What Is Systemic Risk? Moral Hazard, Initial Shocks, and Propagation

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This paper discusses different aspects of the notion of systemic risk. It contains a selective survey of the research on related topics, a review of some case studies of financial crises and failures, and a discussion pointing toward the importance of moral hazard as a key element of systemic risk. The main ideas studied are the links between capital structure theory and bank capital regulation, and moral hazard and agency theory at the level of the individual trader, the financial firm, and the overall financial system. Another important idea is the co-determination of asset prices and bank solvency. My main focus is on moral hazard as a potentially fruitful area for future research. Although existing research emphasizes the powerful propagation mechanisms whereby a small initial shock can be amplified by the financial system, I suggest that moral hazard, together with leverage at the level of the individual firm, can cause a large shock to the financial system.

Key words: Systemic risk; Moral hazard; Bank solvency; Financial system stability; Bank capital regulation

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I. Introduction

The purpose of this paper is to discuss different notions of systemic risk, and to clarify the main ideas and policy issues relating to systemic risk. Although it is partly a survey, it also explores ideas for new directions in research on systemic risk. It is idiosyncratic rather than comprehensive in the sense that, although I cover quite a range of topics (existing research literature, case studies, and ideas on systemic risk), the selection of topics reflects a personal view on what is relevant.

The problem of systemic risk is of great interest to public policy makers, notably central bankers, since the prevention of systemic risks is one of the main tasks of the central bank. The 1998 financial crisis in developing countries in Asia, Russia, and Latin America underlines that this concern is justified. Although the more developed economies have largely escaped damage in this crisis, concern about the present high level of equity markets, notably in the United States, reflects the potential for problems there as well.

Despite this, there is not a fixed, universally recognized definition of systemic risk. The phrase is used to describe several different kinds of financial crisis. For example, it can be used in a narrow sense to describe problems in the payments system, or at the other extreme in a very broad sense to describe a financially driven macroeconomic crisis. In this paper, I shall attempt to address this deficiency, not by providing a comprehensive analysis but by discussing the meaning of systemic risk and by discussing how existing economic models can be related to the problem of systemic risk.

The organization of the paper is as follows. I start by discussing several different notions of systemic risk (Chapter II). My starting point is the idea that systemic risk, being a matter of public policy, should refer to cases of risks being imposed on the financial system where some element of externality exists. In other words, financial regulators have a legitimate interest in intervening when somebody takes a risk that then causes a further risk for others in the financial system. This externality means that overall risk-taking may be excessive.

I next survey some selected research that bears on the topic (Chapter III) and synthesize and discuss the main ideas that emerge from this literature (Chapter IV).

Having explored the academic literature on systemic risk, I look at the problem in another way by turning to a small number of cases of financial crises of regulatory interest, including both cases where an individual firm was the source of the problem, and cases of more general failure of the financial sector (Chapter V). Some of these are well-known cases, others less so. These cases are not selected to have any special common features, nor to support any particular theory. From them I infer that moral hazard, broadly defined, is an important element of financial crises.

This motivates a discussion of problems of moral hazard in relation to financial failure. I discuss different kinds of moral hazard problem in Chapter VI, both at the individual level and at the collective level. I then return (Chapter VII) to a more comprehensive review of various cases of financial failure, discussing which aspects of moral hazard are of greatest importance in these cases. My main conclusion is that straight moral hazard of the kind usually studied in economics is less important than

a kind of collective moral hazard in which the corporate culture is flawed in terms of incentives, either by being too weak and passive or by encouraging aggressive individual behavior that may not be in the collective interest. Chapter VIII concludes.

The main departure in this paper from the existing literature on systemic risk is that I emphasize the origin of the shocks that can cause financial crises, rather than the propagation mechanisms whereby a small shock to one firm can spread to other firms and be amplified into a large shock to the whole system. Implicitly, the approach suggested here is that initial shocks can be multiplied inside the firm by moral hazard and financial leverage, so that an individual firm may deliver a large shock to the financial system. Additionally, it may be that many firms take similar actions and hence may deliver highly correlated shocks. The Long-Term Capital Management (LTCM) crisis is an example. I do not suggest that the propagation mechanisms are unimportant, but that it may also be fruitful to consider the initial shocks that may trigger systemic risk.

II. Different Notions of Systemic Risk

The term "systemic risk" has been used to cover different types of economic and regulatory problems. I shall discuss four of these different meanings, to provide an organizing framework for the ideas developed later in this paper.

A. Systemic Risk and Depositor Protection

Research in banking has focused heavily on the role of deposit insurance in influencing the development of the banking industry (for a survey, see Freixas and Rochet [1997]). This deposit insurance may be explicit, or it may be implicit—banks that are too big to fail provide an example of institutions whose implicit insurance from the government is probably more valuable to depositors than whatever explicit deposit insurance scheme may be in place. Starting from Bagehot (1873), deposit insurance and the central bank's role as lender of last resort have been identified as important instruments for preventing general bank panics as well as individual bank runs. On the negative side, deposit insurance encourages asset substitution: banks have an incentive to take excessively risky positions so that, in the event of insolvency, the losses will be borne by the deposit insurer rather than by either the shareholders or the depositors. The savings and loan (S&L) crisis in the United States in the 1980s exemplifies these problems and suggests a view of deposit insurance as an exogenous, politically inspired distorting subsidy.

A different perspective is given in Dewatripont and Tirole's book (1994b). They take the view that some form of depositor protection is an important and desirable part of banking regulation. Essentially, their argument is that banks are just like other firms except that they are highly leveraged with many small debt-holders (i.e., the depositors). Since banks are highly leveraged, their debt-holders should monitor the management, but since the depositors are small and dispersed it is impractical for them to do so. Hence the need for a regulatory agent (e.g., the deposit insurer) to act in the depositors' interests.

Although depositor protection has been a dominant theme of academic research on banking regulation, I shall not say much about it in this paper. There are two reasons for this. The first is that I believe the existing research does not leave much unsaid. For example, the standard argument against depositor insurance as an incentive to asset substitution is clear and has been made many times in the literature. For a comprehensive account of banking research, see Freixas and Rochet (1997).

The second reason for concentrating on other aspects of systemic risk is that the adverse incentive effects of deposit insurance can be reduced substantially by prompt closure of banks that are approaching insolvency. This can occur in either of two ways. First, if regulators can continuously monitor the capital adequacy of a bank, they can intervene to force it to close before its equity value falls to zero. Secondly, if the market can observe the same information, the bank will also be forced to close since it will cease to be able to find trading counterparties. Improvements in transparency, caused by both regulatory measures such as the Basle Committee capital adequacy rules and by private-sector developments such as better risk management systems, will surely make these mechanisms increasingly effective in the next few years. For example, when Yamaichi Securities closed in 1997, it was claimed to be marginally solvent (in fact, it was probably insolvent, but still not by much when one considers that it practiced bookkeeping irregularities to create hidden trading losses). Although press reports described the Yamaichi failure in predominantly negative terms, it seems on the contrary to have been a relatively well-controlled closure: the firm was closed before it had accumulated very large losses, and the closure was partially anticipated by the market and reflected in increasing funding costs for the firm. If greater transparency and risk management ensure that future closures of banks and securities firms are as smooth as Yamaichi Securities, many aspects of the problem of systemic risk will be much reduced.

B. Systemic Risk and Payments Systems

The disruption to the payments system caused by the default of one or more banks is often viewed as a form of systemic risk. The chaos caused by the Herstatt failure illustrates some of these problems. Much of the recent debate has focused on difference between gross and net settlement: gross settlement avoids most of the problems of systemic risk, and progress in information technology has made it much easier to implement.

As this is a rather technical subject, I start by explaining the differences between the institutions of gross and net settlement. With deferred net settlement (DNS), payment orders are accumulated at the settlement system over a suitable interval (e.g., a day), and at the end of the period the net amounts are settled either on a bilateral basis between pairs of banks (e.g., CHIPS in the United States), or on an overall basis between each individual member bank and the central system organizer. With real-time gross settlement (RTGS), all payments are immediately settled by making a transfer from the sending bank's account at the system organizer (usually the central bank) to the payee's account. In many countries, both DNS and RTGS coexist. For example, the Bank of Japan Financial Network System (BOJ-NET) has

both a DNS portion and a (much smaller) RTGS alternative, while the United States has both the privately organized CHIPS (DNS) and the Federal Reserve's Fedwire (RTGS). Within RTGS systems, there is an important dichotomy: on the one hand, some systems do not allow the participants ever to overdraw on their accounts with the organizer (as in the Swiss National Bank's SIC), or else they only allow fully collateralized credit (as in the United Kingdom's private-sector CHAPS). On the other hand, Fedwire allows uncollateralized overdrafts and thus, effectively, the Fed's lender-of-last-resort function becomes entangled with its role as a payments system operator.

If we focus more specifically on the differences between RTGS and DNS payments systems in terms of systemic risk (i.e., ignoring the separate question of lender-of-last-resort policy) the appropriate comparison should be between DNS and RTGS without overdrafts (or with fully collateralized overdrafts). The traditional discussions in the literature (see the useful survey by Holthausen [1997]) mostly suggest that RTGS has the benefit of reducing systemic risk at the cost of requiring banks to hold higher reserves in their accounts with the payment system operator. The incentive for banks to use DNS is illustrated by Fedwire's declining payment volume relative to CHIPS: from 57 percent of the total in 1980, to 48 percent in 1990 and 42 percent in 1994 (Summers [1996]). However, being required to support RTGS payments with a proportionate non-interest bearing reserve deposit at the central bank cannot be regarded as a social cost. It is pure distortion that could be eliminated by paying market interest rates on the deposits or by allowing banks the alternative of depositing government securities as collateral. Hence, moves toward RTGS, such as the European Union's TARGET system for the euro currency zone, seem desirable.

Since the arguments concerning payments systems are somewhat separate from the other issues that are the main focus of this paper, and since there is quite a well-developed literature on payments systems, I shall not discuss them further. The reader is referred to Rochet and Tirole (1996b) and Freixas and Parigi (1997) for models of risk in payments systems, and to Holthausen (1997) for a survey of the literature in this area.

C. Systemic Risk and Endogenous Asset Values

The third notion of systemic risk that I shall consider in this paper is linked to the idea that asset values are determined endogenously in equilibrium. In general, the assets of one bank depend on the actions and the profitability of one or more other banks. For example, if bank A has deposits with bank B and B becomes insolvent, this will damage A, perhaps to the point that A becomes insolvent also. Or if bank A has real estate and also holds real estate mortgages, and other large banks in the same economy are also involved in the real estate market, if these banks decide to sell their holdings or foreclose on more of their loans, this will depress property prices and damage bank A.

This effect could operate in more attenuated ways, as well as more extreme ways. For an example of the former, we can consider what happens if a bank's value falls and, either to maintain capital adequacy ratios or as part of a policy of optimal

capital structure, it responds by selling assets. This can depress asset values and hence set off the same process at other banks. This weaker form of the effect illustrates that it is not necessary for any firm to default for asset prices to be depressed by this mechanism. A more extreme version of this effect would be when one firm defaults and sells assets, depressing asset values to the point where another firm may also default. This chain reaction is similar to what is often called the "domino effect" of default.

D. Macroeconomic Aspects of Systemic Risk

The final type of systemic risk that I wish to distinguish is essentially a macroeconomic variant of the previous one. The effect I just described was microeconomic in nature, but one can see that similar effects could also arise in a macroeconomic context. Falling asset values, leading to reduced capital adequacy for banks and lower collateral values for borrowers, could reduce national income. Fisher (1933), "The Debt-Deflation Theory of Great Depressions," is a classic analysis of the macroeconomic role of debt; below, I shall survey more recent research that captures some of these effects.

III. Review of Selected Research Literature

In this chapter, I review some of the main research contributions that are related to the idea of systemic risk. The papers are, for the most part, simply described and summarized individually in this chapter. Later, in Chapter V, I relate the papers to each other and draw out what I believe are the main themes that emerge from this research in relation to systemic risk.

The papers surveyed are Blum and Hellwig's (1995) paper on macroeconomic implications of capital regulation, Hellwig's (1995) work on intermediation and risk allocation, Allen and Gale's (2000) model of financial crises, empirical work by Bernanke (1983) and others, and theoretical work by Kiyotaki and Moore (1997a, 1997b) and by Suarez and Sussman (1997a, 1997b) on the role of credit in business cycles, and Holmström and Tirole's (1997) model of bank lending cutbacks in recession.

There are, of course, many other papers that touch on the theme of systemic risk. The papers surveyed here are chosen because they suggest certain common themes that will be elaborated in the discussion in Chapter V below.

A. Blum and Hellwig (1995): Macroeconomic Effects of Capital Adequacy Rules

Blum and Hellwig's paper was inspired by the widespread international efforts (e.g., by the Basle Committee on Banking Supervision) toward the introduction of bank capital requirements. Their idea is that minimum capital requirements impose an upper bound on the amount of bank lending for a given capital base. A negative shock to the economy, by reducing bank profits and hence bank capital, will lead to reduced lending in subsequent periods. Hence, the effects of a negative shock to the economic system will be amplified by the rigid link between banks' balance sheets and their capital base. They show this using a standard macroeconomic model similar to IS-LM.

B. Hellwig (1995): Hidden Aggregate Risk Exposure

Hellwig has written several papers on risk and the role of banks in the economy, e.g., Hellwig (1991, 1994a, 1994b, 1995, 1998). One point that emerges in several of these is that risk regulation (such as the Basle Committee capital adequacy rules) may be defective because it focuses only on the individual bank and not on the banking system as a whole. For an extreme example, consider a banking system of 500 individual banks, where the n-th bank (all the way from $n = 1$ to $n = 500$) has liabilities of duration n months and holds assets of duration $n + 1$ (Hellwig [1995]). While each may look as if it is not highly exposed to the term structure, the interest rate exposure of the banking system is large because it has transformed a one-month liability into a 40-year asset. For a more realistic example driven by similar principles, if banks trade a large amount of swaps among themselves, there will be a low "signal-to-noise" ratio as interbank swap volume is large relative to fundamentals. Individual risk exposures will not reveal the exposure of the whole system.

Similar effects could also arise through inadequate modeling of risk exposure in the economy. For example, a bank might consider itself hedged against interest rate risk, but could still be hit by an interest rate rise that causes debtor insolvencies. Thai banks might borrow in U.S. dollars and lend in dollars to domestic firms that subsequently turn out to have no dollar income.

C. Allen and Gale (2000): Bubbles and Crises

Allen and Gale (2000) attempt to model the role of asset price bubbles in financial crises. Their model has two main ingredients. First, financial institutions engage in asset substitution, thereby bidding up the price of risky assets and causing a bubble. Secondly, credit expansion enhances the effect of asset substitution both contemporaneously and in anticipation.

Allen and Gale (2000) present two versions of their model. In the simpler version, banks with a fixed supply of funds to lend interact with firms or individuals that want to borrow. Borrowers can choose either safe investments or risky ones and, because of the limited liability option, will tend to prefer risky investments: in other words, asset substitution will occur. In their model, the supply of risky investments is fixed, hence the increased flow of cash into risky investments will tend to drive up the price. Both the price of the risky asset and the incidence of default are higher than they would be in the absence of asset substitution. The authors interpret the higher asset prices as a bubble and the higher chance of default as a financial crisis.

In the more complex version of the model, the asset substitution problem becomes more severe in a multi-period setting. Uncertainty about the supply of funds for investment (interpreted as being under the control of government monetary policy) introduces an extra element of risk and increases the value of the limited liability option for borrowers. This increases the size of the bubble and the chance of crisis.

Unlike most of the other papers reviewed here, Allen and Gale (2000) do not model the spillover effect of the financial sector on the real economy. Hence, although they implicitly take for granted that financial crises will have real effects, this is not part of their analysis.

D. Bernanke (1983) and Others: The Credit Channel

Traditional (neoclassical) macroeconomic analysis has downplayed the role of economic institutions in economic crises (this also applies to the more recent real business-cycle theory). In particular, Friedman and Schwartz's (1963) study of the U.S. financial crisis of 1930–33 suggested that the primary way in which bank failures made the recession worse was through the "monetary channel," i.e., the banking crisis led to a rapid contraction in the supply of money which in turn affected national income. Bernanke (1983) argues that, in addition to their role in the monetary channel, banks have an important role in producing and processing information as part of their business of making loans. Hence, a destruction of part of the banking system as a result of bank failures has real economic costs just as the destruction of physical assets would (note that one-third of U.S. banks failed over the period 1930–33). In addition to the effects of bank failures, surviving banks in the Great Depression made fewer loans, as they switched to more liquid assets rather than holding loan portfolios. A third effect is caused by the nature of loan contracts: a defaulting borrower must enter a costly and protracted bankruptcy process. Together, these effects suggest a "credit channel" for the real effects of the financial crisis. Bernanke gives empirical evidence to support the existence of the credit channel.

Bernanke and Gertler (1989) present a theoretical model that represents a stylized view of how the credit channel might operate. They argue that a borrower with a strong balance sheet is effectively fully collateralized and can borrow without the lending bank incurring any monitoring costs, while a borrower with a weak balance sheet needs more intensive bank monitoring. These monitoring costs are shifted onto the borrower in equilibrium in the form of a higher interest rate, and hence may reduce investment as projects that are positive net present value (NPV) at the riskless rate become uneconomic at the higher rate. Thus, shocks to balance sheets, including distributional shocks, can initiate macroeconomic fluctuations.

Some empirical evidence in favor of the credit channel is presented by Kashyap, Stein, and Wilcox (1993). They show that an overall contraction in firms' financing is accompanied by a switch in short-term external financing from bank loans to commercial paper. This switch away from bank financing also seems to have real effects on investment. This suggests that non-intermediated financing is an imperfect substitute for bank financing.

Subsequent work in this field has concentrated on refining the idea that banks in recession will switch to holding more liquid assets. This idea is often described as a "credit crunch" or a "flight to quality." Gertler and Gilchrist (1993, 1994) find that, in recessions, large firms in the United States appear to be able to continue financing inventories as sales fall, while small firms cut back sharply. Similarly, Oliner and Rudebusch (1993) find that small firms are quicker to cut back investment. These results are confirmed by more recent work by Bernanke, Gertler, and Gilchrist (1996) using disaggregated data on individual manufacturing firms. They also note that, while small firms make up around half of the manufacturing sector in the United States (by sales), they account for over three-quarters of sales in wholesale and retail trade, services, and construction.

E. Kiyotaki and Moore (1997a): Credit Cycles

Kiyotaki and Moore (1997a) construct a model in which firms' borrowing is constrained by the collateral they can provide in support. The collateral consists of holdings of suitable fixed assets such as land. A small negative shock to productivity reduces firms' profits and hence their cash position, and if their collateral constraint is binding they will be unable to borrow more to maintain investment. Hence investment, including investment in assets, must be reduced. This will cause asset prices to fall, exacerbating the collateral constraint.

This describes a static multiplier process by which a temporary shock to productivity may have a magnified effect on asset prices and hence on lending and output. However, there is also a stronger dynamic element to the multiplier. The temporary shock to productivity has a permanent effect on the profitability of firms whose borrowing is collateral-constrained, since in each period their investment is reduced and hence their profits next period are also reduced—repeating the initial process. Thus, their demand for collateralizable assets will be permanently reduced, and this permanent fall in asset demand will be reflected in a much larger current drop in asset prices.

These ideas are developed further in Kiyotaki and Moore (1997b) and in Kiyotaki (1997). One problem with the analysis in Kiyotaki and Moore (1997a) is that the model is highly complex, and hence the initial shock is modeled as an unanticipated disturbance, rather than the outcome of a random variable whose uncertainty is anticipated by firms. Another problem is that the contracts are suboptimal in the sense that it would be better to index the repayment promised to the level of asset prices. In current research, Kiyotaki and Moore are working a fully specified stochastic model that extends the analysis to address both of these problems.

F. Suarez and Sussman (1997a): Endogenous Financial Cycles

The research described above (Bernanke [1983] and Kiyotaki and Moore [1997a]) describes how the financial sector may have a significant role in initiating and propagating recession, and in amplifying the effect of shocks to the economy. However, these accounts are incomplete in that they do not provide an account of how an economy may pass in and out of successive recessions over time. There is a propagation mechanism (the "credit channel") but no reversion mechanism. Suarez and Sussman (1997a) address this by providing a model of a highly stylized and simplified economy that cycles in and out of recession over time, and where the financial sector is the main mechanism driving these cycles. They concentrate on describing a reversion mechanism rather than the propagation mechanism.

The model is based on an extension of the Stiglitz and Weiss (1981) model of credit, extended to two periods. The Stiglitz and Weiss model (which also served as a motivation for Bernanke's work on the credit channel) is based on the idea that, from a bank's point of view, borrowers' creditworthiness tends to fall as the interest rate demanded increases (this can happen either because of adverse selection or because of moral hazard). This leads to inefficiencies in funding investment by bank loans: for example, credit rationing may occur in equilibrium. For example, Suarez and Sussman suppose that firms are run by entrepreneurs whose effort level affects

the viability of the firm's projects. External financing reduces their incentives to provide effort.

Cycles in their model are caused by the following mechanism. A boom results in high output of both capital and consumption goods, leading to lower prices. This in turn reduces firms' profitability and worsens the incentive problems caused by external finance, leading to increased business failures and recession. As a result prices rise, restoring profitability to surviving firms, reducing incentive problems and causing a boom again. They show that, even in the absence of any external shocks, their economy will display cycles.

While the model is arguably oversimplified in many ways, two virtues are that it endogenizes the price of capital goods as part of the equilibrium, and that it considers optimal contracting arrangements for external financing rather than exogenously specified contractual forms such as a standard bank loan agreement.

These ideas are developed further in Suarez and Sussman (1997b), a related paper that places greater emphasis on the role of capital goods prices in financially intermediated business cycles. The mechanism they suggest is as follows: firms that invest in a boom will buy capital goods at a high price, hence they need more external finance and this debt burden will give them a higher likelihood of bankruptcy. The resulting wave of liquidations will result in lower prices of capital goods, and firms that invest then will have a lower chance of default, leading to a boom. The paper also examines the effect of different insolvency codes on the economy in equilibrium, concluding that, surprisingly perhaps, a more debtor-oriented code (such as Chapter 11 bankruptcy in the United States) will accentuate the economy's cyclicality.

An interesting application of this analysis that suggests itself (although not mentioned by the authors) would be to use it to study the real estate market. Beyond that, the advantage of this model is that, although more stylized than the other analyses reviewed here, it provides an equilibrium description of the complete cycle and not just of the onset of recession.

G. Holmström and Tirole (1997): The Balance-Sheet Channel

Like many of the papers described above, Holmström and Tirole (1997) present a model where banks are intermediaries whose economic role is to reduce informational asymmetry. The main difference is that it also describes the role of banks' balance sheets on the patterns of financing in the economy. Hence, it can separately represent a "balance-sheet channel" and a "lending channel" for the real effects of financial intermediation. In the "balance-sheet channel," if the value of firms' collateral is reduced it will be harder for them to raise external finance, and if they do they will be forced to rely more heavily on bank finance rather than (cheaper) securities issues. A contraction via the "lending channel" (a reduction in bank capital) reduces both the accessibility of external finance and the relative use of intermediated finance versus the issue of debt securities.

As in much of the literature, a crucial initial assumption is the difficulty of raising equity finance (for either banks or other firms). Although there are various theoretical models that can be invoked to help justify this assumption (e.g., Myers and Majluf

[1984]), this remains an open and important question for research. Holmström and Tirole conclude their paper with a discussion of this point.

IV. Central Themes in Research on Systemic Risk

A number of central themes emerge from the above discussion of the research literature. Here I shall discuss what seem to me to be the main ones.

A. Institutions Do Matter

Traditional (neoclassical) economics takes the view that an economy is determined by its "fundamental" characteristics such as individual preferences, technological possibilities, and resource endowments. An institution such as a bank or a firm is merely a "veil" that covers, but does not hide, the underlying form of the economy's production function. There are two different instances of this point of view that are relevant to the above literature.

The first arises in macroeconomics and is exemplified by the traditional "monetary channel" view of the role of the banking system in recessions. This view is that the main channel for propagating the recession is the aggregate money supply (the Friedman and Schwartz view of the U.S. Great Depression only admits a role for institutions insofar as they consider the degeneration of the clearing houses, caused by the Fed, to have led to the reduction in the money supply). In contrast, more recent research has emphasized that financial intermediaries have a real economic function in producing information and in monitoring borrowers. Note that the analytical tool used to model this function is the economics of asymmetric information.

The second instance is in relation to the Modigliani-Miller theorem, which views the firm as a transparent vehicle for the claim-holders to own the assets of the firm. Much of the research described above (Bernanke [1983], Bernanke and Gertler [1989], Kiyotaki and Moore [1997a], and Suarez and Sussman [1997a, 1997b], etc.) is based on violations of this principle, using asymmetric information as the reason why firms cannot costlessly raise external finance. However, from the point of view of systemic risk it is also important that the M&M theorem cannot apply to banks either: for example, discussion of capital adequacy regulations makes no sense unless we acknowledge that banks find equity expensive relative to other forms of capital (Schaefer [1990]). Holmström and Tirole (1997), Blum and Hellwig (1995) and Hellwig (1998) explicitly start from the assumption that bank equity is limited. For a model of bank capital structure, see Dow and Rossiensky (1997). For a discussion the applicability of the M&M principle to banking, see Miller (1995).

Unfortunately, our understanding of why and when the M&M principles fail to apply is incomplete. It is easy to see that a firm with a limited equity base may face a variety of difficulties in raising debt; some ways in which this can happen are due to the presence of asymmetric information. However, the reasons for limitations on equity finance are less obvious (particularly if rights issues are used). Myers and

Majluf (1984) suggest an explanation based on divergent interests between existing and new shareholders. However, there are theoretical problems with the foundations of this model (see Raposo [1999]).

B. Endogenous Asset and Collateral Values

Several papers reviewed above feature models where firms require collateral to raise finance, and collateral values are endogenously determined in equilibrium. We can view the effect of endogenous asset values at two levels. First, at the level of nonfinancial firms, their real asset values are endogenously determined, as in Kiyotaki and Moore (1997a) and Suarez and Sussman (1997a, 1997b). Secondly, similar effects may operate at the level of banks. For example, if a bank is capital constrained or is closed while holding a large portfolio of property mortgages or business loans, the result might be a more aggressive policy on foreclosures or bad loans. This could result in depressed land prices or in business failures that in turn could weaken other banks.

This effect has clear policy relevance for bank regulatory policy, although the literature does not seem to have explored this. Blum and Hellwig's (1995) model has similar implications for regulatory policy, but does not operate via the same effect of endogenous asset prices.

C. Costs of Financial Distress

A more extreme version of these kinds of effects can occur when banks or nonfinancial firms fail. This also provides an instance of the idea that the corporate "veil" may be more substantial. The idea that financial failures may acerbate economic downturns is, of course, an old one going back to Fisher (1933) and others. Among the literature reviewed above, it is present in Allen and Gale (2000) and Bernanke (1983). Together, they suggest that debt may have costs in aggravating and propagating financial crises (supporting the notion of minimum capital requirements).

One has to distinguish carefully between financial distress *per se* and costly financial distress. Traditionally, financial economics, and particularly the theory of corporate finance, has been careful to maintain this distinction. Modigliani and Miller (1958) emphasized that bankruptcy, in itself, does not affect the validity of their central result on the irrelevance of capital structure. What does make debt more costly, however, is when the bankruptcy process is costly and reduces the value of the firm's business.

Studies for nonfinancial firms confirm that bankruptcy can be quite costly. For example, Warner (1977) estimates the legal and other direct fees of a sample of U.S. railroad companies at 4 percent on average, while other studies suggest the more intangible costs could be several times as high. See Senbet and Seward (1995) for a survey of research on bankruptcy costs. This work is based on nonfinancial firms and there do not seem to be any corresponding empirical studies for banks. However, one could easily imagine that the costs for a bank could be much higher than for a typical nonfinancial firm. Dow and Rossiensky (1997) analyze the optimal financial structure for a bank that faces intangible bankruptcy costs.

V. Review of Selected Cases

Having surveyed some of the academic research on systemic risks, I shall now discuss a few selected cases of failure of financial firms. This is not a systematic overview of cases of failure; it is based on a selection of cases that seem suggestive. They include some that are archetypal examples of systemic risk, and others that are not classical cases: they are less well known and less frequently discussed. They are also not selected to support any particular theory or model of systemic risk. However, to give a preview of the discussion later in the paper, one conclusion that I do draw from these and from other cases is that the academic literature may have overemphasized the importance of the propagation mechanism for systemic risk, rather than the source of the systemic risk. This is not to say that the propagation mechanism is unimportant, but rather that the initial source of systemic risk needs to be studied as well. In fact, my conclusion is that the problem of moral hazard, broadly defined, is an important source of risk. These cases are provided as an introduction to the ideas developed later in the paper, where I discuss models of moral hazard in banking.

A. Herstatt

Perhaps the most frequently cited case of the potential for systemic risk was the Herstatt failure in 1974. The bank was closed when it became insolvent as a result of taking on large foreign exchange positions (for references to the Herstatt affair, see the *Financial Times* [1974a–e]). The episode took place soon after exchange rates were allowed to float in the early 1970s, in response to which many banks expanded their forex trading operations. Eighty-five percent of the bank was owned by Hans Gerling and the Gerling Insurance Company; furthermore, 5 percent was owned by the general partner, Iwan Herstatt, who had unlimited personal liability for the bank's debts. The failure caused widespread disruption because many forex counterparties had made payments to settle recent deals with Herstatt, while Herstatt had not made the corresponding payments in the other currency. The case is interesting because it illustrates the dangers of systemic disruption of the payments (in particular, a system with deferred settlement and without collateral). However, it also illustrates that an individual trader may cause huge problems by making trades that are not in the best interests of the bank's owners. It is interesting to note that this took place in a firm with a close ownership structure, even though economic analysis usually associates such problems with a dispersed ownership structure that gives inadequate monitoring incentives (e.g., Dewatripont and Tirole [1994b]).

B. Swiss Real Estate Crisis of 1991 and 1992

The Swiss banking industry was affected by a general economic downturn, falling property markets, and exposure to the bankrupt Omni holding company (in the case of lending to Omni, several banks exceeded regulations that limit unsecured lending to 20 percent of own capital). The main problem was exposure to real estate prices and interest rates: although the majority of Swiss mortgages are floating rate, banks were hit by rising interest rates as some borrowers became unable to service their mortgages. The smaller regional and cantonal banks were particularly hard hit by the

economic downturn. A few regional banks were forced to close, e.g., Spar und Leihkasse Thun, but a rather larger number were taken over. In many of these cases, they were probably insolvent. (For reference, see the *Financial Times*, March 18, 1991, April 10, 1991, October 10, 1991, December 16, 1991, February 7, 1992, April 8, 1992, May 5, 1992, and August 8, 1992.) These events took place at a time when there was overcapacity in the Swiss banking industry, when traditional practices, and the corresponding rents, had been eroded by increased competition and a more aggressive policy by the competition authorities. Also, pressures for the large banks to produce more transparent accounts had led to a demand for higher returns on equity.

The "hidden" exposure to interest rates is highly reminiscent of the effects described by Hellwig (1995) (see Section III.B). However, it is interesting that, despite the strong negative shock, the banking industry was able to absorb the impact just as effectively as the rest of the economy. In other words, the strength of the initial shock to the banking system was large, but it does not seem to have been disproportionately amplified by a propagation mechanism.

C. Chilean Economic Crisis of 1981 and 1982

The Pinochet regime seized control of four banks (representing almost 20 percent of all peso deposits) and four finance companies in late 1981 in a marked reversal of its general policy of *laissez-faire*. A large part of the banks' loan portfolio was nonperforming, and the government cited "administrative deficiencies" and violations of the banking code as the reason for intervention, which also included the arrest of two bank directors. The cost of this operation was estimated at US$600 billion. Foreign bankers alleged that loan decisions at Chilean banks were often based on poor criteria, if not outright corruption. Ultimately, in the course of 1982, the financial crisis became hard to separate from a general economic recession that also saw a shift in the balance of political power toward the more interventionist forces such as the military (for example, in the course of 1982 there were two changes of central bank governor, as well as several changes in the composition of the ministerial cabinet). Banks' bad debts by the summer of 1982 amounted to over US$1.5 billion, more than half the reserves of the bank sector, and 23 out of 39 banks had either been sold or turned over their portfolio of bad debts to a government-sponsored rescue operation (for reference, see the *Financial Times*, November 4, 1981, November 10, 1981, February 18, 1982, March 26, 1982, May 6, 1982, July 15, 1982, August 3, 1982, September 3, 1982, and November 17, 1982).

The Chilean episode does have a similarity with the case previously described for Switzerland: it seems to have been the strength of the basic shocks, rather than the effect of a propagation mechanism, that caused the problems (this is not to deny that there was also a propagation effect). An additional element appears to have been a kind of failure of individual incentives, in that the bad debts accumulated by the banks were probably not the result of actions that benefited their shareholders, but rather resulted from defective organizational structures.

D. UBS and SBC Merger in 1997

The merger between Union Bank of Switzerland (UBS) and Swiss Bank Corp. (SBC) announced in 1997 was initially presented as a merger of equals, but it gradually

emerged that UBS had been weakened by a number of recent loss-making events and that the merger was actually an SBC takeover (for reference, see the *Economist,* January 24, 1998 and January 31, 1998, and *Euromoney,* March 1988). Derivatives losses at UBS related to imperfect hedging of positions in convertible debt securities issued by Japanese banks amounted to about SFr650 million (for comparison, UBS's own capital was over SFr10 billion). The bank also lost about SFr200 million as a result of an unexpected change to British tax regulations for financial traders, and suffered extremely bad publicity in relation to its treatment of Nazi Holocaust victims.

The problems at UBS cannot be described as systemic, in the sense of being transmitted to other organizations within the financial system. However, one could say that potentially they could have had a systemic impact if they had been larger or if UBS had had much greater leverage. They are also important in the sense that UBS/SBC between them comprise a large part of the Swiss banking industry. The key feature seems to have been a failure of managerial culture, with an inadequate focus on profitability and transparency.

VI. Moral Hazard

I now turn to a discussion of the role of moral hazard in systemic risk. There are several motivations for this. First, the existing literature on systemic risk has given relatively little emphasis to moral hazard, hence it remains a fruitful area to explore. Secondly, it is evident that moral hazard is an important element of many financial crises. Beyond the arguments made in Chapter V, this connection will be investigated more systematically in Chapter VII below. Thirdly, I believe that the kinds of moral hazard that arise in financial crises suggest interesting variants of the standard principal-agency problem usually studied in the economics literature: the existing models normally study a single agent and a single principal, where the principal designs the contract with full knowledge of the trading environment. In contrast, experience of financial crises suggests the presence of incentive problems at a collective level, and where an explicit contract design process is absent. In this paper, I will not explicitly formulate alternative models to represent these situations, but I will explore them in a qualitative and preliminary way.

Before starting the discussion of moral hazard, it is worth clarifying the role of moral hazard in relation to traditional banking research. Most traditional research has assumed, implicitly or explicitly, that the financial system is a unique part of the economy because relatively unimportant shocks are amplified by a powerful propagation mechanism. Hence, the source of the shocks has received less attention than the functioning of the different possible propagation channels. In contrast, moral hazard is not a propagation mechanism but a mechanism for initiating shocks. This raises a number of very interesting and interrelated questions: are the shocks correlated, so that in the aggregate they can be large even without a propagation mechanism? Are these shocks multiplied by leverage and the use of derivatives, with the same effect? Indeed, are banks qualitatively unique or are they simply very highly leveraged firms? A full exploration of these questions is beyond

the scope of the paper, but they should be borne in mind throughout the discussion that follows.

Research on banking has emphasized the moral hazard for bank equity-holders to expropriate debt-holders (or the deposit insurer) by asset substitution (i.e., holding a riskier portfolio of assets). Undoubtedly, this emphasis has been reinforced by the experience of the United States in the 1980s, where many S&Ls engaged in risky exposure to the yield curve. However, recent experience, as well as experience from earlier periods, has pointed to the importance of two other types of moral hazard:

(1) The possibility that individual traders will take actions (specifically, excessive risk-taking) at the expense of the firm as a whole.
(2) The possibility that bank management will not act in the shareholders' interests.

A. Incentive Problems for Traders

I shall consider these two kinds of moral hazard in turn, starting with the moral hazard or agency problem for individual traders or small groups of traders. This case seems the easier of the two to analyze. In the first place, most traders have a bonus or incentive element to their remuneration that includes an option-like element: in other words, they share in the profits they make (above a given threshold), but not in the losses. To maximize their expected remuneration, therefore, they should take on as much risk as possible. Even when this consideration is balanced with an aversion to risk in their remuneration, traders will still have a strong incentive to take on risky positions. What is more, this incentive will become progressively stronger as their trading position deteriorates below the level required to earn a bonus (let alone when it deteriorates below the level at which they would be sacked). Hence, a trader who has performed badly has an incentive to take increasingly risky positions ("gambling for resurrection"), as well, of course, as to manipulate his accounts to hide the losses. One of the best-known examples of this problem in recent years was Nick Leeson at Barings (Hogan [1996]).

B. Why Is Traders' Remuneration Convex?

A remuneration package consisting of a base salary plus a constant share of profits above a given threshold is an example of a convex payoff function (a function $f(x)$ is convex if it always lies above its tangent, or equivalently, $f(\alpha x + (1 - \alpha)y) = \alpha f(x) + (1 - \alpha)f(y)$). By Jensen's inequality, the expectation of a convex function of wealth is increased by adding on a pure, actuarially fair, gamble (i.e., $Ef(x) \ \exists \ f(Ex)$). In other words, the expected value of a convex payoff such as a bonus scheme will be increased by adding risky, zero-NPV trades to the trading position. Another way of putting this is to note that a base salary plus bonus equates to giving the trader a call option on the value of his position. The Black-Scholes value of an option increases in the variance of the underlying asset; hence, the value of the bonus option increases if the underlying trading position becomes riskier.

This can be misleading. Traders care about the risk of their bonus as well as the expected value. It is true that the expected value of a convex bonus payment increases in the risk of the position, but the risk of the payment will increase also. Or to put it in terms of option pricing theory, the Black-Scholes formula gives the valuation of the

option to someone who can hedge the risk of the option by trading in the underlying security. Since options are highly risky; someone who is risk-averse and cannot trade directly in the underlying security will value an option much less than the Black-Scholes value, and will not always welcome an increase in risk. In addition, there is a dynamic aspect to the problem, since poorly performing traders will tend to be fired (or—depending on the culture of the country—transferred to other tasks within the firm). This dynamic aspect is not captured by viewing remuneration incentives as a single-period option. Hence, traders' bonuses will not necessarily always induce an excessive appetite for risk-taking—though there is unquestionably a danger that they may do so.

This tendency for bonuses to increase the incentive to take risks is well understood. This raises the question of why traders' compensation is structured this way. Is it optimal to give traders convex payoffs? Why should it be optimal to encourage them to take on risk in this way? If it is not optimal, why are they given convex payoffs?

This is an interesting question that has several dimensions. Generally speaking, research has ignored the question of optimality, and confined itself to noting the risk incentive problems arising from bonuses. Research into optimal contracts, on the other hand, has generally predicted remuneration contracts that are not bonus-like (Bhattacharya and Pfleiderer [1985], and Stoughton [1993]). There are two ways in which observed (bonus-like) contracts differ from optimal contracts in the literature. First, the optimal contracts are not always increasing. A trader whose profits are "too large" will be penalized: this is because such profits are more likely to arise by mistake (as the result of a wildly inaccurate prediction of asset values) rather than as a result of a good analysis of the situation. This is the case in Bhattacharya and Pfleiderer (1985), for example, where the optimal reward function is quadratic. In reality, however, one can point to many cases where traders were simply rewarded for very large profits when, in retrospect, managers would have done better to react negatively and to investigate the source of these profits more carefully (it is only fair to say that managers of financial firms are well aware of this problem and invariably claim that they do take it into account).

Secondly, the optimal contracts in the literature involve payments from the trader to the firm (in the case of bad performance) as well as payments from the firm to the trader (in the case of good performance). It is not clear why such contracts are rarely seen in practice. Some firms have tried to force traders' bonuses to be retained within the firm for some years—effectively allowing part of the bonus to be reclaimed later in case of poor performance—but these efforts have met with resistance in the labor market.

Dow and Gorton (1997b) present a model of optimal contracting in which traders cannot be forced to make payments to the firm in case of poor performance, and hence the optimal contract has a bonus-like element. In that model, even though the option-like contract is optimal among the feasible alternatives, it induces traders to trade excessively and take on more risk.

C. Incentive Problems for Bank Management

The above discussion of agency and incentive problems has focused on individual traders (or trading desks). As such, it is within the standard incentive-contracting

paradigm. However, as I have argued above, an interesting and somewhat different problem is the problem of incentives for bank management: does bank management have an incentive to take on too much risk? This problem seems more important because, after all, each time an individual trader takes excessive risk, there is a failure of management that did not prevent, or may have encouraged, the risk-taking. Post-mortems of notorious trading losses such as Barings in 1994, Herstatt in 1974, NatWest Markets in 1997, and UBS in 1997 tend to emphasize that the failure is as much a failure of control on the part of management as a failure of a single trader's position.

On the other hand, losses that cannot be ascribed to out-of-control individuals (or small groups) are often blamed on poor management. For example, Yamaichi Securities' failure in 1997 was the culmination of a series of structural problems in the firm's corporate culture. Among these, exposure of the firm's connection with racketeers dealt a humiliating blow to its prestige and to its management's credibility. Perhaps equally important was the exposure of accounting irregularities resulting from Yamaichi Securities' acceding to compensation demands from corporate clients for trading losses.

Among the examples given in Chapter V, the problems in Switzerland in 1991–92 and in Chile in 1981–82 seem less specific, and it is harder to point to a source of management failure. However, they both share the feature that the corporate culture apparently produced a system with some inertia that was not responsive to change.

This aspect of moral hazard has not been addressed much in research, yet seems an important priority. Jensen (1986) has promoted the idea of "free cash-flow theory," namely, that firm managers may be motivated to increase the size of the firm even when this is not in the interests of equity-holders. This is similar to the idea of a weakness in corporate culture, but still treats the bank management as if it were a single decision-making agent. In reality, the problem of a weak or defective corporate culture seems to have inherent collective characteristics. Within a group of managers, there may be inadequate incentives for an individual to diagnose and draw attention to problems, and to implement solutions to those problems. This inertia can operate at the level of the firm, or indeed at an industry-wide level.

D. Are Managers Rational Expected-Utility Maximizers?

Economic theory has a well-developed set of tools to analyze (individual) incentive problems using expected-utility theory. As in other areas of economics, insight and predictions are based on rational, utility-maximizing behavior. However, it is worth pointing out that this assumption may not always be warranted. Particularly in relation to behavior in the face of risk, standard economic behavioral assumptions may be inaccurate. People may face distorted perceptions of risk and make distorted evaluations of the consequences of risky decisions.

There has traditionally been relatively little research on irrationality in financial markets, but it is now beginning to be accepted and recognized as a rich and important area for investigation. For example, Daniel, Hirshleifer, and Subrahmanyam (1998) investigate the theoretical implications of investor irrationality for asset pricing.

Fenton O'Creevy (1999) and Nicholson *et al.* (2000) investigate the behavior of financial market traders in simulated trading environments, using a sample of traders from various firms in the City of London. They find that traders display systematic

overconfidence in their ability to control their portfolio returns, a phenomenon recognized and studied by psychologists and known as "illusion of control." Furthermore, traders with higher illusion of control have systematically lower trading profits.

In addition, economics traditionally defines rational behavior in a rather narrow way. Hence, principal-agent models focus exclusively on the monetary dimension of incentives. Nicholson *et al.* (2000) discuss how incentives for traders depend on other social and psychological influences, and explain how these influences can cause excessive risk-taking.

VII. Which Kind of Systemic Risk Is Most Important?

As I have argued above, "systemic risk" is often used as a catchall phrase to cover many different kinds of problems. The academic literature has developed several research tropes that bear on this question. However, when one looks at particular episodes of financial failure, these do not necessarily seem to be the most relevant ones. For example, the Herstatt collapse posed grave problems of settlement risk but was also a problem of unauthorized trading, i.e., a moral hazard problem. The recurrent problem of excessive risk-taking in bank loan portfolios is also often a moral hazard problem, e.g., in the S&L crisis of the United States in the 1980s or in the Crédit Lyonnais debacle—in the latter case, the moral hazard taking a broader, more political dimension in that neither the bank management nor the French state appears to have been concerned to implement a more disciplined approach to making loans. Looking at these and other cases, it would seem that moral hazard, broadly defined, is the single unifying thread running through them. Here I will try to specify which kinds of moral hazard seem most relevant by surveying a larger number of cases (they include various problem cases as well as actual failures). These are listed in Table 1. (Although the table was compiled

Table 1 Selected Instances of Moral Hazard

Episode	Nature of problem	Episode	Nature of problem
Sumitomo (1996)	RT	Crédit Lyonnais (1990s)	PCC
Metallgesellschaft (1993)	RT	NatWest Markets (1997)	RT
Barings (1994)	RT	U.S. S&L crisis (1980s)	ACC
Yamaichi Securities (1997)	PCC	Gibson Greetings-Bankers Trust (1994)	ACC
Yamaichi Securities (1965)	PCC	Procter and Gamble-Bankers Trust (1994)	ACC
Sweden (1990)	COE	Salomon Brothers (1994)	ACC
Herstatt (1974)	RT	UBS (1997)	PCC
Switzerland (1991–92)	COE (PCC?)	Drexel Burnham Lambert (1990)	ACC
Continental Illinois (1984)	?	County NatWest (1997)	ACC
Chile (1981–82)	COE, PCC		

Key:

RT: "rogue trader": excessive risk-taking or fraudulent behavior by trader or small group of traders, together with a failure of management control that fails to detect them.

ACC: "aggressive corporate culture": the firm's focus on profitability is so strong that traders take excessive risks to enhance short-term profitability.

PCC: "passive corporate culture": management culture of the firm is inadequately focused on sound profitability and transparency.

COE: "collective overexposure": a large number of banks are, collectively, heavily exposed to the same risk (even though each individual bank's position may not seem particularly imprudent *ex ante*).

Note: Most instances of RT, ACC, and PCC are cases of the general moral hazard problem.

from press cuttings, Steinherr [1998] is an excellent source for descriptions of many of these events.)

After considering the cases in the table, I have tried to categorize the nature of the problem. It seems that in many cases, some form of inadequacy of incentives was at work. However, one cannot say that they are all examples of a similar kind of moral hazard problem. Rather, the deficiencies of the incentive system take different forms that I have tentatively classed into three groups. The first, and simplest, kind of moral hazard problem is a simple "rogue trader" problem. These are all cases where a single trader (or a small group) had a disproportionate amount of discretion and was able to use this power to build up large losses and conceal them. Of course, each such instance also implies a failure of control at a higher level of management, but in most of these cases one cannot generally identify this management failure except with the benefit of hindsight. In other words, it is not easy to point to a general distortion of incentives within the firm that led to the problem; rather, it is a case of being able (*ex post*) to document some specific, often serious, control lapses which permitted the trader to continue accumulating large losses. I have denoted these cases RT in the table. They include the Sumitomo copper trading losses, Metallgesellschaft, Barings, and Herstatt, etc.

In some other cases, one cannot point to such a clear failure of control, nor to a single individual as the main instigator of the problem. It would seem in these cases that the firms had an aggressively profit-oriented culture which encouraged, or at least permitted, some employees to overstep the mark. The culture facilitated or sometimes encouraged excessive risk-taking. I have denoted these cases "aggressive corporate culture," or ACC, for want of a better description. This group is actually rather varied: for example, I have included Drexel Burnham Lambert, which is intimately identified with a single individual. I have also included the U.S. S&L crisis of the 1980s, in which the stimulus to take risks came primarily from the commercial and regulatory environment, i.e., from outside the firms themselves.

Although the second group is rather heterogeneous, it is interesting chiefly to provide a contrast with a third group. This third group is what I call "passive corporate culture," or PCC. Recall that the first group of cases (RT) corresponded fairly closely to the standard agency and moral hazard problems that have been studied in the academic literature, i.e., a single agent whose incentives, in case of failure of the firm's control mechanisms, may encourage risky or suboptimal actions. Generally, the problem has been that the trader's incentives were in some sense "too strong"—in other words, the trader's incentives (such as convexity arising from the bonus) led him to try hard to make large profits but without giving enough weight to the consequences of failure. The other two groups (ACC and PCC) involve a kind of collective moral hazard encompassing a group of people rather than a single individual. This situation has not been studied intensively in the academic literature, unlike the single-agent moral hazard problem. What is interesting is that many of the instances of this collective moral hazard problem do not involve excessively strong incentives to make profits. Some of them involve excessive inertia in companies where lack of transparency coexists with long-term low profitability.

Finally, one can also distinguish a fourth category, which I have called "collective overexposure," or COE. These cases seem to capture some of the features of Hellwig's analysis described in Chapter III: namely, the problem was not that an individual bank was overexposed to a particular risk. Rather, it was that the whole system turned out to be exposed and hence no individual bank had a strong incentive to correct the problem.

VIII. Conclusions

In this paper, I have approached the economics of systemic risk in two ways. First, I discussed the existing literature that is related to the problem of systemic risk. Secondly, I turned to a study of a number of cases where problems arose within the financial sector and individual firms. This led to the discussion of the role of moral hazard in financial crises.

Research has emphasized the simultaneous determination of asset prices and the possible macroeconomic consequences of this. One key assumption in much of this literature is that banks are capital constrained, or strongly prefer debt financing to equity. Although this may be in keeping with facts about how banks do finance themselves, it is also a worrying assumption because we do not have a full economic understanding of why this should be true.

A review of selected cases suggests that the vast majority of cases are caused by moral hazard, broadly defined. However, problems caused by a single trader with distorted incentives are in the minority. A more common problem is a collective failure of management at the bank (or across the financial system), leading to inertia and the inability to respond to changed economic circumstances.

This suggests several interesting conclusions as well as pointing to areas for future research. One conclusion is on the relative role of the mechanism that initiates shocks to the financial system and the mechanism that propagates them. Traditional banking research is based on the premise that banking is fundamentally different from other industries and that the financial system contains a powerful propagation mechanism that can amplify small initial shocks. Implicitly, the moral hazard approach suggested here is based on the idea that initial shocks are amplified within the firm by moral hazard and by financial leverage, so that the shock delivered to the financial system by the individual firm can itself be large. Hence, systemic risk does not necessarily depend on a powerful propagation channel that multiplies the effects of small shocks. The propagation effects may or may not be large, but the initial shock itself can be large enough to cause systemic harm. The LTCM crisis is an example.

This perspective also seems interesting because it suggests that banks may not be, fundamentally, economically unique institutions—or rather, what makes them unique is simply their ability to use leverage and to multiply their risk exposure.

The other idea that seems promising for future research is the formulation of models of what I have called "collective moral hazard"—while it may not be possible to define the meaning precisely before actually specifying such a model, what I have in mind is a situation in which many agents are involved and no single agent has the role of designing a contract as a standard constrained optimization problem.

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