CORPORATE FINANCIAL STRUCTURE, INCENTIVES AND OPTIMAL CONTRACTING

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Abstract

The firm can be regarded as consisting of several groups of investors and managers whose interests are regulated by the contracts between them. This survey covers the literature that looks at the nature of optimal financial contracts in the face of various asymmetries of information, control and type. Five areas are considered: (i) costly state verification and agency; (ii) adverse selection; (iii) the allocation of control rights among investors and the design of ownership structure; (iv) the allocation of risk and (v) acquisition of information.

1. Introduction

The dominant paradigm in modern corporate finance views the firm as a nexus of contracts between various economic agents, particularly managers and investors. Beginning with Jensen and Meckling (1976), an ever-increasing volume of papers has addressed optimal corporate financial structure within this basic framework. These papers can be divided into two groups: those (*security design*) which derive optimal financial contracts as optimal mechanisms for overcoming various frictions between agents, and those (*capital structure*) which take certain contracts such as debt and equity as given and analyze the optimal mix of these contracts firms should issue - again, in the face of frictions between agents.

Although our survey focuses on the design of optimal financial contracts,[1] the distinction between the two groups is not always clear-cut: some papers on security design make assumptions which immediately guarantee the use of specific contract types, while some papers on capital structure model the optimal choice of specific features of debt or equity securities. We have tended to err on the side of inclusion rather than exclusion. Nonetheless, a large literature on optimal capital structure is excluded; these papers are covered in other chapters of this handbook and in other recent surveys (Harris and Raviv (1991) and Hart (1991)).[2]

We have divided our survey into five sections by topic. These include costly state verification and agency, when investors find it costly or impossible to verify or contractually control certain outcomes and actions relating to the firm; adverse selection, when investors cannot identify certain innate characteristics of the firm or manager; the allocation of control and ownership rights among investors; the allocation of risk between different types of investors; and the acquisition of information.

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[1] The early work on asymmetric information and incentives from which this literature developed is surveyed in Ross (1978).

[2] More recently, Harris and Raviv (1992) links the optimal financial contracting literature surveyed here and the optimal capital structure surveyed in their 1991 paper.

2. Costly State Verification and Agency

The models in this section assume that investors find it costly or impossible to verify ex post features of firms such as output or managerial actions. Borrowers can make an announcement about the features in question, and the contract's terms are based on this announcement. In equilibrium, the contracts must be incentive compatible - that is, borrowers act as investors expect them to act. Since these models are typically partial equilibrium in nature, one agent (usually the borrower) maximizes his or her return subject to incentive compatibility and reservation return constraints for other agents (usually investors). Papers almost invariably assume that the utility of consumption is separable from the disutility of any direct costs of verification.

In models of costly state verification, the characteristic which cannot be freely observed is the borrower's income or return. Early work in this area focuses on contracting between a single investor and borrower within a single period, when one or both parties are risk neutral. Recent work has generalized this in two ways. The first involves broadening technical assumptions: allowing for more general preferences, contracting over multiple periods, and so forth. The second set of papers looks at changing the underlying asymmetry to better reflect institutional features of large modern firms which restrict management's ability to appropriate returns. We address each of these areas in turn.

Townsend (1979) is the first paper to use the costly state verification framework. There are two agents, one risk averse but endowed with risky income, the second risk neutral with constant income. The agents would like to enter into a risk-sharing agreement, but the first agent's income is costly to verify. Assuming that verification must be a deterministic function of announcements by the first agent, and that the cost of verification is constant, Townsend shows that an optimal incentive compatible contract will have the following features: income is verified whenever reported income is below a certain level,

payments to the second agent are constant when income is not verified, and payments are strictly lower than this constant when income is verified.[3]

If the contracting situation is viewed as a loan to a risky borrower, this implies that the optimal contract has some of the features of debt. In fact, if both agents are risk neutral, Gale and Hellwig (1985) prove that the optimal contract gives all of the borrower's income to the lender whenever this income does not exceed the fixed (non-verified) payment; this is precisely the arrangement specified by a simple single period debt contract. They also show that, whenever there is a chance of default, there will be less borrowing and investment than there would be with symmetric information.

Diamond (1984) also derives debt as the optimal borrowing contract, but with a somewhat different approach. In his model, agents are risk neutral and borrower returns are unobservable, but lenders can inflict potentially unlimited non-pecuniary penalties on the borrower. The optimal contract is debt, enforced by penalties which impose disutility equal to the amount by which the borrower's payment falls short of the debt's face value. While this view of debt contracts seems most applicable to early Victorian Britain with its debtors' prisons, the model has been generalized by Lacker (1990). He shows that, for certain restrictions on utility functions,[4] a risky borrower with a good that always has higher marginal utility to her than to the lender will find it optimal to borrow under a debt contract collateralized by this good. Debt is optimal because it minimizes the expected amount of good transferred, which is a deadweight loss under the model's assumptions. In Diamond's model, the "collateral" takes the form of the borrower's freedom from pain and suffering, which has no value to the lender; other

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[3] The intuition for these results is as follows. Suppose that income of y is verified, but income of x is not. If payments from the first agent to the second in y exceed those in x, the first agent would never report y. Similarly, if both x and y were unverified, and payments in y were higher than those in x, the first agent would never report y. Thus verified payments are lower than unverified payments, and unverified payments are effectively constant. Because the first agent is risk averse, he prefers to make the lowest payments in those regions where his marginal utility is highest - that is, where his income is lowest. Thus verified (low) payments are optimally made when the first agent's income is low.

[4] Risk neutrality satisfies the restrictions on the utility function.

examples include home mortgages, car loans, or loans backed by a new business' assets, where individual tastes, lemons market effects, or specialized managerial skills may make the collateral more valuable to the borrower than to the lender.

While these models motivate the use of debt-like contracts, they use a number of simplifying technical assumptions: risk neutrality, single period contracting with one investor, deterministic verification, and one type of borrower. In reality, people exhibit risk averse behavior, firms typically exist for many years and borrow from multiple investors, agents may be able to randomize their decision of whether or not to verify and there are many different types of borrowers; in addition, returns may be observable yet difficult to verify in court. We now turn to papers that allow for these complications.

Krasa and Villamil (1991) and Winton (1993b) examine the impact of more general preferences. Both papers show that Townsend's results extend to the case where both agents are risk averse: basically, for any distribution of payments to the lender, the borrower still prefers to make the lowest (verified) payments in states where the borrower's income is lowest. Krasa and Villamil show that this also holds for contracting with multilateral information asymmetries and costly public state verification.

Chang (1990) addresses multi-period contracts in a setting where a firm produces independent returns in each of two periods. Assuming that the firm only borrows once and is not allowed to make interim dividend distributions to its owner, the optimal contract has some resemblance to a bond with interim coupon or sinking fund payment and final principal repayment; in addition, the borrower may have the option to call part of the bond in the first period at a fixed price. Verification will only occur when the fixed (coupon or sinking fund) payment is missed in the first period, or when the final payment is missed in the last period. Although allowing additional borrowing or interim dividend payments would

change these results, the firm would prefer to precommit to avoiding these actions.[5] In fact, debt contracts commonly include covenants which restrict both borrowing and dividends.

Mookherjee and Png (1989) and Krasa and Villamil (1991) both address contracting when stochastic verification is feasible. The first paper observes that, if penalties for lying can be imposed, verifying with certainty is generally not optimal: in equilibrium, the borrower wouldn't lie at all, and so the lender can verify less often. While risk aversion on the borrower's part will typically lead to a contract in which borrower consumption doesn't always increase with returns (Winton (1993b) shows this is true even with deterministic verification), Krasa and Villamil show that payments to the **lender** will weakly increase with returns. These authors also prove that the probability of verification weakly decreases with reported returns. Thus, with randomized verification, optimal contracts look much less like simple debt, but still retain a certain amount of monotonicity. Whether randomized verification is credible in actual financial contracts remains an open question.

If more than one investor is needed to fund the borrower's project, and verification is private information, use of a symmetric debt-like contract will result in duplication of monitoring effort. This has been used by Diamond (1984) and Williamson (1986) to obtain the optimality of well-diversified financial intermediation when all agents are risk neutral and borrowers' projects are stochastically independent of one another. However, these results assume that there are no diseconomies of scale - one lender can monitor large numbers of loans at constant marginal cost. To the extent this isn't the case, investors (institutional or otherwise) may optimally have imperfectly diversified portfolios, and multiple lenders may lend to the same borrower.

Analysing the case where several investors lend directly to the same borrower, Winton (1993b) shows that the borrower prefers issuing debt-like contracts with varying degrees of seniority rather than

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[5] If dividends cannot be restricted ex ante, the optimal contract has a similar form, but with a more complicated call price. Chang does not explicitly analyze the optimal contract that results when interim borrowing is allowed.

symmetric debt-like contracts. In the case where investors are risk neutral, priority among investors of different seniority is absolute - that is, more junior investors receive nothing until more senior investors are paid in full. This corresponds with actual practice, in which the absolute priority rule is the basic standard and firms issue securities with multiple levels of seniority - senior debt, subordinated debt, or preferred stock. The intuition for the result is that, when investors are risk neutral, reducing total verification costs is paramount. By giving senior investors their fixed (unverified) payment as often as possible, their verification costs are made as small as possible.[6]

Boyd and Smith (1991) consider the case where borrower return distributions are completely unobservable, so that there is adverse selection as well as costly state verification. Provided verification costs are positive, debt is an optimal contract. Credit rationing where loans are granted randomly allows good borrowers to separate from bad ones. To see this, consider a pooling contract which breaks even: good borrowers effectively subsidize bad ones. A decrease in the interest rate benefits good borrowers relatively more, because bad borrowers have more chance of defaulting and losing any benefit from a lower interest rate. Thus, in order to obtain a lower interest rate, good borrowers are more willing to endure random rationing than are bad borrowers. In the separating equilibrium, good borrowers face credit rationing but pay a lower interest rate than bad borrowers, who are always granted loans.

Hart and Moore (1989) consider a problem which is somewhat different from the usual costly state verification setting. An entrepreneur wishes to raise funds to undertake a project when contracting possibilities are incomplete: both the entrepreneur and the outside investor can observe the project payoffs at each date, but they cannot write contracts based on these payoffs because third parties such as courts cannot observe them. The focus of Hart and Moore's analysis is the problem of providing an incentive

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[6] The model also offers an explanation for why managers (as employees) become general creditors of the corporation for any unpaid salary when it enters into bankruptcy: when investors are risk neutral and the manager is risk averse, it is generally optimal to give the manager some compensation in states where junior investors receive nothing.

for the entrepreneur to repay the borrowed funds. Among other things, it is shown that the optimal contract is a debt contract and incentives to repay are provided by the ability of the creditor to seize the entrepreneur's assets.

Lacker (1989) pursues a more complex form of this problem. As in Hart and Moore (1989), returns are observable to both borrower and lender (sometimes the lender incurs a cost), but now contracts based on returns can be enforced in a court of law - at a cost. He shows that optimal contracts resemble debt so long as enforcement is used deterministically; however, as in the costly state verification literature, mixed strategies may dominate deterministic contracts.

Thus, relaxing the technical assumptions of the basic costly state verification model leads to optimal contracts which still have certain features in common with real debt or debt-like securities: fixed maximum payments, interim coupon payments, multiple levels of seniority, and credit rationing. Nevertheless, the application of these models to modern corporations is still open to question: all assume the firm is effectively owned by a single insider, who can costlessly lie and appropriate all of the firm's returns if verification does not occur. Although this may be appropriate for closely-held firms, many corporations in the United States actually issue equity to large numbers of outside investors, most of whom cannot be thought of as insiders in any sense. To some extent, this difficulty is caused by the single period assumed in much of the analysis: if the firm operates over multiple periods, excessive managerial consumption might affect future returns, leading to eventual discovery and penalties. In addition, accounting systems and outside auditors are used to control such behavior. Several papers have attempted to incorporate some of these institutional features into the design of optimal financial contracts.

Lacker and Weinberg (1989) develop a model in which the borrower can only falsify reported earnings at a cost which increases in the amount of the discrepancy, reflecting costs of physical concealment, keeping two sets of books, and so forth. If it is required that no falsification occur, optimal contracts look like outside equity for the investors, and a combination of fixed salary plus equity for the

borrower. The falsification cost places an upper bound on the rate at which the borrower's compensation can increase with reported income, since steeper increases would make lying profitable; thus, the lenders' claim increases with reported earnings. The authors show that, under certain conditions on the cost of falsification, contracts that are optimal under the requirement of no falsification are optimal over all incentive compatible contracts.

In Chang (1993), a firm exists for two periods. After first period output is realized, it is optimal for a random fraction of output to be reinvested in the firm, with the remainder paid out to investors. The manager observes the optimal payout while investors do not. If the payout is less than this optimal amount, the difference is diverted into projects which yield the manager some utility but give below average returns to investors in the second period. The manager reports the optimal payout level, which results in an interim payment to investors and to herself by contract. In the absence of a bankruptcy mechanism, optimal incentive compatible contracts resemble equity with dividends - the interim payments to both the manager and the investors increase in reported optimal payout, and there is corporate slack invested in inefficient projects. Chang defines the bankruptcy mechanism as a costly liquidation of the firm which deprives the manager of her utility from corporate slack. Once contracts are allowed to include this mechanism, the optimal contract resembles debt plus the equity contract described previously.

A related body of work adopts principal-agent theory to financial contracting between an investor and the manager of a firm. In classic models of this sort, firm output is observable, but its distribution or realization is influenced by the manager's effort, which is hidden. In the absence of limited liability constraints or risk aversion, the first-best solution is to give the manager the entire risk of the project; the investor gets a fixed payment, and the manager maximizes the return from the project because it all accrues to her (see Harris and Raviv (1979)). Thus the manager's position corresponds to unlimited liability equity, while that of the investor corresponds to riskless debt.

Since the manager's wealth is usually limited, a more realistic model is that of Innes (1990).[7] Here the manager's costly effort improves the distribution of firm returns according to the monotone likelihood ratio property of Milgrom (1981), but the manager has no wealth and his effort cannot be observed by the investor. If the investor's compensation is constrained to be monotone increasing in firm returns, the optimal contract will in fact be debt; however, without monotonicity, optimal contracts have a "live or die" form that gives the manager the firm's entire output when firm returns are equal to or above a given level, and nothing otherwise.[8]

Innes defends monotonicity by showing that it is necessary when either the investor can sabotage the firm ex post or the manager can borrow risklessly on the side and merge the amount raised with the firm's output. Both situations seem somewhat unlikely. A more plausible approach is that of Dionne and Viala (1992), who combine unobservable managerial effort with costly return verification. Although monotonicity is not always an optimal outcome, sufficiently high verification costs do make the standard debt contract of Gale and Hellwig (1905) optimal.

In a setting similar to that of Innes, Chiesa (1992) investigates the effect of having a random state of nature determined before the effort decision is made. She shows that standard debt is not optimal; instead a debt contract with warrants for the lender and cash/equity settlement options for the borrower is optimal. This contract shifts payments on the debt to the good states and helps provide incentives to supply effort when the state of nature turns out to be bad. With a standard debt contract the borrower would have little incentive to provide effort in bad states because the bondholder would receive most of the benefits.

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[7] Yet another difficulty with the Harris and Raviv model is that it assumes the manager is risk neutral. However, the presence of risk aversion complicates principal-agent models considerably (see for example Grossman and Hart (1983)); not surprisingly, there has been little work applying results from this literature to optimal financial contracting.

[8] The intuition is that, by being given everything in high output states and nothing in low output states, the manager has the greatest incentives to try to ensure high output and avoid low output.

Hart and Moore (1991) also consider the funding of an entrepeneurial firm, but focus more explicitly on the importance of the entrepeneur's skills in a dynamic setting. There is no uncertainty, and contracting possibilities are complete except that the entrepreneur cannot precommit to stay with the firm; she can always leave and withdraw her human capital. In an optimal contract, the investor lends a sum of money to finance the project, and the entrepreneur promises a series of payments in return. If a payment is made, the entrepreneur has the right to keep using the project's assets for another period; if a payment is missed, the lender obtains control and can liquidate the project. The entrepreneur's threat of leaving limits the payments, since she can threaten to leave if a payment is too high. As a result, some projects which would be undertaken in an ideal world are not undertaken here. As the project's assets become more durable or its cash flows come later, debt payments are pushed further into the future. These results correspond to practitioners' maxims "lend long if the loan is supported by durable collateral" and "match assets with liabilities."

As with costly state verification, most agency models have focused on entrepeneurial firms. The next two papers investigate optimal solutions to agency problems in an institutional setting closer to that of a large corporation.

Williams (1989) investigates optimal contracting when the firm's output and the managerial effort that influences the distribution of output are both unobservable. "Ex-ante monitoring systems" (e.g., accounting controls, or security for debt) are assumed to prevent the manager from consuming the firm's output, but they do not reveal its true level. The manager announces current earnings and makes a distribution as per contract; residual claimants then receive the remaining value of the firm. Williams assumes investors are effectively risk neutral, and that the firm's value is revealed at some point in the future.[9] In this setting, optimal contracts resemble combinations of equity and up to three classes of debt.

[9] Strictly speaking, he assumes markets are complete, and cash flows are measured in state-contingent price terms. However, complete markets are incompatible with a firm-specific agency problem.

Williams' results do not require any special assumptions about the way in which the manager can affect the distribution of returns, although special cases lead to the use of fewer securities.

Although Hart and Moore (1990) take the use of debt contracts as given, they provide insight into how differential seniority can control managerial agency problems. In this model, managers wish to expand their firms so as to increase their power; as a result, they are willing to undertake projects with negative net present value as well as those with positive net present value. It is not possible for outsiders to observe whether or not a project is profitable ex ante, so managers' actions cannot be controlled directly by contract. Nevertheless, managers can be controlled indirectly by choosing an appropriate seniority structure. If a firm has outstanding senior debt, it will be unable to raise new funds unless its prospects are good because the senior debtholders have a prior claim to the output from any new investment. An optimal debt structure ensures that the firm can only obtain financing when prospects are good enough for new projects to have a positive NPV.

3. Adverse Selection

While the previous section focused on models where investors could not freely observe the borrower's efforts or results ex post, models of adverse selection typically assume that the asymmetry involves innate characteristics of the borrower; that is, the asymmetry involves ex ante information. Now the focus is on contracts that borrowers can use as credible signals of their type.[10] Since signalling models typically produce a multiplicity of equilibria, many of the models surveyed here attempt to narrow

[10] In certain cases, adverse selection and moral hazard can produce observationally equivalent results; Hagerty and Siegel (1988) discuss this in the context of a managerial compensation setting. Their equivalence result requires that, just as the moral hazard setting assumes more effort is more costly, the adverse selection setting must assume the manager's reservation wage increases in her ability. In other words, the manager has some method of capturing her ability's value outside of the firm, perhaps by starting a company of her own. Since most models in this section implicitly assume that different types of borrowers have the same reservation return, they will not meet this requirement.

down the number of equilibria through the refinements of sequentiality now standard in the signalling literature. This has been a particular focus of models seeking to use adverse selection to explain noncontingent financial contracts.[11]

Standard contract theory suggests that optimal contracts should be contingent on all relevant information, which generally implies they will be extremely complex (see Hart and Holmstrom (1987)). However, an important feature of many existing financial contracts is that they are not contingent on easily available information which would appear to be relevant. For example, standard debt contracts are not contingent on the firm's earnings; this appears to be inconsistent with optimal risk sharing, which requires that borrowers and lenders have equal marginal rates of substitution between states. Although there are forms of debt such as income bonds where payments are contingent on the accounting earnings of the firm, these are rarely used. The next three papers show that, with adverse selection and certain refinements on beliefs, noncontingent securities like standard debt are optimal.

Allen and Gale (1992) develop a model where adverse selection interacts with measurement distortion and this leads to noncontingent securities being used. In practice, securities cannot be made contingent on "states of nature". Some type of measurement system such as an accounting system is necessary to generate the variables such as earnings that payoffs are contingent on. These measurement systems can be distorted at some cost by firms if they have sufficient incentive to do so. Allen and Gale argue that a case of interest is where the cost of distorting the measurement system is positively correlated with firm type so good firms have a high cost of distortion and bad firms have a low cost. In this case bad firms are more likely to offer securities such as income bonds where payments are contingent on earnings since the net benefits of distorting are greater for bad firms. The equilibrium where all firms offer a noncontingent contract is then Universally Divine (Banks and Sobel (1987)) since investors deduce

[11] A related area concerns the role of reputation in financial contracting. For recent contributions in this area see Diamond (1989; 1991a) and Boot, Greenbaum and Thakor (1993).

that any firm offering a contingent contract is likely to be bad since they gain the most from the contingency.

Nachman and Noe (1992) consider a model where a firm issues a security to investors in order to undertake an investment which generates an uncertain output. The probability distribution of outputs depends on whether the firm is good or bad which is known to the firm but not to investors. A good firm's output conditionally stochastically dominates that of a bad firm. It is assumed that the security is monotonic in the sense that the payment to investors is nondecreasing in the firm's earnings. A good firm would like to signal its type by reducing the payment it makes when output is high and increasing it when output is low. Firms pool at a debt contract in the equilibrium which is stable according to the D1 version of Universal Divinity discussed by Cho and Kreps (1987). A good firm cannot try to separate itself by increasing payments in low output states since this would violate feasibility or by reducing payments in the high output states since this would violate monotonicity. The equilibrium contract is thus noncontingent in the sense that the payment is equal to a constant except when there are insufficient earnings to pay this.

In a related paper, De and Kale (1993) assume that a firm can use some combination of two types of contract, Fixed-Periodic-Obligation Debt (FD) and No-Periodic-Obligation Debt (ND). Standard debt is an example of a FD security and income bonds are an example of a ND security. Having offered the market its securities, they are priced by the market. Investors infer that firms that offer ND contracts are more likely to be bad firms since they will benefit more from the low payments if earnings are low. The unique equilibrium that is stable in the sense of Universal Divinity involves only FD being used by firms. As with Nachman and Noe's monotonicity condition, the restriction of contract forms to combinations of FD and ND prevents firms trying to signal their type.

In a somewhat different vein, Ravid and Spiegel (1992) develop a theory of why small firms use debt and equity which combines adverse selection and agency concerns. They assume the number of

entrepreneurs who have positive net present value investment projects is limited. Other entrepreneurs can provide an unlimited number of negative net present value projects if there is an incentive to do so. Given that the type of entrepreneur and quality of projects is unobservable, securities must be designed so there is no such incentive; in many circumstances, an appropriate mix of debt and equity accomplishes this. To see why, suppose initially that projects do not include any collateral. In this case, all financing is in the form of equity, and the entrepreneur is given a share of the equity equal to the proportion of costs he provides; given this structure, the entrepeneur prefers to invest in a risk free asset rather than accept negative net present value investments. When projects have collateral, debt can be used along with equity; the collateral ensures the entrepreneur's interests are aligned with those of shareholders.

Yet another use of adverse selection can be found in Diamond (1991b, 1991c), who examines its impact on the choice of seniority and maturity in debt contracts. A manager runs a firm whose chance of success is private information; in addition to any share in the firm's proceeds, he obtains nontransferable rents from controlling the firm throughout its life. A noisy signal of firm type becomes public after initial investment but before output is realized. If the firm is liquidated at this point, it yields a fixed return which is better than the output of a failed firm but less than that of a successful firm; if the firm is liquidated after production, it yields its output. Control rents are high enough that no firm will willingly liquidate at the interim date.

Because cash payments and the signal are observable and output is not, liquidation must be used to enforce payments to investors; thus, optimal contracts resemble debt. Debt can either be short term, in which case it is refinanced at the interim date, or long term. The ability to refinance depends on the market's beliefs about the firm's type, which depend on the signal. Good firms have a better chance of getting a good signal and better refinancing terms, but they must trade this off against the chance of getting a (false) bad signal, being liquidated early, and losing control rents. Bad firms would never be financed if their type was known, so they must imitate the actions of good firms.

Diamond (1991b) focuses on the choice of debt maturity. If the market's prior beliefs are that the firm is very likely to be good, firms optimally issue short term debt; good firms are reasonably certain of getting refinanced, and wish to take advantage of the chance to distinguish themselves from the bad firms. As this prior decreases, good firms prefer to issue more long-term financing so as to avoid an excessive chance of liquidation. However, if this prior is too low, only short-term debt is feasible: too many firms are likely to be bad to support long-term debt, but short-term debt allows early liquidation and a return independent of firm type.

Diamond (1993) allows the firm to choose debt seniority as well as maturity. It proves to be optimal for short-term debt to be senior, for long-term debt to be junior, and for long-term debt to allow the issue of additional senior short-term debt at the interim date. By allowing short-term debtholders to be refinanced at the expense of long-term debtholders, firms obtain a better price for short-term debt, and the firm is liquidated less often. This makes it cheaper for a good firm to take advantage of the information sensitivity of short-term debt.

As with most agency models, these adverse selection models generally assume that the manager is either the firm's sole owner or (equivalently) acts completely in the shareholders' interests. In this case capital structure choice and dividend policy matter because they affect the value of equity. A well-known example from the capital structure literature is Myers and Majluf (1984), who show that managers who know a firm's existing assets are undervalued are reluctant to use equity to finance new investments. The intuition is that, if equity is used, the eventual release of good information to the public will cause an increase in value which is shared between old and new shareholders. As a result, some profitable investments may be foregone.

Dybvig and Zender (1991) point out that a suitably chosen incentive scheme can avoid inefficiencies arising from asymmetric information. For example, in the Myers and Majluf (1984) model, a managerial compensation scheme which is insensitive to the fact that shareholders must share increases

in value with new shareholders eliminates the incentives to forego profitable investments. Dybvig and Zender show that, in a wide range of circumstances where managers are better informed than investors, capital structure choice and dividend policy are irrelevant provided managerial compensation schemes are not tied to the interests of shareholders but instead are chosen optimally before there is any asymmetric information. This result would seem to rule out the use of adverse selection models to explain financial contracts used at large widely-held corporations.

Persons (1993) shows that Dybvig and Zender's result depends crucially on the absence of renegotiation. Ex post, shareholders and manager have incentives to renegotiate the manager's contract; once they have done so, management's interests are aligned with shareholders, and the adverse selection problems discussed by Myers and Majluf reappear. In addition, share-based compensation contracts are robust to such renegotiation, which may explain why such contracts are commonly used.

4. The Allocation of Ownership and Control Among Investors

The papers in the previous two sections are primarily concerned with the allocation of cash flows to and among investors so as to resolve conflicts between the investors and the firm's manager. Another strand of the literature has focused on the allocation of ownership and control rights among different investors so as to improve firm performance. The difference between this literature and that on agency/costly state verification is that, where agency/costly state verification focuses mainly on managerial incentives, research on ownership and control focuses on investors' incentives as well.

As in the previous two sections, the starting point for work on control and ownership is the fact that the agents who control the large modern firm on a day-to-day basis (management) tend to be separate from those who own it (investors). In a series of articles, Fama and Jensen (1983a, 1983b, 1985) discuss factors that favor this separation, and use them to motivate a variety of ownership forms. Our survey

considers more formal modeling of two general issues: the allocation of ownership and control rights among different securities such as debt and equity, and the structure of ownership (equity) claims per se.

Work on allocation of control among different securities typically focuses on the role of outside debt and equity. The basic role of outside debt in these models is illustrated by Aghion and Bolton (1992), who consider an entrepreneur with limited wealth who has a project that requires funding from outside investors. These outside investors are only interested in the monetary profits they receive whereas the entrepreneur is concerned about the effort required to produce the profits as well as the money he receives. The important feature of Aghion and Bolton's model is that contracting possibilities are incomplete so that the conflict of interests between the entrepreneur and the outside investors cannot be solved by a contract specifying entrepreneurial effort and reward. An efficient allocation of resources is achieved by allocating control appropriately using debt and the institution of bankruptcy. This ensures that when earnings and hence future prospects are good the entrepreneur decides whether or not the increased payoffs from expansion are worth the effort involved. However, when earnings and future prospects are bad the investor makes the liquidation decision and this is not frustrated by the entrepreneur who weights the effort of liquidation too highly.

In Kalay and Zender (1992), an entrepreneur needs additional funding from an outsider. Although the entrepreneur is better informed than the outsider about the cost of exerting effort to improve future firm performance, his limited stake in the firm distorts his incentives to exert effort. Thus, even though the outsider must pay a cost to become fully informed and run the firm, it may be optimal in lower productivity states to give the outsider control of the firm and rights to all future cash flows; this resembles debt with transfer of ownership in bankruptcy. Not surprisingly, the number of states in which the outsider takes control increases with the amount of outside funding required. The authors also show that, when liquidation is possible, different firms may prefer contracts with bankruptcy provisions

resembling Chapter 7 or Chapter 11; however, unlike reality, the type of bankruptcy is chosen ex ante rather than ex post.

Like the agency/costly state verification literature previously discussed, the last two papers motivate outside debt only. By contrast, Zender (1991) develops a model in which the use of both outside debt and outside equity is optimal. The project to be undertaken requires two investors to provide the financing; individually, neither has sufficient resources. In order for there to be the correct incentives to make the proper decisions efficiently, only one of the investors can be assigned control. One of the investors is therefore given equity and is made the residual claimant while the other receives debt and does not obtain control unless the initial decisions are not made properly so the firm goes bankrupt.

In Berglöf and von Thadden (1993), the basic problem is that of Hart and Moore (1989): an entrpeneur cannot commit to making payments to investors, who must rely on the threat of liquidation to obtain redress. An investor who provides long-term financing has a weaker bargaining position if the entrpeneur reneges on payments, since liquidation hurts the investor's position as well as that of the entrepeneur; this raises the firm's ex ante cost of capital, and may prevent good projects from being undertaken. By contrast, an additional investor with a short-term claim secured by the firm's assets has stronger bargaining position, since the assets' liquidation value may be enough to satisfy his or her claims even if they are insufficient to satisfy all investors. Thus, a capital structure with both short-term secured debt and long-term claims such as debt or equity dominates having a single investor provide all financing.

Aghion, Dewatripont and Rey (1990) consider a model where managers must be given the correct incentives to provide effort. It is not possible to do this with the manager's compensation scheme because the manager has limited financial resources; this restricts the amount the manager can be penalized if the firm does badly. Introducing voting equity allows the correct incentives to the manager to be provided because there is then the possibility of a high payment to the manager (a "golden parachute") when she exerts effort so the firm is valuable and is taken over. If the manager has private benefits of control, debt

also enhances incentives: if the firm does badly, control is transferred to debtholders, eliminating the manager's private benefit - which gives the manager incentive to exert effort in the first place.

In Aghion, Dewatripont, and Rey, debt serves to commit investors to a course of action ex post which provides ex ante incentives for management. Dewatripont and Tirole (1992) and Berkovitch and Israel (1993) explore this issue in greater detail.

In Dewatripont and Tirole (1992), a firm's manager may not exert optimal amounts of effort in running the firm. Outside investors can intervene ex post, effectively liquidating the firm in whole or in part. This action reduces the manager's control rents, reduces the risk of the firm's return distribution (assets are replaced with cash), but reduces the mean of the distribution as well (there are costs to liquidation). The difficulty with financing the firm with outside equity alone is that, ex post, equityholders view any shirking on the manager's part as a sunk cost - they would rather keep the manager and earn a higher expected return. This leads to renegotiation ex post, weakening the manager's ex ante incentives to work hard. By contrast, debtholders have a concave payoff function, so they prefer less risky return distributions. In an optimal financial structure, some debt is short-term, forcing the manager to try to refinance it at an interim date; if he has shirked, the debt cannot be refinanced, and control is given to the debtholders, who liquidate the firm. Some equity is necessary to maintain sufficient concavity of debtholder payoffs, and some long-term debt is necessary so that the refinancing requirement can be met when the manager does not shirk.

In a related paper, Berkovitch and Israel (1993) focus on the allocation of control rights between holders of debt and equity when control allows the replacement of an incumbent manager. The incumbent manager affects a firm's return distribution both through his effort, which he knows, and his ability, which becomes known to both manager and investors at an interim date. Threat of replacement at the interim date affects managerial effort, so commitment to various replacement schemes is necessary. Because a new manager is something of an unknown quantity, replacing an incumbent manager generates

additional uncertainty over the firm's return distribution. Debtholders dislike uncertainty, and are more likely to retain below average incumbents; the opposite is true of equityholders. Thus, if it is desirable to retain below average managers, debtholders are given substantial control rights (covenants, seats on the board); otherwise, debt is only given the right of control in bankruptcy, and shareholders generally control the firm.

The next two papers serve to bridge the gap between research on the allocation of control between debt and equity and work on the design of ownership (equity) contracts. These papers also place more emphasis on an externality which the control rights literature tends to ignore: just as a firm's management and employees may use their day-to-day control of the firm to take advantage of investors, investors may use their own control rights in ways which take advantage of managers and employees.

In Garvey and Swan (1992), a firm has a hierarchy which, in simplest form, consists of a CEO and a divisional manager, whose joint effort influences firm output. The CEO can also devote effort to monitoring the divisional manager, and is responsible for administering the latter's compensation; however, the results of monitoring cannot be verified in court. Thus any contracts between the firm and the divisional manager must be implicit. This leads to the following problem: if the CEO has a (large) equity type stake in the firm, she will have incentive to breach the contract with the other manager ex post so as to increase the firm's profits. However, if she bears none of the firm's downside risk, she has no incentive to monitor or expend effort on the firm's output. Thus residual claims on the firm's profits should be given to outside (passive) investors, and the CEO's optimal compensation will be concave: flat in good states, and positively sloped in bad ones. In order to commit to hurting the CEO in bad times, the firm issues debt to outside investors, and the CEO is fired in the event of default.

Garvey and Swan's optimal contract motivates separation of ownership and control, the use of outside debt and equity, and the lack of large equity stakes for CEOs, all in the context of a firm which resembles the way large corporations are actually organized. One caveat is that real CEOs often receive

options which give them much upside potential; such contracts might be useful in offsetting managerial risk aversion. Although such options might give CEOs incentives to breach subordinates' contracts, this might in part be offset by long-term reputational concerns. Since Garvey and Swan focus on single period contracting and risk neutral CEOs, these concerns are beyond the scope of their model.

Chang (1992) obtains somewhat similar results in a model where employees (modeled as a representative agent) run the firm for outside investors. All parties observe an unverifiable signal of future output; if the signal is low, restructuring will improve output at a noncontractible cost to the employees. Although the employees cannot directly commit to restructure, they can commit indirectly by funding the firm with a combination of short-term debt and equity. The output signal determines whether or not the debt can be refinanced in the open market; if the signal is low, the debt is not refinanced, the firm defaults, and debtholders seize control and restructure the firm. Since they are risk averse and investors are not, employees receive a fixed wage with priority, which accords with actual practice. Chang argues that it is necessary that outside shareholders be dispersed, so that employees make the financing decision; otherwise, the shareholders would ignore the employees' cost of restructuring and issue too much debt.

The remaining papers in this section focus on the design of ownership (equity) structure, which involves the allocation of shares to different investors, the allocation of liability to shareholders, and the allocation of control (voting rights) among shares. A relatively early piece in this area is that of Holmstrom (1982). A team of workers jointly determine a firm's output through their individual efforts, which are unobservable. Holmstrom demonstrates that no sharing rule that divides up total firm output among the workers will induce first-best effort: free rider effects will always come into play. Incentive schemes that can break the firm's budget constraint - i.e., those that impose aggregate penalties - can enforce the first-best outcome. The problem is that the workers cannot enforce such a scheme, because ex post they will always prefer to divide up whatever is on hand. Introducing a principal (owner) provides

a credible means of enforcing such penalties. Thus "capitalistic" firms (those owned by investors) may dominate partnerships (those owned by workers).

When uncertainty is present, Holmstrom's result may require an extremely wealthy owner. To the extent individual investors can cooperate, this assumption presents no problems, since a large number of owners can pool their wealth. Cooperation seems reasonable enough if ownership simply involves pledging assets for an enforceable incentive scheme. However, to the extent ownership involves monitoring (addressed in the second half of Holmstrom's paper), which in turn requires individual effort, there may be free rider problems among multiple owners. Having a single owner monitor may dominate, but limited wealth will restrict that individual's incentives to monitor.[12] Thus, one important feature of optimal ownership structure is ownership concentration, including both the number of owners and the amount of wealth each commits to the firm.

Although there has been little work on optimal concentration per se, several papers touch tangentially on this issue. Shleifer and Vishny (1986), Huddart (1993), and Admati, Pfleiderer, and Zechner (1992) all model equity-financed firms which have one large shareholder and a fringe of smaller ones. In all these models, distributional assumptions are such that more wealth commitment by owners increases monitoring and firm performance. Shleifer and Vishny find that firm value unambiguously increases in the large shareholder's holding; this needn't be true in Huddart and Admati, Pfleiderer, and Zechner, because the large shareholder is risk averse.

One difficulty discussed in all three papers concerns the large shareholder's incentives to acquire and maintain her share of the firm. As shown by Huddart and by Admati et al., if the large shareholder can trade shares piecemeal and anonymously, she will do so: in this fashion, she captures the perceived value of her monitoring without actually bearing the cost involved. Of course, in equilibrium this causes

[12] Note that monitoring costs may hurt working partnerships as well: to the extent partners monitor one another, costs will rise exponentially with the number of partners, and free rider effects may decrease each partner's incentive to monitor.

a breakdown in monitoring. The papers discuss various methods for mitigating this problem: Huddart shows that requiring the large shareholder to trade proportionately with other investors removes her incentives to sell out; Admati et al. show that diversification motives will lead the large investor to hold large stakes in each firm in the economy; Shleifer and Vishny discuss means for compensating the large investor for her efforts. The importance of the ability to "trade away" from the optimal ownership structure suggests that future work on optimal ownership structure should examine the impact of varying degrees of market liquidity.

In a somewhat different vein, Winton (1993a) describes a model in which a number of symmetric large investors own a firm which may require additional financing from other investors, and any owner can independently monitor the manager of the firm with some probability. In Winton's model, owners always weakly prefer to increase the amount of wealth they commit to the firm (effectively reducing the debt-equity ratio, but see below). The impact of increasing the number of owners depends on the nature of the monitoring cost function; for most functions, free rider effects dominate in the limit, and firm value decreases, but in some cases firm value may increase over some range.

Closely related to the issue of ownership concentration is the nature of the owners' financial commitment to the firm. Even if distributional assumptions are such that increasing the amount of the firm's risk that is borne by the owners increases both their incentive to monitor and firm value (a common thread in the last three papers), they can make their wealth commitment in two ways: initially, by investing their funds in the firm, or on a contingent basis, by raising additional firm debt which they guarantee with their outside wealth. This ties into the large (mainly legal) literature discussing the tradeoffs between limited and unlimited liability for owners.[13] While at first glance the difference between these two regimes would seem to relate to risk aversion, these authors suggest this is more

[13] See for example Easterbrook and Fischel (1985) and Halpern, Trebilcock, and Turnbull (1980), as well as Jensen and Meckling (1976).

apparent than real. A limited liability shareholder could invest all of her wealth in the firm, and an unlimited liability shareholder can never lose more than her total wealth. Unlimited liability certainly reduces the choice set of the shareholder, but the shareholder could limit her liability to any desired amount by purchasing insurance. Furthermore, limited liability in British law merely means that there is an upper bound (set when shares are issued) on each shareholder's potential liability; this bound need not be zero. Thus the major difference between regimes seems more related to the contingent nature of shareholder commitments under any regime where their liability exceeds zero, unlimited liability being one extreme and zero liability (as in U.S. corporations) the other.

Several authors have pointed out drawbacks of regimes where shareholders bear significant contingent liabilities. Jensen and Meckling (1976) note that the extent of any one shareholder's own liability will depend on the wealth of each of the other shareholders, so that shareholders and creditors will have to monitor shareholder wealth. The costs of this will increase (geometrically, if monitoring is private information) with the number of shareholders, and firms with large numbers of owners will find such a system prohibitively expensive. Woodward (1985) points out that under contingent liability, the value of a share decreases in the holder's outside wealth, since poorer individuals have less they can lose in the event the firm defaults. Thus, if shares are freely traded, wealthy investors will tend to sell such shares and poorer investors will buy them; in the limit, adverse selection will lead to a firm owned by individuals with no remaining outside funds, and the shareholders' liability will be valueless.[14]

The difficulty with these arguments is that contingent liability is and has been used in a number of settings.[15] A possible explanation is given by Winton (1993a). As discussed earlier, firm owners in his model have incentive to use their wealth as a means of bonding themselves to monitor management.

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[14] This effect will be mitigated to the extent investors exhibit increasing relative risk aversion; see Winton (1993a).

[15] Winton (1993) gives a number of examples.

To the extent the bulk of their wealth is illiquid, they will prefer to commit wealth via a contingent guarantee rather than actual investment so as to minimize the probability of liquidation costs - just as in Lacker's (1990) model. The firm is then funded with liquid funds from a large number of other investors, whose claim is equivalent to debt backed by the shareholders' guarantee.[16] However, if shares are issued or traded freely, the adverse selection problem noted by Woodward (1985) occurs. Thus trading restrictions and wealth verification are necessary to enforce contingent liability regimes, and their cost tends to increase with the number of shareholders. Winton uses these results to motivate several actual ownership structures.

The last issue considered in this section concerns the allocation of voting rights among different investors. A particular focus of research on this issue has been identifying the circumstances under which the use of one vote per share and majority voting are optimal.

Grossman and Hart's (1988) starting point is the fact that when securities are widely held there is a free rider problem; individual shareholders do not have an incentive to expend sufficient resources to monitor management. The situation where voting rights matter most is when outside "rivals" monitor the "incumbent management" and make a takeover bid. Grossman and Hart consider the corporate charter an entrepreneur should adopt to maximize the initial value of the firm. The important determinant of the allocation of voting rights in their model is the distribution of the private benefits of control between the rival and the incumbent management. If there is an asymmetry so that one group has much larger benefits than the other then one share one vote is optimal because it maximizes the amount that has to be paid to acquire control; concentrating votes makes it cheaper to acquire control because fewer shares have to be bought. If there are symmetric private benefits of control then concentrating votes is optimal since it

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[16] Winton assumes that payments to outsiders must be monotone. However, if owner wealth is sufficiently high, the optimal contract between owners and outside investors may take the form of higher payments in bad states than good ones, analogous to the result of Innes (1990). As in that case, incorporation of costly output verification for outsiders might avoid this problem.

makes rivals and incumbents compete and pay for the private benefits. Grossman and Hart argue that the asymmetric case is relevant because the extent to which incumbents can extract private benefits is limited by the law and suggest that this is why one share one vote is so prevalent.

Harris and Raviv (1988) consider a model that is closely related to Grossman and Hart's. However, they distinguish between privately optimal arrangements where the corporate charter is chosen to maximize the initial value of the firm as in Grossman and Hart and the socially optimal arrangement which takes into account the private benefits accruing to rival and incumbent management teams. They show that one share, one vote majority rule is socially optimal because it ensures that the team that generates the greatest total amount gains control; any deviation gives an advantage to the incumbent or rival that may allow them to gain control even though they generate a lower total amount. In contrast to Grossman and Hart, they focus on the case where both rivals and incumbents have private benefits of control. They therefore argue that issuing two sets of securities one with all the voting rights and one with all the dividends is privately optimal because it makes them compete for the right to extract the private benefits. This difference in results suggests that an important empirical issue in this area is the extent to which private benefits differ between incumbents and rivals.

Blair, Golbe and Gerard (1989) consider a model similar to that of Harris and Raviv (1988) except that they assume the rival and incumbent bid simultaneously whereas Harris and Raviv assume they bid sequentially. This difference in assumptions leads to a difference in results in that Blair, Golbe and Gerard (1989) find that in the absence of taxes, one share one vote majority rule and extreme securities that unbundle voting rights and cash flows are equivalent and both lead to social optimality. The main concern of Blair, Golbe and Gerard is to consider the effect of capital gains taxes on the allocation of voting rights and cash flows. If capital gains taxes are in effect then welfare is improved if extreme securities are used. This is because a lock-in effect means capital gains taxes may prevent a superior rival from winning if there is one share one vote majority rule; tax liabilities may be higher

when the rival wins than when the incumbent wins. Allowing separate trading of votes alleviates this effect.

Harris and Raviv (1989) consider the allocation of voting rights and cash flows when the firm is not restricted to issuing just equity using a model similar to that of Grossman and Hart (1988); they focus on private optimality and assume there are asymmetric private benefits of control. The problem of the entrepreneur who owns the firm initially is to design securities that prevent the incumbent management that has private benefits from maintaining control when a superior rival appears. This means that the cost of resisting takeovers must be maximized. As in the papers focusing only on equity, one share one vote among voting securities is an important component of this, since it means that control cannot be acquired cheaply by the party with private benefits. In addition, nonvoting risky securities should not be sold to outside investors; if nonvoting securities are sold to the outside investors they should be risk-free debt. The reason is that these maximize the cost of obtaining control and so tend to favor the superior rival.

Nagarajan (1993) uses a mechanism design approach to investigate what forms of takeover mechanism are generically efficient in the sense that the person or team that values the firm the most always acquires control. It is assumed that shareholders' valuations of the firm are private information but there are no private benefits to control. Among other things, it is shown that a pure proxy mechanism where there is no exchange of shares is not generically efficient. Also, there does not exist a takeover mechanism which involves the largest stockholder gaining control which is generically efficient. Finally, it is shown that if the initial owner's valuation is common knowledge there exists a mechanism which is generically efficient but if there are more than two shareholders it is not simple majority rule.

The approach of considering the allocation of voting rights when an incumbent management team is challenged by a rival team is not the only possible one. Bagwell and Judd (1989) instead consider the optimality of majority rule where control is concerned with payout and investment decisions. Initially in

their model, all investors are identical, corporate charters are designed and securities are issued to finance firms' investments. Investors then discover whether they prefer early or late consumption and how risk averse they are. After this firms decide on how much to pay out and whether to invest in risky or safe projects. In an ideal world investors can acquire the shares of firms which adopt their preferred policies. In this case majority rule is optimal since, within firms, shareholders will be homogeneous. The problem is if investors face high costs of reallocating their portfolios such as capital gains taxes with lock-in effects, the reallocation of investors will not be optimal. In this case shareholders are no longer homogeneous within firms and majority rule is no longer optimal. Instead, when the costs of reallocation are high the initial corporate charters should specify a utilitarian form of objective function where the weights assigned to each type correspond to their representation in the population.

Maug (1993) considers the important issue of the role of outside boards of directors. In his model, investment in firm-specific human capital by managers is necessary for the firm to be productive and the level of skill that managers attain cannot be contracted upon. The use of debt and liquidation when bankruptcy occurs has the drawback that managers' incentives to invest in firm-specific human capital are attenuated because bankruptcy may occur in states where in an ideal world it would not. Maug shows that by introducing an outside board of directors it is possible to reduce this inefficiency.

Bagwell and Judd's and Maug's models illustrate that the allocation of voting rights and control may be important in situations other than takeovers. They focus on two particular situations of this type but there are many others. For example, when there are differences in beliefs on the effects of various policies the firm might adopt, the allocation of control by appropriate design of securities and corporate charters is important.

5. The Allocation of Risk

Traditional financial theories suggest that one of the major advantages of having different types of securities is that they allow different groups of investors with different risk tolerances to bear the amount of risk they desire. This raises the question of how securities should be designed when risk sharing rather than control is the important issue. The Modigliani and Miller result, that capital structure is irrelevant when markets are complete, suggests that the form of securities are irrelevant in these circumstances. In order to develop a theory of optimal corporate financial structure in a risk sharing context, it is necessary that markets be incomplete. One possible reason for incompleteness that is suggested is transaction costs. Allen and Gale (1988; 1991; 1994), Madan and Soubra (1991), Pesendorfer (1991) and Bisin (1993) have considered models of this type.[17]

Allen and Gale (1988) consider a perfectly competitive, symmetric information model where different groups of investor have different degrees of risk aversion and there are transaction costs of issuing securities. It is shown that restrictions on short sales are necessary if an equilibrium is to exist. This is because a firm that issues multiple securities must be able to recoup the transactions costs of issuing the securities and so must be more valuable than a similar firm with fewer securities. If costless short sales were possible there would be an arbitrage opportunity; by going short in the multiple security firm and long in the firm with fewer securities it would be possible to make a profit equal to the difference in transaction costs. Hence for equilibrium to exist there must be short sale restrictions. These restrictions mean that different types of investor value securities differently on the margin and the price of a security is determined by the group that values it most. Among other things, it is shown that equilibrium is constrained efficient. Also, debt and equity are not optimal. Optimal securities are extreme

[17] For an analysis of security design by futures exchanges, see Duffie and Jackson (1989) and Cuny (1993), for security design by options exchanges see Allen and Gale (1990) and for security design by governments see Gale (1990).

in the sense that they allocate all of a firm's payoff in a particular state to one security or another. This allows the securities to be used most effectively in investors' portfolios to smooth consumption.

Madan and Soubra (1991) combine the approach of Allen and Gale (1988) with that of Ross (1989) to take into account the problem of marketing securities. The important transaction costs in their model are the costs of marketing securities. Widening the appeal of a security reduces the marketing costs. In this framework it is shown that optimal securities are no longer extreme. In some cases equity, debt and warrants are optimal.

Pesendorfer (1991) has also considered financial innovation in a model which is related to Ross (1989). He assumes there are standard securities that can be traded with zero costs. Intermediaries purchase these and repackage them to create intermediated securities. These need to be marketed which is costly. As in Allen and Gale (1988), there are short sale constraints for intermediated securities; without these, short selling would be equivalent to issuing securities and avoiding marketing costs.

Three main results are obtained. It is shown that innovation can improve agents' utilities even if markets are as complete as before, because innovation can allow the costs of marketing to be reduced. The second result is that the level of innovation is not necessarily constrained efficient. This is because no intermediary has access to all standard security markets, so there is no mechanism to coordinate innovations. As a result it is possible to get stuck at equilibria where there is too little innovation. If two intermediaries were to innovate simultaneously in these equilibria everybody could be better off because of complementarities provided by the innovation. Since there is no mechanism to coordinate them, and it is not worthwhile for either of them to do it individually, they do not innovate. The final result concerns the role of innovation in eliminating indeterminacy. Balasko and Cass (1989) and Geanokoplos and Mas-Colell (1989), among others, have shown that if securities pay off in nominal units of account and markets are incomplete then there is an indeterminacy in real equilibrium allocations. The reason is that the payoffs to securities which are specified in nominal terms can have different values in different

equilibria. With complete markets this does not happen since all that is changing is the numeraire; the set of real payoffs does not alter. Pesendorfer shows that as marketing costs tend to zero, the markets become complete and any real indeterminacy is eliminated.

Allen and Gale (1991) develop an approach to security design which does not rely on there being short sales restrictions. The crucial feature of this model is the assumption concerning the timing of events. Firms first choose the securities to issue and these securities are then traded on competitive markets. When there are short sale restrictions the results are essentially the same as those in Allen and Gale (1988). However, when there are no short sales restrictions an equilibrium exists. This is consistent with there being no arbitrage opportunities because at the second stage, multiple security firms can have the same value as otherwise similar firms with fewer securities. The reason that there are still incentives to innovate is that instead of being price takers as in Allen and Gale (1988), firms take into account the fact that their actions will affect equilibrium prices in the second stage security markets. Thus they may be willing to innovate and issue costly securities even though ex post the value of their firms is the same as that of non-innovating firms; they compare their utilities in different second stage equilibria. The results here are somewhat different from those in Allen and Gale (1988). Equilibrium is no longer constrained efficient. An example is given of too little innovation; the change in firm value across security market equilibria is such that firms fail to issue a security even though everybody could be made better off if such a security were issued. An example is also given of too much innovation; in this case firms issue securities even though everybody could be made better off if fewer securities were issued. The endogenous incomplete market structure that arises from profit maximizing behavior in this model is not necessarily efficient.

Bisin (1993) uses an imperfectly competitive model related to that in Allen and Gale (1991) to reconsider the Balasko and Cass (1989) and Geanokoplos and Mas-Colell's (1989) real indeterminacy result. At the first stage intermediaries optimally design the pay-off structure of the securities they issue

and choose the spread between the buying and selling prices. These intermediaries bear a transaction cost for each security issued that has a fixed component and a variable component that is proportional to the volume traded. At the second stage the securities are traded on Walrasian markets where investors are price takers. Intermediaries have rational expectations about the second stage equilibria when they design securities at the first stage. Bisin's main result is to show that the introduction of intermediaries that choose securities optimally removes the real indeterminacy result of Balasko and Cass (1989) and Geanokoplos and Mas-Colell (1989). Unlike Pesendorfer's (1991) related result which depends on transaction costs being vanishingly small, it is shown that the real determinacy of equilibrium does not depend on the level of transaction costs.

6. Acquisition of Information

One of the determinants of a security's value is the information that investors have. This raises the possibility that securities will be designed to affect the extent to which information is acquired in order to maximize value. Boot and Thakor (1993) have considered a noisy rational expectations model of this type. A firm, which can be high or low value, sells its securities to investors. The firm knows its own value but investors do not unless they pay to become informed. There is a group of liquidity traders whose demand for securities is exogenously determined and random; this ensures that asset prices are noisy and do not fully reveal firm type. The investors who do not choose to become informed are the residual holders of the security. All traders are risk neutral. The informed traders cannot borrow or sell short; if they find out the firm has high value they invest all their wealth in it and if it has low value they invest nothing in it. The price is determined by the residual holders who will only hold it if price is equal to the expected value of the stock conditional on the sum of the liquidity and informed traders' demands. In equilibrium the profits of the informed are just sufficient to cover the cost of buying the information.

Good firms want there to be as many informed investors as possible because this creates a high demand for their securities and increases the amount the firms receive. By splitting its cash flow into a safe and a risky portion, i.e. into debt and equity, a good firm provides better incentives for investors to become informed. The reason is that the fluctuations in price of the risky component are increased and this raises the profits an informed investor earns. As a result more investors become informed and the value of the firm is raised. Bad firms always find it worthwhile to mimic the good firms so they can receive the average value of the two. Thus in equilibrium all firms find it worthwhile to split.

One extension of the model is where the information informed investors receive does not perfectly signal firm type and there are many firms. In this case it is worthwhile to bundle the securities and then to split this portfolio into a safe and risky component. This allows the idiosyncratic risk associated with the signals to be eliminated and for the firms to receive more because people are better informed. This result is consistent with the fact that financial intermediaries such as collateralized mortgage obligations CMOs) pool securities and then issue multiple claims against them.

In a related paper, DeMarzo and Duffie (1993) analyze the effect of information acquisition by intermediaries on the design of securities such as CMOs. Suppose that an intermediary finds out that the value of an asset they have acquired and plan to sell is below the expected market price that it will fetch. It will have an incentive to sell as much of the asset as possible. On the other hand, if it finds out the market value is above the expected market price it will have an incentive to retain some of the asset. This "option" on the amount to trade means that the payoff from selling the asset is convex in the intermediary's private valuation. DeMarzo and Duffie show that this convexity makes it worthwhile to split the cash flows in ways which resemble CMOs. For example, rather than split marginal cash flows between securities, they should be allocated to one security or another as is done with different CMO tranches.

When a new security is introduced investors may face a kind of uncertainty which is different from that which they face when they buy a familiar security. They may be unsure what the characteristics of the security are and how it will operate in practice. To offset this they must gather information to discover how the security will help them increase their ability to hedge risks or increase the expected returns on their portfolio. If this information is costly they will demand a premium from the issuer so that the price the issuer can obtain is reduced. In contrast, standard securities whose operation investors are familiar with will not require this type of reduction in price. Gale (1992) has shown that this preference for standard securities can lead to a coordination failure because issuers can get stuck at an undesirable equilibrium. Any single firm will be reluctant to issue a new security with better characteristics but if all firms were to do this a Pareto superior equilibrium could result. The costs of gathering information about a new security mean that the privately optimal security does not necessarily correspond to the socially optimal one.

Demange and Laroque (1992) consider the relationship between private information and the design of securities in a noisy rational expectations model. Entrepreneurs who have a large stake in a single company will want to diversify their holdings. However if they have superior information investors will be reluctant to trade with them; in extreme cases they will not be able to diversify at all. Demange and Laroque show that entrepreneurs can overcome this problem to some extent by designing the securities they sell so they are uncorrelated with their information. The optimal security design trades off insurance opportunities with speculative gains. Rahi (1993) considers a model that is similar to Demange and Laroque's but without noise traders and is able to show that equity is the optimal security.

7. Concluding Remarks

The existing research on optimal financial contracting has contributed greatly to our understanding of the situations under which actual securities are in fact optimal responses to various capital market

imperfections. For example, from the viewpoint of risk-sharing, debt seems inoptimal, and costs of financial distress associated with bankruptcy should make debt even less attractive; yet, as our survey shows, debt-like contracts are often optimal responses to agency and adverse selection problems. Similarly, although equity has risk-sharing appeal, various institutional features need to be in place before equity can be used as an effective investment vehicle.

Nevertheless, despite the considerable amount of work on the role of incentives and optimal contracting in determining corporate financial structure, several important areas require further research. The first concerns the robustness of simple optimal contracts in different environments. In general in this literature, small changes in the assumptions of the underlying model can lead to an important change in the optimal contract. In practice, however, certain simple contracts and securities appear to be used in a wide variety of circumstances.

The second area for further research is to identify the effects of more complicated agency problems on ownership structure and financial contracting. At present most of the models involve relatively simple agency problems and the results focus on one or a few aspects of the resulting arrangements or contracts. The way in which various different agency problems interact is an important issue. Along the same lines, many of these models essentially focus on entrepreneurial firms; more work needs to be done on firms which resemble large corporations with effective separation of ownership and control.

Finally, many securities issued by public corporations are liquid and can be easily traded. Most models abstract from this important feature and assume a signal period structure where security owners remain unchanged throughout time. Allowing for the possibility that a security might be sold to a new investor with different risk aversion or information is an important step which may considerably extend our understanding of the phenomena we observe.

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