

Chapter 2

Asset/liability risks and the nature of financial intermediation

Krzysztof M. Ostaszewski
Professor, Illinois State University

The old story explaining the nature of the work of a banker is: ‘Borrow at 3%, lend at 5%, and be at a golf course at four.’ This story does contain a grain of truth, and a perspective on the nature of financial intermediation that many find troubling. The banker would, of course, be in the business of arbitrage – the creation of a portfolio without an outlay of capital and without risk, yet earning income.¹ It is often described using the more colloquial expression of ‘a free lunch’.

Are financial intermediaries in the arbitrage business? One would be naturally inclined to answer in the negative. After all, the nature of the business should be much more sophisticated. Perhaps the situation is best summed up by proposing that financial intermediaries face an omnipresent and continuous *temptation* of arbitrage (see also Ostaszewski, 2002), but the argument here is that this temptation should be resisted. ALM should not be viewed merely as a methodology of hedging exposures of the economic (or, worse yet, merely accounting) balance sheet, but rather as an integrated process of managing the exposures created by both the assets and liabilities sides of the balance sheet. If so viewed, it becomes stochastic management: probabilistic modeling of assets and liabilities is now the bread and butter of financial intermediation. The new quantitative models are not just about mathematics, they are the technology of the assembly lines of the businesses of financial intermediation.

ALM methodologies have developed in recognition of the fact that a financial institution’s current and future cash flows of both assets and liabilities play an integral role in its success. This recognition was, in a way, a rebellion against a one-dimensional view of the institution as an entity with a fixed liabilities portfolio and with a creative asset management side (the view too often accepted by asset managers), or as an entity with a determined asset income stream and with a creative financial product side (the view too often accepted by liabilities product development). If such a one-dimensional standpoint represents a traditional view, it is a relatively short-term tradition. There have been periods in the past of stable liabilities, such as the 1950s, and periods of stable asset returns, again in the 1950s, and possibly the second half of the 19th century in Great Britain, but most of human financial history is quite volatile. The volatility of capital markets beginning with the 1973–74 recession can be viewed as a return to the long-term trends in the level of volatility, not a dramatic departure from the experience of the 1950s and the 1960s. It was exactly the recognition of the volatile nature of both sides of the balance sheet that led to the creation of ALM.

ALM methodologies

A closer look at the temptation of arbitrage is available via a review of ALM methodologies. Those methodologies are generally grouped into the following widely understood categories.

- *Static methodologies*, seeking a match between liability and asset cash flows, generally created by an inflexible liabilities side. The standard here – what can be called the benchmark for this group of methodologies – is dedication (ie, cash flow matching): finding assets producing exactly the cash flows needed to discharge the liabilities.
- *Dynamic passive methodologies*, with two benchmark approaches: immunization and indexing.
 - (a) Immunization seeks to match asset and liability sensitivities to key parameters, such as interest rates (by matching duration or, if needed, also seeking assets with convexity in excess of convexity of liabilities), or spreads (using spread duration and spread convexity measures, for example as presented by Leibowitz, Krasker, and Nozari, 1989), or multiple factors (the key rate duration concept of Ho, 1990, or the partial duration concept of Reitano, 1990, 1991a, and 1991b).
 - (b) Indexing seeks to duplicate the performance of an index serving as a benchmark for a given financial institution.
- *Dynamic active methodologies*, with two key approaches: contingent immunization and active management.
 - (a) *Contingent immunization* (Leibowitz, Martin, and Weinberger, 1982, 1983) calls for active management as long as assets are sufficient to pay the liabilities, and for immunization (or dedication) when they fall to the level only sufficient for such a payment. This methodology is conceptually equivalent to portfolio insurance: holding the underlying asset together with a put option on it, with an exercise price set at the minimum level needed to pay the liabilities. If the underlying asset in the portfolio insurance ends up below the exercise price, it is turned into cash and liabilities are paid. Otherwise, its excess return is enjoyed by the holder of the portfolio. In the contingent immunization methodology, active management assumes the role of the underlying, and the insured strategy provides full payment of liabilities.
 - (b) Active management, such as total return optimization (Miller, Rajan and Shimpi, 1989), or some other form of actively managing assets against liabilities in view of defined corporate objectives of a financial intermediary.

This simplified classification highlights an obvious point: most commonly practiced ALM methodologies are rooted in the pursuit of arbitrage. This is quite clear in the case of dedication: *after all, the combined asset/liability portfolio produces no net cash flow, and the financial intermediary must be able to extract a positive flow upfront, otherwise the transaction would not have been consummated.* But as pointed out by Shiu (1990), and discussed by Ostaszewski (2002), immunization calls for the creation of a zero net cash outlay portfolio, which will not suffer any losses under any change of interest rates or other market factors, and gains in most scenarios – ie, with positive probability, which is a classical arbitrage portfolio. In an even more extreme exhibition of the pursuit of arbitrage, multivariate immunization, if ideally constructed, must lead to a dedicated portfolio (Shiu, 1991a and 1991b).

On the other hand, a hedging methodology, which seeks to remove exposures on the balance sheet of a financial intermediary by purchasing or selling securities matching those

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exposures and allowing their removal from the balance sheet, has become a tool of most intermediaries' strategy. Increasingly, banks hedge credit risk, government-sponsored enterprises hedge interest rate risks, and so do insurance companies. Does this mean that hedging is their core business? Rather it is a tool of sculpting their risk profile, so that they can achieve exposures that they deem appropriate for their core business. In other words, they are not in the business of hedging – they hedge to be in the business of managing their risk exposures. The same approach should be used in viewing dedication, immunization, or any methodologies derived from them – they can only serve as tools, while yielding the spotlight to the greater strategy of the financial firm.

One may believe that seeking arbitrage is unrealistic, but of course this never stopped anyone from looking for a free lunch. But such pursuit may be, first and foremost, a distraction from the main course of business. One may say that if arbitrage is available in the market, customers will not find it, as they are not sophisticated enough, so financial intermediaries are simply using their comparative advantage. Not so. Arbitrage business has virtually no barriers to entry, and it is not the customers, but rather the competitors of financial intermediaries – either official ones (in the same industry), or unofficial ones (in other industries, other countries, etc) – that will enter it, and eliminate the underlying arbitrage. Even if customers are perfectly naive and can be taken advantage of, competitors will be ruthless. The examples of Orange County, Barings Bank, or Long-Term Capital Management should undermine any complacent attitudes based on supposed sophistication.

If financial intermediaries do not do arbitrage, what do they do? In a world without financial intermediaries, the national economy's flow of funds would concentrate on the exchange between the household sector, which contains net savers, or better yet net purchasers of securities, and the production (ie, business) sector (corporations and other businesses), which contains net borrowers, or net providers of securities. However, because of monitoring costs, liquidity costs, price risk, and similar financial reasons, the average household saver may view investment in securities provided by the business sector as unattractive. Thus, financial intermediaries intervene to 'grease the wheels of commerce'. They provide products (those are financial assets, even though not traded) that are indeed needed by the household sector (thus assuming a short position in those securities) and use the funds to purchase securities supplied by the corporate sector (therefore assuming a long position in those securities), and other net issuers of securities (governments, government-sponsored enterprises, and even consumers themselves, when they borrow). There are also other types of situations where this short/long portfolio is automatically created by intermediation. For example, in payment facilitation, where the intermediary is short accounts receivable and long accounts payable. Arguably creation of such a short/long portfolio is the essence of the intermediation business, and, therefore, the essence of ALM. Also, the protection of the resulting link between savers and producers is one of the major missions of financial intermediaries' regulation.

Analyzing financial intermediation

What financial intermediaries do is often described as the 'spread business'. This, of course, is a very traditional perspective. At the same time, it is widely acknowledged that financial intermediaries write options included in their products and their portfolios. The important point is that the coupon-clipping 'spread' description addresses only the manner in which banks, insurance companies, or investment companies are often paid, while

option-writing and derivatives creation provides a wider, more accurate description of the complexity of intermediaries' portfolios. Their operations are built on assuming a long position in securities created by the business sector and a short position in securities issued to savers (ie, bank accounts, insurance policies, investment accounts, and so forth). Thus financial intermediaries effectively restructure cash flows provided by the securities of the business sector into the cash flows demanded by the household sector. In modern financial terminology, a security created out of cash flows of another security is termed a derivative security. This derivative, however, must be understood in a much broader sense than commonly used – in other words, not just restricted to options or futures. In the popular press it is often assumed that derivatives increase risk, but one of the most common features of derivatives issued by financial intermediaries is that they actually reduce risk faced by their customers. For example:

- life annuities provide minimum interest rate guarantees;
- equity-linked annuities protect accumulated principal with a series of cliquet options granted to the customer; and
- home mortgages provide an extremely valuable early prepayment option.

Here is an illustration of the difference between the 'spread perspective' and the 'derivatives perspective' on financial intermediation. When Michael Milken single-handedly established the original issue junk bond market in the 1980s, this creation was built on the thesis that junk bonds provided a higher level of return than investment-grade bonds, with lower levels of risk, if return was measured by the expected return, and risk by the standard deviation of return. So junk bonds looked like a 'dominant' security with respect to investment grade – more return with less risk.

The logical extension of this idea is what could be called 'the Milken arbitrage': if junk dominates investment-grade bonds, can we sell AAA bonds short and use the proceeds to buy junk? This cannot be done easily in the market, but can be a design for an insurance company.² If such a company acquires a high credit rating, it can sell deferred annuities that (implicitly) have that rating, while investing the proceeds in junk bonds – thereby earning a comfortable spread. Since the short position is presumably riskier (has higher standard deviation of historical returns) than the long position, the insurer looks very comfortable. In reality, the return of the short/long position is uncertain, and should be modeled as such. The most direct approach is to view it as a function of several random variables. Investment-grade bonds are not positively correlated with below-investment-grade bonds – in fact, historical data shows negative correlation. Therefore, the combined short/long position could end up being more than twice as risky as the individual pieces (if variance is used as a measure of risk). The spread business is really a 'pseudo-arbitrage'. In reality, the risk of the short AAA/long junk position is additionally amplified by numerous options offered to holders of deferred annuities, and by the call option on the long junk position, so common in high-yield bonds, and the option to default, the most dangerous option embedded in low-grade bonds. The insurance company is paid for those options: granting them to the customers allows the company to credit less than a regular high-grade bond pays, and a low-grade bond pays higher coupon than an otherwise equivalent investment-grade bond. But just as there is no free lunch, there is no free spread margin. One must accept the increased risk in the form of variance of returns or otherwise in order to achieve the spread.

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Thus the exposures of a financial intermediary's combined short and long position can be thought of, or represented, as a complex portfolio of derivatives, many of them not directly available in the market, and created solely because the buyers of banks', insurance companies', and other intermediaries' products demand them. Therefore, it appears more appropriate for financial institutions to view themselves as 'peddlers of derivatives' rather than as participants in the spread business (or simple insurance business). Financial intermediaries create and market short/long derivative positions, and seek to maximize profits in the process. Given the negative publicity derivatives have so often received, this may seem to be a frightening proposition, and adding to it the perspective that derivatives valuation requires probabilistic models, escaping easy maximization algorithms, means the proposition becomes a nearly impossible business scenario. Or does it? After all, it is not just financial intermediaries that face great uncertainty. Simple deterministic procedures for profit maximization exist only in microeconomics textbooks. In practice, no firm is ever certain of the demand for its products, its revenue stream, or its cost structure.

Financial intermediaries differ in some other ways. Merton and Perold (2001) point out these important distinguishing features.

- Their customers are liability holders. The result is that the credit rating of the financial intermediary is of utmost importance.
- Financial intermediaries have asset holdings, which are not always fully understood by their customers. One notable issue is that financial firms are susceptible to risks of a high-impact, low-probability event that can entirely change their credit rating. This situation is, of course, the natural consequence of the short/long derivatives portfolio held by financial intermediaries – ie, it is not caused by excessive risk taking, but rather by the very nature of their business activities. After all, large losses in such extreme events are precisely what the customers of financial intermediaries want to avoid, and their avoidance is the reason why they choose to buy financial intermediaries' liabilities instead of securities issued by the business sector. Note that the cost of those risks accrues to the risk capital of the intermediary, where the risk capital is defined as the smallest amount that can be invested to insure the value of the firm's net equity (capital) against a loss to value relative to risk-free investment of the same net equity.
- Financial intermediaries operate in competitive financial markets, and their profitability is highly sensitive to their cost of risk capital.

Asset transformation structure

So, the uniqueness of financial intermediaries lies in the structure of asset transformation, not in the 'spread' between assets and liabilities, or even the options they have written. The amount of risk capital needed by the firm depends only on the riskiness of its net short/long position. Complete elimination of asset/liability risk – ie, pursuit of arbitrage – may amount to a complete elimination of the entire earnings of the intermediary. But partial elimination of asset/liability risk through hedging and risk management has a very legitimate function in the ALM of a financial intermediary. The actual balance of hedging and assumption of market risks (that can be hedged) should depend on the cost of risk capital. If there were no spread cost for the risk capital, a larger amount of risk capital would impose no cost on the firm, and can easily be pursued. Hedging and any form of elimination of exposures, through dedication,

immunization, or other 'pseudo-arbitrage' activities, are justified as methods of risk capital cost management.

It is important to remember that there is an authentic need for asset restructuring – which can be termed 'derivatives creation' – and while this creates risky exposures for intermediaries, it is a business where they meet genuine needs, because neither the business sector nor the saving sector should be assuming those exposures. Merton and Bodie (1995), as well as Jordan (1996), present a related conceptual framework. They propose viewing financial intermediaries from the functional perspective. This implies that functions rather than institutions should be the benchmarks for understanding financial intermediation. The main reasons for adopting such an approach are: (a) it is the function that remains relatively stable over time and place (in various countries, at various times); and (b) the form must adapt to the function eventually. Six core functions are usually identified.

1. To provide ways of clearing and settling payments to facilitate trade.
2. To provide a mechanism for the pooling of resources and for the subdividing of shares in various enterprises.
3. To provide ways to transfer economic resources through time, across borders, and between industries.
4. To provide ways of managing differential risk between assets and liabilities.
5. To provide price information to help coordinate decentralized decision-making in various sectors of the economy.
6. To provide ways of dealing with the agency problem created when one party to a transaction has information that the other party does not, or when one party acts as agent for another.

An important aspect emerging from this analysis is the question of the relationship between institutional intermediaries and capital markets. Merton and Bodie (1995) view the evolution of this relationship as an innovation spiral in which organized markets and intermediaries compete with each other in a static sense, and complement each other in a dynamic sense. In other words, when financial intermediaries issue any instruments, their customers compare those instruments to the supply of marketable securities. At the same time, intermediaries must create their products out of the supply of securities available and, thus, must adjust to the changing nature of that supply.

Linkage with derivative pricing methodology

The central premise of what is being proposed here is the idea that the management of financial intermediaries is inherently tied with the methodology of pricing derivative securities. Therefore, intermediaries' ALM exposures must be viewed in a manner analogous to the process of evaluation of derivatives exposures. To a degree, it is a well-known fact that many financial products have derivatives embedded in them. Banks make forward loan commitments, issue mortgages that contain prepayment options, and all of their loans are more or less risky, thus extending an option to default to the borrower. Banks' liabilities can often be very easily put back to them at principal value. Life insurance companies work with numerous options in their assets and liabilities (Smith, 1982, presents a life insurance policy as an options package; see also Ostaszewski, 2002). Life insurance investments are generally callable bonds and mortgages, with large exposure to risky corporate debt. At the same time,

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their liabilities can be viewed as quite an extensive web of derivative exposures entangled with fixed-income securities.

- Term life insurance, the simplest life insurance liability, is a derivative on the human capital – ie, the earning power of the insured life – with the derivative payoff being triggered by death. The financial exposures created by human capital may be the most under-investigated risks in financial literature. They are the key reason why most financial products exist, and yet most of the attention is paid to the asset side of the balance sheet, without noticing the powerful effect that the human capital has on the structure of the liabilities of all financial intermediaries.
- Any form of whole life insurance adds purely financial derivatives to those created out of human capital. A whole life insurance policy offers a long-term minimum interest rate guarantee on the cash value, and typically has a credited rate structure following the market, as well as thus embedding both an interest rate call and put in the product. As a life insurance company is short both the interest rate options on the asset side, and on the liabilities side, its position is a short straddle, and this model of its exposure is termed the ‘short straddle model’ (see Ostaszewski, 2002).
- A traditional fixed deferred annuity usually provides both an interest rate guarantee (initially a higher one, and a long-term minimum interest rate guarantee), and an option to withdraw principal (with a surrender charge in early years). This, of course, is the same short straddle position as in the whole life, but magnified by the fact that an annuity is first and foremost a savings vehicle, unlike life insurance. Variable annuities often provide minimum interest rate guarantees. The newly created equity-linked annuities provide a variety of exotic embedded option, mostly of a lookback type, providing guarantees of not losing principal from various levels reached in accumulation.

Disability insurance is also a fascinating human capital-based derivative. It is effectively an option to put the insured’s human capital to the insurance company when its market value drops below the insured level as a result of the insured event (Ostaszewski, 2002). Property-casualty policies give replacement value for the property insured, thus providing an inflation-linked embedded option.

One could venture the hypothesis that the insurance products’ relationship to their customers’ balance sheets should be viewed in a more comprehensive fashion: consumers have other financial assets and liabilities, which rarely are considered together with their insurance assets. Between 1979 and 2003 the purchase price of a retirement life annuity has at least doubled in the United States, due to the combined effect of the decline in interest rates and longevity improvements. This dramatic increase in the cost of this financial asset (retirement life annuity) representative of the increase in every consumer’s liability (as one must be a recipient of a life annuity once one stops working) was not mitigated by any product offered to consumers, except for defined benefit pension plans, which were in that period abandoned en masse by employers, and for the Social Security system, which has been nearly continuously reducing benefits (through the increase of the normal retirement age, taxation of benefits, and changing the relationship of the wage subject to payroll tax to the wage used as the base for benefit calculation) as well. Consumers enjoy prepayment options in their long-term fixed-rate mortgages, and minimum interest rate guarantees in their long-term fixed retirement annuities, thus doubling up on their interest rate risk protection, of course at a price. One

must wonder if such extensive interest rate risk protection is needed as much as it is provided, and if the two products – mortgages and deferred annuities (or other guaranteed retirement products) – were provided by the same entity, instead of two separate ones, would as many options be granted. Should financial intermediaries' products account for the major part of non-marketable assets held by consumers, such as their homes, defined benefit pension benefits, or social insurance benefits?

The omnipresence of options and other derivatives in financial intermediaries' balance sheets is, from the macroeconomic perspective, not an accident. Franke, Stapleton, and Subrahmanyam (1998) ask a fundamental question: 'Who buys and who sells options?' in the national economy. They resolve this question with an equilibrium model, in which some investors are assumed to face a non-insurable background risk, which cannot be traded. This results in the background risk affecting the optimal sharing rule applying to the investor who faces it. The presence of background risk produces a non-linear demand for claims on the market portfolio. An agent with relatively high variance of background risk will purchase contingent claims. An agent with no, or a very low level of, background risk will sell contingent claims in the market.

The conclusions of Franke et al (1998) are of significance to the financial industry. Financial intermediaries provide a variety of contingent claims backed by holding a portfolio much more closely resembling one available in the market. The model suggests that this is simply because *financial firms face significantly less background risk than their customers do*. It should also be noted that an essential part of this model is the distinction between marketable securities and the non-marketable background. Such a distinction is clear at any given point in time. For example, individual consumers have substantial background risk caused by their dependence on their human capital, and for their banks, insurance companies and other financial institutions they use, such risks are irrelevant. Clearly, such consumers will want to purchase contingent claims providing them with some degree of protection from the unique risks they face. Financial institutions can sell those contingent claims, and one could view a large portion of financial intermediation as selling contingent claims. They must be sold at a proper price, providing compensation for the cash capital and the risk capital of the intermediary. While this is not identical to selling automobiles, one should not dismiss similarities. Financial intermediaries are in a derivatives business not because various dealers peddle derivatives to them, but rather because financial intermediaries are derivatives peddlers themselves – by design. Those contingent claims that we create are not, in fact, peddled. They create value. They allow business transactions to happen that would not otherwise happen. They grease the wheels of commerce.

Note also that over time more and more financial exposures have become traded assets. Mathematically, one could venture a statement that at the limit, markets converge to becoming complete, trading all contingent claims in a liquid fashion. The recent introduction of futures contracts for delivery of energy, or insurance derivatives (eg, catastrophe bonds or spreads), and credit derivatives, are examples of such a process of gradual completion. The increased role of derivatives and stochastic modeling of them is a natural process, in which new mathematical technologies allow us to create new ALM practices (see Chapter 7).

Conclusions

The ALM process must therefore be expanded to include an integrated view of asset and liability cash flows, their uncertainties, and the management of such integrated exposures.

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Furthermore, it must be expanded beyond two traditionally limiting perspectives.

1. ALM is not only about a currently existing balance sheet, but also about the firm on a going-concern basis (Panning, 1987 and 1993). This means, for example, that one must include the real options – ie, options on real, other than financial, assets (such as an option to create new productive capacity at some point in the future), and the franchise value of the firm in the integrated process of ALM.
2. Risk management becomes a special case and tool for ALM. Stulz (2001) discusses risk management practices of firms in light of modern financial theory, and points out that even in the context of the Modigliani–Miller irrelevance argument³ risk management for non-financial firms does create value by controlling taxes, agency costs, and costs of financial distress. But she also points out that risk management practices are often equivalent to purchasing options that are deeply out-of-the-money, allowing for control of asymmetric extreme outcomes, which can result in complete elimination of the underlying firm (which, of course, reinforces the importance of stress testing as a tool that deals with exactly these exposures). However, the unique position of financial intermediaries results from the fact that their process of risk management must create the highest credit rating for the products offered to their liability holders, while managing all possible (credit, interest rate, currency, liquidity, etc) risks on their asset side (see Chapter 1).

Modern financial engineering technologies are too often perceived as the source of risk, while the very purpose of their existence is to manage risk, not to create it. Why is it then that such perception has appeared and is so prevalent, at least in non-financial literature? The answer may be that derivatives debacles are caused by intermediaries (but not only intermediaries!) pursuing arbitrage, or rather a ‘pseudo-arbitrage’, as a business model. Instead of being on the golf course at four, what’s needed are solid eight-hour days of modeling cash flows of assets and liabilities under a variety of scenarios of the future, provided by an appropriate stochastic model of the evolution of the underlying exposures (see Chapter 10). No tricks of the trade can ever replace learning the trade, or, in Ayn Rand’s words: ‘There is no substitute for competence.’

There is no free lunch. But, in a competitive market economy, a nutritious lunch is always available at a reasonable price.

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¹ With positive probability, so that there can be outcomes where there is no income, but there is no loss ever.

² It has been suggested that Executive Life Insurance Company's problems were caused by such a situation – Modugno, 1992.

³ Stating that in the absence of taxes, bankruptcy cost, and agency cost, the value of the firm is independent of its mode of financing.