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Incorporating Prepayment Risk Considerations when Making Hedging Decisions

by

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Introduction

Efforts to manage interest rate risk at financial institutions are complicated by the many different options that are often embedded in traditional fixed income instruments – most notably prepayment options. Risk managers typically endeavor to manage these risks by assessing the potential volatility in earnings (earnings at risk), and they conduct some form of sensitivity analysis to estimate value changes per incremental rate change. If they deem the exposure to be unacceptable, they'll often overlay a derivative instrument position to offset at least some portion of the prospective effects.

In the following discussion, we describe the general features of basic interest rate modeling at financial institutions and explain alternative risk management approaches. Because many banks hold longer-term assets and shorter-term liabilities, we assume this structure as a starting position. The analysis should reflect the fact that many securities (typically the assets) are structured with embedded options. Virtually all depository institutions face this problem, with the most ubiquitous embedded option being the borrower's option to prepay. Such options are especially common in mortgages, mortgage-backed securities, mortgage servicing rights, and a substantial number of other commercial loans.

From the lender's perspective, the prepayment option is a short call with an American style exercise.[1] Specifically, the lender holds the loan as an asset; and the borrower has the right to buy the loan (i.e., the asset) back from the lender for an amount equal to the outstanding balance – a balance that will typically differ from the market value of the loan. This option may be exercised at any time during the life of the loan. In advance of the exercise, the value of the option is difficult to measure because prepayments are affected by different factors. For example, the pace of prepayments may be influenced by changes in the general level of economic activity, social or demographic adjustments, and, of course, variability of market interest rates. Clearly, it would be difficult to assign a high level of confidence to any prepayment schedule forecast, given the inherent uncertainty associated with each of the various underlying factors. The best we

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[1] It is not clear precisely how the lender is compensated for selling this option. Is it via a higher rate, a portion of the origination fee, deferred revenues that will ultimately be generated through mortgage servicing activities, or is it explicit prepayment charges? Given seemingly low mortgage rates, analysts frequently argue that lenders are not adequately compensated for selling the prepayment option.

can do is to apply modeling techniques to estimate these sensitivities, but we should be clear that these techniques will yield imperfect information. As a consequence, the *ex post* performance of derivative hedges will typically generate some measure of unintended gains or losses.

This imprecision may be particularly critical under the regime of FAS 133, the accounting standard that pertains to derivative instruments and hedging activity, in that hedge accounting might be proscribed if these unintended effects are of a sufficient magnitude. In such a situation, financial managers could be forced to choose between (a) hedging their risks and accepting the fact that the hedge results might impact earnings in periods *other than* those in which the hedged items' income effects will occur, or (b) not hedging these risks and bearing the associated, otherwise avoidable, market exposures.

So how should banks proceed? If management chooses to hedge, should it view the loans as a portfolio of long-term fixed-rate assets and hedge the value of these assets? Alternatively, because most intermediaries focus on net interest margin, should management instead hedge its exposure to the risk associated with the roll-over of shorter term liabilities? Before addressing these questions directly, we first provide some background on various approaches relating to measuring interest rate sensitivity.

GAP and Earnings Sensitivity Analysis

Earnings sensitivity analysis has evolved from static GAP analysis, in which managers compare the dollar amount of rate-sensitive assets with the dollar amount of rate-sensitive liabilities across different time intervals, where GAP equals the corresponding difference.[2] A positive (negative) GAP indicates relatively more rate-sensitive assets (liabilities) such that the bank's net interest income will generally rise (fall) when interest rates rise. Among its many weaknesses, GAP measures generally either ignore the impact of embedded options or assume a known prepayment schedule. In reality, however, the rate sensitivity of an asset or liability with an embedded option will vary because the frequency or pace of option exercise differs under different interest rate conditions. In addition, static GAP analysis ignores the differential adjustments in rates paid on interest-bearing liabilities versus rates earned on earning assets.

Earnings sensitivity analysis strives to overcome this problem because it represents "What if" or scenario analysis. It involves the following steps: 1) identify a base case interest rate environment including a benchmark interest rate and spreads/correlations between the benchmark rate and other rates; 2) given the assumed rate environment, identify assets and liabilities that will re-price within a time

[2] Formally, static GAP equals rate-sensitive assets (RSAs) minus rate-sensitive liabilities (RSLs) where the dollar amount of RSAs and RSLs is determined by estimating the amounts that management expects to reprice within specific time intervals.

interval (e.g., one year), and assess the underlying principal cash flows and their associated gains or losses; 3) estimate the growth in loans, securities, core deposits, and non-core liabilities during the same time interval; 4) estimate net interest income and net income; and 5) select another interest rate environment and repeat 2) through 5). The output appears as a matrix of different assumed rate environments versus the base case and the associated changes in net interest income versus the base case.

One limitation of a GAP presentation is the fact that results presume a given prepayment exercise schedule, such that the reliability of the estimates will depend on whether the modeling process has accurately anticipated the pace of repayments under the respective rate scenarios. To the extent that these assumptions are violated, some discrepancies between the realized results versus those that may have been anticipated should be expected. An even more critical shortcoming, however, is the fact that the process doesn't eliminate the exposure – it simply delays its realization. For example, assume a starting position with more rate-sensitive assets than liabilities and the decision to minimize the GAP for, say, the coming 12 months. If interest rates fall, it is true that the bank's margin will be protected during this year, but unless rates post a reversal, the effect of the lower interest rates (i.e., a squeezed margin) will have to be realized through all subsequent periods for which those assets remain on the balance sheet.

Duration and Economic Value of Equity Sensitivity Analysis

Market value (price) sensitivity analysis is an alternative approach to GAP analysis. With this orientation, banks endeavor to measure the institution's economic value of equity (EVE) by calculating the market value of assets minus the market value of liabilities. The difference represents the residual market value of the bank, which is labeled EVE. Given the interest rate sensitivities of the assets and liabilities, respectively, analysts can then predict the incremental change in this residual market value due to rate perturbations and use the information to design appropriate hedge positions.

Generally, a bank with longer duration assets versus liabilities will lose (gain) when interest rates rise (fall) because the market value of assets will fall (rise) more than the market value of liabilities. However, measuring the effects of this exposure for a given portfolio of loans with embedded options is tricky, because the values and properties (i.e., the *deltas*, *gammas*, *vegas*, *thetas*, and *rhos*) of these options are subject to considerable volatility and lack of consensus. Moreover, even if there were uniformity of opinion, all of the relevant considerations are subject to change with time passing and/or changing market conditions.

Additionally, it is worth noting that because the duration being hedged is a moving target, hedging the economic value requires using a dynamic process. That is, the hedge requires ongoing adjustments. Ultimately, the object of the dynamic adjustments would be to replicate in reverse the performance the

amortizing loans being hedged, inclusive of their short option, and, as with any replication procedure, the ex post results of the process may likely differ – possibly significantly – from ex ante expectations. Not surprisingly, many institutions do not focus on hedging EVE given its emphasis on long-term cash flows.

Alternative Hedge Strategies

Independent of the prepayment issue, the classic interest rate risk of the institution arises from the typical structure of longer-term assets and shorter-term liabilities. In addressing this risk, managers have the choice of either focusing attention on the longer-termed assets by synthetically converting fixed rate loans to floating rate loans or, alternatively, focusing on liabilities by synthetically extending the maturity of deposits. While the presence of a prepayment option adds a complicating factor, in fact, the two approaches still serve as prospective starting points.

Hedging long-term fixed-rate assets

As previously mentioned, from the perspective of the lender, the prepayment option is a short call with an American style exercise feature. That is, the mortgage or loan is a fixed-rate asset held by the financial institution, and any time during the life of the loan the borrower has the right to buy it back from the lender at a price equal to the outstanding balance. Critically, with non-constant interest rates, this balance will likely differ in value from the market value of the remaining cash flows of the loan.

If no prepayments were to occur – ever – a *receive fixed / pay variable* interest rate swap with a term equal to the maturity of the associated loan and an identical amortization schedule would serve as the perfect hedge. However, with the contingency of prepayment at the discretion of the borrower, the hedger would need to be able to liquidate the swap position without suffering a loss. Given the fact that the strike price would have to change to reflect the remaining balance of the loan, the hedger might choose to buy a series of swaptions to cover this risk -- each with a horizon to the next payment date, and each having a strike price equal to the prevailing outstanding loan balance. Alternatively, the hedger could assess the interest rate sensitivity of the loan (inclusive of the prepayment optionality), and simply identify a derivative position with an offsetting interest rate effect. In fact, this latter approach, anecdotally, seems to be the more common.

Given that the “hedged item” is a fixed-rate loan, if hedge accounting were applied, the correct treatment would be *fair value* accounting. It is by no means clear that the bank would be able to qualify for this treatment, however, despite its efficacy in an economic sense. The critical question is whether or not the hedger can demonstrate, prospectively, that the hedge gains or losses could be expected to offset changes in the fair value of the loan due to changes in the benchmark rate. The hedger must also demonstrate that the hedge was effective in that same sense, retrospectively. Assuming both prerequisites can be validated, total gains and losses of the derivatives would be recorded in income, as would the change

in the value of the loan due to the risk being hedged. On the other hand, if hedge effectiveness prerequisites cannot be satisfied, the accounting treatment of the loan would be unchanged from current practice, which, for most institutions is the lower of cost or market (LOCOM). In this case, derivative gains and losses would be recognized in earnings. Of course, hedgers might elect *not* to apply special hedge accounting, but in doing so, they would virtually assure having to report a level of income volatility that could otherwise be avoided.

Assuming hedge accounting could be applied, yet another problem arises. In practice, lenders tend to consider the risk of loans in a portfolio, rather than individually; that
is, they tend to consolidate loans having similar characteristics and hedge portfolios. FAS 133 imposes some rather serious constraints relating to portfolio hedges. Specifically, the standard requires that if one component of the portfolio changes by 10 percent, price changes of all other components must fall between 9 and 11 percent for hedge accounting to apply. If, instead, the other components change by 7 percent or 13 percent, hedge accounting would not be permitted.[3]

Hedging short-term variable rate liabilities

Instead of hedging the asset side of the balance sheet, a bank may choose to operate on the liability side. Assume that the balance sheet is composed of longer-term assets and shorter-term (i.e., variable rate) liabilities. In this case, focusing on the liabilities forces a change in the accounting treatment. Here, the hedged item is the uncertain cash flows associated with variable-rate funding, and thus the hedge would be designated as a *cash flow* hedge. Critically, to qualify for this treatment, the forecasted event (i.e., the anticipated variable interest expense) must be probable. The prepayment possibility might seem to compromise this assertion, but FASB does not require lenders to dedicate specific funding instruments to specific assets. As long as funding takes place for the designated amounts, hedge accounting is not in jeopardy. With this approach, the hedger may elect to hedge rollover funding for virtually any horizon, constrained by the requirement that the funding must be expected to actually take place with a very high degree of confidence over the designated horizon.

The difficulty of this approach is that prepayment risk is specific to specific loans or securities. That is, the amount to be hedged in the prospective periods is an amount that is subject to the pace of prepayment activity. Thus the hedger may find that he or she successfully locks up the cost for funds for a given notional amount, but prepayments force a substitution of lower-yielding assets, thereby resulting in a lower net interest margin. On the other hand, if rates rise and the pace of prepayments slows, funding costs would rise for those loans that had been expected to be retired, again to the detriment of net interest margin.

At least theoretically, this uncertainty with respect to the prospective outstanding balance of pre-payable loans might be handled with a derivative

[3] See Paragraph 444 of Financial Accounting Standard No. 133.

having optionality, such as a swaption, or a series of swaptions. Based on some modeling, bankers might be able to assess a minimum outstanding balance that they could expect to remain – i.e., an amount reflecting the most rapid prepayment assumption under the scenario of the largest possible rate decline. For this exposure, they could use a standard, pay fixed / receive floating swap. Then, they could buy an option to enter a *pay fixed /receive floating* swap with a notional amount that would equal the difference between the outstanding loan balance under the fastest prepayment assumption versus the balance under the slowest prepayment assumption. These options could be arranged with monthly expirations rolling into a new swaption position following each expiration.

Critically, the use of swaptions in this way would not qualify for hedge accounting treatment, as the hedged item's quantity is uncertain. Thus, the swaptions' result would have to be recognized in current earnings throughout the process. The result with swaps, on the other hand, would qualify for hedge accounting treatment. That is, the swaps settlements and accruals and any other "ineffective" hedge results would be recorded in earnings, along with the realized interest expense on the deposits. All other mark-to-market effects from the swap would be recorded in other comprehensive income. Presuming the forecasted funding occurs as "on schedule," these deferred mark-to-market effects will be reclassified into earnings over the remaining course of the swap.

Conclusions

This article describes the basic framework for measuring interest rate risk at financial institutions and focuses attention on problems associated with hedging prepayment risk. It offers a critique of issues associated with hedging long-term fixed-rate assets with embedded prepayment options.

One approach designates the loan, per se, as the hedged item, where fair value hedge accounting applies. In general, when operating on the asset side of the balance sheet, fair value hedge accounting would be intended. Assuming a hedge is designed with the ideal derivative positions, hedge gains or losses would be recorded in income along with the changes in the value of the hedged item (i.e., the loans) due to the risk being hedged. The primary shortcoming of this approach is that modeling capabilities being as they are, the capacity to measure the interest rate sensitivities of these assets with sufficient accuracy to preclude material unintended income effects is questionable. Importantly, institutions that are better at this type of modeling should emphasize this approach.

An alternative approach is to designate the exposure as being associated with variable-rate funding. As such, cash flow hedge accounting applies. In this case, a potential problem may arise in connection with uncertain pace of prepayment activity, which implicitly translates to uncertainty with respect to the volumes of required funding. This lack of certainty could force some portion of the hedging derivative's results to fail the prerequisite conditions that allow for the application of special

hedge accounting, thereby forcing at least some portion of derivative's results to be recognized in current earnings without a countervailing offset. The resulting income volatility under cash flow hedge accounting is therefore less than ideal.

This shortcoming notwithstanding, cash flow hedging may still be elected by significant numbers of institutions bearing this risk. The rationale for doing so is the following. Most institutions tend to hedge only a portion of their exposures. Realizing (a) that the perfect hedge for the entire exposure is a combination of a swap with a swaption and (b) that overall interest rate sensitivity of this combination is smaller than the interest rate sensitivity of the swap by itself, hedgers may choose to simply use a swap with smaller notional value, designed with an interest rate sensitivity no larger than that of the ideal hedge. In setting up this hedge, the documentation would simply ignore the prepayment issue, per se, and designate cash flow hedges for a specified portion of the funding, for some given horizon, which might easily turn out to be a serious omission.

It appears, then, that both approaches may be less than perfect -- either because they fail to address some portion of the existing economic exposure or because they foster accounting results that show some unintended income volatility. When compared to the possible consequences of *not* applying these techniques, however, these imperfections will likely be deemed to be of relatively minor consequence.