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MANAGERIAL AUTONOMY, OPTIMAL SECURITY ISSUANCE AND CAPITAL STRUCTURE

by

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MANAGERIAL AUTONOMY, OPTIMAL SECURITY ISSUANCE AND CAPITAL STRUCTURE

Abstract

In this paper we address two related puzzles: (i) why do firms issue equity when stock prices are high and (ii) why do firms so often not issue securities to counteract the mechanical effect of their stock returns on their leverage ratios? Our theory builds on the importance of managerial autonomy in the face of potential disagreement with investors. The firm’s management values autonomy because it allows management to make decisions it believes are best for shareholders without being blocked by dissenters. The amount of autonomy management has at any point in time depends on how the firm is financed. Debt offers maximum autonomy when it can be backed by assets in place with a sufficiently high value, and minimum autonomy when assets in place have a low value. The managerial autonomy offered by equity depends on the extent to which shareholders are inclined to agree with management’s strategic choices. Equity offers the greatest autonomy when the propensity for shareholder agreement is the highest, and this is also when the firm’s stock price is the highest. Thus, the autonomy benefit of equity and high stock prices go hand in hand. Debt is the optimal security to issue when the probability of the assets in place having a high value is sufficiently high. Otherwise, the firm’s optimal security-issuance choice trades off the autonomy benefit of equity against the tax shield benefit of debt. An implication is that optimal capital structure is essentially dynamic and equity-centered. The optimal debt-equity ratio is decreasing in the firm’s stock price, implying that firms issue equity when stock prices are high and debt when stock prices are low. The theory explains many stylized facts that fly in the face of existing capital structure theories and also generates new testable predictions. Moreover, the theory can rationalize the use of debt in the absence of taxes, agency costs or signaling considerations.
1. INTRODUCTION

Capital structure theory is at a crossroads. The two dominant paradigms in the literature have been shown to be at odds with the stylized facts. One paradigm is the (static) tradeoff theory of optimal capital structure. It consists of Jensen and Meckling’s (1976) agency costs theory, DeAngelo and Masulis’ (1980) debt tax shields argument, as well as free cash flow and management discipline considerations (Grossman and Hart (1982)). All of these theories predict that an increase in stock prices -- which lowers leverage ratios in market value terms -- should lead firms to borrow more to bring their capital structures back in line with their respective optima. But the facts say otherwise. Firms issue equity rather than debt when equity valuations are high (e.g., Asquith and Mullins (1986), Jung, Kim and Stulz (1996), and Marsh (1982)). More recently, Graham and Harvey’s (2001) survey evidence indicates that CFOs considered equity market prices to be one of the most important factors in deciding whether to issue equity or debt. Baker and Wurgler (2002) find that the level of the firm’s stock price is a major determinant of which security to issue and that managers appear to be attempting to time the market, assuming that investors are irrational and hence raising equity when its perceived cost is low. The second dominant paradigm is Myers and Majluf’s (1984) “pecking order” theory which predicts that firms should finance first with internal cash or riskless debt, then risky debt and use equity only as a last resort (under duress). Consequently, firms should display “equity aversion” and equity issues should be rare in the data. Recently, however, Fama and French (2004) have presented evidence that equity issues are much more commonplace than predicted by Myers and Majluf (1984) and that equity issuance patterns are clearly inconsistent with the pecking-order theory. Moreover, the “equity aversion” predicted by the pecking order is contrary to the propensity of firms to prefer equity issuance to debt when their stock prices are high. Thus, the first puzzle for the theory is: why do firms issue equity when stock prices are high? A second related puzzle for the theory is: why do firms so often not issue securities to counteract the mechanical effect of stock returns on their leverage ratios, as documented by Welch (2004)? In fact, Welch (2004) finds that 40% of capital structure dynamics can be explained by stock return dynamics alone.

Our goal in this paper is to develop a theory that addresses these questions and also generates additional testable predictions. The theory pivots on the concept of managerial autonomy in the face of potential disagreement. Simply put, autonomy is the ability of the manager to make the investment decisions he thinks are best even when others (like major investors) disagree. The firm’s manager values

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1 This is not an exhaustive list; there are also other theories of capital structure. In Boyd and Smith (1999) the capital structure decision depends on whether returns are observable or state verification is costly. In Brander and Lewis (1986) capital structure affects strategic product-market competition. In Shah and Thakor (1987) capital structure is driven by project financing considerations.

2 Empirical evidence also suggests that firms tend to issue equity when investors are very enthusiastic about earnings prospects. See Loughran and Ritter (1997), Rajan and Servaes (1997), Teoh, Welch and Wong (1988a, 1988b) and Dennis and Sarin (2001).
this autonomy and will make capital structure decisions that provide him the desired future autonomy. The reason why capital structure and autonomy are linked is that debt and equity have different degrees of autonomy for the manager. We let the corporate governance system dictate the degree of control that shareholders have over management. We show that when debt can be backed by assets in place that have sufficiently high value, it offers the manager maximum autonomy, but otherwise it offers the manager less autonomy than equity. In that case, the manager’s tradeoff is that the debt tax shield lowers his cost of capital, but equity offers him greater autonomy. Our analysis recognizes that, even when debt restricts management, equity offers only relatively more autonomy than debt and that there may be instances in which shareholders, who disagree with the manager, end up blocking the manager’s action, thereby denying him ex post the autonomy he associated ex ante with equity.

Disagreement arises in our model due to heterogeneity in prior beliefs among the manager and investors about the precision of a commonly-observed signal about a project. Rationality demands that agents are Bayesian in updating their prior beliefs, but the issue of how the priors themselves are arrived at is not addressed in economic theory. Priors are taken as part of the primitives, along with preferences and endowments. In this sense, we are following Kreps (1990, p. 370) who argues that the assumption of homogeneous priors has “little basis in philosophy or logic.” While economic theory permits rational agents to have either homogeneous or heterogeneous priors, we believe that the assumption of heterogeneous priors is more appropriate in our setting. This is because the decision over which disagreement potentially arises in our model is the choice of a novel project about which there is a scarcity of historical data that could be used by agents to arrive at a common set of beliefs. That is, we are focusing not on replicable decisions, where the history of payoffs on previous project choices can serve as the basis for common prior beliefs about the next project, but on a “one-off” accept/reject decision about a new project. Our assumption of heterogeneous priors for such projects is thus consistent with Kurz’s (1994a, b) theory of “rational beliefs” in which individuals are allowed to have different beliefs as long as these beliefs are not ruled out by historical data. Heterogeneous priors represent a natural assumption in such settings, and there are many previous models that have employed heterogeneous priors, such as Abel and

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3 During financial distress, debt is particularly restrictive (Opler and Titman (1994)). We could also distinguish among different types of debt based on autonomy. For example, bank debt is considered more flexible than public debt due to its easier renegotiability (Berlin and Mester (1992)).

4 Kreps (1990) notes: “Economists (of a neoclassical stripe) would rarely if ever insist that consumers have the same ordinal preferences over bundles of goods or the same levels of risk aversion or risk tolerance. Individual consumers are allowed to have individual preferences. Seemingly then, one would allow subjective probabilities, as another part of the expression of personal preferences, to vary across individuals. If this seems so to you, and it certainly does to me, you are forewarned that, amongst many microeconomists, it is dogma (philosophy?) that two individuals having access to the same information will necessarily come up with the same subjective probability assessments (p. 111)… This convention follows from deeply held “religious” beliefs of many game theorists. Of course one hesitates to criticize another individual’s religion, but to my own mind has little basis in philosophy or logic. Accordingly, one might prefer, being more general, to have probability distributions $\rho$ and $\rho_i$, which are indexed by $i$, reflecting the possibly different subjective beliefs of each player.” (p. 370)

Note that our disagreement-based autonomy approach is not rooted in agency problems between the manager and shareholders (e.g. Jensen and Meckling (1976) and Ross (1973, 1979)) that incentive contracting can readily solve, since the manager truly believes he is maximizing firm value. Nor is it an issue of insufficient information aggregation or asymmetric information, since management and investors observe exactly the same signal; the key is that, conditional on that signal, agents arrive at different posterior beliefs about project value because of heterogeneity of priors about the precision of the signal.

The investment opportunity in our model is characterized by two parameters: the quality of the opportunity (opportunity quality), and the probability that others will agree with the manager that it is a good opportunity (potential agreement). For any value of the manager’s assessment of the opportunity quality, the higher the stock price, the higher is the agreement parameter because investors value the firm more highly when they perceive a lower probability the manager will take actions that they will disapprove of. Similarly, the lower is the stock price, the lower is the potential agreement parameter. So the manager finds equity most attractive when the price of his own firm’s stock is high and opposition from shareholders least likely. Nevertheless, debt may be preferred even in this case if the probability is sufficiently high that the firm’s assets in place will have a high value. The reason is that bondholders are relatively unconcerned about the firm’s project choice under these circumstances and therefore provide the manager more autonomy than equity does. If the probability is high that the firm’s assets in place will have a low value, then the bondholders’ payoff becomes dependent on the cash flow of the chosen project. Due to asset-substitution moral hazard concerns, bondholders now impose restrictive covenants and provide the manager less autonomy than equity does. Equity will now be preferred if the potential agreement between investors and management (and hence the stock price) is sufficiently high. When this agreement parameter is relatively low, as reflected in a low stock price, the autonomy advantage of equity over (restrictive) debt is not high enough to offset the tax benefit of debt, and the firm issues debt.

Our theory has implications for the literature on optimal security issuance as well as that on optimal capital structure. Our model produces a direct prediction that when equity is issued, stock prices will be high, whereas debt may be issued either during periods of low or high stock prices, depending on the probability distribution of the value of the assets in place. Our analysis also suggests that a firm will not issue securities to rebalance its capital structure when no project is available, even though movements in the firm’s stock price mechanically alter its capital structure away from where it was previously. That is, firms will let their capital structure ratios “drift” based on their stock return dynamics. Thus, our theory predicts exactly what Welch (2004) found empirically, namely that firms often do not proactively issue securities to counteract the effect of stock returns on their leverage ratios.
The capital structure implications of our theory are striking. The recent empirical findings that capital structure seems to be driven by stock prices and returns have led to the conclusion that firms do not seem to behave as if they have a target capital structure (see, for example, Baker and Wurgler (2002) and Welch (2004)). Our theory reveals that there is no inconsistency between firms having target capital structures and these capital structures being driven by the firms' stock prices. This is because the firm’s optimal capital structure is dynamic, varying (continuously) with its stock price. While our analysis assumes debt has a tax advantage, we also show that debt can be valuable to the firm’s shareholders even if there are no taxes, agency costs or signaling considerations because it helps the shareholders to obtain a precommitment against investing in the project in circumstances where the value of the assets in place is relatively low and shareholders disagree with the manager that the project should be taken. This brings to light a previously-unexplored role of debt as an “autonomy-limiting” device. Moreover, when the value of the assets in place is relatively high, debt is preferred because it provides maximum autonomy to the manager. In addition to these results, our autonomy theory of capital structure generates numerous testable predictions.

The theoretical paper most closely related to ours is Zwiebel’s (1996). In his model, the manager, who has a choice between a good and a bad project, enjoys an exogenous control benefit from his job, which he can lose via a takeover. To cope with this takeover threat, the manager precommits to not invest in the bad project by issuing debt because this amplifies the impact of the bad project on the probability of losing control rents via bankruptcy. Since the firm’s stock price is higher when the probability of a good project is higher, the importance of debt as a disciplining device diminishes as the stock price rises, so leverage decreases when stock prices are high.

The similarities between Zwiebel’s analysis and ours is that both take the perspective that managers -- rather than shareholders -- set the firm’s capital structure, and both imply a negative relationship between leverage and stock prices. The factors driving this and other results in the two models are entirely different, however. The key differences are as follows. First, managerial utility maximization determines capital structure in Zwiebel’s model, whereas shareholder value maximization determines capital structure in ours. Second, complete managerial control is assumed in Zwiebel’s model, whereas we endogenously derive the allocation of control between the manager and shareholders. Third, Zwiebel’s theory is driven by the disciplinary role of intermediate levels of debt financing in the face of bankruptcy costs. We have no bankruptcy costs and our focus is on the value of equity in providing management with autonomy to maximize shareholder wealth in the face of disagreement. Thus, ours is an “equity-centered” theory of capital structure, whereas Zwiebel’s is “debt-centered”. Finally, our model generates a rich set of

\[\text{That is, a tax advantage to debt is necessary to ensure that the manager will ever use debt, but it is unnecessary for the shareholders to want debt to be issued.}\]
results without any agency problem between the manager and shareholders. Additional differences -- such as the security-issuance announcement effects predicted by our model -- become evident when we discuss our empirical predictions.

Much of the literature on dynamic capital structure choice is also “debt centered”. Building on Jensen’s (1986) free-cash-flow hypothesis, Stulz (1990) shows that debt can be effective in limiting managerial discretion by reducing the free cash flow at the manager’s disposal.\textsuperscript{6} Dangl and Zechner (2004), who extend the dynamic capital structure models of Fischer, Heinkel and Zechner (1989) and Goldstein, Ju and Leland (2001), examine the effect of dynamic capital structure adjustments on the firm’s credit risk, and show that capital structure dynamics lower optimal initial leverage ratios, implying that dynamic considerations could rationalize a greater initial reliance on equity\textsuperscript{7}. In contrast to these papers, we focus on how the differential effects of debt and equity on the manager’s new project choice autonomy affect the firm’s choice of security issuance and hence the source of incremental financing.

The rest of the paper is organized as follows. In Section 2 we develop the application of autonomy to the security issuance decision and present the setup of the model. Section 3 contains the analysis. Section 4 discusses the implications of the analysis for security issuance and capital structure. Section 5 discusses the testable predictions of the analysis. Section 6 concludes. All proofs are in the Appendix.

2. THE ECONOMIC SETTING: DISAGREEMENT, AUTONOMY AND SECURITY ISSUANCE

In this section we describe the model and explain the links between disagreement, managerial autonomy and the firm’s security issuance decision.

Preferences, Choice of Securities and Time Line: We assume universal risk neutrality and a zero riskfree rate of interest. There are four points in time at which agents are risk neutral. At $t=0$, the firm has existing assets in place (AIP), with a value, $V_{AIP}$, that is stochastic. We assume $V_{AIP}$ will be $F$ with probability (w.p.) $\beta \in (0,1)$ and 0 w.p. $1-\beta$, and it is realized at $t=3$. We let $F > I$, where the investment $I$ is to be defined below. Whether $V_{AIP}$ is $F$ or 0 at $t=3$ becomes known between $t=1$ and $t=2$. The firm also has an opportunity to invest in a new project at $t=2$. This could be a (risky) innovative project, a riskless mundane project, or a lemon. The “mundane” project produces a riskless payoff at $t=3$. The lemon project yields a stochastic payoff at $t=3$. The mundane and lemon projects are available for sure at $t=2$.

\textsuperscript{6} See also Polevikov (2004) for a dynamic formulation.

\textsuperscript{7} Dynamic considerations may also lead to capital structure indeterminacy. Hennessy and Whited (forthcoming) state that a firm’s use of retained earnings to finance projects offers a tax advantage over paying the earnings out as dividends first and then raising external equity due to the fact that the firm’s retention of earnings to finance projects gives investors the opportunity to defer personal taxes. Hence, the firm’s leverage ratio keeps declining over the time it sustains its profitability and builds up retained earnings. Hennessy and Whited state that their model generates a data series that is consistent with the main Baker and Wurgler (2002) results. Lewellen and Lewellen (2004) qualify the Hennessy and Whited result by showing that it depends on the absence of a fully-offsetting capital gains tax.
In addition, an innovative project arrives at $t = 2$ w.p. $\theta \in (0,1)$. This probability is common knowledge. Thus, when the innovative project is available, the firm can choose between the innovative, mundane and lemon projects at $t = 2$. If the innovative project does not arrive, the firm’s choice is limited to the mundane and lemon projects. The arrival of the innovative project is observed only by the manager. So, if he does not like the innovative project he can simply choose to not propose it to investors and assert that the project did not materialize. Moreover, while investors can tell whether the manager invested in the mundane project or not, they cannot distinguish his investment in the innovative project from his investment in the lemon.

The firm is all-equity financed at $t = 0$. The manager’s objective is to maximize the expected terminal ($t = 3$) wealth of those who are shareholders at $t = 0$. The initial shareholders determine the firm’s corporate governance structure (the autonomy to be given to the manager) at $t = 0$. At $t = 0$, not only is the availability of the innovative project uncertain, but there is also uncertainty about the extent to which the manager’s future assessment of the innovative project value at $t = 2$ will agree with the market’s. The firm’s stock price at $t = 0$ will reflect the market’s expectation of the extent of this agreement as well as the market’s assessment of the innovative project that may arrive at $t = 2$. The market becomes aware of the likelihood of agreement with the manager at $t = 1$. Following this, the firm raises $SI$ in financing through debt or equity at $t = 1$. At that moment, financiers face uncertainty about the availability of the innovative project and about the value of the assets in place (AIP). The investment in the chosen project (mundane, innovative, or lemon) is made at $t = 2$.

We assume that debt financing offers a tax benefit, i.e. debt repayments are tax deductible, and that the tax rate on payoffs at $t = 3$ is $\tau \in (0,1)$. To simplify the analysis, we assume that the investment is either 100% debt financed or 100% equity financed. In the case of debt financing, the repayment obligation (at $t = 3$) equals $D$, with $D = (1 + r)I$, where $r$ is the yield on the debt. Although funds are raised through this security issuance at $t = 1$, the actual investment of $SI$ in the project is made only at $t = 2$. Payoffs are realized at $t = 3$.

**Project Investments and Payoffs:** All projects require an investment $Y$ at $t = 2$. The mundane project pays off a certain amount $R$ at $t = 3$, and has a positive NPV on an after-tax basis, i.e., $R[1-\tau] > I$. The lemon pays off a cash flow with a known mean of 0, a variance of $\nu^2$, and a density function $f(u|0,\nu^2)$.

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*Actually, to ease parametric complexity, we will assume that all payments to bondholders are tax deductible.*

*The idea is that the capital appropriation request is approved at $t = 1$ and all the preinvestment groundwork is done between $t = 1$ and $t = 2$, which accounts for the time lag between raising funds and investing them, both here as well as in practice. In our model, this makes it possible to have the financing contracts depend on future contingencies, e.g. a realization of a low value (zero) of the AIP could trigger intervention from the bondholders (note that financing is raised prior to the realization of the value of the AIP).*
for simplicity, we deal with probability distributions than can be completely described by mean and variance. There is no disagreement between the manager and any external financiers about the value of either the mundane project or the lemon. The innovative project pays off a random amount $u$ at $t = 3$, but management (insiders) and financiers (outsiders) may disagree at $t = 2$ about the expected value of $u$ and hence about the expected value of this project.

We interpret the different projects as follows. The mundane project is a routine extension of the firm’s existing business. Examples would be expanding capacity to increase the output of an existing product, replacing old equipment with new equipment, and providing a division with investment equal to its annual depreciation to continue operations. The innovative project represents a departure from routine operations. It is thus more risky and also subject to greater potential disagreement about its value. Examples are a new business design such as e-Bay’s launching of an online auction business, market entry into a new country, and acquisition of another firm such as Hewlett-Packard’s acquisition of Compaq, which was the subject of considerable disagreement. It is not necessary for our analysis that the mundane project be riskless, only that it be less risky than the innovative project. The lemon is simply a negative-NPV project that has the potential to expropriate bondholder wealth and is never desired unless there is an incentive problem between debt and equity.\(^\text{10}\)

**Disagreement Over Future Payoff of Innovative Project:** At $t = 2$, a signal $z$ is observed about the expected payoff of the innovative project at $t = 3$. Everybody observes the same signal, but the manager interprets it as $x$, whereas investors interpret it as $y$. Viewed at $t = 0$, $t = 1$ and $t = 2$, $x$ and $y$ are random variables for all agents, with means $\mu_x$ and $\mu_y$ respectively. That is, $x$ is the realization of a random variable that represents management’s interpretation at $t = 2$ of the expected value of the payoff on the innovative project at $t = 3$, and $y$ is the realization of a random variable that represents investors’ interpretation at $t = 2$ of the expected value of the payoff on the innovative project at $t = 3$. We assume that $x$ and $y$ are privately-observed non-contractible valuation assessments. Moreover, the manager observes $z$ first. This determines whether the manager proposes the project to investors. The implication of this setup is that, for example, with equity, if the manager interprets $z$ as $x \geq R$, the project is presented to shareholders who see $z$ and interpret it as $y$. If $x < R$, the manager simply states that no innovative project arrived, so shareholders do not observe $z$. Thus, disagreement over project choice is relevant only when $x \geq R$ and $y < R$.

We can think formally about $x$ and $y$ as follows. Both the manager and investors observe the same $z$ and start out with the same prior beliefs about the payoff at $t = 3$. However, each group receives a private

\(^{10}\) We assume that the manager can secretly switch to the lemon when investors think he is investing in the innovative project. In the content of the examples of innovative projects discussed earlier, the idea is that one can think of the lemon as a bad version of the innovative project. That is, a good acquisition may be an innovative project, whereas a bad acquisition may be a lemon project.
signal that determines its prior belief about the precision of $z$. This signal for each group is a random draw from a distribution. These private signals can potentially vary across the manager and investors, so that their posterior assessments of the mean payoff at $t = 3$, represented by $x$ and $y$, can be different. Conditional on the means $x$ and $y$, let $f(u|x, \Lambda_i)$ and $f(u|y, \Lambda_i)$ be the density functions of $u$ (the random payoff on the innovative project) assigned by the manager and the investors respectively, where $\Lambda_i$ is the variance of $u$, about which there is no disagreement. Assume $\Lambda_N > \Lambda_1$, so that the variance on the lemon project exceeds that on the innovative project.

The joint density $x$ and $y$, conditional on the correlation $\rho \in (-1, 1)$ between $x$ and $y$, is $q(x, y|\rho)$. The support of $q$ is $[-\infty, \infty] \times [-\infty, \infty]$. We assume that, conditional on $\rho$, the joint density $q(x, y|\rho)$ is common knowledge. However, $\rho$ is unknown at $t = 0$ and is realized at $t = 1$, with its realized value being reflected in the firm’s stock price at that time. In the subsequent analysis, the manager does not observe $\rho$ directly but infers it from the stock price at $t = 1$. The commonly-known distribution function of $\tilde{\rho}$ at $t = 0$ is $\Phi(\tilde{\rho})$; we will use $\tilde{\rho}$ to denote the unknown value of the correlation at $t = 0$ and $\rho$ its realized value at $t = 1$. Let $\mu_{\rho}$ denote the expected value of $\tilde{\rho}$. The correlation coefficient $\rho$ captures the extent to which management and investors are likely to agree on the value of the innovative project. That is, $\rho$ is the “agreement parameter”, and the higher its value, the more likely it is that management and investors will agree on the value of the innovative project. The firm’s stock price reflects $\rho$ because investors will tend to value the firm more highly when they know that it is less likely that the firm will invest in a project that investors disapprove of.

For later use, it will also be useful to define the marginal densities of $x$ and $y$, which are:

$$
 g(x|\rho) = \int q(x, y|\rho) dy, \text{ and } h(y|\rho) = \int q(x, y|\rho) dx
$$

Managerial Autonomy and Corporate Governance: We begin by noting that the manager is indispensable for managing projects and producing cash flows. The issue then is the amount of autonomy each group of

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11 We assume that the prior beliefs of investors and the manager about the precision of $z$ are rational in the sense of Kurz (1994a,b) but heterogeneous. That is, we assume that the observables in the economy that agents use to form beliefs about the precision of $z$ have the technical property of “stability” but not stationarity. Kurz (1994a) shows that every stable process is associated with a specific stationary measure, and that multiple stable processes can give rise to the same associated stationary measure. While historical data can be used to construct the stationary measure, they cannot generally be used to distinguish between multiple stable processes associated with the same stationary measure. That is, for beliefs to be rational, agents cannot have beliefs that are precluded by historical data, but multiple rational beliefs can be consistent with the historical data since a stable but non-stationary process is not generally uniquely identified even with countably infinite data points. This permits rational and heterogeneous prior beliefs, not all of which will conform to rational expectations. This heterogeneity of beliefs leads agents in our model to attach different interpretations to the same information. Supporting empirical evidence appears in Kandel and Pearson (1995) where it is shown that trading volume around public information announcements can be best understood within a framework in which agents interpret the same information differently.
financiers gives to the manager. This autonomy determines the “elbow room” the manager has to select the project he thinks is best -- one that maximizes the value of equity at \( t = 3 \) -- even when financiers disagree. Our perspective is that the degree of managerial autonomy with equity is determined at \( t = 0 \) to maximize the terminal \( t = 3 \) value of equity, and it is a component of the corporate governance put in place at \( t = 0 \). The restrictiveness of debt (i.e., covenants) is negotiated by management, while shareholders determine the restrictiveness of corporate governance with equity at \( t = 0 \). Conditional on these degrees of autonomy, the manager determines the firm’s security issuance (and hence capital structure) decision at \( t = 1 \) so as to maximize his expectation of the firm’s equity value at \( t = 3 \). This decision determines management’s overall elbow room at \( t = 2 \) in terms of project choice.\(^\text{12}\)

We model managerial autonomy as follows. When the manager interprets \( z \) as \( x \geq R \) and financiers interpret it as \( y < R \), there is disagreement in that the financiers want to invest in the mundane project and the manager wants to pursue the (risky) innovative project. Let \( \eta \) be the probability that the manager will be able to pursue the innovative project, conditional on the manager preferring it and the financiers being opposed to it. Thus, \( 1 - \eta \) is the probability that the financiers will be successful in blocking the manager from pursuing the innovative project and forcing investment in the mundane project.

Let us begin by discussing the role of \( \eta \) with equity. Since the lemon project has a known (deterministic) mean of zero, it has negative expected NPV equal to \(-1\). Given that the manager has the same preferences as shareholders about the objective function being maximized, both sides will agree to always forsake the lemon. Moreover, if \( x \geq R \) and \( y \geq R \), both will wish to invest in the innovative project. Disagreement arises when \( x \geq R \) and \( y < R \), in which case, \( \eta \) is effectively the probability of being able to invest in the innovative project. We view \( \eta \) as being determined by the corporate governance in place, i.e. by the requirements about information disclosure and the number of truly-independent directors on the Board, as well as the feasibility of active shareholder involvement in managerial decisions.

Intrusiveness by investors is costly. The greater the intrusiveness by investors, as reflected in a higher value of \( 1 - \eta \), the higher is the cost. The idea is that investors need to incur costs to have processes in place that allow them to get more directly involved in managerial decisions. This cost is a function \( K(1 - \eta) \) with \( K^{'}(\cdot) > 0 \), \( K^{''}(\cdot) > 0 \) and the Inada conditions \( K^{'}(0) = 0 \) and \( K^{'}(1) = \infty \). In the subsequent analysis, we will examine the endogenous determination of \( \eta \) at \( t = 0 \) permitting \( K(\cdot) \) to vary cross-sectionally, so that different firms may choose different values of \( \eta \). Moreover, we assume that \( K(\cdot) \) is incurred by the initial shareholders at \( t = 0 \) when \( \eta \) is chosen. Thus, \( K \) will affect firm valuation

\(^{12}\) The analysis is unaffected if the shareholders set the bond covenants. However, we believe it is more realistic to view bond covenants as a consequence of negotiations between management and bondholders.
at $t = 0$, but will thereafter be treated as a sunk cost that does not appear in subsequent valuations. Since $\eta$ is chosen at $t = 0$, it is based on $\mu_\rho$.

We now turn to debt. Bondholders care about the risk they face. This risk could arise not only from disagreement (i.e. the manager chooses a project that the bondholders view as having negative NPV) but also from the inherent risk in a project that bondholders believe has positive NPV. The bondholders’ risk exposure depends partly on the value of the AIP, $V_{AIP}$. If $V_{AIP} = F > I$, then riskfree debt can be issued and the bondholders are indifferent to having control, so the manager can obtain complete autonomy (i.e., $\eta = 1$).\(^{13}\) Given riskfree debt, the manager has no incentive to invest in the lemon project, and the bondholders face neither project nor disagreement risk. This leads to:

**Lemma 1:** When the value of the firm’s AIP is high, $V_{AIP} = F$, debt financing leaves the manager with complete autonomy.

When $V_{AIP} = 0$, bondholders are exposed to both project and disagreement risk. We will show that in this case it is optimal for the bondholders to not leave the manager with any autonomy ($\eta = 0$), i.e., the control allocation embedded in the debt contract is bang-bang ($\eta \in \{0,1\}$).

**Summary of Sequence of Events:** To recapitulate the sequence of events, at $t = 0$ the firm is all-equity financed, with assets in place that have value $V_{AIP} \in \{0, F\}$ at $t = 3$. At $t = 0$, the firm knows that at $t = 2$ a mundane project and a lemon project will become available for it to invest in at that time. Whether it will also have the innovative project available will become known only at $t = 2$. At $t = 0$, it is also uncertain what the agreement parameter, $\rho$, will be at $t = 1$. The expected value of $\rho$, $E(\hat{\rho})$, is common knowledge. Based on this, shareholders at $t = 0$ determine $\eta$, which fixes the intrusiveness of equity-linked corporate governance. Alternatively, with debt the contract stipulates state-contingent autonomy for the manager that depends on the realized value of $V_{AIP}$. At $t = 1$, the realized value of $\rho$ is observed by the market and revealed in the stock price, and on the basis of this revelation the manager decides whether to issue debt or equity to raise the $SI$ needed for investment in the project. At $t = 2$, it becomes privately known to the manager whether the innovative project is available. If the innovative project is available, he chooses between the innovative project, the lemon and the mundane project. Otherwise, only the lemon and the mundane project are available.

The manager knows that at $t = 2$ he will receive a signal $z$, that he will interpret as $x$ and investors interpret as $y$, about the expected value of the payoff, $u$, of the innovative project at $t = 3$. Viewed at $t = 2$,

\(^{13}\) Although the project cash flow can be negative (the support of $q$ is $[-\infty, \infty] \times [-\infty, \infty]$), we assume that bondholders can have a first lien on the AIP and hence face no risk in their debt claim.
$u$ is a random variable with a density function $f(u|x, \lambda)$ for the manager and $f(u|y, \lambda)$ for the investors, where $\lambda$ is the variance of $u$. Viewed at $t=1$, $x$ and $y$ are random variables with a joint density function $q(x,y|\rho)$. The manager may not know $\rho$, but the density function $q(x,y|\rho)$, conditional on $\rho$, is common knowledge. The firm’s stock price at $t=1$ will reveal $\rho$ to the manager since the market will anticipate the firm’s choice of security at $t=1$ and set a price conditional on all of the information available to the market at $t=1$ (including $\rho$). After observing the firm’s stock price at $t=1$, management decides (at $t=1$) whether to use debt or equity to raise the investment, $I$, needed for the project. Between $t=1$ and $t=2$, the value of the AIP becomes known, which determines the managerial autonomy with the debt contract. At $t=2$, $z$ is observed and interpreted as $x$ and $y$ respectively by the manager and investors. The manager then makes his project choice. At $t=3$, the payoffs are realized and investors are paid off. In Figure 1 we summarize the sequence of events.

3. ANALYSIS OF SECURITY ISSUANCE AND CAPITAL STRUCTURE

As in the usual backward induction fashion, we begin with an analysis of what happens at $t=2$, then analyze events at $t=1$, and finally examine the optimal design of corporate governance at $t=0$. The analysis at $t=2$ proceeds in two steps. We first focus on the valuation of the firm at $t=2$ prior to the actual project choice but conditional on the capital structure decision of the firm and the assumption that the innovative project materialized. This highlights the dependence of the market valuation on the degree of anticipated agreement between management and investors. We then analyze the link between the project choice and the market valuation of the firm. This is a Nash equilibrium in which the market (correctly) anticipates the firm’s project choice, and the firm uses the market valuation as an input in its project choice decision.

3.1 Valuation at $t=2$

Suppose first that equity was issued at $t=1$. Then, it is clear that because the lemon project has negative NPV and the manager and shareholders have identical preferences, the lemon will always be eschewed. If the manager proposes the innovative project and shareholders have interpreted $z$ as $y$, their valuation of the firm (just prior to the actual project choice being made by the firm) will be:
\[
V_2^t(\rho, \eta) = \begin{cases} 
\int u[1-\tau] f(u \mid y, \wedge_{\gamma}) \, du + \bar{V}_{\text{AR}}[1-\tau] & \text{if } y \geq R \\
\{ \eta u[1-\tau] + [1-\eta] R[1-\tau] \} f(u \mid y, \wedge_{\gamma}) \, du + \bar{V}_{\text{AR}}[1-\tau] & \text{if } y < R
\end{cases}
\]

(1)

where \( \bar{V}_{\text{AR}} \in \{0, F\} \) is the realized value of \( V_{\text{AR}} \).

If the manager proposes the mundane project, shareholders will value the firm at

\[
V_2^t(m) = R[1-\tau] + \bar{V}_{\text{AR}}[1-\tau]
\]

(2)

Now suppose debt was issued at \( t = 1 \). The actual control that bondholders exercise depends on the realization \( \bar{V}_{\text{AR}} \in \{0, F\} \). If \( \bar{V}_{\text{AR}} = F \), then \( \eta = 1 \) (Lemma 1). And as we will show later, \( \eta = 0 \) when \( \bar{V}_{\text{AR}} = 0 \). For now, we just assume this. When the bondholders are in control, they will enforce the choice of the mundane project.\(^{14}\) The value of the firm, as assessed by investors, is

\[
V_2^t(D = I | \bar{V}_{\text{AR}} = F ) = \int u[1-\tau] f(u \mid y, \wedge_{\gamma}) \, du + [F - D][1-\tau] + D
\]

(3)

Since debt is riskless when \( \bar{V}_{\text{AR}} = F \), we have \( D = I \), given that the riskless rate is zero. Thus, we can write

\[
V_2^t(D = I | \bar{V}_{\text{AR}} = F ) = \int u[1-\tau] f(u \mid y, \wedge_{\gamma}) \, du + F[1-\tau] + \tau
\]

(4)

If \( \bar{V}_{\text{AR}} = 0 \) and the bondholders are in control, then they will always enforce the choice of the riskless mundane project, so again \( D = I \). Hence, the value of the firm will be

\[
V_2^t(D = I | \bar{V}_{\text{AR}} = 0 ) = [R - D][1-\tau] + D = R[1-\tau] + \tau
\]

(5)

4.2 Valuation at \( t = 1 \) Conditional on the Firm Issuing Equity at \( t=1 \)

We first focus on the valuation of the firm’s equity conditional on the firm having chosen equity financing at \( t = 1 \). Recall that neither the manager nor shareholders wish to choose the lemon, so the only choice is between the innovative and mundane projects. Moreover, the autonomy parameter \( \eta \) was determined at \( t = 0 \) based on the optimal choice of corporate governance, and \( \rho \) was realized at \( t = 1 \).

Management takes this \( \eta \) as given at \( t = 1 \) and recognizes that \( 1-\eta \) is the probability that shareholders will block the firm’s choice of the innovative project (when available) in case of disagreement, i.e., when \( x \geq R \) and \( y < R \). In that case, the mundane project will be chosen. Recall that w.p. \( \theta \) the innovative project is available; w.p. \( 1-\theta \), no innovative project is available and the mundane project is taken. The

\[\text{To see this, note that for any } D, \text{ the value of debt at } t = 2 \text{ is } \int_{-\infty}^{y} f(u \mid y, \wedge_{\gamma}) \, du + \int_{y}^{\infty} D f(u \mid y, \wedge_{\gamma}) \, du < D \text{ with the innovative project and } D \text{ with the mundane project.}\]
shareholders’ valuation at \( t = 1 \) is:

\[
V_1^i(\rho, \eta, \theta) = \theta \hat{V}_1^i(\rho, \eta) + [1 - \theta] V_1^i(m)
\]

where

\[
\hat{V}_1^i(\rho, \eta) = \int \int \{ y[1 - \tau] \} q(x, y|\rho) \, dx \, dy + \eta \int \int \{ y[1 - \tau] \} q(x, y|\rho) \, dx \, dy
\]

\[
+ [1 - \eta] \int \int \{ R[1 - \tau] \} q(x, y|\rho) \, dx \, dy + \int \int \{ R[1 - \tau] \} q(x, y|\rho) \, dx \, dy + E(V_{\text{app}})
\]

where \( E(V_{\text{app}}) \equiv BF[1 - \tau] \), the inner integral is over \( x \) and the outer integral is over \( y \). Moreover,

\[
V_1^i(m) = V_1^ii \equiv [1 - \tau] + E(V_{\text{app}}).
\]

The first term in (7) is the after-tax payoff to the initial shareholders when there is agreement that the innovative project dominates the mundane project, the second term is the payoff perceived by the shareholders when they believe the mundane project is better but management succeeds in investing in the innovative project, the third term is the payoff perceived by the shareholders when they believe the mundane project is better while management believes the innovative project is better and shareholders are able to prevail, and the fourth term is the payoff when management and shareholders both agree the mundane project dominates. The last two terms are the cost of corporate governance and the expected (after-tax) value of the assets in place. Equation (8) provides the value of the firm if the innovative project fails to materialize. Suppose a fraction \( \alpha \in (0, 1) \) of the firm is sold to raise \$I in equity needed for the investment. Then, in a competitive capital market, it follows that

\[
\alpha V_1^i(\rho, \eta, \theta) = I
\]

For the rest of the analysis, it is convenient to assume that \( q(x, y|\rho) \) is bivariate normal, i.e.

\[
q(x, y|\rho) = \frac{1}{2\pi \sigma_x \sigma_y \sqrt{1 - \rho^2}} \exp\left\{-\frac{1}{2(1 - \rho^2)} \left[ \frac{(x - \mu_x)}{\sigma_x} \right]^2 - 2\rho \left( \frac{x - \mu_x}{\sigma_x} \right) \left( \frac{y - \mu_y}{\sigma_y} \right) + \left( \frac{y - \mu_y}{\sigma_y} \right)^2 \right\}
\]

where \( \sigma_x \) and \( \sigma_y \) are the standard deviations in the marginal densities of \( x \) and \( y \) respectively. To avoid assuming that management is expected to be more or less optimistic or more or less overconfident than investors, we assume that \( \mu_x = \mu_y = \mu > 0 \) and \( \sigma_x = \sigma_y = \sigma < \infty \). We can now examine the relationship between the firm’s stock price and the agreement parameter, \( \rho \).

**Lemma 2:** Conditional on the firm issuing equity at \( t = 1 \) to raise \$I, the firm’s market value is strictly increasing in the agreement parameter, \( \rho \), for any value of the autonomy parameter \( \eta \).
This lemma is intuitive. As the potential for agreement between management and investors increases, it becomes more likely that the investment decisions of management will match the preferences of investors. Investors thus value the firm more highly when their assessment becomes more highly correlated with that of management.

There are many ways to interpret the agreement parameter, \( r \), in this context. One is that a higher \( r \) means that management has done a more effective job of communicating to investors the basis on which it processes information about new investment opportunities, so that investors tend to interpret a common set of information signals the same way that management does. Another is that investors have greater confidence in management’s ability to identify good investment opportunities based on management’s track record. That is, the better is management’s track record in previously selecting successful innovative projects, the higher \( r \) will be.

Lemma 2 says that the firm’s stock price is increasing in the agreement parameter \( r \). This suggests that even if management were \textit{a priori} uninformed about \( r \), they could invert the stock price to infer \( r \) at \( t = 2 \). We return to this later (Theorem 2).

Thus far we have focused on how \textit{investors} value the firm at \( t = 1 \). We now value expected payoffs using management’s valuation rule. The goal of management is to maximize the expected value of the payoff at \( t = 3 \) of those who are shareholders at \( t = 0 \). That is, management seeks to maximize

\[
[1 - \alpha]V_x^1(\rho, \eta, \theta) \tag{11}
\]

where \( \alpha \) is given by (9) and

\[
V_x^1(\rho, \eta, \theta) = \theta V_x^1(\rho, \eta) + [1 - \theta] V_x^1(m) \tag{12}
\]

\[
\dot{V}_x^1(\rho, \eta) = \int_R^\infty [x[1 - \tau]q(x, y|\rho)] \, dx \, dy + \eta \int_R^\infty [x[1 - \tau]q(x, y|\rho)] \, dx \, dy \nonumber
\]

\[
+ [1 - \eta] \int_R^\infty R[1 - \tau]q(x, y|\rho) \, dx \, dy + \int_R^\infty R[1 - \tau]q(x, y|\rho) \, dx \, dy + EV_{AIP} \tag{13}
\]

and \( V_x^1(m) = V_x^1(m) = R[1 - \tau] + E(V_{AIP}) \).

We can now state the following result.

**Lemma 3:** \( \partial V_x^1(\rho, \eta, \theta)/\partial \rho > 0 \) and \( \partial \alpha/\partial \rho < 0 \) for any value of the autonomy parameter \( \eta \).

Lemma 3 is merely Lemma 2 restated for management’s valuation. Management’s valuation, \( V_x^1 \) is increasing in the agreement parameter \( \rho \) because an increase in \( \rho \) makes it less likely that management

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15 The firm’s pre-security-issuance shareholder base at \( t = 1 \) is the same as that at \( t = 0 \). So, maximizing the wealth of the \( t = 0 \) shareholders is the same as maximizing the wealth of the \( t = 1 \) pre-equity-issuance shareholders.
will be blocked from investing in the innovative project when \( x \geq R \). Further, we will assume
\[
\mu > R + \widetilde{\theta}
\]
where \( \widetilde{\theta} = \max \left\{ \frac{1}{\theta} \left[ \frac{V_i^j(\rho, \eta, \theta)}{V_i^j(\rho, \eta, \theta)[1-\tau]} - 1 \right] \right\} \). The parametric restriction (14) basically says that the expected value enhancement from the innovative project, relative to the mundane project, \([\mu - R]\), should be sufficiently high. This condition, it turns out, is sufficient (not necessary) for equity to be the optimal security to issue over a non-empty set of exogenous parameters.

3.3 Valuation at \( t = 1 \) Conditional on the Firm Issuing Debt

We saw in Lemma 1 that when \( \overline{V}_{AIP} = F \), the debt contract involves \( \eta = 1 \), giving management maximum autonomy. We will now establish that when \( \overline{V}_{AIP} = 0 \) and the lemon problem is sufficiently severe (i.e., when its payoff variance, \( \wedge_N \), is sufficiently high), it is optimal to concede all control to the bondholders, so that the debt contract involves \( \eta = 0 \).

**Lemma 4:** Suppose \( V_{AIP} = 0 \). Then there exists a finite value of \( \wedge_N \), call it \( \wedge_N^* \), such that \( \forall \wedge_N > \wedge_N^* \) the initial shareholders prefer that if debt is issued, all control rests with the bondholders (\( \eta = 0 \)).

Henceforth, we will assume \( \wedge_N > \wedge_N^* \). The reason why the debt contract involves giving the bondholders all control is the familiar asset-substitution moral hazard problem with debt, which is encountered when the value of the AIP is sufficiently low. Thus, when \( \overline{V}_{AIP} = 0 \), debt provides management no autonomy (\( \eta = 0 \)), whereas Lemma 1 asserted that \( \eta = 1 \) when \( \overline{V}_{AIP} = F \). Equity is more flexible than debt when \( \overline{V}_{AIP} = 0 \) because the shareholders have to worry about only one problem, namely potential disagreement with the manager about whether the innovative project is good enough. Bondholders, by contrast, must worry about that disagreement plus the possibility that the manager will switch to a negative-NPV lemon project even when everybody may agree that the innovative project is a good investment. The cost of this moral hazard is borne \emph{ex ante} by the manager, and he eliminates that cost by making the debt contract devoid of moral-hazard costs by giving up autonomy when \( \overline{V}_{AIP} = 0 \).

We can now determine the firm value at \( t = 1 \) when the firm chooses debt financing, and the value of the AIP is stochastic. Note first that the repayment \( D \) to the bondholders equals \( I \) because bondholders are never exposed to risk, given the structure of the debt contract (see Lemmas 1 and 4).

The value of the firm, as assessed by the manager, equals:
\[
V_i^j(D' = I) = [1-\theta] V_i^j(m, D' = I) + \theta \left\{ \hat{\beta} V_i^j(D' = I \theta, \overline{V}_{AIP} = F) + [1-\beta] V_i^j(D' = I \theta, \overline{V}_{AIP} = 0) \right\}
\]
where
At \( t=1 \), the manager seeks to maximize the value of equity. Since debt is riskfree, this is identical to maximizing (15). When we compare debt and equity financing ((15) and (12)), we see that the allocation of control with debt is bang-bang \( (\eta \in \{0,1\}) \), whereas it is more smooth with equity \( (\eta \in [0,1]) \).

We will now examine when the manager will issue which security.

### 3.4 The Firm’s Optimal Security Issuance Decision at \( t = 1 \)

We can now use the results of the previous two subsections to examine which security management will issue at \( t = 1 \).

**Theorem 1:** For \( \beta \geq \beta^* \), management finds it optimal to finance the project with debt. For \( \beta < \beta^* \), there exists a critical value of the autonomy parameter, \( \eta^*(\beta) \), with \( \frac{\partial \eta^*}{\partial \beta} > 0 \), such that management prefers to issue equity regardless of the value of the agreement parameter \( \rho \), as long as the equity-linked corporate governance chosen at \( t = 0 \) yields \( \eta > \eta^*(\beta) \). For each \( \eta \leq \eta^*(\beta) \), there exists a critical value of the agreement parameter, \( \rho^*(\eta,\beta) \in (0,1) \), with \( \frac{\partial \rho^*}{\partial \eta} < 0 \) and \( \frac{\partial \rho^*}{\partial \beta} > 0 \), such that the firm will find it optimal to finance the project with: (a) an equity issue if the actual agreement parameter, \( \rho \), inferred from the firm’s stock price, exceeds \( \rho^* \), and (b) a debt issue if \( \rho \leq \rho^* \).

The intuition is as follows. The first part of the theorem highlights the fact that debt is preferred when the value of the AIP is sufficiently likely to be high. Debt then offers a distinct autonomy advantage over equity, in addition to its tax shield advantage. For low \( \beta \), this autonomy benefit is small and equity could be preferred. In this case, when the optimal \( \eta \) is very high, the fact that investors may disagree with management over the desirability of investing in the innovative project matters little to management if equity is issued. For instance, if \( \eta = 1 \) and the firm has issued equity, shareholder dissent becomes irrelevant to management in its quest to maximize the expected terminal wealth of the initial shareholders. Thus, management, knowing it can invest in the innovative project at will with equity, prefers to issue equity regardless of the agreement parameter, \( \rho \). However, as the optimal \( \eta \) declines, equity provides less autonomy and hence its attractiveness to management declines, so that at a low enough \( \eta \), the agreement parameter makes a difference to the attractiveness of equity relative to debt. Holding \( \eta \) fixed at some value in this range, the attractiveness of equity declines as \( \rho \) declines because the lower the \( \rho \) the less
likely it is that management will be able to invest in the innovative project when it prefers that project over the mundane project \((x \geq R)\). Since the firm now anticipates that it is likely to be forced to invest in the mundane project, it might as well take advantage of the debt tax shield by issuing debt. Thus, debt is preferred to equity for lower values of the agreement parameter \(\rho\) because the autonomy distinction between debt and equity is then small but debt has a tax-shield advantage. At higher values of \(\rho\), equity is preferred because the autonomy advantage it offers overwhelms the tax advantage of debt. Moreover, regardless of \(\rho\), debt will be preferred if the firm has no access to the innovative project or if the probability \(\theta\) of such access is sufficiently low.\(^{16}\)

**Theorem 2:** Assume \(\beta < \beta^*\) and that the optimally-chosen autonomy parameter \(\eta < \eta^*\). Then it is a Nash equilibrium for the firm to issue equity when its pre-issuance stock price is relatively high, and to issue debt when its pre-issuance stock price is relatively low. When the equilibrium involves the firm issuing equity, management will be able to infer the agreement parameter \(\rho\) unambiguously from the pre-issuance stock price. When the equilibrium involves the firm issuing debt, management will only be able to infer the range in which \(\rho\) lies.

This theorem is an almost immediate consequence of combining Lemma 2 and Theorem 1. Lemma 2 says that if we assume that the firm will issue equity, then its pre-issuance stock price is increasing in \(\rho\), and Theorem 1 states that the firm prefers equity financing if \(\rho\) is high enough. For relatively high values of \(\rho\), the firm will prefer equity, the market will correctly anticipate it and the stock price will be high (revealing a high \(\rho\)), leading the firm to issue equity, thereby confirming the market’s conjecture. For relatively low values of \(\rho\), the firm prefers debt, the market correctly anticipates it and sets the pre-issuance stock price assuming that the mundane project will be chosen with probability one. In a Nash equilibrium, the firm’s actual security issuance decision should mirror the market’s conjecture. However, since the agreement parameter is irrelevant conditional on the mundane project being chosen, the pre-issuance stock price is invariant to \(\rho\) when debt is (correctly) anticipated to be issued. In this case, management can only infer that \(\rho\) is below a cutoff, and not its precise value. *Figure 2* shows the relationship of stock price and security issuance to the agreement parameter \(\rho\).

*Figure 2 goes here*

This result provides a theoretical explanation for the Baker and Wurgler (2002) empirical finding that firms tend to issue equity when stock prices are high. Note, however, that this does not require managers to think that investors are irrational and hence issue equity to time the market. In our analysis this result arises from management’s inference that investors are more likely to agree with their future

---

\(^{16}\) Note that (14) effectively puts a lower bound on \(\theta\), thereby excluding this case.
decisions and hence equity is more flexible when stock prices are high.

**Corollary 1:** The critical agreement parameter, $\rho^*$, such that equity is preferred whenever $\rho > \rho^*$ and debt whenever $\rho \leq \rho^*$, decreases as the optimally-chosen autonomy parameter $\beta$ increases. That is, $d \rho^*/d\beta < 0$.

As the autonomy parameter increases, equity becomes more attractive to management because of an increase in the probability that the firm can invest in the innovative project even when investors object. Moreover, an increase in $\eta$ makes investor agreement less important to management when equity is issued. Thus, as the $\eta$ chosen by shareholders at $t = 0$ increases, management prefers to issue equity for lower values of the agreement parameter.

This corollary has an interesting implication. As one increases the stringency and intrusiveness of corporate governance and investors intervene more directly in major decisions by management (i.e., as $\eta$ decreases), then $\rho^*$ increases and debt is preferred over a larger set of agreement parameter values below $\rho^*$. Thus, debt-equity ratios are predicted to be higher for firms that have more stringent equity-linked corporate governance.

**Corollary 2:** For any fixed $\eta$, an increase in management’s uncertainty about the innovative project $\sigma^2_s$ increases the measure of the set of values of $\rho$ for which management prefers to issue equity. That is, $d \rho^*/d\sigma^2_s < 0$.

The intuition is that an increase in uncertainty enhances the value of the option that management has to invest in the innovative project. Since investing in the innovative project is only possible with equity financing, the attractiveness of equity also increases as $\sigma^2_s$ increases. That is, uncertainty increases the value of the autonomy that is provided by equity.

**Corollary 3:** For a given autonomy parameter $\beta$ and values of the agreement parameter $\rho$ such that equity issuance is optimal at $t = 2$, the pre-equity-issuance stock price is increasing in $\mu$, the expected value of the innovative project.

This corollary follows immediately from the observation that an increase in $\mu$ makes it more likely that the innovative project will be chosen, and, conditional on that choice, the value of the firm is higher as $\mu$ increases.

### 3.5 Further Results Concerning Events at $t = 1$

We continue to assume $\beta < \beta^*$, so that equity is not unequivocally dominated by debt. At $t = 1$, the realized value of the agreement parameter, $\rho$, is observed by the market but there is uncertainty about whether an innovative project will be available at $t = 2$. What we examine now is the inference problem of...
an econometrician who can observe the market price at \( t=1 \) just prior to the firm’s issuance of debt or equity but does not directly observe \( \rho \). The price will, of course, impound the realized \( \rho \). Just prior to the security issuance to raise \( $I \), the firm will trade at the following price:

\[
\begin{align*}
\bar{V}_y^i (\rho, \eta, \theta) &= \left\{ 1 - \alpha \right\} V_y^i (\rho, \eta, \theta) I_{\{\rho \in \text{[set]} \}} + \left\{ \left[ R - I \right] [1 - \tau] + E (V_{\text{arp}}) \right\} I_{\left\{ \rho \in \text{[set]} \right\}} I_{\text{[set]}} \\
&+ \left\{ 1 - \alpha \right\} V_y^i (\rho, \eta, \theta) I_{\text{[set]}} 
\end{align*}
\]

(29)

where \( I_{\{ a \}} \) is an indicator function over the set \( A \) with \( I_{\{ a \}} = 1 \) if \( a \in A \) and \( I_{\{ a \}} = 0 \) if \( a \notin A \). Thus, at \( t=1 \), if the autonomy parameter \( \eta \) is below the cutoff \( \eta^* \) (see Theorem 1), the firm’s security issuance decision is known to depend on the agreement parameter \( \rho \). If \( \rho < \rho^* (\eta) \), where \( \rho^* (\eta) \) is a cutoff value, the firm will be expected to issue debt and its pre-issuance stock price will be \( [R - I] [1 - \tau] + E (V_{\text{arp}}) \). If \( \rho \geq \rho^* (\eta) \), the firm issues equity and its pre-issuance stock price will be \( [1 - \alpha] V_y^i (\rho, \eta, \theta) \), where \( V_y^i (\rho, \eta, \theta) \) is given by (6) and \( \alpha \) by (9). If \( \eta \geq \eta^* \), the firm issues equity regardless of \( \rho \). We now have the following result:

**Theorem 3:** Suppose we hold fixed a commonly-known stringency of corporate governance such that firms may issue either debt or equity, i.e., \( \eta < \eta^* \). Then there exists a cutoff pre-issuance stock price level at \( t = 1 \), say \( V_y^{i*} \), such that the probability of equity issuance at \( t = 1 \), as assessed by an econometrician (who is a priori unaware of the agreement parameter \( \rho \) as well as the probability of the innovative project arriving, \( \theta \)), is strictly increasing in the level of the pre-issuance stock price at \( t = 1 \) for all stock prices exceeding \( V_y^{i*} \).

The intuition for this theorem, which refers to situations in which \( \eta < \eta^* \), can be seen by examining (19). A higher probability of project availability (\( \theta \)) increases the stock price at \( t=1 \), \( V_y^i (\rho, \eta, \theta) \), since \( V_y^i (\rho, \eta, \theta) \) is increasing in \( \theta \) and \( \alpha \) is decreasing in \( \theta \). Further, the higher is the agreement parameter \( \rho \), the higher will be \( V_y^i (\rho, \eta, \theta) \), whereas the value of the firm with debt financing, \( [R - I] [1 - \tau] + E (V_{\text{arp}}) \), is invariant to \( \rho \). Thus, for \( \rho < \rho^* (\eta) \), increases in \( \rho \) have no impact on the stock price because the firm is financing with debt, but increases in \( \theta \) cause the stock price at \( t = 1 \) to increase. In that case, stock price increases at \( t = 1 \) do not affect the probability of an equity issue at \( t = 1 \).

For \( \rho > \rho^* (\eta) \), the stock price at \( t = 1 \) is increasing in both \( \rho \) and \( \theta \), and, conditional on a project being available, the probability of an equity issue is one. As the probability of a project’s availability rises, so does the unconditional probability of an equity issue. Hence, the probability of an equity issue at \( t = 1 \) is nondecreasing in the stock price at \( t = 1 \). This theorem produces the prediction that
not only will equity be issued when stock prices are high, but equity issuances will be preceded by periods of high (and increasing) stock prices. This result obtains even though management is not attempting to “time” the market and issue equity at inflated prices.

This result has an immediate implication for the link between growth opportunities and security issuance. In what follows, we will refer to \( \theta \) as the “likelihood of future growth opportunities” and the opportunity quality \( \mu \) as the value of future growth opportunities.

**Corollary 4:** Suppose we hold fixed a commonly-known stringency of corporate governance such that firms may choose either debt or equity (i.e., \( \rho < \rho^* \)), and there is a distribution of firms with agreement parameters \( \rho \in (-1,1) \). Then the number of firms seeking equity financing is increasing in the likelihood (\( \theta \)) and value (\( \mu \)) of future growth opportunities.

The intuition is similar to that for the previous result. An increase in \( \theta \) increases the probability that the firm will seek external financing. An increase in \( \mu \) means that the innovative project becomes more valuable relative to the mundane project. For any \( \rho \), equity thus becomes more attractive relative to debt. Thus, the cutoff \( \rho^* \) above which \( \rho \) must lie for the firm to prefer equity declines as \( \mu \) increases, and more firms opt for equity.

### 3.6 Determination of the Degree of Management Autonomy at \( t = 0 \):

We will now move back to \( t = 0 \) and examine the corporate governance with equity that is optimal for the initial shareholders at \( t = 0 \). Our notion is that things as fundamental as corporate governance are determined at the outset and changed relatively infrequently after that. Management is then allowed to operate within the guidelines stipulated in the design of corporate governance, using whatever new information becomes available to management subsequent to the governance being put in place. The stock price of the firm at \( t = 0 \) will be:

\[
V^0_t(\mu_r, \eta, \theta) = \int \bar{V}^t_r(\bar{\rho}, \eta, \theta) \Phi \left( d\bar{\rho} \mid \mu_r \right)
\]

where \( \mu_r \) is the mean of \( \bar{\rho} \) and \( \bar{V}^t_r(\bar{\rho}, \eta, \theta) \) is given by (19), with \( \rho \) replaced by the random \( \bar{\rho} \). The optimal \( \eta \) is now obtained as \( \eta \in \arg\max_{\eta \in (0,1)} \left\{ V^0_r(\mu_r, \eta, \theta) - K(1-\eta) \right\} \), which leads to the following result.

**Theorem 4:** There exists an interior optimum at \( t = 0 \) with respect to the autonomy parameter, \( \eta \in (0,1) \), and the optimal \( \eta \) is increasing in \( \mu_r \), the mean of the agreement parameter \( \rho \).

The intuition is as follows. If we examine (6), we see that the shareholders’ expectation of firm value is strictly decreasing in \( \eta \) if we ignore the cost of intrusion, \( K(\cdot) \). Thus, if shareholders could costlessly limit managerial autonomy, they would set \( \eta = 0 \). However, when \( K(\cdot) \) is recognized, the cost
of such intrusion -- which effectively makes the separation between ownership and control a moot point -- is prohibitive. The tradeoff between the higher perceived firm value with greater intrusion and the higher direct cost of such intrusion leads to an interior optimal $\eta$. The reason why $\eta$ is increasing in $\mu_\rho$ is that giving the manager greater autonomy is less costly at the margin for shareholders when it is more likely that they will agree with the manager’s decisions.

4. IMPLICATIONS FOR SECURITY ISSUANCE ANNOUNCEMENT EFFECTS AND CAPITAL STRUCTURE

In this section we discuss what our analysis implies about security issuance announcement effects, the firm’s capital structure decision and shareholder preferences for debt even when management does not find debt useful. Again, we focus on the case in which $\beta < \beta^*$, so that either equity or debt could be preferred.

4.1 Security Issuance Announcement Effects

In our model, the revelation of $\rho$ to the market and the raising of the capital for the project occur simultaneously at $t=1$. This means there will be an announcement effect at $t=1$ that will reflect both the resolution of uncertainty about $\rho$ and whether investors agree with the firm’s choice of security. The announcement effect of a debt-financed project will generally be small. The reason is that debt financing always leads to the choice of the mundane project, which has a modest NPV, and there is no disagreement about this project’s value.

The announcement effect of equity depends on the agreement parameter $\rho$ and the autonomy parameter $\eta$. We saw in Theorem 4 that $\eta$ is increasing in $\mu_\rho$, the expected value of $\rho$. However, the actual realization of $\rho$ can be low or high, regardless of the $\eta$ chosen at $t=0$. When $\rho$ is high, disagreement is unlikely and the equity-announcement effect is positive on average regardless of $\eta$. But this announcement effect is decreasing in $\eta$. That is, for high $\rho$ and low $\eta$, the probability of disagreement is low and the likelihood that the manager will go against the investors if there is disagreement is also low, so the announcement effect is the highest for this combination. For low $\rho$, disagreement is quite likely, and the sign of the announcement effect depends critically on $\eta$. When $\eta$ is sufficiently high, disagreement is virtually irrelevant for management in terms of its ability to invest in the innovative project. In that case, the equity-announcement effect will be negative on average for sufficiently

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17 This announcement effect should be typically positive. However, if investors assign a high probability ex ante that a project will be available at $t=1$ and the perceived likelihood of disagreement is low, then the prior on the innovative project will be high. The choice of debt financing and the mundane project will then be viewed as “bad news”, generating a negative announcement effect, unless the probability of $V_{AIP} = F$ is very high.
low $\rho$, since investors are very likely to face an investment they do not like. If both $\rho$ and $\eta$ are low, debt dominates and no equity issuance should be observed. But if equity is issued anyway, the announcement effect will be the most negative.

These results have clear cross-sectional implications. The low-$\eta$ and high-$\rho$ case is descriptive of firms that started out with low expected $\rho$ values (leading to low $\eta$) and experienced high $\rho$ values prior to their equity issuance. Thus, these are firms that have experienced large stock returns prior to issuing equity. These firms would experience the most positive equity-issuance announcement effects. Firms that started out with high expected $\rho$ will experience smaller returns prior to the equity issue. Announcement effects will be smaller for such firms, becoming negative at sufficiently low value of $\rho$.

Thus, if we examine the cross-section of firms, we would expect equity issuance announcement effects for firms that use the proceeds to finance projects to be positively correlated with returns immediately preceding the equity issue.

4.2 Implications for the Capital Structure of the Firm

Thus far we have considered a setting in which the firm starts out with an all-equity capital structure and then examined the changes in this capital structure due to subsequent security issuances. But what about a firm that already has debt in its capital structure?

The presence of pre-existing debt affects management’s total autonomy in any period, and this will affect its security issuance decision in that period. Consider now such a firm that finds itself in period $t$ with a new project, an associated security-issuance decision, and an inherited leverage ratio (book value of debt/sum of the book value of debt and the market value of equity) of $L_t$ that defines a particular degree of autonomy for management. Suppose now that the firm’s stock price is relatively high in the sense that the value of autonomy exceeds the value of the debt tax shield. Then, as our analysis has shown, management will issue equity to finance the new project. Consequently, its leverage ratio will be driven down further. By contrast, if the firm’s stock price is relatively low, its leverage ratio will (by definition) be high. Moreover, management will perceive the autonomy provided by equity to be correspondingly low, and will thus prefer to issue debt, further driving up the leverage ratio.

This has an important implication for the current capital structure debate. The standard “tradeoff theories” of capital structure have asserted a (static) target debt-equity ratio that firms strive to maintain. The recent empirical evidence (see Baker and Wurgler (2002), Hovakimian, Opler and Titman (2001), and Welch (2004) for U.S. firms, and Antoniou, Guney and Paudyal (2002) for French, British and German firms) indicates that:

1. Capital structure appears to be driven by stock prices/stock returns more than other factors.
2. Regardless of whether firms issue new securities, their debt/equity ratios appear to be inversely
related to their stock prices.

(3) Rather than issuing debt when their stock price is high (so as to return to a target leverage ratio), firms tend to issue equity.

Based on this, these papers have concluded that firms do not appear to have target capital structures as suggested by the tradeoff theories of capital structure. What our analysis shows is that the fact that capital structure is driven by stock price levels is not inconsistent with the notion of a target leverage ratio. However, there is no such thing as a static target leverage ratio; it is a function of the firm’s stock price and hence inherently dynamic.

A key empirical implication of this is that capital structure, rather than adjusting back to some static target, will appear to move further away from this target as it responds to stock price movements. When the firm’s stock price increases, it produces two effects: an “auto-pilot” decline in its leverage ratio and an enhanced autonomy-driven desire to issue equity. The first effect is simply mechanical - the firm’s stock price goes up and yet it does nothing to adjust its leverage ratio, so it declines. The second effect reinforces the first. Similarly, when the firm’s stock price decreases, it also produces two reinforcing effects: an “auto-pilot” increase in its leverage ratio and an enhanced desire to issue debt. That is, movements in stock prices engender two effects on capital structure, an auto-pilot effect and possibly a reactive (to the stock price) capital structure adjustment effect, with both effects working in concert rather than against each other as suggested by existing theories.

All this assumes that the firm has a new project. But suppose we extend the model to include a probability \( \gamma \in (0,1) \) that no investment opportunity will materialize at \( t = 2 \), and that the realization of this uncertainty occurs at \( t = 1 \). That is, with probability \( \gamma \), the manager learns that at \( t = 1 \) that no investment opportunity -- innovative, lemon or mundane -- will be available at \( t = 2 \). If no project is available, there may not be any security issuances (reactive capital structure adjustments), so that capital structure is driven only mechanically by stock price changes. Welch’s (2004) evidence shows that this auto-pilot effect is a very striking part of the data -- even in the absence of new security issuance, firms do not appear to adjust their capital structures to security price changes. This is a big puzzle to explain. Our theory predicts, however, that it is exactly what we should expect firms to do. When the firm’s stock price rises, management infers a higher autonomy parameter \( \rho \), so the perceived optimal capital structure shifts in favor of a lower debt-equity ratio, which is precisely what is being achieved by doing nothing but letting this ratio drift downward. And if the increase in the stock price is sufficiently large, the firm finds it optimal to reinforce the downward drift by issuing equity and retiring debt, because at a sufficiently high stock price the inferred \( \rho \) is so high that the firm’s optimal leverage ratio is below where the mechanical drift takes it. Similarly, when the stock price drops and the debt/equity ratio rises due to the auto-pilot
effect, management will find it optimal to let the ratio drift upward. Eventually if the stock price drops sufficiently, the inferred $\rho$ may be so low that the firm finds it optimal to issue new debt and repurchase stock. In either case, if there is a reactive capital structure adjustment, it will reinforce the auto-pilot effect of the stock price movement on capital structure.

### 4.3 Shareholder Preferences and the Role of Debt

Although the security-issuance decision is made by management at $t=1$, we can ask what shareholders would want. Comparing (6) and (12), it is easy to show that $V^i_0(\rho,\eta,\theta) > V^i_1(\rho,\eta,\theta) \forall \rho$. This means that the cutoff agreement parameter, $\rho^*$, beyond which the shareholders would like equity to be issued is higher than the corresponding cutoff $\rho^*$ chosen by management. This is the shaded area in Figure 2, i.e., when $\rho \in (\rho^*, \rho^*_r)$, management wants to issue equity but shareholders would like debt to be issued. The intuition is that autonomy is valued positively by management and negatively by shareholders, so the latter value equity (with its greater autonomy) less than the former.

This means that for intermediate values of the stock price, those corresponding to $\rho \in (\rho^*, \rho^*_r)$, debt can serve a role even without taxes. Since a precommitment by management to issue debt in this range increases the firm’s stock price at both $t=0$ and $t=1$, the Board of Directors may wish to limit management’s autonomy about which security to issue at $t=1$. While this would leave our analysis qualitatively unchanged—only the range of values of $\rho$ for which equity is issued would decline to $(\rho^*_r, 1)$—it would carve out a role for debt as an “autonomy-limiting” instrument for stock prices below a threshold. Debt can thus be useful even without taxes, agency costs or signaling considerations because it can serve as a form of “investor protection” that is distinct from the usual protection from self-serving managerial expropriation (e.g., Shleifer and Wolfenzon (2002)). That is, the tax advantage of debt is necessary to get management to ever use debt, but shareholders may want debt even without this advantage.

### 5. SUMMARY OF EMPIRICAL IMPLICATIONS

In this section we discuss numerous empirical implications of our analysis. While our first prediction is what the model was designed to generate and the next three predictions are supported by the existing evidence, the remaining empirical implications are new, so they may be used to differentiate our theory from others and also to potentially reject the model.

1. The firm’s capital structure will be determined dynamically by the response of the manager to the information he gleans from his firm’s stock price. That is, management’s perception of the firm’s optimal capital structure varies with the firm’s stock price. Firms will issue equity when the stock price is high and the value of their assets in place is relatively low. They will issue debt either
when the value of assets in place is very high (regardless of the stock price), or when the stock price is relatively low.

This prediction follows from Theorem 2 and our discussion in Section 4.2. It is consistent with the empirical evidence in Baker and Wurgler (2002), Hovakimian, Opler and Titman (2001) and Welch (2004). It is also consistent with the evidence in Antoniou, Guney and Paudyal (2002), Barclay, Smith and Watts (1995) and Rajan and Zingales (1995) that the cross-sectional relationship between market-to-book ratios and leverage ratios is negative for U.S. and OECD firms. However, our result arises for reasons almost completely unrelated to the conjectures offered in these empirical papers. For example, Baker and Wurgler (2002) suggest that their finding may be attributable to market timing efforts by managers who think investors are irrational and raise equity when the cost of equity is perceived to be low. Barclay, Smith and Watts (1995) and Rajan and Zingales (1995) explain their findings by arguing that growth options and hence associated agency costs of debt and bankruptcy costs are high precisely when stock prices are high, so firms would prefer to issue equity rather than debt.

By contrast, our theory predicts that capital structure will move in precisely the way it has been found to move in the data. Capital structure varies continuously with the firm’s stock price since the firm’s decision of which security to issue at any point in time is driven by management’s perceived tradeoff between autonomy and debt tax shields, and this tradeoff depends on the observed stock price. For the rest of the predictions, we will assume that the firm’s assets in place do not have such a high value ex ante as to preclude equity financing altogether, i.e., either debt or equity could be optimal.

2. As the likelihood and value of future growth opportunities increase, firms rely more on equity financing and their leverage ratios decline. Similarly, if the firm operates in an environment in which the probability of having innovative projects to invest in is sufficiently low, its leverage ratio will be high.

This prediction comes from Corollary 4 and the discussion following Theorem 1. It is consistent with the evidence for the U.S. defense industry provided by Goyal, Lehn and Racinic (2002). Their evidence is that the debt levels of U.S. weapons manufacturers increased as their growth opportunities declined during 1985-95. Moreover, the finding that leverage ratios will be high among firms--such as regulated utilities--that operate in industries that mostly provide opportunities to invest in mundane projects is also consistent with the evidence.

3. Even in the absence of security issuance, there will be an inverse relationship between the firm’s leverage ratio and its stock price. When the firm’s stock price changes, its leverage ratio will move in the direction implied by the mechanical (auto-pilot) effect of the price change on leverage. Moreover, this change in leverage will be at least as great as that implied by the auto-pilot effect and may even exceed it.
This prediction was discussed in Sections 4.2, and can be understood as follows. Suppose we have three leverage ratios: \( L_1 < L_0 < L_2 \). Suppose an increase in the stock price causes the firm’s leverage ratio to mechanically decline from \( L_0 \) to \( L_1 \). As we indicated in Section 4.2, the firm will typically choose not to undertake any security issuance in response to this drop, unless it needs to issue securities to finance a new project. However, if security issuance occurs to finance a new project, it will involve an equity issue and this reactive capital structure adjustment results in an eventual leverage ratio of \( L' \leq L_1 \), i.e. it drives an even bigger wedge between the new and old leverage ratios. Similarly, suppose a decrease in the stock price causes the firm’s leverage ratio to mechanically increase from \( L_0 \) to \( L_2 \). Again, as we explained in Section 4.2, the firm will undertake no security issuances in response to this, unless it needs financing for a new project. If financing is raised, it will be done with debt and this drives the new leverage ratio to \( L' \geq L_2 \). The prediction that firms will not counteract the mechanical effects of stock returns on leverage is consistent with the evidence in Welch (2004). In particular, we believe that ours is the first theoretical paper that explains why corporations do not issue securities to counterbalance the “auto-pilot” effect of stock returns on their capital structures. This rationalizes the empirical evidence in Welch (2004) who finds that a significant percentage of the observed changes in capital structure is driven by the auto-pilot effect of stock returns; Welch (2004) concludes: “…U.S. corporations do little to counteract the influence of stock price changes on their capital structures.”

In addition to providing a possible explanation for Welch’s evidence, our model also produces the testable prediction that firms that do issue securities will experience capital structure changes that appear to move them even further away from their (static) target capital structures than the extent by which non-issuing firms appear to be moving away from their target capital structures due to the mechanical impact of their stock returns. This prediction comes from the “overshooting” aspect related to \( L' \leq L_1 \) when the stock price increases and \( L' \geq L_2 \) when the stock price falls.

4. **An increase in uncertainty leads to lower leverage ratios.**

   This prediction follows from Corollary 2. While it is also consistent with other theories of capital structure, such as agency theory and the bankruptcy-cost argument, it obtains here for different reasons. In particular, higher uncertainty lowers the critical cutoff values for both the autonomy and agreement parameters above which equity is preferred to debt.

5. **Debt-equity ratios will be higher in capital markets in which equity-linked corporate governance is more active and intrusive and in firms with more independent and active boards of directors.**

   This prediction follows from Corollary 1. As we showed, if shareholders begin to restrict management’s autonomy, the value of equity to management goes down, and the tradeoff shifts in favor of debt. We are not aware of any existing evidence on this prediction. It may be ideal to test this prediction in
an international context, so that one can compare capital structure choices across capital markets distinguished by different degrees of shareholder activism. However, it may even be possible to test this within the context of a single capital market, such as the U.S. The corporate governance literature has developed empirical proxies for the intensity with which boards of directors monitor management, and the cross-sectional differences in intensity among U.S. firms could permit testing this prediction. Alternatively, the Sarbanes-Oxley Act is predicted to lead to an increase in debt-equity ratios.

6. **Equity issuance will be preceded by periods of relatively high stock prices.**

   This prediction comes from Theorem 3. One implication of this prediction is that if one views firms as attempting to time the market in their equity issuance decisions, it will appear that they are inexplicably delaying their equity issues, waiting for prices to become even higher before issuing equity. Again, we are not aware of any direct test of this prediction. Further, equity issuances will be preceded by positive stock returns (as in Welch (2004)).

7. **When external financing is raised to finance a new project, equity will have the largest announcement effect, whereas debt will have a smaller announcement effect on average.** For firms that use the equity proceeds to finance new projects, the announcement effect of equity will be positively correlated with the stock return immediately preceding the equity issue. Similarly, the announcement effect of debt will be smaller (and possibly negative) when the stock price is higher.

   These predictions were discussed in Sections 4.1 and 4.2. When the agreement parameter $\rho$ is high, the firm’s stock price will be high. Thus, if the firm elects to invest in an innovative project, investors are likely to agree with this choice, so the equity announcement effect will be positive. Similar logic applies to the case in which $\rho$ is low and the pre-issuance stock price is low. In the case of a debt issue, when the stock price is high (high $\rho$), a debt-cum-mundane-project announcement is a negative surprise. Note that this prediction applies only to cases in which the firm is raising financing for a new project. Our theory does not deal with cases in which financing is raised even though there is no project.

6. **CONCLUSION**

   As Fama and French (2004) have pointed out, the actual security-issuance decisions of firms appear to be inconsistent with existing theories. Moreover, as Welch (2004) indicates, the lack of security issuance in response to stock price movements represents a conundrum for capital structure theories. Our goal in this paper has been to shed light on these two important capital structure puzzles: why firms issue equity rather than debt when stock prices are high and why leverage ratios are inversely correlated with stock prices even when no security issues are involved. In developing a theory to explain this, we have

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18 This prediction refers only to the level of the stock price (e.g., market to book ratio) and not to any price runups prior to the equity issue. That is, it does not assert that a large price runup prior to the equity issue will lead to a large announcement effect.
introduced the concept of managerial autonomy as an important determinant of the security issuance and capital structure decisions. Our theory correctly predicts some of the known stylized facts about capital structure that are at odds with existing capital structure theories and also generates additional testable predictions. In particular, we believe ours is the first theory that explains why firms so often do not issue securities to counteract the mechanical effect of stock returns on their leverage ratios, and why the securities they do issue are the exact opposite of what existing theories predict.

At the heart of our theory is the notion that people confronted with the same information may disagree on the optimal course of action, and that this leads management to value the autonomy to pursue what it believes is optimal in the face of such disagreement. Such autonomy is not valued equally at all times; its value depends on the decisions management intends to make in the future and how much disagreement these decisions are likely to spark. When the value of AIP is sufficiently high, debt will give maximum autonomy, and will be the preferred security. When the value of AIP is low, equity will typically provide more autonomy than debt. It will then be preferred when future decisions are likely to involve substantial risk and shareholders are sufficiently more likely (than creditors) to agree with management, so that the benefit of equity overcomes the tax shield advantage of debt. Thus, autonomy considerations are likely to dictate which security the firm issues, and the tradeoff between autonomy and tax shields is dynamic. Moreover, the potential for future disagreement also affects the firm’s stock price since it informs investors about the likelihood that management will do something in the future that investors don’t like. This creates a natural link between the security-issuance decision and the firm’s stock price via their common dependence on the value of autonomy. With this link, the notion of a static optimal capital structure is rendered obsolete. The firm has an optimal capital structure at every point in time, but it dynamically depends on its stock price. Thus, the notion of an optimal capital structure is not inconsistent with observed capital structures being driven largely by stock prices/returns.

We have taken debt and equity as given here, although we have provided a new rationale for shareholders to prefer debt even without taxes, agency costs or signaling considerations. It would be interesting to endogenize debt and equity in a mechanism design framework using autonomy as one of the determinants of security design.¹⁹ And to fully endogenize the design of these contracts, one would also need to accommodate the potential impact of collateral (see, for example, Rajan and Winton (1995)).

¹⁹ This would provide an alternative to the risk-sharing and information-based approaches to security design currently in vogue, e.g. Allen and Gale (2000), and Fulghieri and Lukin (2001).
APPENDIX

**Proof of Lemma 1:** Bondholders have first lien on the cash flow from the AIP. When \( \bar{V}_{AIP} = F > I \), the AIP cash flow exceeds the debt repayment obligation, \( I \). Hence, bondholders do not care about control and the firm’s cost of capital is unaffected by \( \eta \). Since the value of the firm, assessed by the manager, is increasing in \( \eta \) for any fixed cost of capital, it is optimal to set \( \eta = 1 \).

**Proof of Lemma 2:** Rearranging (7), we can express it as

\[
\hat{V}_y(\rho, \eta) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \left\{ w\sigma_y + \mu_y \right\} [1-\tau] q(x, y|\rho) dxdy + \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} R [1-\tau] q(x, y|\rho) dxdy \\
+ \int_{-\infty}^{R} \int_{-\infty}^{\infty} R [1-\tau] q(x, y|\rho) dxdy - \eta \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} [R - y] [1-\tau] q(x, y|\rho) dxdy + E\left(V_{AIP}\right) \tag{A-1}
\]

Now define:

\[
u \equiv \frac{x - \mu_x}{\sigma_x}, \quad w \equiv \frac{y - \mu_y}{\sigma_y} \tag{A-2}
\]

Substituting (A-2) in (A-1) and writing \( q(x, y|\rho) \) as a bivariate normal density, we can express (A-1) as:

\[
\hat{V}_y(\rho, \eta) = \int_{[\mu_x, \mu_x]} \int_{[\mu_y, \mu_y]} \left\{ w\sigma_y + \mu_y \right\} [1-\tau] \hat{q}(u, w) dudw \\
+ \int_{[\mu_x, \mu_x]} \int_{-\infty}^{\infty} R [1-\tau] \hat{q}(u, w) dudw + \int_{[\mu_x, \mu_x]} \int_{-\infty}^{\infty} R [1-\tau] \hat{q}(u, w) dudw \\
- \eta \int_{[\mu_x, \mu_x]} \int_{[\mu_y, \mu_y]} [R - w\sigma_y - \mu_y] [1-\tau] \hat{q}(u, w) dudw + E\left(V_{AIP}\right) \tag{A-3}
\]

where \( \hat{q}(u, w) = \frac{\exp \left\{-\left[(1/2)/(1-\rho^2)\right] \left[u^2 - 2 \rho \mu w + w^2\right]\right\}}{2\pi \sqrt{1-\rho^2}} \), which upon simplification yields:

\[
\hat{q}(u, w) = \frac{\exp \left\{-\left[(1/2)/(1-\rho^2)\right] \left[(u - \rho \mu)^2 + (1-\rho^2) w^2\right]\right\}}{2\pi \sqrt{1-\rho^2}}
\]

Now substitute \( \alpha = \frac{u - \rho \mu w}{\sqrt{1-\rho^2}} \) and \( d\alpha = \frac{du}{\sqrt{1-\rho^2}} \) into (A-3), use the fact that \( \mu_x = \mu_y = \mu \), \( \sigma_x = \sigma_y = \sigma \), and rearrange to write:

\[
\hat{V}_y(\rho, \eta) = \int_{[\mu_x, \mu_x]} \left\{ \int_{-\infty}^{\infty} \frac{e^{-\alpha^2/2}}{\sqrt{2\pi}} d\alpha \right\} \left\{ w\sigma + \mu \right\} [1-\tau] e^{-\alpha^2/2} d\alpha \\
\times \frac{1}{\sqrt{2\pi}} d\alpha
\]

\[29\]
\[ + \eta \int_{[\sigma, \mu]} e^{-\frac{w}{2}} d\alpha \left[ \left( \int_{ \frac{1}{2\pi} } \frac{e^{-\frac{w}{2}}}{\sqrt{2\pi}} d\omega \right) \frac{w \sigma + \mu \left[ 1 - \tau \right]}{2 \pi} \right] e^{-\frac{w}{2}} d\omega \\
+ \int_{[\sigma, \mu]} R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega + \int_{\eta}^{w} \frac{R \left[ 1 - \tau \right]}{2 \pi} e^{-\frac{w}{2}} d\omega \\
- \eta \int_{[\sigma, \mu]} e^{-\frac{w}{2}} d\alpha \left[ \left( \int_{ \frac{1}{2\pi} } \frac{e^{-\frac{w}{2}}}{\sqrt{2\pi}} d\omega \right) \frac{R \left[ 1 - \tau \right]}{2 \pi} e^{-\frac{w}{2}} d\omega \right] + E(V_{\text{air}}) \]

where \( J(\rho, w) = \left[ \left( R - \mu \right) / \sigma \right] - \rho w \)

Also define \( P(J(\rho, w)) = \int_{\eta}^{w} e^{-\frac{w}{2}} d\alpha \) \tag{A-4}

Adding and subtracting equal quantities and rearranging, we obtain

\[ \dot{V}_{\eta}(\rho, \eta) = \int_{[\rho, w]} P(J(\rho, w)) \left[ w \sigma + \mu \left[ 1 - \tau \right] e^{-\frac{w}{2}} \right] d\omega + \int_{[\rho, w]} R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega \\
- \left[ 1 - \eta \right] \int_{[\rho, w]} R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega + \int_{[\rho, w]} \left[ 1 - P(J(\rho, w)) \right] R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega \\
+ \int_{[\rho, w]} \left[ 1 - P(J(\rho, w)) \right] R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega + E(V_{\text{air}}) \]

which can then be simplified by combining terms:

\[ \dot{V}_{\eta}(\rho, \eta) = \int_{[\rho, w]} P(J(\rho, w)) \left[ w \sigma + \mu \left[ 1 - \tau \right] e^{-\frac{w}{2}} \right] d\omega \\
+ \int_{[\rho, w]} R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega + \int_{[\rho, w]} \left[ 1 - P(J(\rho, w)) \right] R \left[ 1 - \tau \right] e^{-\frac{w}{2}} d\omega \\
- \int_{[\rho, w]} \left[ 1 - P(J(\rho, w)) \right] \left[ w \sigma + \mu \left[ 1 - \tau \right] e^{-\frac{w}{2}} \right] d\omega + E(V_{\text{air}}) \tag{A-5} \]

Our goal is to show that \( \partial \dot{V}_{\eta}(\rho, \eta) / \partial \rho > 0 \).

To show this, we begin by noting that

\[ dP(J(\rho, w)) / d\rho = [\partial P / \partial J] [\partial J / \partial \rho] \tag{A-6} \]

where \( \partial P / \partial J < 0 \) always and

\[ \partial J / \partial \rho = \left[ \frac{\rho \left[ R - \mu \right] / \sigma} {1 - \rho^2} \right] - \frac{w}{1 - \rho^2} \tag{A-7} \]

Now differentiating (A-5) with respect to \( \rho \) yields
\[
\frac{\partial \tilde{V}_\nu}{\partial \rho}(\rho, \eta) = \int_{\mathbb{R}^2} \left\{ \frac{dP/d\rho}{\sqrt{2\pi}} \left[ w\sigma + \mu \right][1-\tau] e^{-\nu^2/2} \right\} dw
- \int_{\mathbb{R}^2} \left\{ \frac{dP/d\rho}{\sqrt{2\pi}} \left[ R[1-\tau] e^{-\nu^2/2} \right] dw \right\}
- \int_{\mathbb{R}^2} \left\{ \frac{dP/d\rho}{\sqrt{2\pi}} \left[ \eta R + \left[1-\eta\right][w\sigma + \mu] \right][1-\tau] e^{-\nu^2/2} \right\} dw
+ \int_{\mathbb{R}^2} \left\{ \frac{dP/d\rho}{\sqrt{2\pi}} \left[ w\sigma + \mu - R \right][1-\tau] e^{-\nu^2/2} \right\} dw
\]
\]

It is clear that the second term in (A-8) is positive. To see this, note that for \( w \in (-\infty, \{R - \mu\}/\sigma) \), we have \( w\sigma + \mu < R \), so \( w\sigma + \mu - R < 0 \). Further,
\[
dP/d\rho = \frac{-e^{-\nu^2/2} \left\{ \rho \left[ \{R - \mu\}/\sigma \right] - w \right\}}{\sqrt{2\pi} \left[ 1 - \rho^2 \right]^{3/2}} < 0 \forall w \in (-\infty, \{R - \mu\}/\sigma)
\]
We will now show that the first term is strictly positive as well. Substituting for \( dP/d\rho \), we can write it as:
\[
\int_{\mathbb{R}^2} \frac{-e^{-\nu^2/2} \left\{ \rho \left[ \{R - \mu\}/\sigma \right] - w \right\}[w\sigma + \mu - R][1-\tau] e^{-\nu^2/2} \right\} dw
\]
\[
= \int_{\mathbb{R}^2} \left\{ \frac{e^{-\nu^2/2} \left[ w + \frac{\mu - R}{\sigma} \rho \right][w\sigma + \mu - R][1-\tau] e^{-\nu^2/2} \right\} dw
\]
\[
+ \int_{\mathbb{R}^2} \left\{ \frac{-e^{-\nu^2/2} \left[ w + \frac{\mu - R}{\sigma} \rho \right][w\sigma + \mu - R][1-\tau] e^{-\nu^2/2} \right\} dw
\]
\]
It is clear that the second integral in (A-9) is strictly positive because \( w \in \left[ \{\mu - R\}/\sigma \right], \infty \) so that the integrand is unambiguously positive pointwise. As for the first integral, define \( \xi_1 \equiv \{\mu - R\}/\sigma > 0, \xi_2 \equiv \xi_1 [1 + \rho] > 0, \xi_3 \equiv \xi_1^2 \rho, \text{ and } \xi_4 \equiv \frac{\sigma [1-\tau]}{\sqrt{2\pi} \left[ 1 - \rho^2 \right]^{3/2}} > 0 \). Then we can write the first integral in (A-9) as:
\[
\int_{[\mu,\mu]^{2}} \xi_{2} \cdot \left[ w^{2} + \xi_{2} w + \xi_{1} \right] e^{-\beta w} d\omega
\]

Define \( \Psi(w) = e^{-\beta w} \), and \( \hat{\omega} = \omega/\sqrt{1-\rho^2} \). Thus, \( d\hat{\omega} \sqrt{1-\rho^2} = d\omega \) and we can write the first integral in (A-9) as:

\[
\int_{[\mu,\mu]^{2}} \tilde{\xi}_{2}^{2} \Psi(\hat{\omega}) e^{-\beta \left[ \hat{\omega}^{2} + \xi_{2} \hat{\omega} + \xi_{1} \right]} \sqrt{2\pi} d\hat{\omega}
\]

where \( \Psi(\hat{\omega}) \equiv \left\{ \hat{\omega}^{2} \left[ 1 - \rho^2 \right] + \xi_{2} \hat{\omega} \sqrt{1-\rho^2} + \xi_{1} \right\} e^{-\beta \hat{\omega}^{2}} \),

and \( \hat{f} \equiv \left\{ (R-\mu)/\sigma - \rho \hat{\omega} \sqrt{1-\rho^2} \right\} \). 

Defining \( \hat{\Psi}(\hat{\omega}) \equiv \left\{ \hat{\omega}^{2} \left[ 1 - \rho^2 \right] + \xi_{2} \hat{\omega} \sqrt{1-\rho^2} + \xi_{1} \right\} \), we see that \( \hat{\Psi}(\hat{\omega}) \) is convex in \( \hat{\omega} \). We can thus write the above integral as:

\[
\tilde{\xi}_{2} \int_{[\mu,\mu]^{2}} \frac{\sqrt{1-\rho^2}}{\sqrt{2\pi}} \Psi(\hat{\omega}) e^{-\beta \left[ \hat{\omega}^{2} + \xi_{2} \hat{\omega} + \xi_{1} \right]} d\hat{\omega}
\]

\[
= \tilde{\xi}_{2} \left( \int_{[\mu,\mu]^{2}} \frac{\sqrt{1-\rho^2}}{\sqrt{2\pi}} \Psi(\hat{\omega}) e^{-\beta \hat{\omega}^{2}} d\hat{\omega} \right) ^{2}
\]

where \( \Psi(\hat{\omega}) \equiv \hat{\Psi}(\hat{\omega}) e^{-\beta \hat{\omega}^{2}} \), \( \tilde{\xi}_{2} \equiv \frac{\exp\left\{ -\frac{[R-\mu]/\sigma}{2[1-\rho^2]} \right\} \Psi(0)}{\sqrt{1-\rho^2}} \) and the inequality above follows from Jensen’s inequality applied to the convex function \( \tilde{\Psi}(\hat{\omega}) \). The last step above follows from the fact that \( \hat{\omega} \) is a mean-zero normal random variable. Note further that \( \xi_{2} > 0, \xi_{5} > 0 \) and \( \tilde{\Psi}(0) = \xi_{3} > 0 \) \forall \rho > 0 \). Thus, we have proved that \( \tilde{\xi}_{2} \tilde{\Psi}(0) > 0 \), which implies that

\[
\int_{[\mu,\mu]^{2}} \frac{\tilde{\xi}_{2} \cdot \left[ w^{2} + \xi_{2} w + \xi_{1} \right] e^{-\beta w} d\omega}{\sqrt{2\pi}} > 0.
\]
This completes the proof that \( \partial \hat{V}_i^j (\rho, \eta) / \partial \rho > 0 \ \forall \rho > 0 \) since we have established that (A-9) is strictly positive for \( \rho > 0 \).

Now consider \( \rho < 0 \). Note that we can write (A-9) as:

\[
\begin{align*}
\int_{[\rho, -\rho]} \xi \xi e^{-j/2} e^{-w/2} dw + \int_{[\rho, -\rho]} \xi \xi e^{-j/2} e^{-w/2} dw + \int_{[\rho, -\rho]} \xi \xi e^{-j/2} e^{-w/2} dw \\
+ \int_{[\rho, -\rho]} \xi \xi [w^2 + \xi x] e^{-j/2} e^{-w/2} dw + \int_{[\rho, -\rho]} \xi \xi [w^2 + \xi x] e^{-j/2} e^{-w/2} dw
\end{align*}
\]

(A-10)

It is obvious that

\[
\int_{[\rho, -\rho]} \xi \xi e^{-j/2} e^{-w/2} dw > 0
\]

since \( w > 0 \) over \([\{\mu, -\rho\}/\sigma], \{\mu, -\rho\}/\sigma]\). Further, we can write:

\[
\int_{[\rho, -\rho]} \xi \xi e^{-j/2} e^{-w/2} dw = \xi \xi \xi E \left( we^{-j/2} \right)
\]

where \( E (\cdot) \) is the conditional expectation of a function of \( w \) over \( w \in \{\{\mu, -\rho\}/\sigma], \{\mu, -\rho\}/\sigma]\), and \( \xi > 0, \xi_i > 0 \). Moreover,

\[
E \left( we^{-j/2} \right) = \text{cov} \left( w, e^{-j/2} \right) + E \left( w \right) E \left( e^{-j/2} \right)
\]

\[
= \text{cov} \left( w, e^{-j/2} \right) \quad \text{since} \ E \left( w \right) = 0
\]

where \( \text{cov} \left( \cdot, \cdot \right) \) is the conditional covariance, given \( w \in \{\{\mu, -\rho\}/\sigma], \{\mu, -\rho\}/\sigma]\). Now

\[
\partial e^{-j/2} / \partial w = \frac{\partial e^{-j/2} / \partial w}{\partial e^{-j/2} / \partial w} > 0 \quad \text{when} \ \rho < 0 \ \text{since} \ \xi > w.
\]

This means that \( \text{cov} \left( w, e^{-j/2} \right) > 0 \), which implies that \( \xi \xi \xi E \left( we^{-j/2} \right) > 0 \). Having shown that the first two terms in (A-10) are positive, we now turn to the third term, which can be written as:

\[
\int_{[\rho, -\rho]} \left\{ \xi \xi \xi [w^2 - \mu R / \sigma] \left[ e^{-j/2} e^{-w/2} \right] \right\} dw
\]

Now,

\[
\partial e^{-j/2} / \partial w = \frac{\partial e^{-j/2} / \partial w}{\partial e^{-j/2} / \partial w}
\]
> 0 \text{ if } J < 0.

Since \( w < \left[ \mu - R \right] / \sigma < \rho \) in the integral above, and \( \rho < 0 \), we know that \( J < 0 \). Hence, \( e^{-J/\ell_p} \) is strictly increasing in \( w \forall \rho \in (-1, 0) \). Given this and the fact that \( w^2 \) is increasing in \( w \), we can write:

\[
\int_{[\mu - R] / \sigma \left[ [\rho] \right]}^{[\mu - R] / \sigma} \left| w^2 - \rho \left[ \left( \frac{\mu - R}{\sigma} \right) \right]^2 \right| e^{-J/\ell_p} e^{-w^2/2} dw
\]

\[
> \int_{[\mu - R] / \sigma \left[ [\rho] \right]}^{[\mu - R] / \sigma} \left| \left( \frac{\mu - R}{\sigma} \right)^2 - \rho \left( \frac{\mu - R}{\sigma} \right)^2 \right| e^{-J/\ell_p} e^{-w^2/2} dw
\]

> 0 \forall \rho \in (-1, 0).

As for the fourth term in (A-10), we can write it in its original form (see (A-9)) as:

\[
\int_{[\mu - R] / \sigma \left[ [\rho] \right]}^{[\mu - R] / \sigma} \left| \left( \frac{\mu - R}{\sigma} \right)^2 - \rho \left( \frac{\mu - R}{\sigma} \right)^2 \right| e^{-J/\ell_p} e^{-w^2/2} dw
\]

Since the integrand is unambiguously positive pointwise \( \forall w > \left[ \mu - R \right] / \sigma \rho \), we see that the above integral is strictly positive. Thus, we have proved that (A-10) is strictly positive, which means (A-9) is strictly positive for \( \rho < 0 \).

\begin{proof}
\end{proof}

Proof of Lemma 3: The proof of \( \partial V^1 \left( \rho, \eta, \theta \right) / \partial \rho > 0 \) is very similar to that of Lemma 2 and therefore omitted to conserve space. The fact that \( \partial \alpha \beta \rho < 0 \) follows from (9) and Lemma 2.

\begin{proof}
\end{proof}

Proof of Lemma 4: To prove this lemma, we proceed as follows. Note \( \overline{\nu}_{\text{apr}} = 0 \). Let \( D^i \) be the debt repayment obligation determined at \( t = 1 \) under the debt contract providing complete autonomy to management \( (\eta = 1) \) when \( \overline{\nu}_{\text{apr}} = 0 \). Solve for \( \overline{\pi} \left( D^i \right) \) as the value of \( x \) such that the manager is indifferent between the innovative project and the lemon. That is,

\[
\int_{D^i}^{[u - D^i]} f \left( u \mid \overline{\pi} \left( D^i \right), \lambda \right) du = \int_{D^i}^{[u - D^i]} f \left( u \mid 0, \lambda \right) du \quad (A-11)
\]
Since \( \wedge_N > \wedge_1 \), it follows that \( \pi(D^i) > R \). This assumption implies that the manager will choose the lemon project whenever \( x < \pi(D^i) \) and the innovative project whenever \( x \geq \pi(D^i) \). Consequently, the mundane project is never voluntarily chosen with debt financing, i.e., when the manager has autonomy. Now let \( b \) represent the actual random payoff to the bondholders, we see that \( D^i \) is determined by the bondholders to satisfy:

\[
(1 - \theta)D^i + \theta \mathbb{E}[b|\theta, D^i] = 1
\]  

(A-12)

where \( \mathbb{E}[b|\theta, D^i] \) is the expected payoff to the bondholders, as assessed by the bondholders, conditional on the innovative project being available and the repayment obligation being \( D^i \).

\[
\mathbb{E}[b|\theta, D^i] = \int \int \left\{ \min[u, D^i] f(u|y, \Lambda_i) du \right\} q(x, y|\rho) dx dy
\]

\[
+ \int \int \left\{ \min[u, D^i] f(u|\theta, \Lambda_N) du \right\} q(x, y|\rho) dx dy
\]

(A-13)

Alternatively, if all control rests with the bondholders, they enforce the choice of the mundane project and since this project is riskless, the repayment obligation is \( I \). Let \( V^i_y(D^i) \) be the firm value associated with \( \eta = 1 \) (all control with the manager) and \( V^i_y(I) \) the firm value associated with \( \eta = 0 \) (all control with the bondholders), as assessed by the initial investors. Then

\[
V^i_y(D^i) - I = [1 - \theta] (R - D^i) [1 - \tau] + \theta \hat{V}^i_y(D^i|\theta)
\]

(A-14)

where

\[
\hat{V}^i_y(D^i|\theta) = [1 - \tau] \int \int \left\{ \min[u - D^i] f(u|y, \Lambda_i) du \right\} q(x, y|\rho) dx dy +
\]

\[
+ [1 - \tau] \int \int \left\{ \min[u - D^i] f(u|\theta, \Lambda_N) du \right\} q(x, y|\rho) dx dy
\]

(A-15)

Inserting (A-12) into (A-14) to replace \( D^i \) we get

\[
V^i_y(D^i) - I = [1 - \theta] (R - D^i) [1 - \tau] + \theta \hat{V}^i_y(D^i|\theta) + \mathbb{E}[b|\theta, D^i] [1 - \tau] - I [1 - \tau]
\]

\[
= [1 - \tau] [(1 - \theta) R + \theta V^i_{TOT} - I]
\]

(A-16)

where we have defined \( V^i_{TOT} \equiv \hat{V}^i_y(D^i|\theta) /[1 - \tau] + \mathbb{E}[b|\theta, D^i] \) which, using (A-15) and (A-13), equals
\[
V_{TOT}^1 = \int_{-\infty}^{\Lambda} \int_{-\infty}^{yD(x,y)dx} q(x,y|\rho) dx dy.
\]

\[
= \int_{-\infty}^{\Lambda} \int_{-\infty}^{\infty} yq(x,y|\rho) dx dy \tag{A-17}
\]

Recall that (A-16) is the value for investors when the manager is in the control. With all control vested with the bondholders, the firm value is:

\[
V_I^1(I) - I = [R - I][1 - \tau] \tag{A-18}
\]

Comparing (A-18) to (A-16), and simplifying we see that giving the bondholders autonomy is optimal, when \( V_{TOT}^1 < R \).

We will now show that \( V_{TOT} \) is monotonically decreasing in \( \Lambda_N \), with \( V_{TOT} > R \) for \( \Lambda_N \to 0 \) and \( V_{TOT} < R \) for \( \Lambda_N \to \infty \). This then proves the Lemma. Note \( \frac{\partial V_{TOT}^1}{\partial \Lambda_N} = \frac{\partial V_{TOT}^1}{\partial \bar{x}(D^1)} \frac{\partial \bar{x}(D^1)}{\partial \Lambda_N} \). From (A-17) follows that \( \frac{\partial V_{TOT}^1}{\partial \bar{x}(D^1)} < 0 \), and from (A-11) it follows \( \frac{\partial \bar{x}(D^1)}{\partial \Lambda_N} > 0 \). Hence \( \frac{\partial V_{TOT}^1}{\partial \Lambda_N} < 0 \). Next, using (A-11) for \( \Lambda_N \to 0 \), \( \bar{x}(D^1) \to -\infty \), and from (A-17) we see that

\[
V_{TOT}^1 \bigg|_{\Lambda(D^1) \to -\infty} = \int_{-\infty}^{\Lambda} yh(y|\rho) dy = \mu_y.
\]

Since \( \mu_y > R \), we have \( V_{TOT}^1 > R \). For \( \Lambda_N \to \infty \), \( \bar{x}(D^1) \to \infty \) (use (A-11)), and from (A-17) we see that \( V_{TOT}^1 \bigg|_{\Lambda(D^1) \to \infty} = 0 \). Hence, \( V_{TOT}^1 < R \). This completes the proof.

\textbf{Proof of Theorem 1:} We first show that \( \exists \beta^* \in (0,1) \) such that the manager prefers debt financing \( \forall \beta > \beta^* \). The expected terminal \( (t=3) \) wealth of those who are shareholders at \( t = 0 \), as assessed by management, when equity is chosen is \( [1-\alpha]V_\theta^i(\rho,\eta,\theta) \) and is given by (11) and (12). With debt financing, the expected terminal wealth of those who are shareholders at \( t = 0 \), is \( V_\theta^i(D^1 - I) \), where \( V_\theta^i(D^1 - I) \) is given by (15); we can subtract \( I \) as the fixed repayment obligation to bondholders because debt represents a riskfree claim (see Section 3.3). Debt is strictly preferred to equity if:

\[
[1-\alpha] \left\{ \theta V_\theta^i(\rho,\eta) + [1-\theta] [R(1-\tau) + E(V_{ap})] \right\}
\]

\[
< \theta \left\{ \beta V_\theta^i(D^1 - I) + R(1-\tau) + \tau \right\} + [1-\theta] \left\{ R(1-\tau) + \tau + E(V_{ap}) \right\} - I \tag{A-19}
\]

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where $\bar{V}_i^j(\rho, \eta)$ is given in (13), $E(V_{AIP}) = \beta F[1-\tau] \equiv \beta \bar{F}$, and $\bar{V}_i^j(D' = I | \theta, V_{AIP} = F)$ is given in (17).

Also note that $\alpha = I/V_i^j(\rho, \eta, \theta)$, where $V_i^j(\rho, \eta, \theta)$ is defined in (6). Further, recall from (12) and (13) that $\theta \bar{V}_i^j(\rho, \eta) + [1-\theta] \{ R[1-\tau] + E(V_{AIP}) \} \equiv V_i^j(\rho, \eta, \theta)$.

Now we can write (A-19) as:

$$
\frac{IV_i^j(\rho, \eta, \theta)}{\bar{V}_i^j(\rho, \eta, \theta)} > \begin{cases} 
\theta \left[ \bar{V}_i^j(\rho, \eta) - E(V_{AIP}) \right] - \theta \beta \left[ \bar{V}_i^j(D' = I | \theta, V_{AIP} = F) - \bar{F} \right] \\
- \left[ 1-\theta \right] \{ R[1-\tau] + \tau I \} + I
\end{cases}
$$

which means:

$$
\frac{IV_i^j(\rho, \eta, \theta)}{\bar{V}_i^j(\rho, \eta, \theta)} > \begin{cases} 
\theta \left[ \bar{V}_i^j(\rho, \eta) - E(V_{AIP}) \right] - \theta \beta \left[ \bar{V}_i^j(D' = I | \theta, V_{AIP} = F) - \bar{F} \right] \\
- \left[ 1-\theta \right] \tau I + I
\end{cases}
$$

The right-hand side (RHS) of (A-21) is strictly decreasing in $\beta$ since:

$$
\bar{V}_i^j(D' = I | \theta, V_{AIP} = F) - \bar{F} > R[1-\tau] + \tau I.
$$

and both $\left[ \bar{V}_i^j(\rho, \eta) - E(V_{AIP}) \right]$ and $\left[ \bar{V}_i^j(D' = I | \theta, V_{AIP} = F) - \bar{F} \right]$ are independent of $\beta$. Note also that the RHS of (A-21) is strictly less than $I$ when $\beta = 1$.

We will now show that the LHS of (A-21) exceeds $I$. From (6) and (12), note that

$$
V_i^j(\rho, \eta, \theta) > V_i^j(\rho, \eta, \theta)
$$

For external equity financing to be viable (see (9)), we know that

$$
V_i^j(\rho, \eta, \theta) > I
$$

Taken together, (A-22) and (A-23) imply that the LHS of (A-21) is strictly greater than $I$. Since we have already shown that the RHS of (A-21) is less than $I$ for $\beta = 1$, we have proved that debt financing is strictly preferred by the manager for $\beta = 1$. 

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To complete the proof for $\beta \in (0,1)$, recall that the RHS and LHS of (A-21) are decreasing in $\beta$ (note that $\beta$ enters both $V_i^i(\rho, \eta, \theta)$ and $V_j^i(\rho, \eta, \theta)$ only via $E(V_{i\rho})$), but the LHS is decreasing at a strictly lower rate than the RHS, i.e., both the LHS and RHS are concave in $\beta$ with $\partial^2\text{LHS}/\partial \beta^2 > \partial^2\text{RHS}/\partial \beta^2$.

Given the continuity of the LHS and RHS of (A-21) in $\beta$, (A-21) holding as a strict inequality for $\beta = 1$, $\partial^2\text{LHS}/\partial \beta^2 > \partial^2\text{RHS}/\partial \beta^2$, and for now taking as a given that equity is strictly preferred for $\beta = 0$, we have proved that $\exists \beta^* \in (0,1)$ such that equity is optimal for $\beta < \beta^*$ and debt is optimal for $\beta \geq \beta^*$ (note that the second derivatives here are unambiguously of the same sign and preferences are distinct at $\beta = 0$ and $\beta = 1$, which means that the curves representing the LHS and the RHS intersect only once).

However, we need to show that equity is optimal for $\beta = 0$. Hence, reversing the inequality in (A-21), we want to show that at $\beta = 0$:

$$\frac{IV_i^i(\rho, \eta, \theta)}{V_j^i(\rho, \eta, \theta)} < \begin{cases} \theta \bar{V}_i^i(\rho, \eta) + [1-\theta] \left\{ R[1-\tau] \right\} \\ -\{R[1-\tau] + \tau I\} + I \end{cases}$$

(A-24)

First we will show that for equity to be preferred, $\theta$ must be sufficiently large. From (9), (12), (A-22) and (A-23), we know that:

$$\frac{V_j^i(\rho, \eta, \theta)}{V_j^i(\rho, \eta, \theta)} > 1 \text{ and } \lim_{\theta \to 0} \left\{ \frac{V_j^i(\rho, \eta, \theta)}{V_j^i(\rho, \eta, \theta)} \right\} = 1.$$  

It is straightforward to show that $\left\{ \frac{V_j^i(\rho, \eta, \theta)}{V_j^i(\rho, \eta, \theta)} \right\}$ is strictly increasing in $\theta$. Also observe from (A-24) that equity is never optimal for $\theta = 0$.

We can now derive a sufficiency condition for equity to be optimal when $\beta < \beta^*$. Substituting $\rho = -1$ in $\bar{V}_i^i(\rho, \eta)$ in (A-24) and noting that $\partial \bar{V}_i^i(\rho, \eta)/\partial \rho > 0$, we have
\[ \bar{V}_i(-1, \eta) > \left\{ \left\{ \frac{1}{\theta} \right\} \left\{ [1-\tau] [R-I] \right\} - \left\{ \frac{1-\theta}{\theta} \right\} \left\{ R[1-\tau] \right\} + \left\{ \frac{I}{\theta} \right\} \left\{ V_i^j(\rho, \eta, \theta) \right\} \right\} \]  \hspace{1cm} (A-25)

which can be rewritten as:

\[ \bar{V}_i(-1, \eta) > [1-\tau] R - [1-\tau] [I/\theta] + [I/\theta] \left\{ \frac{V_i^j(\rho, \eta, \theta)}{V_i^j(\rho, \eta, \theta)} \right\} \]  \hspace{1cm} (A-26)

Observe that (see (13)):

\[ \bar{V}_i(-1, \eta) = \int_{\mu+\mu-R}^{\mu} x [1-\tau] g(x|1-1) dx + \int_{\mu+\mu-R}^{\mu} R[1-\tau] h(y|1-1) dy 
+ \int_{\mu+\mu-R}^{\mu} R[1-\tau] g(x|1-1) dx + \eta \int_{\mu+\mu-R}^{\mu} [x-R][1-\tau] g(x|1-1) dx \]

Now substitute

\[ \int_{\mu+\mu-R}^{\mu} h(y|1-1) dy = \int_{\mu+\mu-R}^{\mu} g(x|1-1) dx, \]

to get

\[ \bar{V}_i(-1, \eta) = \int_{\mu+\mu-R}^{\mu} x [1-\tau] g(x|1-1) dx + \int_{\mu+\mu-R}^{\mu} R[1-\tau] g(x|1-1) dx 
+ \int_{\mu+\mu-R}^{\mu} R[1-\tau] g(x|1-1) dx + \eta \int_{\mu+\mu-R}^{\mu} [x-R][1-\tau] g(x|1-1) dx \]  \hspace{1cm} (A-27)

If \( \eta = 1 \), substituting (A-27) in (A-26) yields

\[ \int_{\mu}^{\mu} x g(x|1-1) dx - \int_{\mu}^{\mu} R g(x|1-1) dx > \frac{1}{\theta} \left\{ \frac{V_i^j(\rho, \eta, \theta)}{V_i^j(\rho, \eta, \theta)[1-\tau]} - 1 \right\} \]

Define

\[ A \equiv \frac{1}{\theta} \left\{ \frac{V_i^j(\rho, \eta, \theta)}{V_i^j(\rho, \eta, \theta)[1-\tau]} - 1 \right\} \]

\[ \bar{A} = \max_{\rho} \left\{ \frac{1}{\theta} \left\{ \frac{V_i^j(\rho, \eta, \theta)}{V_i^j(\rho, \eta, \theta)[1-\tau]} - 1 \right\} \right\} \]

We can now write the above inequality as (use \( \mu = \int_{\mu}^{\mu} x g(x|1-1) dx \)):

\[ \mu > R + A - \left\{ \int_{\mu}^{\mu} R g(x|1-1) dx - \int_{\mu}^{\mu} x g(x|1-1) dx \right\} \]  \hspace{1cm} (A-28)

Since \( \int_{\mu}^{\mu} R g(x|1-1) dx - \int_{\mu}^{\mu} x g(x|1-1) dx > 0 \),
the condition given below is sufficient for (A-28) to hold:
\[ \mu > R + A, \]

which we know is satisfied given (14). Thus, (A-24) holds.

This means that for \( \beta = 0 \), \([1-\alpha]V_i^1(\rho,1,\theta) > V_i^i(D^i = I) - I \) \( \forall \rho \). By continuity of \( V_i^i(\rho,\eta,\theta) \) in \( \eta \), we know that \([1-\alpha]V_i^i(\rho,\eta,\theta) > [R-I][1-\tau] \) in a neighborhood of \( \eta = 1 \). Inspection of (A-25) reveals that debt strictly dominates equity if \( \eta = 0 \) and \( \rho = -1 \). By continuity of \( V_i^i(\rho,\eta,\theta) \) in \( \rho \) and \( \eta \) and the fact that \( V_i^i(\rho,\eta,\theta) \) is linear in \( \eta \), we know now that \( \exists \eta^* \in (0,1) \) such that equity is strictly preferred to debt for all \( \eta > \eta^* \), as long as \( \theta \) is high enough. In the limit, as \( \theta \downarrow 0 \), debt is always preferred. For \( \theta \) high enough and \( \eta \leq \eta^* \), debt may be preferred depending on \( \rho \). And since \( \partial V_i^i(\rho,\eta,\theta)/\partial \rho > 0 \), we have shown that for \( \eta \leq \eta^* \), \( \exists \) a critical value \( \rho^*(\eta) \) such that management prefers to issue equity \( \forall \rho \geq \rho^*(\eta) \) and debt if \( \forall \rho < \rho^*(\eta) \), for \( \theta \) high enough.

**Proof of Theorem 2:** Suppose \( \eta < \eta^* \). Also suppose \( \rho \geq \rho^*(\eta) \). Then in the conjectured Nash equilibrium, the market believes the firm will issue equity. It thus sets the pre-equity-issuance stock price of the firm at \([1-\alpha]V_i^i(\rho,\eta,\theta) \). Now, \( \partial V_i^i/\partial \eta = 0, \) so \( \partial V_i^i(\rho,\eta,\theta)/\partial \rho = \partial V_i^i(\rho,\eta)/\partial \rho \). Because \( \partial V_i^i(\rho,\eta)/\partial \rho > 0 \), we know that \( V_i^i(\rho,\eta,\theta):[-1,1] \times [0,1] \times [0,1] \rightarrow R^+ \) is one-to-one in \( \rho \) and invertible (here \( R^+ \) is the non-negative real line). Moreover, from (9) \( \partial \alpha/\partial \rho < 0 \), so \([1-\alpha]V_i^i(\rho,\eta,\theta) \) is also strictly increasing in \( \rho \) and invertible in \( \rho \). Management can thus observe \( V_i^i(\rho,\eta,\theta) \) and correctly infer \( \rho \).

Given its knowledge of \( \rho \), management recognizes that \( \rho \geq \rho^*(\eta) \) and thus finds it optimal to issue equity. This is consistent with the market’s beliefs about what the firm will do.

Now suppose \( \rho < \rho^*(\eta) \). In the conjectured Nash equilibrium, the market believes the firm will issue debt. It thus sets the pre-debt-issuance stock price of the firm at \([R-I][1-\tau] + E(V_{aw}) \). Observing this stock price does not allow management to learn the precise value of \( \rho \), but it infers that \( \rho < \rho^*(\eta) \). For these values of \( \rho \), it is optimal for management to issue debt, thereby confirming the market’s beliefs.

**Proof of Corollary 1:** The manager seeks to maximize \([1-\alpha]V_i^i(\rho,\eta,\theta) \). From (12) we know that \( \partial V_i^i(\rho,\eta,\theta)/\partial \rho > 0 \). Moreover, \( \partial \alpha/\partial \rho < 0 \). Thus, \( \partial [1-\alpha]V_i^i(\rho,\eta,\theta)/\partial \rho > 0 \). Now consider two values of \( \eta \), say \( \eta_0 \) and \( \eta_1 \), with \( \eta_0 < \eta_1 \). Let \( \rho^*(\eta_0) \) be the cutoff with \( \eta_0 \). That is,

\[ [1-\alpha(\eta_0)]V_i^i(\rho^*(\eta_0),\eta_0,\theta) = [R-I][1-\tau] + E(V_{aw}). \]
But since \[ \frac{\partial V^i_t (\rho, \eta, \theta)}{\partial \eta} > 0, \] we know that:

\[ [1 - \alpha(\eta)] V^i_t (\rho^* (\eta), \eta, \theta) > [R - I][1 - \tau] + E(V_{ap}) \]  \hspace{1cm} (A-29)

Since

\[ [1 - \alpha(\eta)] V^i_t (\rho^* (\eta), \eta, \theta) = [R - I][1 - \tau] + E(V_{ap}) \]  \hspace{1cm} (A-30)

and \( \frac{\partial V^i_t (\rho, \eta, \theta)}{\partial \rho} > 0 \), we see from (A-29) and (A-30) that:

\( \rho^* (\eta) < \rho^* (\eta) \)

Proof of Corollary 2: Following steps similar to those in the proof of Lemma 2 we can establish that \( \frac{\partial \alpha}{\partial \sigma} < 0 \) and \( \frac{\partial V^i_t (\rho, \eta, \theta)}{\partial \sigma} > 0 \) (steps available upon request). Now the cutoff \( \rho^* \) such that equity is preferred for \( \rho \geq \rho^* \) and debt for \( \rho < \rho^* \) satisfies

\[ [1 - \alpha] V^i_t (\rho^*, \eta, \theta) = [R - I][1 - \tau] + E(V_{ap}) \]  \hspace{1cm} (A-29)

By the continuity of \( [1 - \alpha] V^i_t (\rho, \eta, \theta) \) in \( \rho \) and \( \sigma \), with \( \frac{\partial [1 - \alpha] V^i_t (\rho, \eta, \theta)}{\partial \rho} > 0, \frac{\partial [1 - \alpha] V^i_t (\rho, \eta, \theta)}{\partial \sigma} > 0 \), we have \( d \rho^*/d \sigma < 0 \).

Proof of Corollary 3: The pre-equity issuance stock price is \( [1 - \alpha] V^i_t (\rho, \eta, \theta) \). The proof is immediate upon inspecting (6), (7) and (9).

Proof of Theorem 3: The statement of the theorem assumes \( \eta < \eta^* \). We know that equity will be issued at \( t = 1 \) if a project is available and if \( \rho \geq \rho^* (\eta) \). At \( t = 0 \), we know from (6), (7) and (8) that the pre-issuance stock price \( [1 - \alpha] V^i_t (\rho, \eta, \theta) \) is increasing in \( \theta \). The stock price at \( t = 1 \), conditional on a debt issue at \( t = 1 \), is \( [R - I][1 - \tau] + E(V_{ap}) \). So once the pre-issuance stock price rises above \( V^i_t (m) \equiv [R - I][1 - \tau] + E(V_{ap}) \), we know at \( t = 1 \) that \( \rho > \rho^* \) almost surely and equity will be issued at \( t = 1 \); recall \( \hat{V}^i_t (m) \) from (8). Conditional on equity being issued, an increase in the stock price beyond \( \hat{V}^i_t \) conveys the joint information about the two-dimensional random variable \( (\theta, \rho) \), and it implies higher values of \( \theta \).

Now having observed a particular stock price at \( t = 1 \), say \( \hat{V}^i_t (\alpha) \equiv [1 - \alpha][\hat{V}^i_t (\rho, \eta, \theta)] \), the econometrician can infer \( \theta \) (let the inferred \( \theta \) be called \( \hat{\theta} \)) as follows for every possible \( \rho \) (use (6)):

\[ \hat{\theta} (\rho | \hat{V}^i_t (\alpha)) = \frac{(1 - \alpha)[V^i_t (\rho, \eta, \theta) - V^i_t (m)]}{V^i_t (\rho, \eta) - V^i_t (m)} \]  \hspace{1cm} (A-31)

where \( \eta \) is common knowledge and fixed. The probability of equity issuance is now a strictly increasing function of the expectation of \( \hat{\theta} \) taken over \( \rho \), i.e.,
\[ E\left( \theta \left( \rho \bigg| \bar{V}_y^\tau (\alpha) \right) \right) = \int_\rho \theta \left( \rho \bigg| \bar{V}_y^\tau (\alpha) \right) \Phi(d\rho) \]  

(A-32)

where \( \Phi(\cdot) \) is the probability measure over \( \rho \). Note that \( \partial \theta \left( \rho \bigg| \bar{V}_y^\tau (\alpha) \right) / \partial \bar{V}_y^\tau (\alpha) > 0 \), so the integral in (A-32) is increasing pointwise in \( \bar{V}_y^\tau (\alpha) \). Thus,

\[ \partial E\left( \theta \left( \rho \bigg| \bar{V}_y^\tau (\alpha) \right) \right) / \partial \bar{V}_y^\tau (\alpha) > 0 \]

Proof of Corollary 4: All firms with \( \rho > \rho^d(\eta) \) issue equity and all firms with \( \rho \leq \rho^d(\eta) \) issue debt, conditional on a project being available (see Theorem 1). It follows immediately that the number of firms issuing equity is increasing in the likelihood of future growth opportunities, \( \theta \). Since \( \partial V_\nu^\tau(\rho, \eta, \theta) / \partial \mu > 0, \partial \alpha / \partial \mu < 0 \) and \( \rho^d(\eta) \) solves \( \left[ 1 - \alpha \right] V_\nu^\tau(\rho^d(\eta), \eta, \theta) = \left[ R - I \right] \left[ 1 - \tau \right] + E(V_{\text{MFR}}) \), it follows that \( \partial \rho^d(\eta) / \partial \mu < 0 \). Hence, an increase in \( \mu \) strictly increases the number of firms for which \( \rho > \rho^d(\eta) \), leading to more equity issues being observed.

Proof of Theorem 4: First assuming \( \eta < \eta^* \), and using (19), we can express (20) as

\[ V_\nu^\eta(\mu_\rho, \eta, \theta) = \theta \int_\rho \tilde{V}_\nu^\eta(\alpha, \eta) \Phi(d\rho_\mu) d\rho + \theta \int_{-\alpha} \left\{ R \left[ 1 - \tau \right] + E(V_{\text{MFR}}) \right\} \Phi(d\rho_\mu) + [1 - \theta] \left[ \left[ R - I \right] \left[ 1 - \tau \right] + E(V_{\text{MFR}}) \right] \]

where \( \tilde{V}_\nu^\eta(\rho, \eta) \) is given by (7). We now optimize for \( \eta \), when \( \eta \in \max_{\eta \in [0, 1]} \left\{ V_\nu^\eta(\mu_\rho, \eta, \theta) - K(1 - \eta) \right\} \), using the optimality condition:

\[ \partial V_\nu^\eta(\mu_\rho, \eta, \theta) / \partial \eta = \theta \int_\rho \tilde{V}_\nu^\eta(\rho, \eta) / \partial \eta \right\} \Phi(d\rho_\mu) + K'(1 - \eta) = 0 \]

or

\[ -\theta \int_\rho \tilde{V}_\nu^\eta(\rho, \eta) / \partial \eta \right\} \Phi(d\rho_\mu) + K'(1 - \eta) = 0 \]

(A-33)

Given the Inada conditions on \( K \), the \( \eta \) that satisfies (A-33) will be in the interior of \( (0, 1) \). The second-order condition for a unique maximum is satisfied since \( -K''(1 - \eta) < 0 \). One should verify that the \( \eta \) obtained above is indeed less than \( \eta^* \). For \( \eta \geq \eta^* \), we can write

\[ V_\nu^\eta(\mu_\rho, \eta, \theta) - K(1 - \eta) = \theta \tilde{V}_\nu^\eta(\rho, \eta) \Phi(d\rho_\mu) + [1 - \theta] \left[ \left[ R - I \right] \left[ 1 - \tau \right] + E(V_{\text{MFR}}) \right] \]

and repeat the above steps.

To show that \( \eta \) is increasing in \( \mu_\rho \), differentiate the first-order condition (A-33) with respect to \( \mu_\rho \) to obtain:

\[ -\theta \left[ \begin{array}{c} \int_{\mid \rho \mid} M(\rho) \Phi(d\rho_\mu) \\ \end{array} \right] / \partial \mu_\rho - \left[ K''(1 - \eta) d\eta / d\mu_\rho \right] = 0 \]

(A-34)
where
\[ M(\rho) \equiv \int_{-\infty}^{\infty} \left[ R - y \right] \left[ 1 - \tau \right] \delta(x, y|\rho) \, dx \, dy \]

Since \( \partial M(\rho) / \partial \rho < 0 \), we see that
\[ \partial \left[ \int_{\rho(\eta)}^{1} M(\rho) \Phi\left( d\rho \big| \mu_\rho \right) \right] / \partial \rho < 0. \]
Further, since \( K''(\cdot) > 0 \), it follows from (A-34) that \( d\eta / d\mu_\rho > 0. \)
REFERENCES


Figure 1: Sequence of events

- It becomes known whether the value of the AIP at \( t = 3 \) will be 0 or F.
- With probability \( \rho \), the innovative project becomes available.
- If the manager prefers the mundane project, based on his assessment \( x \), he can simply state that the innovative project was not available. In this case the mundane project is chosen.
- If the manager prefers the innovative project, he proposes it to investors, who then observe \( z \) and interpret it as \( y \).
- The manager observes \( z \) and interprets it as \( x \). This is his assessment of the expected value of the payoff of the innovative project at \( t = 3 \).
- Actual project choice is made. Investors may seek to veto the manager’s project choice.
- Payoffs are realized.
- Financiers are paid if payoff’s permits.

- Firm has existing assets in place (AIP) that produce a stochastic output at \( t = 3 \), which can be either 0 or F.
- Existing activities are equity financed (share price is observed).
- Shareholders determine the intrusiveness of corporate governance with equity \( \eta \).
- The value of the agreement parameter \( \rho \) is observed by the market and reflected in the firm’s stock price.
- Firm chooses to issue debt or equity to raise the needed financing I for the project. The firm knows that the mundane project and the lemon project are available, regardless of whether the innovative project becomes available at \( t = 2 \).
- Investors may seek to veto the manager’s project choice.
- Actual project choice is made.
- Payoffs are realized.
- Financiers are paid if payoff’s permits.
Figure 2: Relationship of Stock Price and Equity Issuance to the Agreement Parameter

<table>
<thead>
<tr>
<th>Security Issuance and Stock Price at $t = 1$</th>
<th>Agreement Parameter $\rho_y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt issued</td>
<td>Shareholders prefer debt to be issued</td>
</tr>
<tr>
<td>Stock Price</td>
<td>Equity issued</td>
</tr>
<tr>
<td>Disagreement region</td>
<td>$?^*$</td>
</tr>
<tr>
<td></td>
<td>$\rho_y^*$</td>
</tr>
</tbody>
</table>

| Value of debt tax shield exceeds value of autonomy to management | Value of autonomy to management exceeds value of debt tax shield |