liquidation value. Since deposits have a very short maturity, the value of deposits will be equal to the book value D_0. And the change in the liquidation value of deposits (ΔD_0) following an increase in interest rate will be equal to zero.

Hedging requires the change in market value of equity to be equal to zero:

$$\Delta Market\,Value\,of\,Equity_0 = [\Delta B^*_0 - 0] + \Delta\left(\frac{(1-t)x(b^*_1 - d^{***}_1)xD^*_1}{(1+b^{***}_1)} + \frac{(1-t)x(b^*_2 - d^{***}_2)xD^*_2}{(1+b^{***}_1)x(1+b^{***}_2)} + \ldots\right) = 0$$

$$\Delta Market\,Value\,of\,Equity_0 = [-B^*_0 x \frac{Duration_B}{1+R} x\Delta R - 0] + \Delta\left(\frac{(1-t)x(b^*_1 - d^{***}_1)xD^*_1}{(1+b^{***}_1)} + \frac{(1-t)x(b^*_2 - d^{***}_2)xD^*_2}{(1+b^{***}_1)x(1+b^{***}_2)} + \ldots\right) = 0$$

One can solve to find the duration of bonds that makes the market value of equity immunized. An increase in interest rates will reduce the value of the bond, but, in most countries, an increase in interest rate will increase the franchise value on deposits, because of the well documented inelasticity or rigidity of deposit rates (Dermine and Hillion, 1992). Intuitively, the larger the stability of deposit rates and volumes of deposits, the longer can be the duration of assets that will neutralize the impact of an interest rate increase. This indirect approach allows to compute the implicit duration of non-maturing deposits. Data inputs demand a forecast of volume of deposits and interest margins under several interest rate curve scenarios.

The above approach to measure the interest rate risk, which takes into account the impact of interest rate on the value of the franchise is fully consistent with the so-called OTS Model for the value of savings deposits. Developed by the US Office of Thrift Supervision (OTS, 2000), it defines the value of savings deposits as the present value of future deposit cash outflows. This is identical to the value of deposits developed in the *fundamental* valuation model. It was shown to be equal to a liquidation value plus a franchise value of deposits. The principle benefit of the franchise value-based approach to measure interest rate risk is to make transparent the assumptions regarding the impact of interest rates on the volumes of deposits and interest rates over time, as well as the number of years of franchise value that is taken into account.

Conclusions

One hears often that bank valuation is difficult. A *fundamental* bank valuation model is presented. Based on sound finance and economics principles, it allows to separate the liquidation value from a franchise value. Moreover, it calls to the attention that the corporate bonds and credit derivative markets provide information on risk premium expected on credit risk of different classes. Finally, the valuation model provides a conceptual framework to estimate the relevant duration for non-maturing accounts, such as demand and savings deposits. This result should prove useful when the new capital regulation, Basel II, recommends to evaluate the impact of interest rate changes on the economic value of a bank.

Appendix A: Value of equity as discounted value of future economic profits.

Consider first the case of equity generating every year forever a constant ROE, with the entire profit paid out as a dividend. So, there is no retained earnings and no growth:

$$Value\ of\ Equity = \frac{dividend}{1+R_s} + \frac{dividend}{(1+R_s)^2} + \frac{dividend}{(1+R_s)^3} + \ldots$$

$$= \frac{ExROE}{1+R_s} + \frac{ExROE}{(1+R_s)^2} + \frac{ExROE}{(1+R_s)^3} + \ldots$$

$$= \frac{ExR_s + Ex(ROE - R_s)}{1+R_s} + \frac{ExR_s + Ex(ROE - R_s)}{(1+R_s)^2} + \ldots.$$

$$= \frac{ExR_s}{R_s} + \frac{(ROE - R_s)xE}{1+R_s} + \frac{(ROE - R_s)xE}{(1+R_s)^2} + \ldots.$$

$$= Equity_0 + \sum (ROE - R_s)xE$$

The value of equity is the equity plus the present value of future economic profit.

Now, consider that, at the end of Year 1, we have retained earnings (RE_1) reinvested forever with a constant ROE: Let us compute the present value of a negative cash flows followed by positive additional dividends:

$$Value\ of\ retained\ earnings_1 = \frac{-RE_1}{1+R_s} + \frac{ROExRE_1}{(1+R_s)^2} + \frac{ROExRE_1}{(1+R_s)^3} + \ldots..$$

$$= \frac{-RE_1}{1+R_s} + \frac{R_s xRE_1 + (ROE - R_s)xRE_1}{(1+R_s)^2} + \frac{R_s xRE_1 + (ROE - R_s)xRE_1}{(1+R_s)^3} + \ldots..$$

$$= \frac{-RE_1}{1+R_s} + \frac{\frac{R_s xRE_1}{R_s}}{1+R_s} + \frac{(ROE - R_s)xRE_1}{(1+R_s)^2} + \frac{(ROE - R_s)xRE_1}{(1+R_s)^{\#}} + \ldots$$

$$= \frac{(ROE - R_s)xRE_1}{1+R_s} + \frac{(ROE - R_s)xRE_1}{(1+R_s)^2} + \frac{(ROE - R_s)xRE_1}{(1+R_s)^3} + \ldots.$$

The value of retained earnings is equal to the present value of future economic profits on these retained earnings. This could be repeated for retained earnings in Year 2, Year 3.....Adding the value of retained earnings to the value of the bank computed for the case of a 100%-dividend payout ratio, one obtains:

$$Value\ of\ Equity = \frac{dividend_1}{!+R_s} + \frac{dividend_2}{(1+R_s)^2} + \frac{dividend_3}{(1+R_s)^3} + \ldots$$

$$= Equity_0 + \sum_{i=1} (ROE - R_s)xE_i$$

The value of equity is the current equity plus the present value of future economic profits.

If one adds to this a constant rate of growth for equity *g*, this simplifies to:

$$Value\ of\ Equity = Equity_0 + \frac{(ROE - R_s)xEquity}{R_s - g}$$

and, (1- p) denoting the *plow-back* ratio -the ratio of retained earnings-, the growth of equity g is equal to:

$$g = \frac{retained\ earnings}{equity} = \frac{(1-p)xprofit}{equity}$$

$$= \frac{(1-p)xROExEquity}{Equity} = (1-p)xROE$$

A constant ROE and and dividend-payout ratio *p* imply also constant growth *g* for profit and dividend. So, in the case of constant perpetual growth with constant ROE, the value of equity is equal to:

$$Value\ of\ Equity = Equity_0 + \frac{(ROE - R_s)xEquity}{R_s - (1-p)xROE}.$$

Appendix B: Proof of fundamental valuation formula (no tax, no risk)

We show that a two-period asset A with a historical return a, a current (one-period) return a* and a discount rate of b* is equal to :

$$MV = \frac{aA}{1+b^*} + \frac{(1+a)A}{(1+b^*)^2}$$

$$= A_1^* + \left[\frac{(a^* - b^*) x A_1^*}{1+b^*} + \frac{(a^* - b^*) x A_2^*}{(1+b^*)^2} \right]$$

with

$$A_1^* = \frac{aA}{(1+a^*)} + \frac{(1+a)A}{(1+a^*)^2}$$

$$A_2^* = \frac{(1+a)A}{(1+a^*)}$$

The analysis can be repeated for loans, bonds and deposits to obtain the valuation formula.

Proof :

$$MV = \frac{aA}{1+b^*} + \frac{(1+a)A}{(1+b^*)^2} = \left(\frac{aA}{1+a^*} + \left(\frac{aA}{1+b^*} - \frac{aA}{1+a^*}\right)\right)$$

$$+\left(\frac{(1+a)A}{(1+a^*)^2} + \left(\frac{(1+a)A}{(1+b^*)^2} - \frac{(1+a)A}{(1+a^*)^2}\right)\right)$$

$$= \left(\frac{aA}{(1+a^*} + \frac{(1+aA)}{(1+a^*)^2}\right) + \left(\frac{aA(a^* - b^*)}{(1+a^*)(1+b^*)} + \frac{(1+a)A(a^* - b^*)((1+a^*)+(1+b^*))}{(1+a^*)^2(1+b^*)^2}\right)$$

$$= A_1^* + \frac{(a^* - b^*)\left(\frac{aA}{1+a^*} + \frac{(1+a)A}{(1+a^*)^2}\right)}{(1+b^*)} + \frac{(a^* - b^*)\frac{(1+a)A}{1+a^*}}{(1+b^*)^2}$$

$$= A_1^* + \left[\frac{(a^* - b^*)x A_1^*}{1+b^*} + \frac{(a^* - b^*)x A_2^*}{(1+b^*)^2}\right]$$

Appendix C: Bank valuation, the corporate tax and risk case

We show that the after-tax value of a 1-Year asset A issued at par with historical return a, current (one period) return a^*, and discount rate b^* is equal to :

$$\frac{(1+a(1-t))A}{1+b^*} = \frac{(1+a(1-t))A}{1+a^*(1-t)} + \frac{(1+a(1-t))A}{1+b^*} - \frac{(1+a(1-t))A}{1+a^*(1-t)}$$

$$= A^* + \frac{(1+a^*(1-t))(1+a(1-t))A - (1+b^*)(1+a(1-t))A}{(1+b^*)x(1+a^*(1-t))}$$

$$= A^* + \frac{[(1+a^*(1-t)) - (1+b^*)]x[(1+a(1-t))A]}{(1+b^*)(1+a^*(1-t))}$$

$$= A^* + \frac{[a^*(1-t) - b^* + b^*t - b^*t]xA^*}{1+b^*}$$

$$= A^* + \frac{(1-t)(a^* - b^*)A^*}{1+b^*} - \frac{tb^*A^*}{1+b^*}$$

A proof for a 2-Year asset is available in Dermine (2007).

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