Operation and Regulation of Financial Markets

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Operation and Regulation in Financial Intermediation:
A Functional Perspective**

1. Introduction

Financial intermediation – the process of transforming financial assets from one form into another – is a central activity within all financial systems. Financial intermediaries such as banks, insurance companies, and mutual funds perform this transformation by buying financial assets (e.g., government and corporate bonds, mortgages, and shares of stock) and issuing other financial assets (e.g., demand deposits, insurance policies, bonds, and stock) which are contractual obligations or liabilities of the intermediaries. The buying and issuing transactions by intermediaries can take place in organized financial markets (e.g., stock or bond exchanges) or in negotiated transactions directly with individual households, business firms, governments, or other intermediaries. This paper examines the basic processes surrounding the operation and regulation of the financial intermediation activity.

The theoretical, empirical, management, and public-policy literatures covering financial intermediation and financial intermediaries are truly vast. Even a partial synthesis of the subject must therefore be severely selective in its abstractions from the complex whole. Rather than attempt a sweeping overview, I instead try my hand at synthesis by exemplification, using four focused topics: the first examines institutional competition and complementarity between financial intermediaries and financial markets; the second and third address key internal operations processes for an intermediary: one, the production process, involves decisions at the level of a single product while the other, risk control and the capital-budgeting process, involves decisionmaking at the level of the entire intermediary. The fourth and final topic discusses regulation of intermediaries.

My thoughts on each of these topics are still very much in flux. The formal analytical models are therefore not complete and the observations

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on real-world financial institutional behavior are still quite tentative. Thus, from the substantive dimension, this paper should be treated as only a point of departure for extensive further research. Nevertheless, I harbor the hope that the paper serves a more current purpose of exemplifying a particular synthesizing approach to understanding financial intermediation.

Three common themes run throughout the analyses: the first is the emphasis on dynamics: the dynamics of change in institutional structure; the dynamics of the production process; the feedback dynamics between regulatory changes and financial innovation. The second theme holds that the relations between financial institutions are typically both competitive and complementary: this is so not only for intermediaries and markets, but for intermediaries and governments, and even for marketers and traders within an intermediary. The third theme is the focus on financial functions instead of financial institutions, as the unit of analysis.

There are two fundamentally different frames of reference for analysis of financial intermediation. One perspective takes as given the existing institutional structure of financial intermediaries, and views the objective of public policy as helping the institutions currently in place to survive and flourish. Framed in terms of the banks, or the insurance companies, private-sector managerial objectives are similarly posed in terms of what can be done to make those institutions perform their particular intermediation services more efficiently and profitably. An alternative to this institutional perspective is the functional perspective that takes as given the economic functions performed by financial intermediaries, and asks what is the best institutional structure to perform those functions. In contrast to the institutional perspective, this functional perspective does not posit that existing institutions, whether operating or regulatory, will necessarily be preserved. Instead, its structure rests on two basic premises: 1) financial functions are more stable than financial institutions — that is, functions change less over time and vary less across geopolitical boundaries; and 2) competition will cause the changes in institutional structure to evolve toward greater efficiency in the performance of the financial system. Note that each of these basic postulates is about change. It is perhaps not surprising that this perspective would go together with a dynamical approach to intermediation.

As discussed at length elsewhere1, a functional perspective is useful for analyzing both micro and macro issues involving the financial system. Applicability of this framework ranges widely, from analysis of an entire financial system to individual decisions of business strategy and specific choices of public policy. This perspective is put to use here to identify key topics encompassing the operation and regulation of financial intermediation.

The following section briefly describes the core functions of the financial system as background for the substantive analysis of financial intermediation. It further discusses the analytical benefits of a functional perspective in an environment of rapidly changing technology and substantial financial innovation. Section 3 goes on to consider the future of financial intermediation from a functional perspective. Financial markets are examined as an institutional alternative to financial intermediaries. A case is made for a systematic secular pattern of markets replacing intermediaries as the main provider of many financial products. However, a case is also made for the systematic growth and expansion of financial intermediaries. These seemingly contradictory projections are resolved by distinguishing the financial functions served by an intermediary institution from the products it produces. The analysis shows that although intermediaries and markets are competing institutions in a static context, they are complementary institutions in a dynamic context. The same analysis projects a central trend toward greater custom tailoring of intermediaries' products to meet specific needs of their customers.

The increasingly more “finished” or tailored products that simplify financial life for customers of an intermediary somewhat paradoxically add technical and financial complexity to the operations of the intermediary which thus requires greater managerial sophistication. Section 4 exemplifies this trend by analyzing the production process for intermediation products. Two prototypical models, “underwriting” and “synthesizing,” are developed; their combinations are likely to span the range of intermediary approaches to production. Comparison of the relative costs and benefits of these two basic production structures, together with an assessment of the differing skills required to implement them, provides the basis for conditional predictions of the efficient forms that will be taken by intermediaries in different environments.

Creditworthiness or default risk is of course a financial issue for all business firms — and for households as well. However, for financial intermediaries whose principal businesses involve issuing contingent-payment contracts to their customers, creditworthiness is the central financial issue. As discussed in Section 5, the prospect of a future default by an intermediary on contracts to its customers can significantly reduce the ante efficiency of those contracts and thereby substantially reduce the effectiveness regulatory reform appears to take a more institutional perspective.

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1 See Merton (1989, 1990, 1992a, 1992b, Ch. 14), but especially Bodie and Merton (1992a, b) and Merton and Bodie (1992a, b, c) and others. There are, of course, a number of others whose work fits comfortably within this framework. In the area of financial innovation, see Black and Scholes (1974), Benston and Smith (1976), and Ross (1989). In the banking literature, the analytical approaches of Black, Miller, and Posner (1978), Black (1985), Cottre1 and Pennachioi (1991, 1992), and Piere (1991) are aligned with the functional approach. Diamond and Dybvig (1986) also focus on the functions of banks, but their discussion of
of the main economic function served by the intermediary. In contrast, the possibility of default on investor-held debt of a typical business firm may have little or no impact on the effectiveness of that firm in serving its principal economic function. To distinguish between those two situations, the difference between the "customers" and "investors" of the firm is developed as a core concept in Section 5.

That many of the important businesses run by financial intermediaries are considerably more "credit-sensitive" than most of those run by nonfinancial firms is a critical element that distinguishes the important management issues for an intermediary from those of a typical business firm. Thus, risk management is an activity of first-order importance to the efficient operation of an intermediary, but in general not so for business firms. Similarly, acquiring or issuing guarantees of financial performance is an operating activity of first importance for intermediaries, but only a specialized transaction for most business firms.

In the discussion of the production process in Section 4, the analysis focuses on an individual product or business within the intermediary. In contrast, the analysis for the risk-management process focuses, by necessity, on the entire intermediary. Section 6 uses an extensive hypothetical example to show that the credit-sensitivities of various businesses within an intermediary can cause significant cross-business externalities which induce failure of the "value-additivity" principle, even without any synergistic interactions among the operations of those businesses. Hence, implementing efficient decentralization of capital budgeting and financing decisions for intermediaries with credit-sensitive businesses may be considerably more complicated than for multi-business, nonfinancial firms.

Section 7 concludes the analysis with a discussion of regulation and the various roles of government in affecting financial intermediation. Just as there are special advantages to having government instead of private-sector firms provide certain financial services (e.g., loan guarantees), so there are also special problems. Government can potentially play a key role in moderating the inherent conflicts between product innovation and the evolution of the supporting infrastructure of the financial-intermediation system. However, the advance of financial and physical technologies combined with regulatory competition among governments implies a secular reduction in the power of government to control the financial system. This reduction in control applies not only to financial-market regulation but also to national monetary and fiscal policies. Well-structured public policy must take account of these changing limits to power.

The section closes with a discussion of functional versus institutional regulation of financial intermediation. A summary of my principal conclusions is provided in Section 8.

2. Functions of the Financial System

How would one go about designing a completely new financial system for a country? This question is, of course, no longer a matter of only academic interest. As we know, policymakers around the world are working on fundamental changes to the financial systems of their countries. Changing the financial system in the former Communist countries of Eastern Europe is a major part of a general restructuring of their entire economic system from one based on central planning and government ownership of business to one based on free markets and private ownership.

A number of other countries with well-developed free markets for nonfinancial goods and services nevertheless have centralized government control of their financial systems. With control over both the banking and pension systems and restrictions on cross-border capital flows, those governments collect almost all the savings of the household sector and allocate most of the capital available to the business sector. At least some of these countries are currently considering fundamental reforms to privatize large parts of their financial systems. And even among countries, such as the United States, which have highly-developed private financial markets and institutions, important changes in the way government regulates the system are being actively debated. All of this adds timeliness and relevance to studies that explore broad issues of institutional structure in the financial system.

In building a financial system from scratch, one understandably begins by defining its central role. The primary function of any financial system is to facilitate the allocation and deployment of economic resources, both spatially and temporally, in an uncertain environment. The system consists of the capital markets as well as the basic payment system through which virtually all transactions clear. The international payment system in operation today consists of a complex network of depository institutions and private and government clearing facilities, which employ various means of payment—gold, paper, and primarily electronics—to make transfers. In well-developed economies, capital markets encompass the money, fixed-income, and equity markets, as well as markets for derivative securities such as futures, forwards, swaps, and options. Like the payments system, capital markets became global in scope during the 1980s.

2 This section draws heavily on Merton and Bodie (1992c, Section 2).
3 Examples are Argentina, Israel, and Korea.
4 The term derivative security means that the security's payoff is contractually contingent on the value of some other security or economic index. It does not mean that it is of "derivative" importance in economic terms. For example, Miller (1992) and Fafouzi and Modigliani (1992, p. 12) point out that new economic information is generally embodied in future market prices before it is reflected in the corresponding cash market.

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The capital markets connect the financial activities of households, business firms, and government and make possible the basic cash-flow cycle in which household savings are channeled into capital investments by firms and then returned to households (via security repurchases, dividends, and interest payments) for consumption or further recycling as new savings. Capital-market functions are also performed by financial intermediaries such as commercial banks, investment banks, and insurance companies that provide more customized products and services—especially those that do not lend themselves to the standardization required to support a liquid market. These financial-services firms and the capital markets, together with the regulatory arrangements to govern their activities, constitute the institutional structure of the financial system. The dynamic process by which this institutional structure changes is called financial innovation.

As is the tradition in neoclassical economics generally, a functional perspective on the financial system treats the existence of households, their tastes, and their endowments as exogenous to the economic system. However, this tradition does not extend to other economic organizations such as business firms, markets, and financial institutions. They are regarded as existing primarily because of the functions they serve and are therefore endogenous to the system. Thus, from a functional perspective on the financial system, institutional form follows its function.

From the most aggregated level of the single primary function of resource allocation, we can further distinguish six core functions performed by the financial system:

**Function 1:** A financial system provides a payments system for the exchange of goods and services.

To underscore the importance of this function, one need only consider those rare occasions when the payments system breaks down and transactions are reduced to ones involving bilateral barter.

Depository financial intermediaries such as banks and thrifts serve the payment system with wire transfers, checking accounts, and credit/cash cards. But, other intermediaries such as money-market mutual funds offer transaction-draft accounts and firms whose principal business is not financial such as AT&T, General Electric, General Motors, and Sears Roebuck offer general credit cards.

**Function 2:** A financial system provides a mechanism for the pooling of funds to undertake large-scale indivisible enterprise.

In modern economics, the minimum investment required to run a business is often beyond the means of an individual or even several individuals. The financial system provides a variety of mechanisms (such as security markets and financial intermediaries) through which individual households can pool (or aggregate) their wealth into larger amounts of capital for use by business firms. Looking at it from the other side, the financial system provides opportunities for individual households to participate in large indivisible investments. Mutual funds that hold stocks and bonds are examples of financial intermediaries that provide nearly perfect divisibility in subdividing the individual unit size of the traded securities they hold.

**Function 3:** A financial system provides a way to transfer economic resources through time and across geographic regions and industries.

A well-developed, smooth-functioning financial system facilitates the efficient life-cycle allocations of household consumption and the efficient allocation of physical capital to its most productive use in the business sector. A well-developed, smooth-functioning capital market also makes possible the efficient separation of ownership from management of the firm. This in turn makes feasible efficient specialization in production according to the principle of comparative advantage. Examples of intermediaries serving this function include banks and thrifts in financing corporate investments and housing, insurance companies and pension funds in financing corporate investments and paying retirement annuities, and mutual funds that invest in virtually all sectors.

**Function 4:** A financial system provides a way to manage uncertainty and control risk.

A well-functioning financial system facilitates the efficient allocation of risk-bearing among households and firms. Through often elaborate financial securities and through private-sector and government intermediaries (including the system of social insurance), the financial system provides risk-pooling and risk-sharing opportunities for both households and business firms. It facilitates efficient life-cycle risk-bearing by households, and it allows for the separation of the providers of working capital for real investments (i.e., in personnel, plant, and equipment) from the providers of risk capital who bear the financial risk of those investments. In both an international and domestic context, this separation of real investment and risk-bearing permits specialization in production activities according to the principle of comparative advantage. Insurance companies are the classic example of a financial intermediary offering risk protection. They sell protection against loss in value of human capital.
Function 5: A financial system provides price information which helps coordinate decentralized decision-making in various sectors of the economy.

The manifest function of financial markets is to allow individuals and businesses to trade financial assets. In addition, an important latent function of the capital market is to serve as a key source of information that helps coordinate decentralized decision-making in various sectors of the economy. Interest rates and security prices are used by households or their agents in making their consumption-saving decisions and in choosing the portfolio allocations of their wealth. These same prices provide important signals to managers of firms in their selection of investment projects and financings. While this “discovery” function of price is characteristic of all markets in a capitalist economy, it is especially important for financial markets. Examples of intermediaries that serve this function are banks and insurance companies whose posted rates for corporate loans are used by, (particularly smaller) firms to make investment decisions. In a Stiglitz-Weiss (1981) world of credit rationing, the size of the loans that those intermediaries are willing to make augments the information function served by prices.

Function 6: A financial system provides a way to deal with the asymmetric information problems when one party to a financial transaction has information that the other party does not.

A well-functioning financial system facilitates the resolution of moral-hazard and adverse-selection problems that arise from the existence of information asymmetries between transacting parties. Such problems can prevent efficient separation of ownership and management of business firms (the “principal-agent” problem). They can also prevent borrowers and lenders from entering into otherwise mutually advantageous transactions. In this paper, we refer to these collectively as “agency problems.” Financial intermediaries can help minimize the dead-weight efficiency losses from information asymmetries. For example, banks are specialists in making loans that are difficult to assess without detailed, and often proprietary, information about the borrower. But, for competitive reasons, borrowers are reluctant to reveal to the general public the information which would be necessary for a direct public placement of the debt. By being discreet with information provided by its borrowers and by developing a reputation for making profitable loans with its investors, banks help solve this asymmetric-information problem. As an alternative institutional form, venture-capital firms in the United States serve a similar intermediation function by providing both equity capital and information to start-up companies.

For a variety of reasons – including differences in size, complexity, and available technology, as well as differences in political, cultural, and historical backgrounds – the most efficient institutional structure for fulfilling the functions of the financial system generally changes over time and differs across geopolitical subdivisions. Moreover, even when the corporate identities of institutions are the same, the functions they perform often differ dramatically. For example, banks in the United States in 1992 are very different from what they were in 1922 or in 1952, just as they are very different from the institutions called banks in Germany or the United Kingdom today. The financial markets in New York, London, or Tokyo today are different from what they were as recently as 1980 – before the widespread introduction of trading in fixed-income and stock-index futures, options, and swap contracts.

In contrast, the basic functions of a financial system are essentially the same in all economies – past and present, East and West. And because the functions of the financial system are far more stable than the identity and structure of the institutions performing them, a functional perspective provides a more reliable and enduring frame of reference than an institutional one, especially in a financial environment characterized by rapid changes. Given the considerable institutional diversity across national borders, a functional perspective is more readily adaptable to a global setting for the financial system. Indeed, with the current rate of technological advance and integration of world financial markets, this approach may prove especially useful in predicting the future direction of financial innovation, changes in financial markets and intermediaries, and the places for regulatory bottlenecks.

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6 The manifest and latent functions of social behavior and organizations as a general analytical idea is developed by R.K. Merton (1957, Ch. 1).
7 For instance, once an individual has purchased insurance against fire or theft, he is less likely to take precautions against them. This is the moral-hazard problem facing the insurer. Adverse selection refers to the fact that individuals who are more likely to experience losses are the ones who will tend to buy the insurance. The individual buying the insurance typically has relevant information that may not be available to the insurer. For basic definitions of moral hazard and adverse selection in an insurance context, see Borch.

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A basic tenet of the functional perspective on analyzing the financial system holds that the fundamental economic force of competition will tend to cause the real-world dynamic path of changes in institutional structure to evolve toward improvements in the performance of the functions of the financial system. Major technological developments over the past 20 years, especially in the areas of information processing and telecommunications, have made possible a wide range of important financial innovations. They have also helped ensure implementation of those innovations by substantially lowering the barriers to entry into financial intermediation worldwide. These same technologies have greatly increased the flexibility of financial intermediaries and markets in the choice of their geographic and regulatory locations. As a result, even national governments are increasingly acting more like competitive institutions in this domain. The functional perspective views financial innovation as the "engine" driving the financial system toward its goal of greater economic efficiency.

Theories of financial intermediation that are consistent with this view of the process tend to deal with three broad categories of improvements in economic performance from financial intermediation:

- meeting investor or issuer demands to "complete the markets" with new securities or products that offer expanded opportunities for risk sharing, risk-pooling, hedging, and intertemporal or spatial transfers of resources;
- lowering transactions costs or increasing liquidity; and
- reducing agency costs that arise from either information asymmetries between trading parties or incomplete monitoring of their agents' performance.

As forces making for financial innovation in intermediation, all three are consistent with its working to improve economic efficiency.

Financial innovation in intermediation does not, of course, proceed in a vacuum. When it happens, and the specific forms it takes, are significantly influenced by the surrounding institutional and regulatory environment.

3. On the Future of Financial Intermediaries: Dynamics of Institutional Change

One need only consider financial innovation over the past 20 years to underscore the point that while the functions of the financial system are stable, the ways in which they are performed are not. Those two decades have seen revolutionary changes in the structure of the world’s financial markets and institutions and in our understanding of how to use them to provide households and firms with new investment opportunities and ways of managing risk. For a brief sampling, consider round-the-clock trading from Tokyo-to-London-to-New York, financial futures, swaps, exchange-traded options, mortgage-backed securities, "junk" bonds, shelf-registration, electric funds transfer and security trading, automated teller machines, NOW accounts, asset-based financing, LBO, MBO, and all the other acronyms approaches to corporate restructuring. Those changes in the structure of the financial system came about in part because of a wide array of newly designed securities, in part because of the advances in computer and telecommunications technology that made possible the implementation of large-volume trading strategies in these diverse set of securities, and in part because of important advances in the theory of finance. Each of these has contributed to vastly reduced costs of financial transactions.

Greatly reduced trading costs would be expected to cause transaction volume in financial markets to rise substantially, which it has. But, these reductions in costs more generally have contributed to even a greater expansion in markets through the process of "commodization" in which financial markets replace financial intermediaries as the institutional

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9 The first is exemplified by Allen and Gale (1988, 1990), Duffie and Jackson (1989), Hakansson (1976), Merton (1992b, Sections 14.3, 14.5, 14.6), and Ross (1976) and, of course, by the classic work of Arrow (1953, 1965) and Debreu (1959); for the second, see Benson and Smith (1976) and Merton (1989, 1992b, Ch. 14); for the third, see Barnes, Haugen, and Senbet (1985), Diamond (1984), Fama (1985), James (1987), Leland and Pyle (1977), Ross (1973, 1989), Rothschild and Stiglitz (1976), and Strong and Walker (1997). The transaction-cost economics of Williamson (1985, 1988) addresses issues in both the second and third categories.


11 As Miller (1992, p. 4) describes it, "No 20-year period in financial history has witnessed an even remotely comparable burst of innovative activity."

12 Perhaps in no other branch of economics has the implementation of theory into real-world practice been as rapid as for finance theory and the financial-services industry over this period. See Bernstein (1990) for an in-depth description of this interplay between theory and practice in bringing about some of the major innovations of the last few decades.

13 For example, the trading volume on the New York Stock Exchange runs about 150–200 million shares a day, which is 12–15 times the volume of 20 years ago. The Exchange claims to have the technology to handle a 1-billion share day. Note: These figures overstate the increase in transaction capacity because the number of shares traded per transaction has increased significantly over this period.
structure for performing certain functions. In terms of an “extended” Ross (1989) classification of financial institutions (see Figure 1), there appears to be a secular pattern away from opaque institutions toward transparent institutions.

**Figure 1. Classification of Financial Institutions**

<table>
<thead>
<tr>
<th>Transparent</th>
<th>Translucent</th>
<th>Opaque</th>
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<tbody>
<tr>
<td>Gov. Stocks</td>
<td>Futures</td>
<td>Unit Trusts</td>
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<tr>
<td>Bond Market</td>
<td>Mutual Funds</td>
<td>Pension Funds</td>
</tr>
<tr>
<td>&amp; Options</td>
<td>Insurance Companies</td>
<td>Commercial Banks</td>
</tr>
<tr>
<td>Markets</td>
<td>Investments</td>
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By way of examples, the development of liquid markets for money instruments such as commercial paper allowed the money-market mutual fund (“transparent institution”) to make major inroads as a substitute institutional structure for bank and thrift (“opaque institutions”) demand deposits. Financial futures on equities’ indexes are an efficient alternative to market- and sector-index mutual funds. The creation of “junk-bond” and medium-term note markets made it possible for mutual funds, pension funds, and individual investors to service those corporate issuers who had historically depended on banks as their source of debt financing. Similarly, the creation of a national mortgage market allowed mutual funds and pension funds to become major funding alternatives to thrift institutions for residential mortgages. Creation of these funding markets also made entry possible by agent-type institutions (e.g., investment banks and mortgage brokers) to compete with traditional principal-type intermediaries for the origination and servicing fees on loans and mortgages.

The process of “securitization” is essentially the removal of (non-traded) assets from a financial intermediary’s balance sheet by packaging them in a convenient form and selling the packaged securities in a financial market. This process of reducing the total size of assets or “footings” of intermediaries and transferring them to markets is already widespread for mortgages, auto loans, credit-card receivables, and leases on consumer and producer durables. Now established as a legitimate process, its application to other types of intermediary assets is likely to move forward even more rapidly than in the past.14

As a last example, consider a case that has not as yet happened, but could: municipal-bond insurance. In the United States, there are specialized insurance companies that sell insurance guaranteeing interest and principal payments on municipal bonds against default by the issuer. The policies are typically sold to the issuer municipality which “attaches” them to the bonds to give them an AAA credit rating. Consider as a competing alternative that an options exchange creates a market for put options on municipal bonds. Investors could then achieve the same loss protection by buying an “uninsured” municipal bond and a put option on that bond.15 Note that both structures serve the same function for investors – protection against loss from default. However, the institutions are entirely different – an options exchange is not an insurance company, and most exchanges are not even intermediaries.16

Moreover, the put option traded on the exchange is a different product from the insurance guarantee. This is hardly the place for a cost-benefit analysis of those competing ways for performing this specialized function. To make the point, it suffices to say that the “unbundling” of the downside protection17 and the possibility that an options exchange with market-to-market collateral and a clearing corporation could be a “better credit” than an insurance company provide important potential reasons for issuers and investors to prefer the financial-market structure for guaranteeing the performance of the bonds over the intermediary one.

As these examples indicate, intermediaries and markets compete to be the provider of financial products. Improving technology and the continuing decline in transactions costs has added to the intensity of that competition. Inspection of Finney’s (1988, 1992) extensive histories of innovative financial products suggests a pattern in which products offered initially by intermediaries ultimately move to markets. This temporal pattern may seem to imply that financial intermediaries (especially, opaque ones such as banks) are declining in importance and are being superseded institutionally by financial markets.18 Perhaps. However, exclusive focus on the time path of individual products can lead to biased forecasts, not only with respect to the apparent secular decline in the importance of intermediaries.

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14 For a comprehensive discussion of the implementation of asset securitization, see Norton and Spellman (1991), Zweig (1989), and the entire Fall 1986 issue of *Journal of Applied Corporate Finance*.

15 With a standard fixed exercise price, the put would actually provide more protection because it covers losses in the value of the bond for any reason, not just issuer default. However, the coverage could effectively be “narrowed” to only default risk by making the exercise price “float” to equal the current price of an AAA bond with comparable terms to those of the covered bond.

16 For example, the New York Stock Exchange. However, options (and futures) exchanges do provide intermediation services because they guarantee contract performance through their clearing facilities.

17 That is, to give each individual investor the choice whether to purchase the particular municipal bonds with or without default insurance and to give the issuer a way to price-discriminate among investors with differing assessments of default risk.

18 This proposition is focused on the change, not the level of relative importance between intermediaries and markets. It is thus consistent with Keeley (1990) who reports that bank stocks have been losing market value for the past 20 years and Mayer (1990) who observes that “Banks are the dominant source of external finance in all countries.” (p. 313). See also Gorton and Pennacchi (1992) on the changing institutional structure for serving the depository and lending functions.
ation, but with respect to the general structural relations between financial markets and intermediaries.

Financial markets, as we know, tend to be efficient institutional alternatives to intermediaries when the products have standardized terms, can serve a large number of customers, and are well-enough “understood” that transactors are comfortable in assessing their prices. As we also know, intermediaries are better suited for low-volume products. Some of these products will always have low volume either because they are highly customized or because of fundamental information asymmetries. Others, however, have low volume only because they are new. Among those, the “successes” are expected to migrate from intermediaries to markets. That is, once they are “seasoned,” and perhaps after some information asymmetries are resolved, those products are structured to trade in a market. Just as venture-capital intermediaries that provide financing for start-up firms expect to lose their successful customers to capital-market sources of funding, so do the intermediaries that create new financial products.

Especially in periods with a high intensity of financial innovation, there is a large volume of new products created and therefore, one expects a large number of instances of product migration from intermediaries to markets. Following the time path of individual products can thus lead to the belief that as technology continues to evolve, trading markets for standardized instruments such as securitized loans will ultimately replace financial intermediaries such as banks. For intermediaries which are rigidly attached to a specific product or class of products that may indeed be the case, but not for intermediation generally. Intermediaries, in addition to their manifest function of offering custom products and services, serve an important latent function of creating and testing new products as a part of the general financial-innovation process.

This dynamic product-development interaction between intermediaries and markets can be interpreted as part of a “financial-innovation spiral” pushing the financial system toward an idealized target of full efficiency. That is, as products such as futures, options, swaps, and securitized loans become standardized and move from intermediaries to markets, the proliferation of new trading markets in those instruments makes feasible the creation of new custom-designed financial products that improve “market completeness”; to hedge their exposures on those products, the producers, financial intermediaries, trade in these new markets and volume expands; increased volume reduces marginal transaction costs and thereby makes possible further implementation of more new products and trading strategies by intermediaries, which in turn leads to still more volume. Success of these trading markets and custom products encourages investment in creating additional markets and products, and so on it goes, spiralling toward the theoretically limiting case of zero marginal transactions costs and dynamically-complete markets.

For an example, consider the Eurodollar futures market that provides organized trading in standardized LIBOR (London Interbank Offered Rate) deposits at various dates in the future. The opportunity to trade in this futures market provides financial intermediaries with a way to hedge more efficiently custom-contracted interest-rate swaps based on a floating rate linked to LIBOR. A LIBOR rather than a U.S. Treasury rate-based swap is better suited to the needs of many intermediaries’ customers because their cash-market borrowing rate is typically linked to LIBOR and not to Treasury rates. At the same time, the huge volume generated by intermediaries hedging their swaps has helped make the Eurodollar futures market a great financial success for its organizers. Furthermore, swaps with relatively standardized terms have recently begun to move from being custom contracts to ones traded in markets. The trading of these so-called “pure vanilla” swaps in a market further expands the opportunity structure for intermediaries to hedge and thereby enables them to create more-customized swaps and related financial products more efficiently.

For a second example, consider the financial function of providing a well-diversified portfolio of equities for individual investors. At one time, this function was best served by buying shares on a stock exchange. However, transactions and monitoring costs as well as problems of indivisibilities significantly limited the number of companies that could be held in almost any investor’s portfolio. The innovation of pooling intermediaries such as mutual funds greatly reduced those costs, provided for almost perfect divisibility and thereby allowed individual investors to achieve vastly better diversified portfolios, such as the 500-stock, market-value weighted portfolio of the Standard and Poor’s 500 Index. Subsequently, futures contracts were created on various stock indexes, both domestic and foreign. These exchange-traded contracts further reduced costs, improved domestic diversification, and provided expanded opportunities for international diversification. Moreover, these contracts gave the investor greater flexibility for selecting leverage and controlling risk. In particular, index futures made feasible the creation of exchange-traded options on diversified portfolios. Recent further innovations that serve the diversification function have intermediaries using equity-return swaps to create custom contracts with individual specification of the stock

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19 See Merton (1989, 1990, 1992a, b) for further discussion.


21 See, for example, Aniello (1992) on the Chicago Mercantile Exchange.

22 As in the Eurodollar futures/swaps example, the availability of index futures and options markets allows intermediaries to better hedge their exposures on the products they create.
**Table 1. Institutional Dynamics for the Providers of a Specific Financial Function to Households and Non-Financial Firms: Intermediaries versus Markets**

<table>
<thead>
<tr>
<th>Product #1</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Time 3</th>
<th>Time 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>INT</td>
<td>MKT</td>
<td>MKT</td>
<td>MKT</td>
<td>MKT</td>
</tr>
<tr>
<td>Customer</td>
<td>HH/F</td>
<td>HH/F</td>
<td>INT</td>
<td>INT</td>
<td>INT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product #2</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Time 3</th>
<th>Time 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>INT</td>
<td>MKT</td>
<td>MKT</td>
<td>MKT</td>
<td></td>
</tr>
<tr>
<td>Customer</td>
<td>HH/F</td>
<td>HH/F</td>
<td>INT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product #3</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Time 3</th>
<th>Time 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>INT</td>
<td>MKT</td>
<td>MKT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer</td>
<td>HH/F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Producers Serving HH/F: INT MKT INT MKT INT

HH/F = Households and Non-Financial Firms
INT = Financial Intermediaries
MKT = Financial Markets

This table illustrates the generic time pattern for the institutional providers of a given financial function to households and nonfinancial firms. In this hypothetical example, households are served initially at Time 0 by intermediaries using Product #1. In the next period, Product #1 migrates to a market and households are now served by that market. With the opportunity to trade Product #1 in a market, intermediaries can then innovate to create a new product that better performs for households and firms the function provided by Product #1. Hence, with the introduction of Product #2 at Time 2, households and nonfinancial firms are once again served by intermediaries. Following the pattern of the financial-innovation spiral, the process repeats itself with Product #2 migrating to a market, the subsequent creation of Product #3 and so on. Thus, although products tend to move secularly from intermediaries to markets, the providers of a given function tend to oscillate according to the product-migration and development cycle.

It is evident from further inspection of this dynamic interaction that intermediaries help markets to grow by creating the products that form the basis for new markets and by adding to trading volume in existing ones. In turn, markets help intermediaries to innovate new more-customized products by lowering the cost of producing them. In sum, financial markets and intermediaries are surely competing institutions when viewed from the static perspective of a particular product activity. However, when viewed from the dynamic perspective of the evolving financial system, the two are just as surely complementary institutions, each reinforcing and improving the other in the performance of their functions.

4. Financial Engineering and the Production Process for Financial Intermediaries

Financial engineering is the means for implementing financial innovation. It is a systematic approach used by financial-service firms to find better solutions to specific financial problems of their clients. The process of financial engineering for intermediaries can be usefully broken down into five steps:

1. Diagnosis: identifying the nature and source of the problem.
2. Analysis: finding the best solution to the problem in light of the current state of regulation, technology, and finance theory. The best solution design is typically a new financial instrument (or set of instruments), but it can also be an entirely new financial intermediary.
3. Production: producing the new instrument either by underwriting both sides of the transaction (agent) or by synthesizing it through a dynamic trading strategy (principal), or by a combination of both.
4. Pricing: determining the cost of production and profit margin.
5. Customization: further tailoring the instrument to the specific needs of each customer. In most cases, the problem addressed is relevant to more than one client. A cost-benefit tradeoff is considered in deciding whether to make detail changes to fit each individual more precisely.

The changes in finance theory and computer technology in the last decade and the transaction-cost-reducing effect of the financial-innovation spiral have had their greatest impact on the production part of intermediaries' financial engineering process. To model the production process for a generic intermediary, we consider two polar models, the "underwriting"
and the "synthesizing" models, recognizing that most real-world intermediaries pursue combinations of the two. Instead of developing these basic approaches to production in the abstract, we present them in the context of a simple, hypothetical example.\(^24\)

Suppose that as a result of taking steps 1 and 2 in the financial engineering process, an intermediary determines that a customer's problem would be best solved if it could own the economic equivalent of 1000 shares of XYZ Corporation and have the value of the position insured so that at the end of two years, it has a minimum value of $100,000 ($100/share), which is also the current value of the stock. Thus, one "unit" of this "insured-equity" product has a contingent payoff structure equal to the maximum of the stock price or $100 per share at its maturity date in two years.\(^25\)

Suppose further that the intermediary knows that XYZ stock will sell for either $90 or $115 a share in a year's time. If the former occurs, then the stock will either decline further to $70 a share or rebound to $110 at the end of Year 2. If, instead the stock is $115 at the end of the first year, then it will sell for either $90 or $140 at the end of the second year. The intermediary also knows that XYZ will pay no dividends during this time. A tree diagram of the process is presented in Figure 2. The riskless interest rate is constant over time at 5 percent per year.

**Figure 2. Future Possible Prices of XYZ Stock**

```
Year 0:
Year 1: $70 or $110
Year 2: $90 or $140
```

One approach to producing the product is to create a unit trust (call it "XYZ Trust") with assets of 1000 shares of XYZ and two-year U.S. Treasury bills with a face value of $100,000. The trust has two classes of liabilities: Class A and Class B. Class A is entitled to receive at the end of Year 2 either 1000 shares of XYZ or $100,000, whichever its owner prefers. During the interim period, the Class A holder receives all cash dividends paid on the XYZ shares and dictates how the shares in the trust are voted. Class B is a "residual" security that receives whatever assets remain in the Trust, after the Class A claim has been met.\(^26\)

Based on the intermediary's knowledge of the price process for XYZ, the contingent payoffs to the Trust and each of its liabilities are displayed in Table 2. By inspection of that table, the Class A instrument has the identical payoff pattern to the insured-equity product. However, the structure of the Trust guarantees that the promised payments can be made without making any distributional assumptions about XYZ, because the UST bills are sufficient to meet the minimal $100,000 payment even if the XYZ shares become worthless. Thus, once the Trust is created, the intermediary can meet its customer's objective by selling it the Class A instrument, without having to convince the customer to agree with its stock-return assessments on XYZ.

**TABLE 2: Contingent Payoffs at Year 2**

<table>
<thead>
<tr>
<th>XYZ Stock Price</th>
<th>&quot;Class A&quot; Insured Equity</th>
<th>&quot;Class B&quot; Residual Claim</th>
<th>XYZ Trust</th>
</tr>
</thead>
<tbody>
<tr>
<td>$70</td>
<td>$100,000</td>
<td>$70,000</td>
<td>$170,000</td>
</tr>
<tr>
<td>90</td>
<td>100,000</td>
<td>90,000</td>
<td>190,000</td>
</tr>
<tr>
<td>110</td>
<td>110,000</td>
<td>100,000</td>
<td>210,000</td>
</tr>
<tr>
<td>140</td>
<td>140,000</td>
<td>100,000</td>
<td>240,000</td>
</tr>
</tbody>
</table>

The cost of funding the Trust is $190,700 (= $100,000 for 1000 shares of XYZ plus $90,700 for $100,000 face value of two-year UST bills discounted at 5% per year). Thus, to make a profit, the intermediary must receive at least $190,700 from the sale of the Class A and Class B units plus cover any other expenses of forming the Trust. The intermediary may have to commit some capital to fund the Trust while it is selling the units, but once they are sold, the intermediary has neither capital nor risk exposure to the transaction.

This approach is essentially a ("buyer-driven") underwriting activity and it emphasizes marketing or distribution skills. As with underwriting in general, the intermediary is positioned more like an agent than a principal to the transaction. In terms of product creation, it exemplifies the Ross (1989) "marketing" theory of intermediation. The unit trust used as the intermediation vehicle is a transparent institution. No sophisticated

\(^24\) A development of these production models in a more formal context with the mathematics included is presented in Merton (1989, pp. 237–242, 247–253, 1992b, pp. 441–50, 457–665).
\(^25\) This product is equivalent to a "protective-put" option strategy where the investor buys the stock and a put option on the stock. Chase Manhattan Bank which issues the product based on the Standard & Poor's 500 Stock Index in the U.S. calls it a "market-index certificate of deposit." Swiss Bank Corporation uses the name "guarantee-return-on-investment securities" (GROI) and Merrill Lynch calls its version "Market Index Target Term Securities" (MITTS). Leland, O'Brien and Rubinstein offer the "Super Trust" and "Super Shares."

\(^26\) Although the example focuses on an equity product, this approach is widely used to produce tailored fixed-income products, often with many more than just two classes of liabilities. Indeed, the "residual" security always is called the "Class 2" security even if there are fewer than 25 other classes. Characteristics of the Class A security are designed to meet specific duration, credit-risk, regulatory and tax clienteles. Examples are collateralized mortgage obligations (CMOs) and collateralized bond obligations (CBOs) that use mortgages, bonds, and other fixed-income assets in the trust.
stock-evaluation or trading skills are needed, since operating the Trust requires only a onetime purchase of 1000 shares of XYZ and $100,000 face value of UST bills. And knowledge of the stock-price return distribution (as in Figure 2) is also not needed.

Because the structure of the Class A units is derived as a direct solution to a specific problem faced by an identified (class of) customer, one expects that the placement of those units is a relatively “easy” sale. However, to create the desired equity-insurance product in this fashion, it is also necessary to sell the Class B units. Because they are the residual claims, their payoff structure is not explicitly designed to fit any particular investor group’s “desired habitat.” Thus, these units must be sold on the basis of price (i.e., as an investment “bargain”) and not on the basis of convenience or performance in meeting some explicit customer objective. Therefore, to be successful, the intermediary must charge a sufficient price “premium” (over cost) on the Class A units to offset the price “discount” on the Class B units necessary to induce “bargain-hunting” investors to buy them.

It is evident that an intermediary with a larger number of contacts with price-sensitive investors is more likely to find those who will pay a higher price for the deal. Customers are always looking for “good” products and financial product designs cannot be patented. The least-cost producer of these products is therefore likely to have an important advantage. Hence, to intermediaries that produce products by this “underwriting” approach, a “fat” Rolodex file containing names of “bargain-investor” contacts may be more valuable than one of corresponding size filled instead with “customer” names.

An alternative to this “Rolodex” method of production through underwriting is for the intermediary to act as a principal and issue the desired insured-equity product directly to the customer as a contractual obligation of the intermediary (instead of a separate trust). In principle, the intermediary could do so by buying the same combination of XYZ stock and UST bill assets held in the Trust in the underwriting approach and finance the difference between the cost of those assets and the proceeds from sale of the insured-equity product with equity capital. This strategy would be almost equivalent to the intermediary creating the Trust and buying the Class B piece itself. However, as we know from the work of Jensen (1986) and others, there are potentially significant agency and tax costs associated with equity capital of firms. These “deadweight” costs make equity finance “expensive” and thereby, limit the amount of equity that a value-maximizing intermediary would optimally issue. Hence, this simple way of combining the underwriting intermediary with its bargain-hunting investors may not be efficient.

An alternative which potentially “economizes” on the amount of capital required is the “synthesizing” or “dynamic-trading” approach to production. It substitutes a strong trading facility for a strong distribution system, and it relies on the power of modern computer technology and highly-skilled personnel, trained in advanced methods of estimation and contingent-claim pricing. With its reliance on trading, the synthesizing approach to production benefits disproportionately from the financial-innovation spiral discussed in Section 3.

There is an enormous academic and practitioner literature on the mathematics and economics of contingent-claims pricing and dynamic replication. There is no need to develop it once again here. It is enough to describe the principles and then illustrate the process for our hypothetical example.

The process of implementation is as follows: Once the specification of the terms of the customer liability to be issued is determined by the capital-markets or corporate-finance group of the intermediary, the quantitative-analysis group uses contingent-claims analysis to design a dynamic trading strategy in securities to synthesize (replicate) the payoff structure of the customer obligation in the least-cost way. In the trading operations (often called a “trading desk”) of the intermediary, a “dedicated” portfolio is established with an initial investment equal to the minimum amount necessary to ensure full implementation of the strategy with no further capital infusions. The trading strategy is dynamic in the

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27 In a buyout or takeover with major revisions of a firm’s capital structure, the residual non-equity securities issued are often called “cram-downs,” reflecting the lack of a natural investor-demand for their pattern of payoffs. The payoffs to the Class B units here happen to have the same structure as a two-year, zero-coupon “junk” bond (see Merton 1990, pp. 272–285).

28 Such an intermediary would also have the opportunity to “spread” the trades out with a lower quantity (and possibly higher price) per investor.

29 There are some potentially important credit-risk differences between the two, depending on details of the structuring.

30 Otherwise, as we discuss in more detail in the next two sections, intermediaries with liability obligations to their customers would optimally guarantee performance on those obligations by holding huge positions in liquid assets financed entirely by equity capital.

31 From the descriptions in Loomis (1992) and Picker (1992), it appears that Banksers Trust Company provides a real-world example of this approach to production.

32 See Merton (1992b) for an extensive and up-to-date bibliography.

33 There are often multiple ways to implement the strategy that are in a frictionless environment, but when transactions costs including market impact from trading, taxes, regulation, and modelling error are taken into account, they are no longer equivalent. The offset of customer exposures by netting of the intermediary’s positions and hedging only the systematic components of the portfolio risks for the intermediary may also be optimal when there are costs. See Merton (1989, pp. 242–247, 1992b, pp. 450–452) for further discussion of these issues.
sense that it typically calls for the composition of the portfolio to be revised in response to changes in security prices and the passage of time. The trading desk is charged with implementation of the strategy.

Table 3 illustrates the trading process for our hypothetical example with the return dynamics of XYZ stock described in Figure 2. This cookbook-like prescription calls for an initial investment in XYZ stock and UST bills of $106,315. If the price of XYZ rises, more shares are purchased by selling bills; and if it falls, the share position is reduced and the proceeds placed in bills. At Year 2, the value of the portfolio is equal to the maximum of the value of 1000 shares of XYZ or $100,000. Hence, the portfolio exactly replicates the contractual payoffs which the intermediary has promised to its customer. Since the portfolio never requires a further infusion of capital, the initial investment of $106,315 to fund the portfolio is the production cost to the intermediary for the product.

The process of synthesizing customer financial contracts and securities is for financial intermediaries what the assembly-line production process is for the manufacturing sector. The trading-strategy rules are the “blueprints” for production. The traded securities (XYZ shares and UST bills) used in the portfolio are the raw “inputs” applied in prescribed combinations over time to create a “finished” product or “output” which is a complete set of contingent payments matched to the ones promised on the customer’s contract.

Compared with the underwriting approach to production, the synthesizing approach appears to have several advantages: it makes the part of the transaction seen by the customer easier for the customer because the intermediary simply issues the contract without requiring the intervening element of the trust as “another institution” involved in the transaction. The synthesizing method is considerably more efficient for an intermediary that specializes in unique or “one-off” contracts. Essentially, any contract with payoffs that depend on the price of XYZ stock can be produced by the same type of process described in Table 3. Only the mixing rules for adjusting the stock-bills positions are changed. Thus, by analogy with numerically controlled machines on a physical assembly line, the intermediary need only change the “dials” (mixing rules) to have the same line produce a different output. This approach thus offers the opportunity to create custom-tailored financial products at a (assembly-line) standard-product level of cost. Another advantage to the intermediary operating as a principal is the opportunity to “net” its transactions. Thus, an intermediary that offers a wide variety of customer contracts,

| TABLE 3: Production Technology and Production Cost for Insured-Equity Instrument: Dynamic Trading Rules for Replication |
|---|---|
| **At Year 0** |  |
| $70,400 | Buy 704 shares XYZ $100/share |
| 35,915 | Short-term cash investment 5% |
| **Total** | **Investment** |
| $106,315 | |
| **At Year 1** |  |
|  |
| If XYZ share price is $90: Sell 454 shares $90/share |  |
| **Value Before** | **Value After** |
| $63,360 | 704 shares XYZ $90 |
| 37,711 | Cash & interest |
| **$101,071** | **$101,071** |
|  |
| If XYZ share price is $115: Buy 956 shares $115/share |  |
| **Value Before** | **Value After** |
| $80,960 | 704 shares XYZ $115 |
| 37,711 | Cash & interest |
| **$118,671** | **$118,671** |
|  |
| If share price of XYZ was $90 at Year 1 and, |  |
| **At Year 2** |  |
| If share price of XYZ is $70: |  |
| $17,500 | 250 shares of XYZ $70/share |
| 62,500 | Cash & interest |
| **$100,000** | Value of Portfolio ($100/share XYZ) |
| If share price of XYZ is $110: |  |
| $27,500 | 250 shares of XYZ $110/share |
| 82,500 | Cash & interest |
| **$110,000** | Value of Portfolio ($110/share XYZ) |
| If share price of XYZ was $115 at Year 1 and, |  |
| **At Year 2** |  |
| If share price of XYZ is $90: |  |
| $72,000 | 800 shares of XYZ $90/share |
| 28,000 | Cash & interest |
| **$100,000** | Value of Portfolio ($100/share XYZ) |
| If share price of XYZ is $140: |  |
| $112,000 | 800 shares of XYZ $140/share |
| 28,000 | Cash & interest |
| **$140,000** | Value of Portfolio ($140/share XYZ) |

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34 The derivation of the synthesizing trading rules for the particular example here is presented in Merton (1992b, pp. 337-341, 438-439).

35 See Merton, op. cit., for the trading rules for a general payoff function when the dynamics for XYZ stock are as in Figure 2 here.
each contingent in different ways on the price path of XYZ stock, can run a single replicating portfolio in XYZ stock and bills that hedges the net (aggregate of all customer exposures) contingent payouts.

All this does not imply that the synthesizing approach dominates the underwriting one. Compensation for highly skilled technical and trading employees and the high cost of the supporting technology (e.g. supercomputers) can make the cost of running the synthesizing production system greater than the underwriting system. Moreover, as principal, the intermediary (its employees and shareholders) bears the risk of errors in production: these errors range from a clerk punching in 11 million shares rather than dollars in translating the model prescriptions into orders for execution\(^6\) to fundamental flaws in the assumptions of the model itself (e.g., suppose at the end of Year 2, XYZ shares are selling for $50 or $170 a share, despite these being “impossible” events according to the model description of the process in Table 2).

Perhaps the most important issue surrounding the effectiveness of an intermediary acting as principal is customer perception of the intermediary as a credit risk. This is the topic of Section 5, and so, we only note here that a key factor in assessing the relative costs of the synthesizing and underwriting approaches is the amount and cost of “assurance” or “risk” capital required by each to eliminate customer concern about contract performance by the intermediary.

In constructing the Trust in our hypothetical example, a total of $190,700 was required to purchase the funding assets. If the $106,315 production cost by synthesis is the marginal cost of producing the Class A units for the Trust, it follows that the cost of producing the Class B units is $(190,700 - 106,315) = 84,385$. In the presence of competition among intermediaries, it is reasonable to expect that the prices received from issuing those securities will not differ greatly from their respective marginal costs.

Since once the Trust is funded, customer holders of the Class A units can be absolutely assured of having the contractual obligations of the Trust met, the amount of capital required to provide this assurance is $84,385.\(^7\) Hence, about 44 percent of the total funds to be raised by the intermediary to create the Trust must come from the “residual” piece sold to price-sensitive investors. As already discussed, placing the residual piece is the “difficult” sale and the size of the discount required on the Class B units clearly can have a first-order impact on the profitability of the deal.

\(^6\) As reported in the press, this actually happened in the case of stock-index arbitrage activities at Salomon Brothers in March 1992.

\(^7\) This measure of capital is closely related to the risk-capital measure developed more generally in Merton and Perold (1992).

In contrast, an intermediary selecting the synthesizing approach only needs $106,315 to fund the internal production portfolio. If the insured-equity product is sold at above production cost, then the cash flow from sales to customers would seem to rule out the need for the intermediary to raise additional capital. However, this conclusion implicitly assumes: (1) that customers know and agree with the intermediary’s assessment for the XYZ stock price in Figure 2; (2) that customers believe the intermediary can and will undertake the dynamic strategies described in Table 3; and (3) that customers believe that the other activities of the intermediary will not lead to liens on the assets of the replicating portfolio by other claimholders of the intermediary. These three assumptions are not, of course, robust. Therefore, principal-type intermediaries will in general have to raise additional assurance capital to provide the functional equivalent of the Class B units in the agent-underwriting alternative. Which of the two (or some combination) is the more efficient production process will depend on the detailed structure of the transactions and the nature of asymmetric-information and agency costs.\(^8\)

5. Risk Control: A Major Managerial Issue for Financial Intermediaries

Section 3 concluded that financial intermediaries are the main functional providers of the "most-finished" type of financial products and that technology and competition are constantly driving those products toward ever greater customization. Section 4 concluded that between the two basic approaches to production, the synthesizing one (with the intermediary as principal) is generally superior for custom contracting, provided that the intermediary can find a cost-effective way to assure its customers of its ability to meet its contractual obligations. This section specifically addresses the issue of creditworthiness and risk control at the level of the firm.

Credit risk or the prospect of default by a firm is, of course, a concern to all transactors with that firm, whatever its business. However, unlike most firms, the efficiency of the central business activities of many

\(^8\) In the real-world versions of our insured-equity example cited in footnote 25, the banks and Merrill Lynch used the principal approach and Super Trust of Leland O'Brien Rubinstein (LOR) selected the underwriting one. In the 1980s, LOR, in creating its "portfolio-insurance" version of the insured-equity product chose a hybrid of these two approaches in which it managed a replication portfolio, but as agent (not as principal) for its customers. As a concrete illustration of the complementary relation between markets and intermediaries, the existence of futures and options markets for trading the Standard & Poor's 500 Stock Index greatly facilitated the real-world production process for all these firms.
financial intermediaries depends critically on their customer liabilities being default-free.

This section and the one to follow focus on intermediaries which serve their principal function by issuing liabilities of a certain type to customers, and manage their assets to facilitate this principal function. A straightforward example is a property and casualty insurance company that issues more or less customized insurance contracts to its policyholders, and invests almost exclusively in securities traded in the capital markets. A more subtle but major example is an organized derivative-security exchange. Some classify such exchanges as financial markets, not intermediaries. However, unlike a typical stock or bond exchange, the financial futures and options exchanges serve the fundamental intermediation function of guaranteeing the performance of contracts traded on their exchanges. Buyers and sellers of those contracts have the clearing corporation of the exchange—not each other—as their respective counterparty. Thus, the exchange issues liabilities to both classes of its customers. It would vastly reduce the efficiency of the derivative-security markets if their customers had to "diversify" against contract-default risk by spreading their otherwise homogeneous transactions across a large number of different exchanges. It is therefore absolutely essential that the clearing corporation of such exchanges have the very highest credit-standing with its customers.

To see why creditworthiness is so much more an issue for such intermediaries than for firms in general, it is helpful to draw a formal distinction between the "customers" and the "investors" of the firm. Calling attention to the distinction between customers and investors of nonfinancial firms is rarely necessary, because it is generally obvious. Few would confuse the customer who buys a car from an automobile firm with the shareholder, lender, or other investor who buys its securities. Similarly, no one would confuse a customer who charges money at a bank or takes out a loan from it with an investor who owns shares in the bank. But, the customers of many types of intermediaries receive a promise of services in the future in return for payments to the firm now. Financial services of this type usually involve payments to the customer of specified amounts of money, contingent on events and the passage of time. Those promised future services are liabilities of the firm, both economically and in the accounting sense. Since investors in the firm also hold its liabilities, the distinctions between customers and investors is not always so clear for such intermediaries.

The distinction between customers and investors can however be made. Customers who hold the intermediary's liabilities are identified by their strict preference to have the payoffs on their contracts as insensitive as possible to the fortunes of the intermediary itself. For example, the function served by a life insurance policy is to provide its beneficiaries with a specified cash payment in the event of the insured party's death. That function is less efficiently performed if the contract calls instead for the death benefit to be paid in the joint event that the insured party dies and the insurance company is solvent. Even if the insurance company offers an actuarially fair reduction in the price of the insurance to reflect the risk of insolvency, a risk-averse customer would prefer the policy with the least default risk. Indeed, on introspection, I doubt that many real-world customers would consciously agree to accept non-trivial default risk on a $200,000 life insurance policy in return for a large reduction in the annual premium, say from $400 to $300. Such results obtain even in theoretical models in which the customer has all of the relevant information necessary to assess the default risk of the insurer.

The counterargument for indifference asserts that the customer may be able to eliminate the effect of this default risk either by trading in the securities of the life insurance company ("hedging") or by entering into a large number of tiny insurance contracts with many different companies ("diversification"). Such a case can perhaps be made for frictionless, complete-market economics. However, the very role of the intermediary is to service those entities (its customers) who cannot trade efficiently and enter contracts costlessly. A major rationale for the existence of intermediaries is to reduce the costs that households and firms would otherwise incur to manage risks directly by transacting in the financial markets.

By contrast, investors in the liabilities (e.g. stocks or bonds) issued by an intermediary expect their returns to be affected by its profits and losses. Indeed, their function (as with the Class B holders in the hypothetical example of Section 4) is to allow the intermediary to better serve its customers by shifting the burden of the risk-bearing and resource commitment from customers to investors. The investors of course expect to be compensated for this service by an appropriate expected return. The resulting increase in efficiency of customer contracts from this shift in risk-bearing makes customers better off. Note that although the functional roles of "customers" and "investors" are distinct, the same individual or firm can be both a customer of and an investor in a particular intermediary. Thus, I can both buy an insurance policy from a particular insurance

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39 This discussion of the customer-investor distinction is taken largely and often verbatim from Merton and Bodie (1992a, Section II).

40 An economy with pure Arrow-Debreu securities provides a formal example of this general point. It is well-known that a complete set of such securities permits Pareto-efficient allocations. If, however, the payoffs on such securities were also contingent on the solvency of the issuer of the securities, then they would lose their efficiency. See Merton (1990, pp. 252-255, 1992b, pp. 450-1; 463-7) for a more complete discussion of this point.

41 In most real-world case, the customers do not have the relevant information, and this fact makes the potential welfare loss from default even greater.

43
company and also hold its shares as part of my investment portfolio. The distinction between an investor-held and a customer-held liability claim is not unique to financial intermediaries. For example, a customer who buys a warranty on a new car from an automobile manufacturer wants the repairs paid for in the event that the car is defective. In fact, the customer's contract pays for repairs in the joint event that the car is defective and the automobile manufacturer is financially solvent. If given a choice, customers would prefer not to accept additional default risk in return for an actuarially fair reduction in the cost of the warranty. Much the same point can be made about the implicit contract with customers to ensure that spare parts are available in the future for repairs. Although it can become quite significant for a financially distressed firm, default risk is probably a secondary consideration for most customers of an automobile manufacturer. In contrast, because of the substantial size and long duration of many financial contracts such as annuities and life insurance, default risk is a first-order issue for customers of financial intermediaries. Thus, the success of a financial intermediary depends not only on charging adequate prices to cover its production costs, but also on providing adequate assurances to its customers that promised payments will be made.

In sum, customers in general are likely to know less about the firm's business prospects than its investors. However, the larger cost of customers instead of investors bearing default risk of the firm is not simply a consequence of customers being less well-informed than investors. The "wedge" of additional cost between customers and investors is primarily the result of customers "internalizing" risks of the firm that investors can eliminate by diversification. That is, the efficiency of customer contracts is diminished if they are exposed to default. The term "credit-sensitive" is used to describe the businesses of an intermediary that are significantly affected by changes in customer perception of the credit standing of the intermediary. Business activities that require customers to hold contractual liabilities of the intermediary are credit-sensitive.

There are essentially three ways for an intermediary with credit-sensitive activities to provide assurances against default risk to the customers who hold its liabilities: 1) By holding assets which have payouts that "match" those promised on its contractual liabilities and by choosing a "transparent" structure so that customers can easily verify that such a matching policy is being followed.41 2) By acquiring guarantees of its customer liabilities from a AAA-credit-rated private-sector or government third party. The providing of such guarantees is a large financial-intermediation business, which is itself quite credit-sensitive.42 3) By raising additional capital beyond that required for the funding of the physical investments and working capital needed to run the intermediary. This assurance capital typically takes the form of equity although debt that is subordinated to customer contractual claims can sometimes be used.

The economic costs to the intermediary of acquiring these assurances are mainly agency costs. The following section uses a hypothetical example to illustrate the impact of these costs on managerial decisions in intermediaries.

6. Capital Budgeting for Financial Intermediaries: A Hypothetical Example

The potentially large and direct effect of an intermediary's credit standing on its operating cash flows can create significant synergistic-like effects across individual businesses within an intermediary, even when there are none of the normal "physical" or "relationship" synergies present. The credit-sensitivities of individual businesses within an intermediary can thus cause a significant failure of the "value-additivity" principle,43 even without any synergistic interactions among the operations of those businesses. Efficient decentralization of the capital budgeting and financial decisions is therefore likely to be more difficult to implement for intermediaries with credit-sensitive business activities than for typical multi-business, nonfinancial firms.

To illustrate those effects, we develop a hypothetical example of an opaque intermediary with three separate one-year business operations.44 Each of the three businesses, called A, B, and C, are credit-sensitive, but otherwise there are no operating linkages across the businesses. To

41 "Transparent" is used here in the sense of Ross (1989) as illustrated in Figure 1. Mutual funds and unit trusts are prime examples of transparent intermediaries that address customer concerns about contract performance by matching assets and liabilities.
42 See Merton and Bodie (1992a) for an in-depth analysis of the management of the guarantee business, for both private-sector and government providers.
43 "Value-additivity" means that the value of each business in the firm is unaffected by the other businesses, if any, of the firm and therefore, the value of the firm is simply the sum of the values of each business in the firm computed on a stand-alone basis.
44 The detailed analytics supporting this example are in the appendix.
simplify the analysis, we assume that customers will transact with these
businesses only if the prospect of default on the customers’ contracts is
totally remote. That is, to operate at all, the customer contracts for each
business must have the equivalent of an AAA credit rating. Among the
three ways for providing such credit assurance described in Section 5, we
assume that the intermediary chooses to buy a guarantee of its contract
performance from a third party. That is, a guarantor covers any “short-
fall” in value between the promised payments on customer contracts and
the available assets of the intermediary.

We begin the analysis by describing the postulated characteristics of
the three businesses on a “stand-alone” basis (i.e., as three legally separate
intermediaries) and in various combinations with one another. To estab-
lish a baseline, valuations of the businesses are presented in Table 4 for
the perfect-market case with no agency costs. Define the “actuarial value”
of the contract guarantees as their fair value in the absence of asymmetric
information and other agency problems between the intermediary and the
third-party guarantor. Specified in Table 4 are: the gross present value of
each business or combination of businesses as an AAA credit-rated entity
with the customer-contract guarantee in place but before deducting the
cost of the guarantee; the actuarial value of the guarantee; and the actu-
arial net present value computed by subtracting the actuarial value of the
guarantee from the gross present value.

As is well-known from the option-pricing literature, the actuarial value
of a contract guarantee is (which is isomorphic to a put option on the assets
of the intermediary) is, ceteris paribus, an increasing function of the volatil-
ity of the year-end value of the business (or aggregate of businesses).
Hence, the differences in actuarial guarantee values for the stand-alone
cases in Table 4 reflect different levels of volatility across the businesses,
with C the most volatile and A the least. Thus, although the gross present
value of each business is assumed to be the same, the actuarial present
values are not.

47 In general, there would be a smoother tradeoff between the expected volume of customer
business and the credit rating of the intermediary, either because some customers are toler-
ant of some amount of contract-default risk or because some customers differ in their credit
assessments of the firm. In this general case, the capital-budgeting decision would include
finding an optimal credit rating for the firm where the marginal gain in customer business
equals the marginal cost of improving the credit rating. The extreme credit-sensitivity postu-
lized here leads to a “bang-bang” solution: either pay the cost to make customer contracts
completely default-free or abandon the entire business.

48 As shown in the appendix, the valuation procedure used in this example is the loan-
guarantee pricing model in Merton (1977), which measures volatility by the standard devia-
tion of the (logarithm of) year-end values. This same valuation model is used in Merton and
Perold (1992) to value the risk capital of a business. The principal results derived here are
robust with respect to the particular valuation procedure used.

| Table 4. Hypothetical Example: Business Values with No Agency Costs (S millions)* |
|---------------------------------|------------------|-----------------|-----------------|
| **Business** | **Gross Present Value** | **Actuarial Guarantee Value** | **Actuarial Net Present Value** |
| A | $500 | $200 | $300 |
| B | 500 | 300 | 200 |
| C | 500 | 400 | 100 |
| Total | $1500 | $900 | $600 |

| (i) | A+B+C | 1215 | 615 | 600 |
| (ii) | B+C | 859 | 559 | 300 |
| (iii) | Marg. A | 355 | 56 | 300 |
| (iv) | A+C | 853 | 455 | 400 |
| (v) | Marg. B | 360 | 160 | 200 |
| (vi) | A+B | 170 | 370 | 500 |
| (vii) | Marg. C | 245 | 245 | 100 |

* Model analyses leading to these calculations of gross present value and actuarial guarantee
value are in the appendix.

The effects of locating the three businesses within a single firm depend
on the distributional properties of the combined year-end values of the
businesses. Those properties are fully developed in the appendix. It is
enough to say here that year-end values of A, B, and C are positively, but
less than perfectly, correlated. Because the business returns are not
perfectly correlated with one another, the dollar volatility of the combined
portfolio of businesses is less than the sum of the dollar volatilities of each
of the businesses on a stand-alone basis. It follows immediately that the
actuarial value of the guarantee for the combined business is less than the
sum of the guarantee values for each business taken separately. The results
for the three businesses combined into one firm are presented in (i) of
Table 4. The actuarial value of the guarantee for the combined firm is
$615 million, which is 32% less than the $900 million total value of the
stand-alone guarantees.

The $285 million decrease in the actuarial cost of the guarantee does
not however translate into a corresponding gain in actuarial net present
value. The gross present values in the stand-alone case have embedded in
them that ex-post profits in one business are not used to offset losses in
another. That is, because they are stand-alone, the guarantor must cover
the shortfall on customer contracts in each losing business separately, even
though one or more of the other businesses earns profits. This "optional-

49 See the appendix. This result is a special case of the general proposition that an option
on a portfolio of less-than-perfectly-correlated assets has a lower value than a portfolio of
options on each of the assets. See Merton (1992b, 264-266).
The "value-additivity" feature adds to the stand-alone gross present value of each of the businesses. Once they are combined into a single firm, the guarantor can use the "surplus" of the profitable businesses to offset the shortfall in the losing ones and the value of this optionality feature is lost. In the perfect-market, no-synergy case, the loss in gross present value is exactly compensated for by the decrease in the actuarial cost of the guarantee so that the actuarial net present value of the total remains unchanged at $500 million. That is, the total actuarial net present value of holding all three businesses separately equals the value of combining the three businesses into one firm.

The same "value-additivity" result applies for all combinations of the businesses. To illustrate, consider the intermediary with A, B, and C. If it were to "spin off" or otherwise eliminate business A, then applying the loan-guarantee valuation model to the (ex-spinoff) firm containing B and C, we have (ii) of Table 4) that the actuarial guarantee value is $559 million, the gross present value is $859 million, and the actuarial net present value is $300 million. The marginal values for A can thus be determined by subtracting (ii) from (i) in Table 4. Inspection of Marg. A in Table 4 shows that although the marginal gross present value and actuarial guarantee value for A differ from the corresponding stand-alone values, the actuarial net present value of $300 million is the same.

By inspection of Table 4, similar calculations for spinning off B and retaining A and C and spinning off C and retaining A and B lead to the same results: the marginal net present value of each business is the same as its stand-alone value. In short, absent any operating synergies or costs from combining these businesses with no agency, tax or other spread costs, there is no value gain or loss in merging businesses.

With the perfect-market case as a baseline, we now introduce asymmetric information and other agency problems between the intermediary and the third-party guarantor. With these problems, the guarantor must charge a price greater than the actuarial value of the guarantee and the spread between the two is the agency cost which is a "dead-weight" loss. The agency cost is modeled as a constant-percentage (10%) mark-up on

the actuarial value of the guarantee.52

The higher charge for the guarantee reduces the value of the intermediary's business. Define the actual net present value to be the actuarial net present value minus the agency cost of the guarantee. In parallel fashion to the analysis in Table 4, Table 5 provides the valuations including agency costs for the three businesses on a stand-alone basis and in various combinations. Because agency costs are proportional to the actuarial value of the third-party guarantee, combining the three businesses into a single firm will reduce the aggregate of those costs.53 By inspection of Table 5, the $90 million in total agency costs for the businesses on a stand-alone basis decreases to $61.5 million if they are combined. The saving of $28.5 million in agency costs causes the aggregate net present value to increase to $538.5 million.

The combination of customer-sensitive businesses and agency costs

| Table 5. Hypothetical Example: Business Values with Agency Costs ($ millions) |
|-----------------------------------|----------------|----------------|----------------|----------------|
|                                  | Gross Present Value | Actuarial Guarantee Value | Actuarial Net Present Value | Agency Costs of Guarantees | Actual Net Present Value |
| Business                         |                  |                           |                           |                             |                           |
| A                                | $500             | $200                      | $300                      | $20                         | $280                       |
| B                                | $500             | $200                      | $300                      | $20                         | $280                       |
| C                                | $500             | $200                      | $300                      | $20                         | $280                       |
| Stand-Alone Total                | $1500            | $900                      | $600                      | $90                         | $510                       |
| (i)                              | $1215            | 613                       | 600                      | 6t                          | 538.5                      |
| (ii)                             | $859             | 559                       | 300                      | 55                          | 244.1                      |
| (i) to (ii)                      | $356             | 56                       | 300                      | 5.6                         | 294.4                      |
| (iii)                            | $855             | 455                       | 400                      | 45                          | 354.5                      |
| (i) to (iii)                     | $660             | 160                       | 200                      | 16.0                        | 184.0                      |
| (iv)                             | $870             | 370                       | 500                      | 37.0                        | 463.0                      |
| (i) to (iv)                      | $245             | 245                       | 100                      | 24.5                        | 75.5                       |

52 Any model of agency cost in which the cost increases with the size of the actuarial guarantee value will produce the same results. The particular model here is consistent with an opaque intermediary that marks its assets and customer liabilities to market, reports changes in the aggregate value of its net worth periodically, and otherwise discloses little else about its individual positions and business activities. The guarantor thus has indication of the volatility of the net present value of the intermediary, but not much else.

53 In addition to the opaqueness explanation in footnote 52, this reduction in agency costs could for example reflect a reduction in the moral-hazard incentive to "go for broke" that exists more strongly when each business is separately guaranteed. Alternatively, if performance were assessed by equity capital instead of third-party guarantees, the smaller aggregate amount of equity capital required to cover a "n-standard deviation" loss in the combined firm implies a smaller amount of "passive" assets required within the firm to assure customers. These smaller passive-asset footings in turn lower the potential "free-cashflow" agency costs described by Jensen (1986).
creates complexity in attempts to allocate either costs or capital among the individual businesses of the intermediary. To illustrate, consider the intermediary with A, B and C. To compute the intermediary's marginal agency cost and net present value of each business, we take the difference between the intermediary with all three businesses and the intermediary absent one of those businesses. Thus, from (ii) in Table 5, the agency cost and net present value for the intermediary with B and C (but not A) are $55.9 million and $244.1 million, respectively. Subtracting from (i) in Table 5, we have that the marginal agency cost of A is ($61.5 - 55.9 =)$ 5.6 million and the marginal net present value of A is ($338.5 - 244.1 =)$ 94.4 million. Note that this marginal net present value of A exceeds its stand-alone value by $14.4 million. The corresponding calculations for B and C produce similar results.

By inspection of Table 5, none of the marginal values aggregates to the corresponding total for the firm. As shown in Table 6, this creates problems for cost allocations among the individual businesses. For example, the aggregate of the marginal agency costs, $46.1 million, leaves $15.4 million of unallocated agency costs for the firm if marginal costs drawn from the combined-firm configuration are used for allocation. Correspondingly, the aggregate of marginal actual net present values ($204.4 + 184.0 + 75.5 =)$ 563.9 million exceeds the actual net present value of the whole firm by the $15.4 million of unallocated agency costs. By inspection of Table 6, if instead the "stand-alone" agency costs of the businesses are used to allocate marginal costs, then the resulting aggregate overstates actual costs by $28.5 million. Because of the synergistic-like effects of individual-business volatility on agency costs, value-additivity of the individual businesses fails, and with that failure goes any unique scheme for fully allocating costs. Indeed, as shown in Table 6, the same failure applies for other subdivisions of the firm. If the issuing of equity capital — instead of the purchase of guarantees — is used by the intermediary to provide contract assurance to its customers, the same allocation problem occurs for the capital and agency costs associated with the equity.

It should be underscored that the failure of value-additivity and the resulting arbitrariness in allocating costs among individual businesses does not cause any ambiguity with respect to optimal capital-budgeting decisions of the intermediary made in a centralized fashion that "internalizes" the crossbusiness effects of risk.

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**Table 6. Hypothetical Example: Cost Allocations Among Businesses**

<table>
<thead>
<tr>
<th>Allocation by Marginal Cost</th>
<th>Allocation by Stand-Alone Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A + B + C</td>
<td>A + B + C</td>
</tr>
<tr>
<td>Marginal A</td>
<td>$5.6</td>
</tr>
<tr>
<td>Marginal B</td>
<td>16.0</td>
</tr>
<tr>
<td>Marginal C</td>
<td>24.5</td>
</tr>
<tr>
<td>Total Marginals</td>
<td>46.1</td>
</tr>
<tr>
<td>Unallocated Cost</td>
<td>15.4</td>
</tr>
<tr>
<td>Total Actual Cost</td>
<td>$61.5</td>
</tr>
</tbody>
</table>

**Allocation by Marginal Cost for Various Subdivisions of Intermediary**

<table>
<thead>
<tr>
<th></th>
<th>A + B</th>
<th>A + C</th>
<th>B + C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal A</td>
<td>$7.0</td>
<td>$5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Marginal B</td>
<td>17.0</td>
<td></td>
<td>17.0</td>
</tr>
<tr>
<td>Marginal C</td>
<td></td>
<td>25.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Total Marginals</td>
<td>24.0</td>
<td>31.0</td>
<td>55.0</td>
</tr>
<tr>
<td>Unallocated Cost</td>
<td>15.0</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>Total Actual Cost</td>
<td>$37.0</td>
<td>$45.5</td>
<td>$55.0</td>
</tr>
</tbody>
</table>

As pointed out in footnote 54, the value-maximizing decision for the intermediary in this example is to keep the three businesses in the firm. However, this outcome is dictated by the specific structure of the agency costs. To show that the credit-sensitivity effect does not always lead to the conclusion that diversification "pays," we change the example by replacing business C with business D, which is simply a passive investment in futures contracts on the Standard & Poor's 500 Stock Index. To make comparisons easier, we assume that the scale of business D and its joint-distribution properties with A and B are the same as for business C. By inspection of Table 7, replacing C with D changes the stand-alone entries in Table 5 in only two ways: first, as with all passive investments, the actuarial net present value of D is zero and second, the agency cost of a guarantee for this traded asset alone is zero. The latter follows because as a stand-alone, the futures could be placed in a "transparent" intermediary structure such as a mutual fund or unit trust. Furthermore, put options which trade on the S&P 500 futures in the financial market can be purchased to guarantee any prespecified value for the portfolio with no (incremental) agency cost to the stand-alone intermediary.

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54 Note that by inspection of Table 5, the marginal net present value of each business exceeds its stand-alone value implying that the optimal capital-budgeting decision is to retain all three businesses instead of spinning off any one of them to stand alone.

55 If there were no agency, tax-disadvantage or other frictional costs to issuing equity, then, of course, the optimal solution for every intermediary with credit-sensitive businesses would be simply to issue huge amounts of equity and invest the proceeds passively in assets earning a market rate of return.

56 See the appendix for analysis supporting Table 7.
TABLE 7. Revised Hypothetical Example: Business Values with Agency Costs (in millions)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$500</td>
<td>$200</td>
<td>$300</td>
<td>$20</td>
<td>$280</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>300</td>
<td>200</td>
<td>30</td>
<td>170</td>
</tr>
<tr>
<td>D</td>
<td>400</td>
<td>400</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stand-Alone</td>
<td>Total</td>
<td>$1400</td>
<td>$900</td>
<td>$50</td>
<td>$450</td>
</tr>
<tr>
<td>(i) A+B+D</td>
<td>1115</td>
<td>615</td>
<td>500</td>
<td>61.5</td>
<td>438.5</td>
</tr>
<tr>
<td>(ii) A+B</td>
<td>870</td>
<td>370</td>
<td>500</td>
<td>37.0</td>
<td>463.0</td>
</tr>
<tr>
<td>(i)−(ii)</td>
<td>Marg. D</td>
<td>245</td>
<td>245</td>
<td>24.5 (24.5)</td>
<td></td>
</tr>
</tbody>
</table>

If, however, business D is held as an integrated part of an opaque intermediary with businesses A and B, then it will add to the volatility of the year-end aggregate value of the intermediary. This additional volatility from including D causes the actuarial guarantee value for the intermediary to be larger. Because of the asset integration and the opaqueness of the intermediary, the proportional agency cost applies to this increment. Thus, as shown in Table 7, the actuarial guarantee value and agency cost for the intermediary with A, B, and D are $615 million and $61.5 million, respectively, as in the original example. However, the actuarial net present value is now ($300 + 200 + 0 =) $500 million, and hence the actual net present value of the intermediary is ($500 − 61.5 =) $438.5 million.

Suppose that the intermediary divests itself of D. As a stand-alone spin-off, D has an actual net present value of zero. The actuarial net present value of the intermediary remains unchanged at $500 million. However, the actuarial guarantee value declines to $370 million and the corresponding agency costs are $37 million. The actual net present value after the divestiture is ($500 − 37 =) $463 million or an increase of $24.5 million in the value of the intermediary, which is exactly the marginal agency cost of retaining business D in this structure. Thus, in the model used here, a passive attempt at diversification or retention of a business that does not benefit from either the integrated or opaque structure of the intermediary reduces the value of the intermediary.57

A key requirement for the success of any financial intermediary is its ability to control both the actual and perceived default risk of its customer-held liabilities. Greater customer demand for service and greater complexity of products will intensify the attention given to this issue in the future. The internal finance function of financial intermediaries will be expanded to cover not only the increased working capital needs of the firm, but also the management of its counter-party credit exposure. The single example of this section surely does not provide a fully specified model of the agency-cost structure faced by financial intermediaries. But perhaps it will serve to focus attention and stimulate further research on these issues of first-order importance to intermediaries involved in credit-sensitive activities.

7. Government Regulation and Financial Intermediation58

Promoting competition, ensuring market integrity including systematic or macro credit-risk protections, and managing “public-good”-type externalities cover the broad potential roles for regulation and other government activities in improving economic performance of financial intermediaries.

There are five categories to classify the paths by which government affects financial intermediation: first, as a market participant following the same rules for action as other private-sector transactors, such as with open-market operations; second, as an industry competitor or benefactor of innovation, by supporting development or directly creating new financial products or markets such as securitized mortgages, index-linked bonds, or all-savers accounts; third, as a legislator and enforcer, setting rules and restrictions on financial intermediaries and markets such as minimum-capital rules, asset restrictions, disclosure requirements, margin limits, circuit breakers, and patents on products; fourth, as a negotiator when representing its domestic constituents in dealings with other sovereigns that involve financial intermediaries or markets; fifth, as an unwilling intervenor which changes general corporate regulations, taxes and other laws or policies that frequently have significant unanticipated and unintended consequences for the financial-services industry.59

As stated at the outset, financial innovation is the engine driving the financial system toward its goal of greater economic efficiency. Innovation in financial intermediation improves efficiency by completing markets, lowering transaction costs, and reducing agency costs. The analyses of the preceding sections on the dynamics of institutional change and the operational issues of production and risk control for financial intermediaries have thus emphasized innovation in products and services. However, with

57 This result is consistent with the Ross (1989) model of financial innovation and intermediation.

58 This section draws heavily on Merton (1989, 1990, 1992a).

59 Their potential benefits notwithstanding, these five categories of government activities also have potential costs including direct costs to intermediaries such as legal and registration fees; distortions of prices and resource allocations; transfers of wealth among private-party participants in intermediation; and transfers of wealth from taxpayers to financial intermediaries.
their focus on product and service innovations, these analyses do not address innovations in the financial “infrastructure”—that is, the institutional interfaces between intermediaries and financial markets, regulatory practices, organization of trading and clearing facilities, and management information systems. But, improvements in efficiency from innovative intermediary products and services cannot obtain without the concurrent changes in the financial infrastructure that are necessary to support those products and services. Indeed, perhaps the single most important perspective for public policy on financial innovation is the explicit recognition of the interdependence between product and infrastructure innovations and of the inevitable conflicts that arise between the two.

As an analogy of supreme simplicity, consider the creation of a high-speed passenger train, surely a beneficial product innovation. Suppose, however, that the tracks of the current rail system are inadequate to handle such high speeds. In the absence of policy rules, the innovator, either through ignorance or a willingness to take risk, could choose to fully implement his product and run the train at high speed. If the train subsequently crashes, it is, of course, true that the innovator and his passenger-clients will pay a dear price. But, if in the process, the track is also destroyed, then those, such as freight operators, who use the system for a different purpose will also be greatly damaged. Hence, the need for policy to safeguard the system. A simple policy that fulfills that objective is to permanently fix a safe, but low speed limit. But, of course, this narrowly focused policy has a rather unfortunate consequence that the benefits of innovation will never be realized. An obviously better, if more complex, policy solution is to facilitate the needed upgrading of the track and, at the same time, to set transient limits on speed, while there is a technological imbalance between the product and its infrastructure.

As in this hypothetical rail system, the financial-intermediation system is used by many for a variety of purposes. When treated atomistically, innovations in products and services can be implemented by individual intermediaries unilaterally and rather quickly. Such innovations thus take place in an entrepreneurial and opportunistic manner. In contrast, innovations in financial infrastructure must be more coordinated and, therefore, take longer to implement. As we see, for instance, with recent thrift and banking legislation in the United States, major changes, including outright elimination of obsolete institutions and their surrounding regulatory structure, take place exceedingly slowly. It is thus wholly unrealistic to expect financial innovation to proceed along a balanced path of development for the product and infrastructure components of the intermediary system. It is indeed possible that at times, the imbalance between these two elements could become large enough to jeopardize the very functioning of the system. Hence, the need for policy to protect against such breakdown. But, as we have seen, a single-minded policy focused exclusively on this concern could derail the engine of innovation and bring to a halt the financial system’s trip to greater efficiency.

As an example of policy that did not unnecessarily inhibit innovation, consider the case of the near-collapse of the security-trade processing systems at many U.S. brokerage firms during the bull market of 1970. The technology for processing orders at that time did not allow firms to cope with the large volume of transactions flowing into their “back offices.” Brokerage firms and their customers therefore had incomplete and in many cases inaccurate information about their financial positions. This breakdown eventually caused some of those firms to fail. The problem was temporarily solved without government intervention through cooperative action between the major stock exchanges. For a period of time, they restricted trading hours to allow firms to catch up on their processing of orders and reconciliation of accounts. The problem was finally solved and normal trading patterns resumed after the firms and exchanges made massive investments in new technology for data processing. With the balance restored between product demands and the supporting infrastructure, the system was actually able to handle efficiently a volume of business much larger than had caused the original breakdown.

The back-office problem of 1970 was resolved without formal government intervention. It is however less likely that such intervention could be avoided today if a problem arose of similar magnitude involving security transactions. The number of competing financial intermediaries and exchanges (including derivative-security exchanges) located around the globe would make it extraordinarily difficult for efforts at private voluntary coordination to succeed.

Conflicts between product innovation and the evolution of infrastructure in the financial-intermediation system are inevitable, but government actions can do much to either mitigate or aggravate their disruptive effects. By analogy, hurricanes are inevitable, but government policy can either reduce their devastation by establishing early warning systems or it can aggravate the damage by encouraging the building of housing in locations that are especially vulnerable to such storms.

While government actions can significantly influence the path of development for financial intermediation, successful public policy depends as importantly on recognizing the limitations of what government can do to control and improve the efficiency of the intermediation system.

As discussed in Section 2, the functional perspective emphasizes the discovery of more efficient ways to perform one or more of the six basic functions of the financial system as the fundamental driving force behind product innovations and institutional changes in financial intermediation. However, a different perspective holds that cost reduction or otherwise

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60 This analogy is taken verbatim from Merton (1989, p. 257).
lessening the constraints of regulation including taxes and accounting rules is the main force behind financial innovations. Miller (1986), for example, sees frequent and unanticipated changes in regulatory and tax codes as the prime motivators of financial innovation during the last quarter century. Silber's (1983) view that financial innovation arises from attempts to reduce the cost of various regulatory constraints on businesses is consistent with this perspective as is Kane's (1977, 1984, 1988) theory of dynamic regulation.

The two perspectives are not however in conflict, once differences in time horizon are taken into account. Regulation can have a powerful influence on innovation and the behavior of financial intermediaries in the short run. However, regulation both shapes and is shaped by the time path of financial innovation. Exogenous changes in regulation are surely possible in the short run. But such changes induce responses in financial innovation and institutional change which in turn feed back into the dynamics of regulation. As a result, the feasible set of sustainable regulatory policies are increasingly endogenously determined as the time horizon lengths. Therefore, regulatory change has a limited long-run role as an exogenous force for financial innovation and non-transitory structural changes in financial intermediation.

Both the time horizon that qualifies as the "long run" in this context and the scope of effective national government control over financial intermediation are likely to diminish in the future. Advances in telecommunications and computer technology have provided greatly increased flexibility in the choice of the physical and jurisdictional locations of financial intermediaries and markets. Consider, for example, the interbank foreign exchange market, arguably the largest financial market in the world. Consisting of a series of direct electronic connections among the computers of participating banks from around the globe, this market has no meaningful physical or political location. It is not regulated by any national authority, and it is moreover difficult to see how it could be.

The technological changes that have already dramatically reduced transactions and product-marketing costs are likely to make future changes in the institutional forms of intermediaries even more rapid and far-reaching. With much lower transactions costs, it becomes profitable not only to introduce new intermediation products, but also to change entire institutional arrangements (including geographical and political locations) in response to much smaller changes in customer tastes or operating costs than in the past. These lower transactions costs, together with the prospect of even greater global competition in financial-intermediation services, provide the basis for a substantial increase in both the frequency and the magnitude of the changes in the institutional structure of financial intermediaries. This forecast reduction in the "half-life" or expected duration of institutional forms applies not only to financial-service firms, but also to the regulatory bodies that govern them.

This increasing flexibility and global mobility of financial institutions have far-reaching implications not only for regulation of intermediaries at the national level, but for national monetary and fiscal policies as well. Thus, policymakers are effectively speculating against a long-run trend of declining transactions costs if they continue to assume that the "traditional" frictions of their individual financial systems will allow national governments to pursue monetary and related financial policies with the same degree of control as in the past. Much the same point applies to an individual nation's fiscal policy which will surely be further constrained not just with respect to transactions and other "targeted" taxes on financial intermediaries and markets but even with respect to general income tax rates, both personal and corporate.

As discussed in Section 2, a functional perspective on the financial system should prove more useful than an institutional one in times of rapid change. This perspective focuses attention on predicting the institutional structures that will perform the intermediation functions most effectively in the future. Armed with these forecasts, government could set policies and regulations to facilitate the requisite changes in structures instead of attempting to protect and preserve existing ones. Its flexibility with respect to different institutional environments makes the functional perspective on regulation more readily adaptable to a global setting for financial intermediation, which may be particularly useful if supranational regulatory bodies are to be formed.

A major shift in the format of regulation from "institutional" to "functional" seems inevitable. Increasingly more sophisticated trading technologies (such as the synthesizing production process of Section 4),

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61 This process is the essence of Kane's (1977) regulatory dialectic.
62 See, for example, Umlauf (1991) on the effects of a transactions tax on the location of trading for Swedish stocks and derivative securities.
63 Approximately $500 billion is transacted in this market every day.
together with low-transaction-cost markets to implement them, tend to blur the lines among financial-intermediation products and services. The existence of these technologies and markets also implies easier entry into financial intermediation. As a result, the institutional lines between financial intermediaries are also likely to become less distinct. Indeed, insurance companies now offer U.S. Treasury money-market funds with check writing, while as described in Section 4, banks use option and futures-markets transactions to provide stock-and-bond-value insurance that guarantees a minimum return on customer portfolios. Credit subsidiaries of major manufacturing firms, which once performed the single, specialized function of providing financing for customers of their parents, have become multiple-function financial institutions with intermediation services ranging from merchant banking for takeovers and restructurings to general credit cards and equity-indexed mutual funds sold to retail investors. In contrast, from the perspective of the user, the function of a financial product is relatively well defined.

As in the case of the interbank foreign exchange market, electronics has made problematic the meaning of “the location of the vendor” of these products. Most regulation of financial intermediaries involves products and services for household customers and, hence, the user’s location is often better defined than the vendor’s. Over time, functional uses of products are typically more stable than the institutional forms of their vendors. In keeping with the trend toward greater user access to international financial markets, product and service functions appear to be more uniform across national borders than are the institutions that provide them.

Functional regulation also reduces the opportunities for institutions to engage in “regulatory arbitrage,” which wastes real resources and can undermine the intent of the regulation. It thus promises more consistent treatment for all providers of functionally-equivalent products or services, thereby reducing opportunities for “rent-seeking” and “regulatory capture.” Furthermore, functional regulation can facilitate necessary changes in institutional structures by not requiring a simultaneous revision of the regulations, or the regulatory bodies surrounding them, as is required with the current institutionally-based regulatory structure.

The perceived benefits from a move to functional regulation might seem to support a broader case for widespread coordination, and even standardization, of financial regulations, both domestically and across national borders. However, such extrapolation is valid only if the coordinated regulatory policies chosen are socially optimal. The reduction in “regulatory diversification” that by necessity occurs with more effective coordination will accentuate the social losses if the selected common policies are suboptimal. The international issue of the trade-off between the benefits of regu-

latory cooperation and the benefits of regulatory competition promises to be among the more important financial regulatory issues of the 1990s.

8. Summary

Functions of the Financial System

- In serving its primary function of facilitating the allocation and deployment of economic resources, a financial system performs six core functions: 1) providing a payments system, 2) pooling of funds to undertake large-scale indivisible enterprise, 3) transferring resources through time and across geographic regions and industries, 4) managing uncertainty and controlling risk, 5) revealing information through prices to help coordinate decentralized decision-making, 6) reducing the costs of asymmetric-information problems including moral hazard and adverse selection.

- Financial intermediaries, other financial-service firms and the capital markets, together with the regulatory arrangements to govern their activities, constitute the institutional structure of the financial system. Government agencies that perform intermediary and capital market functions are included in that structure. The dynamic process by which this institutional structure changes is called financial innovation.

- A functional perspective on financial intermediation takes as given the economic functions performed by intermediaries, and asks what is the best institutional structure to perform those functions. Institutional form follows its function in the dynamics of structural changes.

- The most efficient institutional structure for fulfilling the functions of a financial system generally changes over time and differs across geopolitical subdivisions. In contrast, the basic functions of the system are essentially the same in all economies—past and present, East and West. A functional perspective is thus readily adaptable to a global setting for a financial system in an environment of rapid technological advance.

- A basic tenet of the functional perspective is that competition will cause the institutional structure of a financial system to evolve toward greater economic efficiency. This anatomical description of the system’s structural dynamics does not rule out the prospect of transient pathologies.

- Improvements in economic performance from financial intermediation

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69 Competition, as used here, is among alternative institutional structures including government involvement, if any. The tenet is not intended to imply that a perfectly competitive, laissez-faire financial system is always the most efficient institutional structure. It does imply that inefficient structures for a financial system, whether the result of government intervention or not, are not sustainable.
fall into three broad categories: (i) meeting investor or issuer demands to complete the markets, (ii) lowering transactions costs or increasing liquidity, (iii) reducing agency costs.

Institutional Competition and Complementarity: Intermediaries and Markets

- Over time, production of a given product tends to migrate from intermediaries to markets.
- Over time, production of a given function tends to move back and forth between intermediaries and markets.
- Via the "financial-innovation spiral," intermediaries and markets reinforce and improve each other.
- Markets and intermediaries are competing institutions from a static perspective and complementary institutions from a dynamic perspective.

Financial Engineering and the Production Process.

- Underwriting production approach to intermediation: emphasizes product distribution; "traditional" investment-banking methods of an agent; transparent institution; exemplifies Ross "marketing" theory of intermediation.
- Synthesizing production approach to intermediation: emphasizes trading; hedging methods of a principal; opaque institution; exemplifies "transactions cost" theory of intermediation.
- Key efficiency issue between the two approaches is how effectively each handles the risk of contract default on products.
- The interactive dynamics between the two approaches to production are analogous to those for markets and intermediaries: static competitors on products and dynamic complementors as part of the financial-innovation spiral.

Risk Control and Capital Budgeting.

- Customers and investors: customers prefer contract payoffs insensitive to the fortunes of the issuing intermediary.
- Contract-default (credit) risk depends on total (not, just systematic) risk of intermediary because transactions costs for customers prohibit their hedging or diversifying of the default risk of the contract.
- Agency costs for guaranteeing contract performance of an opaque intermediary increase with increases in the total risk of intermediary.
- Value-additivity fails for capital-budgeting decisions in a credit-sensitive multi-business intermediary.
- Passive diversification strategies within an opaque intermediary will not increase market value of the intermediary; hedging may increase value.
- Decentralized capital or agency-cost allocations based on marginal cost of each business will generally leave an aggregate unallocated cost for the intermediary.

Regulation of Financial Intermediaries.

- Government role in improving efficiency of financial intermediaries includes promoting competition, insuring market integrity and "public good" externalities; important example is to protect against breakdown from product and infrastructure imbalance without hindering innovation.
- Regulatory policies must take account of feedback effect on changes in financial products and intermediaries.
- Substantially reduced transactions costs mean that relatively small changes in customer tastes or operating costs can cause intermediaries' institutional arrangements (including global geographical and jurisdictional locations) to change substantially.
- Effective approaches to regulatory, monetary, and fiscal policies must take account of the changes in technology, globalization, and competition among governments.
- The dynamics of the "regulation, deregulation, re-regulation" process between government and intermediaries is similar to the "competitor-complementor" pattern between markets and intermediaries.
- Functional perspective in organizing regulation has multiple advantages from both a national and global perspective.
- Tradeoff between the benefits of global regulatory cooperation and regulatory competition is among the more important financial regulatory issues of the 1990s.
Appendix: A Model of Credit-Sensitive Businesses for Intermediaries

This appendix provides the detailed model development for the hypothetical example of Section 6. All businesses are extremely credit-sensitive so that they can only be operated if customer contracts are default-free. Let \( V_j(t) \) denote the gross asset value of business \( j \) at time \( t \) on a stand-alone basis, given that customer contracts are default-free. It is assumed that, conditional on \( V_j(t) = V_j(t + \tau)/V_j(t) \) is distributed log-normal with expected value \( V_j(t + \tau) = E[V_j(t + \tau)/V_j(t)] \) and variance rate, \( \sigma_j^2 = \text{Var} \{ \log[V_j(t + \tau)/V_j(t)] \} \). Let \( L_j(t) \) denote the value at time \( t \) of customer contracts which are guaranteed liabilities of the issuing intermediary. It is assumed that \( L_j(T) = L_j \), an amount specified at \( t = 0 \) and hence, \( L_j(t) = L_j \exp[-r(T - t)] \) where \( r \) is the riskless interest rate which is constant over time.

The actuarial guarantee value for the aggregate of customer contracts is modelled using the loan-guarantee valuation formula (Merton 1977, p. 8, eq. (4)), given by

\[
G(V,t,L;T,r,\sigma^2) = L \exp(-r(T-t)) \Phi \left( x_1 \right) - V \Phi \left( x_2 \right) \tag{A.1}
\]

where \( x_1 = \frac{\log(L/V) - (r + \sigma^2/2)(T-t)}{\sigma \sqrt{T-t}} \), \( x_2 = x_1 + \sigma \sqrt{T-t} \);

and \( \Phi() \) is the cumulative standard normal distribution density function. In this model, the volatility of the asset value \( V \) is measured by the standard deviation of its logarithmic change between \( t \) and \( T \), \( \sigma \sqrt{T-t} \).

At time \( T \), the (stand-alone) business \( j \) as an intermediary must pay its customers \( L_j \). If the assets of the intermediary exceed \( L_j \), then its owners receive the residual value, \( V_j(T) - L_j \). Otherwise, they receive nothing and the third-party guarantor makes up the shortfall so that the customers still receive \( L_j \). Thus, at time \( T \), the equity value of the intermediary is given by \( V_j(T) - L_j + \max[0,L_j - V_j] \). Let \( I_j \) denote the amount of tangible investment (other than the cost of the customer-contract guarantee) needed to acquire the assets of business \( j \). The gross net present value of business \( j \) on a stand-alone basis at time 0 is defined as

\[
GPV_j = V_j(0) - L_e^{-rT} + G(V_j(0),0;L_j,T,r,\sigma_j^2) - I_j \tag{A.2}
\]

where \( G \) is the actuarial guarantee value of business \( j \) as a stand-alone company using (A.1).

In the example of Section 6, the guarantee is purchased at time 0. It is assumed that the guarantor requires the intermediary to have an initial "cushion" of assets that exceeds the current value of customer liabilities by 5 percent. That is, \( V_j(0) = 1.05 L_j(0) \). The tangible capital of the firm, \( K_j(0) \), is thus defined by \( K_j(0) = V_j(0) - I_j(0) = 0.05 L_j(0) \). It is further assumed that \( T = 1 \) year and \( r = \log(1.05) \). Table A.1 provides the various stand-alone properties of businesses A, B, C, and D for the example of Section 6.

To analyze an intermediary that holds more than one business, we must specify some further distributional properties. Let \( V(t) \) denote the gross asset value for an intermediary that holds \( n \) businesses. By assumption, there are no operating synergies from combining the businesses and so, \( V(t) = \sum V_j(t) \). The aggregate customer-liability value is given by \( L(t) = \sum L_j(t) \). The fraction of the intermediary's asset "portfolio" initially allocated to business \( j \), \( w_j \), is given by \( w_j = V_j(0)/V(0) \). To simplify the computation of the customer-contract guarantee value for the entire intermediary, we approximate the gross asset value of the intermediary at time \( T \) by \( V(0) \exp \{ \sum w_j \log[V_j(T)/V_j(0)] \} \). This approximation is "as if" the asset portfolio were continuously rebalanced between \( t = 0 \) and \( t = T \) to the initial weightings \( (w_1, \ldots, w_n) \). This "log-normal approximation" for the portfolio distribution is commonly used for valuing options on a portfolio of stocks such as the Standard & Poor's 500. The quantitative errors induced by this approximation in no way distorts the basic points illustrated by the example in Section 6.

With this approximation, the variance rate for the intermediary's asset portfolio is computed as \( \sigma^2 = \sum w_i w_j \sigma^2_i \sigma^2_j \) where \( \sigma^2_i \) is the correlation between \( \log[V_i(T)] \) and \( \log[V_j(T)] \). For the example of Section 6, the correlations are assumed to be the same among all businesses and equal to 0.40. That is, \( \sigma_{ij} = 0.40 \) for all \( i \neq j \). The actual value of the guarantee is computed from (A.1) as \( G(V(0), 0; L(T), T, r, \sigma^2) \). Table A.1 provides the various properties for combinations of businesses in the example of Section 6.

**TABLE A.1.** Properties of Businesses: Stand-Alone and in Combinations at Time 0 ($ millions)

<table>
<thead>
<tr>
<th>Business</th>
<th>Standard Deviation</th>
<th>Asset Value $V(0)$</th>
<th>Customer Liability $L(0)$</th>
<th>Tangible Capital $K(0)$</th>
<th>Tangible Investment $I(0)$</th>
<th>Guaran &quot; e Value $G(0)$</th>
<th>Gross Net Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.100</td>
<td>$10,178</td>
<td>$9,693</td>
<td>$485</td>
<td>$185</td>
<td>$200</td>
<td>$500</td>
</tr>
<tr>
<td>B</td>
<td>.200</td>
<td>3,325</td>
<td>5,081</td>
<td>234</td>
<td>54</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>C</td>
<td>.400</td>
<td>2,669</td>
<td>2,884</td>
<td>144</td>
<td>40</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>D</td>
<td>.600</td>
<td>3,029</td>
<td>2,884</td>
<td>144</td>
<td>144</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>A + B + C</td>
<td>.120</td>
<td>15,412</td>
<td>17,658</td>
<td>893</td>
<td>293</td>
<td>615</td>
<td>121%</td>
</tr>
<tr>
<td>A + B</td>
<td>.112</td>
<td>13,515</td>
<td>14,714</td>
<td>739</td>
<td>239</td>
<td>370</td>
<td>70%</td>
</tr>
<tr>
<td>A + C</td>
<td>.141</td>
<td>13,270</td>
<td>12,578</td>
<td>629</td>
<td>229</td>
<td>455</td>
<td>855%</td>
</tr>
<tr>
<td>B + C</td>
<td>.228</td>
<td>8,364</td>
<td>7,055</td>
<td>398</td>
<td>98</td>
<td>559</td>
<td>859%</td>
</tr>
<tr>
<td>A + B + D</td>
<td>.138</td>
<td>18,542</td>
<td>17,658</td>
<td>893</td>
<td>383</td>
<td>615</td>
<td>115%</td>
</tr>
</tbody>
</table>
References


American Enterprise Institute for Public Policy Research.


