Information Spillovers and Capital Structure *

Jayanthi Sunder†

Northwestern University

October 2006
Comments Welcome

*I am grateful to my committee members, Yakov Amihud, Zsuzsanna Fluck, Jay Hartzell, Joel Hasbrouck, Anthony Saunders, Rangarajan Sundaram, and especially my advisor, Kose John, for their guidance and valuable suggestions. I would also like to thank Viral Acharya, Anthony Lynch, Holger Mueller, and all seminar participants at 12th Annual Conference of Financial Economics and Accounting, Boston College, Cornell University, Duke University, New York University, Northwestern University, Notre Dame University, Penn State University, University of Illinois at Urbana-Champaign, University of Southern California, University of Texas at Austin, and Washington University at St. Louis for their valuable suggestions. Any errors are mine. This paper is the first essay of my dissertation, titled, "Information Spillovers and Capital Structure: Theory and Evidence".

†Contact: Jayanthi Sunder, Kellogg School of Management, 6245 Jacobs, Northwestern Universtiy, Evanston, IL – 60208. Tel: 847–491–2672 Fax: 847–467–1202 e–mail: j-sunder@kellogg.northwestern.edu

Information Spillovers and Capital Structure

Abstract

This paper studies the role of information spillovers across securities of a firm on the overall financing costs and security choice. I model the capital structure choice of firms in a dynamic setting and study the intertemporal patterns in security issuance. The model examines the interaction among information production technologies of different securities and the impact of information spillovers from public securities on the capital structure and long run financing costs of a firm. In the model, I show that firms use bank borrowing initially to minimize the lemons cost. Subsequently, when they meet the feasibility conditions for sustaining a market for their securities, they issue public equity (IPO) and then use either bank borrowing or bonds for subsequent financing rounds. This sequence of securities is optimally chosen to maximize the gains from information spillovers from public equity. Firms trade off the initial lemons cost of issuing information sensitive public equity against the gains from having more informative stock prices arising from endogenous information production in financial markets. The information spillover gains occur through a reduction in (i) bank monitoring costs and (ii) adverse selection costs of future financing. This effect has implications for the sequencing of securities over the life of the firm, and in particular the decision to go public.

1 Introduction

In this paper, I present a theory of capital structure in a dynamic setting and under asymmetric information. In the model, information production mechanisms of different securities interact to reduce the overall financing costs. In particular, information produced in financial markets can be partially inferred from observable security prices by other investors in the firm and this results in lower overall financing costs. In Grossman and Stiglitz (1980) stock prices noisily reflect the information of the informed traders. This paper extends that idea of information externality (or spillover) from stock prices and develops a model of how the financing costs and security choice of the firm are affected. Firms issue different securities over time to take advantage of information spillovers across these securities. This yields implications for the sequencing of securities over the life of the firm and determines the optimality of the initial public offering. I study both of these issues in a single framework.

In the traditional capital structure literature, firms choose the optimal capital structure by comparing the costs and benefits of debt and equity.[1] However these theories typically do not recognize the difference between private and public claims, and therefore do not have specific predictions for when a firm should go public. On the other hand, the models that examine the going-public decision do not address the choice of the optimal security and the impact it has on the overall capital structure of the firm. I model the capital structure choice of firms by examining the security choice on two dimensions: (i) payoff structure, i.e. debt versus equity and (ii) privately-held versus publicly-traded claims. In my model, firms have private information and they choose from among bank borrowing, private equity, bonds, and public equity to minimize their overall financing costs. The crucial distinction between private and public claims arises due to the existence of a secondary market for public claims and a publicly observable security price. In

[1] Traditional capital structure theories trade off the bankruptcy costs, tax implications, agency costs, adverse selection costs, etc. of debt versus equity.

the model, the information externality from observable prices of publicly traded securities has an impact on the overall financing costs of the firm and consequently on the capital structure choice and the optimal sequence of securities.[2] I show that firms would issue information-sensitive public equity and use the trading mechanism of public security markets to reduce asymmetric information going forward.

This paper presents an explanation for why it may be optimal for firms to deviate from the static pecking order of Myers (1984) and Myers and Majluf (1984) [3] in order to minimize their adverse selection costs in a dynamic framework. In practice, almost all private firms decide to issue equity[4], the most information sensitive security, in their initial public offering despite the high degree of adverse selection.[5] Before outlining the model, it would be useful to highlight the intuition for equity choice in this model and contrast it with the existing literature. Issuing an information-sensitive security, that is traded, encourages endogenous information production which is then revealed through prices and this partially solves the asymmetric information problem. The security that is most effective in achieving this objective is the one whose value is most sensitive to the private information, i.e. equity. The result that information sensitive securities encourage endogenous information production was first shown in Boot and Thakor (1993) and further developed in Fulghieri and Lukin (2001). In these papers, information production im-

[2]The impact of the information externality of stock on firms' decisions has been explored in other contexts. In Holmstrom and Tirole (1993), firms use stock prices to provide better incentives to managers, Subrahmanyam and Titman (1999) and Boot and Thakor (1997) model the impact on stock prices on real investment decisions and in Faure-Grimaud and Gromb (2004) and Aghion, Bolton and Tirole (2004), public equity provides liquidity for the inside shareholder and strengthens his incentives to monitor.

[3]firms that face this lemons problem would issue the least information sensitive security (a claim with payoffs that do not depend on the private information) in order to minimize the mispricing of the security.

[4]During the period from 1980 through 1998, I find that public debt issues formed about 5% of all initial public offerings by independent private firms, the rest being equity. *(Data Source : Securities Data Corporation).*

[5]It is possible that firms exhaust their debt capacity using private debt and as they move down the pecking order, they issue equity. The puzzle still remains as to why initial debt claims tend to be private and why the first public security is always equity.

proves the pricing of the security issued and therefore reduces the lemons problem at the time of equity issuance. In contrast, in this paper, firms bear the full lemons cost of equity at the time of issuance and information production is associated with the secondary market trading of public equity. The information that is produced in stock markets is then reflected in observable prices and this reduces the information asymmetry between the firm and investors at future dates. Further, public equity is more effective than public debt in providing incentives for endogenous information production. The information spillover from equity to other securities therefore has implications for optimal capital structure decisions and timing of the initial public offering. The intuition here is that firms trade off the costs of issuing an information sensitive security today with the future reduction in asymmetry in information due to the information spillover from security prices.

I examine the security choice of firms in two stages. First, I examine the financing decision of an entrepreneurial firm in a single project setting where I show the optimality of going public. Then, I extend the model to a sequence of projects and derive the optimal sequence of securities. In the first stage, I show that firms may combine public equity with bank debt even if banks are willing to lend the entire amount and bank borrowing is the cheapest single security that a firm can issue. In practice, firms seem to diversify their sources of financing despite the benefits from monitored bank borrowing. The rationale provided by Rajan (1992) is that firms diversify their borrowing to restrict the monopoly information rents that a single bank can extract from the firm. In this paper, I suggest that another reason why bank borrowing may get costly is due to the excessive monitoring of good firms. The excessive monitoring arises for the high quality firms that possess private information about their quality since, in the absence of other signals of firm quality, banks always incur costly monitoring. If the firm has publicly observable stock prices, the bank can decide to monitor only in those states when the stock price is not informative[6]. The bank

[6]In practice, banks do indeed use the information in stock prices to evaluate the quality of their loans. For instance, KMV Corporation of San Francisco uses stock prices as a key input in a default prediction model to produce default predictions for all companies with publicly traded equity (Saunders (1998)) in a software that is used by many investment banks in credit analysis of their clients.

uses the noisier but cheaper information technology, i.e. stock prices when it is informative and relies on its own costly monitoring technology otherwise. Thus firms decide to issue public equity so that banks can use the informative stock prices[7] to improve the efficiency of their monitoring effort, and in turn, reduce the firm's cost of bank borrowing. I characterize the conditions under which firms, that optimally choose bank borrowing as their cheapest source of financing, add public equity to their capital structure by undertaking an IPO.

The basic model of information spillover across securities is then extended to examine the security choice for a sequence of projects. The financing of the second project is also done under asymmetric information. However if the first project is financed using public equity, the trading in this public equity partially mitigates the adverse selection costs of the second financing round. Future investors use the information in observable stock prices to value the new claims and this reduces the lemons costs. At the time of financing the second project, since the firm has already established an active stock market that acts as a noisy mechanism for revealing the true firm value, the firm now issues debt to minimize the residual lemons cost. It chooses either arms-length bonds or monitored bank debt, depending on the benefits and costs of monitoring. Under certain scenarios, firms may wish to issue more equity (seasoned equity offering) for the second project to improve the liquidity and information production in stock markets by increasing the number of endogenous liquidity traders.

The model therefore shows that firms with private information issue private debt (bank) initially, then public equity and then bonds or bank debt as the optimal sequence of financing over time. This result adds to the literature that examines the life-cycle of capital structure of firms and suggests some additional factors related to the informativeness and liquidity of a firm's

[7] Faure-Grimaud and Gromb (2004) and Aghion, Bolton and Tirole (2004) have explored the role of information externality and the IPO decision of VC-backed firms, however the focus in these papers is on the liquidity needs and monitoring incentives of the large inside shareholder. The focus of this paper, however, is the IPO decision by bank-financed firms since these are firms that have access to debt with lower associated lemons cost but still choose the costlier security, equity.

stock, that could further explain the capital structure choice.

The information spillover from public equity therefore has two implications. First, it interacts with the active monitoring by banks and makes it more efficient, thereby reducing the overall dead weight costs of information production.[8] Second, it mitigates the adverse selection costs of all future financing activities of the firm. In fact in cases where the overall cost of maintaining the two information production mechanisms, bank and market, is costlier than the bank by itself, the gains from savings in lemons costs in the future could still make the IPO decision optimal. In such a case, the bank will still use the market signal ex post and the firm will face lower borrowing costs.

The remainder of the paper is structured as follows. Section 2 contains a discussion of the related literature. Section 3 describes the model for the single project case with single security choice. Section 4 allows for multiple securities in the single project setting. Section 5 describes the model for the multiple project case and derives the optimal sequence of securities and Section 6 concludes. The Appendix contains proofs.

2 Related literature

The theories relating to capital structure choice can be broadly classified as trade-off theories and pecking order theories.[9] According to the trade-off theories, firms choose their capital structure by trading-off the costs and benefits associated with leverage such as tax benefits, agency costs and bankruptcy costs. Most of the debate on capital structure and asymmetric information stems from Myers (1984) and Myers and Majluf (1984). They use the idea that asymmetric information is costly for firms raising financing and derive the pecking order of financing. According to the static pecking order theory, firms choose retained earnings then riskless debt and then risky

[8] Sunder (2004) provides evidence that the cost of bank debt is lower for firms with public equity and the cost of bank debt is decreasing in the informativeness of the stock price.

[9] see Harris and Raviv (1991) for an excellent survey of this literature.

securities as the optimal sequence of securities so as to minimize the lemons cost. One approach that has been taken to mitigate asymmetric information costs is to use signaling. However in the absence of perfect or costless signaling, asymmetric information remains an important consideration in financing choice. Bolton and Freixas (2000) build on existing theories of financing under asymmetric information and show how firms choose optimally between equity, bank and bonds. However they are primarily concerned with choosing a single optimal security and ignore the information externality of public securities.

This paper examines the capital structure choice of firms raising financing under asymmetric information in a dynamic setting. The security choice is allowed to vary on two dimensions, i.e., debt versus equity and private versus public claims. The capital structure theories typically focus on the choice between debt and equity while more recently, papers that examine the decision of firms to go public have explored the choice between private and public securities but restrict their analysis to equity. The broader definition of a security in this paper, allows for securities to vary in terms of their incentives for information production and the characteristics of the information production technology. In the model, firms issue costly public equity and trade off the initial lemons costs against future reduction in financing costs that are made possible because information produced in financial markets is noisily revealed through security prices. The information spillover hypothesis has implications for the optimality of going public and the sequencing of securities that firms issue over their life. Several papers have examined the question of why firms go public.

Among a firm's financing events, the initial public offering is probably the most significant since it marks the transition from a closed private firm to a widely-held public firm and is a point in time when insiders tend to have significant private information. Zingales (1995) argues that selling the firm to dispersed shareholders at the time of the IPO increases the bargaining position of the incumbent, who can then extract the full value from potential future bidders. Chemmanur and Fulgheri (1999) model the firm's choice between private equity financing by a risk averse venture capitalist and going public which has duplication of evaluation costs by shareholders. Subrahmanyam and Titman (1999) show that firms go public when there is information in the stock price that has an impact on real decisions by the firm but was unavailable to the insiders. In Stoughton, Wong and Zechner (2001), customers learn about the firm quality and there is a positive feedback to the firm. Maug (2001) relates the decision to go public with the life-cycle of a firm. According to his model, firms stay private when firm-specific information is crucial for monitoring and go public when industry-specific information is crucial and the underpricing at the IPO is compensation for this information collection by investors. Amihud and Mendelson (1988) suggest that firms go public to increase the liquidity of the claims that a firm issues so as to reduce the firm's cost of capital. In Myers (2000), when firms go public, it reduces the bargaining power of the initial investor and this strengthens the incentives of the entrepreneur for making firm specific human capital investment. Pagano and Roell (1998) focus on duplicative monitoring when firms are privately held by multiple shareholders as a reason for going public and reducing each shareholder's stake and the consequently their incentives to monitor. Maksimovic and Pichler (2001) examine the feedback effects between financial and product markets and derive implications for the decision to go public.

The going public decision results in the creation of publicly traded securities and there are two related issues that are key to this paper. The first issue is the role of a publicly observable security price on the firm's operations or the information externality role of stock prices. The second issue is related to the optimal security design for publicly traded claims. The information externality of stock prices that results from public trading has been examined in the existing literature. Grossman and Stiglitz (1980) show how information produced by informed investors gets communicated to the uninformed through stock prices though this is achieved imperfectly. The fact that prices do not fully reflect the information of the informed provides these investors the incentives to invest in costly information production. Allen and Gale (2000) state that information aggregation is an important role played by prices. They argue that when there is uncertainty regarding the optimal action to be taken by firms, financial markets serve as a mechanism for aggregating disperse beliefs. Several papers have examined the information externality role of public securities. In Holmstrom and Tirole (1993) managers are provided with better incentives when there is a stock price that reflects the value of their actions even though it may be a noisy signal. In Subrahmanyam and Titman (1999) and Boot and Thakor (1997), firms use information in public security prices to make real investment decisions as the markets aggregate information that is not available to managers. More recently Faure-Grimaud and Gromb (2004) and Aghion, Bolton and Tirole (2004) have examined the interaction between the existence of an informative stock price and the incentives of the initial equity investor to monitor. In these models, the liquidity needs of the inside shareholder could force the shareholder to liquidate part of the holding before the firm value is realized therefore adversely affecting the ex ante incentives of the investor to exert effort. Having an informative stock price improves the realizable value of the firm at the interim date thereby strengthening the inside shareholder's monitoring incentives. While several papers have used the idea of information externalities of stock prices to model the various benefits to the firm, Sunder (2004) provides an empirical estimate of the benefit of information spillovers on the cost of bank debt of firms. Given that the bank is a relatively sophisticated investor, these results can be viewed as a lower bound of the value of informative stock prices. The paper provides evidence that cost of bank debt is higher for private firms after controlling for firm risk and other loan characteristics. Further the cost of bank debt is decreasing is various measures of informativeness of the stock price or presence of informed investors.

Several papers have examined the optimal security design in the presence of information asymmetry and have examined the role of endogenous information production. Security design of traded securities has been studied by Subrahmanyam (1991) and Gorton and Pennachi (1993) who show that securities that are not information sensitive improve liquidity of markets by reducing adverse selection costs of the liquidity traders. However Boot and Thakor (1993) emphasize that information sensitiveness of securities is important to provide incentives to speculators to gather information when information production is endogenous. Fulghieri and Lukin (2001) build on this intuition and show that in equilibrium, the effective information asymmetry associated with security issuance may actually decrease in the information sensitiveness of the security when information production is endogenous.

Given the objective of minimizing long run financing costs, the paper generates implications for the optimal sequencing of securities over the life of the firm. Recently, there has been heightened academic interest, both theoretical and empirical, in these questions. Fluck (2000) develops a theory of the life cycle of capital structure. In her model, the initial securities that a firm chooses has an impact on the subsequent securities that become feasible because of the stage-dependency of control rights of subsequent claimholders. Maug (2001) develops a theory of capital structure over the life cycle of the firm based on the information needs of the monitoring parties. Diamond (1991) derives some life-cycle implications for monitored debt (bank) versus non-monitored debt (bonds) based on the reputation that firms build over time.

Therefore overall this paper contributes to the literature that examines the information externality role of public securities. The paper models the impact of information production in public equity markets on information production by other investors and shows how interaction among the information production mechanisms reduces the overall financing costs. The existing literature has examined the features of different securities and characterized the conditions under which a particular security is the cheapest. However in this paper, I examine interactions between the securities and therefore derive results for the optimal capital structure, optimality of going public and the sequencing of securities.

3 Single Project Case : Single Security

The model examines the capital structure decision of firms that face asymmetric information about their type. In this section, the insiders are restricted to a single optimal security. Firms choose from among private debt (bank), private equity (VC), public debt (bonds) and public equity to finance its project. Firms trade-off the adverse selection costs and costs of bank monitoring and optimally choose a single security[10]. In the next section, when I allow for information spill-overs between securities, the optimal structure includes multiple securities to take advantage of this interaction on the financing costs of the different claims. The single-project single-security model presented in this section is primarily developed to illustrate the different securities considered and I obtain the traditional result on the superiority of debt under asymmetric information in this set up as well. This is an important starting point for the main results in the model which are elaborated in the following sections.

3.1 Basic Structure

Project Description

There are two types of firms, good (G) and bad (B) and the proportion of G firms is ϕ and B firms $(1-\phi)$ (See Figure 1). The firm's type is private information to the entrepreneur. There is a single project that both firms can invest in. The project requires an initial investment of I_1 (which is normalized to 1) and pays X at time $1c$ for the G firm. The B firm's final payoff is 0 however if the firm is liquidated early, a liquidation value of $L > 0$ is realized with probability δ.

Assumption 1 $X > I_1 > L > \delta L$, *therefore the G firm has a positive NPV project and the B firm has a negative NPV project.*

Assumption 2 *The entrepreneur is wealth constrained and requires external financing to fund the investment* I_1.

Assumption 3 $\phi X + (1-\phi)\delta L \geq I_1 + m$, *which makes monitored external financing feasible at time* 0.

[10]In this paper, the approach is that of security choice and capital structure rather than security design.

Assumption 4 *All private investors have access to the same monitoring technology. The monitoring technology has two aspects to it:*

- ***Monitoring*** *: The private investor spends m and learns the type of the firm.*

- ***Intervention*** *: The private investor can undertake a fixed effort e, costing c(e) and with probability p the cash flows of the good firm are improved to $X+\Delta > X$. If the private investor does not undertake the effort e, then the cashflows of the G firm are X for sure.*

Assumption 5 $(1-\phi)\delta L \geq m$*, which makes early liquidation valuable.*

Assumption 6 *Dispersed investors in public securities issued by the firm do not monitor the firm.*

Assumption 7 *The entrepreneur of the B firm obtains private benefits from operating the project even though it is a negative NPV project. This creates a moral hazard problem at the interim date since the outside investors wish to liquidate but the entrepreneur of the B firm wants to continue.*

I rule out any type of separating equilibrium due to signaling /footnoteWhile costless signaling holds under only some special conditions, signaling in general is costly and may not be available or optimal for all firms. here and therefore the G firm faces financing costs due to the asymmetric information in a pooling equilibrium.

Initially, I examine the entrepreneur's financing choice when I_1 is raised by issuing a single security to issue and then the choice when he can choose multiple securities is analyzed.

3.2 Single Security Choice

The wealth-constrained entrepreneur raises I_1 which is normalized to 1 at time 0. The security choices available to the firm are private debt (bank), public debt (bonds), private equity (VC) and public equity. The entrepreneur's objective is to maximize his own payoffs. He therefore finances the project by issuing the security with the lowest financing cost. The entrepreneur of the G firm chooses a single security to finance $I_1 = 1$, such that it maximizes his own wealth. There is asymmetric information at the initial date resulting in a lemons cost being borne by the G firm. Further there is a moral hazard problem at the interim date since the B firm continues the negative NPV project. All financial contracts are zero NPV claims, i.e. they are priced competitively.

3.2.1 Security Description and Contracts

In this section, I briefly discuss the features of each of the following four securities considered and then derive the optimal contracts under each one.

	Private	**Public**
Debt	Bank	Bonds
Equity	VC	Public Equity

(i) Private debt (bank)

The bank monitors the firm as per Assumption 4, by spending $m > 0$ at time $1b$ and learns the type of the firm in the process of lending. It has to be emphasized here that any private investor's learning about the firm type is perfect and the bank liquidates the B firm at the interim date and realizes L with probability δ. If the firm is a G firm, the bank can choose to expend effort e to improve the cash flows of the firm. The face value of the loan that pays off at time $1c$ is denoted B^0 and it is derived from the bank's individual rationality (I.R.) condition. The bank's contract also has to satisfy the incentive compatibility constraints relative to the two types of monitoring.

$$1 + m + c(e) = \phi[p(e) + 1 - p(e)]B^0 + (1 - \phi)\delta L \quad ...I.R.$$

$$\phi B^0 + (1 - \phi)\delta L - 1 - m \geq \phi B^0 - 1 \quad ...I.C.(1)$$

I.C.(1) implies that $(1-\phi)\delta L \geq m$ which holds by Assumption 5 and therefore this constraint is satisfied.

$$\phi B^0 + (1-\phi)\delta L - 1 - m - c(e) \geq \phi B^0 + (1-\phi)\delta L - 1 - m \quad ...I.C.(2)$$

Since the bank's contract is invariant to the effort e[11], the bank will not choose to invest c(e). Given the above I.R. and two I.C. constraints, the bank will optimally choose to monitor by spending m but not intervene $c(e) = 0$ and this implies that,

$$B^0 = \frac{1 + m - (1-\phi)\delta L}{\phi} \tag{3.1}$$

And the entrepreneur's payoff is given by, $Entrepreneur_{G,Bank} = X - B^0$. Substituting for B^0,

$$Entrepreneur_{G,Bank} = \underbrace{X - 1}_{NPV} - \underbrace{m}_{Infomation\ Costs\ (IC)} - \underbrace{\frac{1-\phi}{\phi}[1 + m - \delta L]}_{Lemons\ Cost\ (LC)} \tag{3.2}$$

(ii) Private equity (VC)

The VC has access to both the monitoring technologies, as per Assumption 4, that have been discussed in the case of the bank, i.e. the VC can spend m and/or e and liquidate the B firm at the interim date to obtain L with probability δ. The share of equity sold to private equity investors is denoted α^{vc}. The I.R. and I.C. conditions for private equity are given by,

$$1 + m + c(e) = \alpha^{vc}(\phi X + \phi p \Delta + (1-\phi)\delta L) \quad ...I.R.$$

$$\alpha^{vc}(\phi X + \phi p \Delta + (1-\phi)\delta L) - m - c(e) - 1 \geq \alpha^{vc}(\phi X) - 1 \quad ...I.C.$$

If we assume that monitoring by spending m will take place, we still require,

$$\alpha^{vc}(\phi p \Delta) \geq c(e) \;\Rightarrow\; \Delta \geq \frac{c(e)}{\alpha^{vc}\phi p} \;=\; \Delta_1$$

[11] Assuming that $X > B^0$ and therefore that the bank has no incentive to intervene is a simplification to capture the effect that debt is less sensitive to the upside potential that arises from the intervention effort. Therefore even if the firm faced a continuum of states, with some states being less than the face value of the loan, the bank's incentives to undertake effort is weaker than that of a private investor. In this set up the contrast is just made sharper and the bank never undertakes the effort e.

Therefore $\forall \Delta \geq \Delta_1$, the VC's equity share under the I.R. condition is

$$\alpha^{vc} = \frac{1 + m + c(e)}{\phi X + \phi p \Delta + (1 - \phi)\delta L} \tag{3.3}$$

The payoff to the entrepreneur is $Entrepreneur_{G,VC} = (1 - \alpha^{vc})(X + p\Delta)$. Substituting for α^{vc},

$$Entrepreneur_{G,VC} = \underbrace{X + p\Delta - 1}_{NPV} - \underbrace{[m + c(e)]}_{IC} - \underbrace{\frac{(1 + m + c(e))(1 - \phi)(X + p\Delta - \delta L)}{\phi(X + p\Delta - \delta L) + \delta L}}_{LC} \tag{3.4}$$

For $\Delta \epsilon [0, \Delta_1]$, there could be a Δ such that the entrepreneur would be willing to offer a higher share of equity to the VC to restore the incentives of the VC to monitor, if the value of intervention is still high enough. This will be discussed later when we choose the optimal single security.

Private Equity and Passive Bank

Alternatively, the entrepreneur could combine a passive (non-monitoring) bank with the VC financing to lower the lemons costs if he can do so without affecting the overall incentives to monitor. Since the bank's claim should be independent of firm type, this implies a face value of the bank loan of δL, which is the maximum face value of debt that minimizes the lemons cost. The contracts under this case are shown in Appendix A.

(iii) Public Equity

There is no monitoring by dispersed shareholders under Assumption 6 . However there is trading in the stock at an interim date, $1a$ between speculators who gather noisy and costly signals about the firm type and liquidity traders who are uninformed. Trading by the speculators reveals their private information with some probability less than one and they make speculative profits, denoted π, the rest of the time. The cost of issuing public equity is the compensation that the entrepreneur has to give to the dispersed shareholders for the expected losses at the interim date, $E(\pi)$ from trading against the informed speculators. The total equity value of the unlevered G firm is X and that of the unmonitored B firm is 0. The trading mechanism will be described in greater detail later. The share of equity sold to public shareholders is denoted α^{ipo}. The I.R.

condition for the initial IPO subscribers when they finance the entire project and the share of equity are given by,

$$1 + E(\pi^E) = \alpha^{ipo}[\phi X] \quad ...I.R.$$

$$\alpha^{ipo} = \frac{1 + E(\pi^E)}{\phi X} \tag{3.5}$$

And the entrepreneur's payoff is given by $Entrepreneur_{G,Public\ Equity} = (1 - \alpha^{ipo})X$

$$Entrepreneur_{G,Public\ Equity} = \underbrace{X - 1}_{NPV} - \underbrace{E(\pi^E)}_{IC} - \underbrace{\frac{(1 - \phi)}{\phi}(1 + E(\pi^E))}_{LC} \tag{3.6}$$

(iv) Public Debt (Bonds)

Bonds are very similar to public equity in the model. However the contract that is traded here is debt with face value, D. The arms-length borrowers are assumed to be dispersed and therefore do not undertake any form of monitoring under Assumption 6. Similar to public equity, trading in public bonds occurs at the interim date, $1a$, between uninformed liquidity traders and informed speculative traders and the corresponding costs are denoted as $E(\pi^D)$. The I.R. condition for the bondholders and the face value of bonds are,

$$1 + E(\pi^D) = \phi D$$

$$D = \frac{1 + E(\pi^D)}{\phi} \tag{3.7}$$

and the entrepreneur's payoff is $Entrepreneur_{G,Bond} = X - D$.

$$Entrepreneur_{G,Bond} = \underbrace{X - 1}_{NPV} - \underbrace{E(\pi^D)}_{IC} - \underbrace{\frac{1 - \phi}{\phi}(1 + E(\pi^D))}_{LC} \tag{3.8}$$

3.2.2 Optimal Single Security

The entrepreneur chooses the security that maximizes his payoff from among the four options discussed here. The optimal security choice takes into account the adverse selection costs at time

0 and the efficient liquidation problem at time $1b$. The entrepreneur chooses the security that maximizes his payoff as described in equations (3.2), (3.4), (3.6) and (3.8).

Since there is value to monitoring by investors by Assumption 5, public securities are dominated by privately-held claims. Between the two private claims, bank debt and VC, bank debt has lower lemons cost, however, there may be some firms where the VC may be able to add more value by intervening and improving the firm's cash flows and this may offset the excess lemons cost of equity. Therefore there are two outcomes for the initial security of the firm, bank debt or private equity (VC) financing.

Proposition 1 ***Optimal Initial Security*** *For all* $\Delta \leq \Delta^*$*, the optimal single security financing is monitored private debt (bank borrowing) and* $\forall \Delta > \Delta^*$*, the optimal security is private equity (VC financing).*

Proof in Appendix B.

Therefore assuming that monitoring is valuable, firms choose between banks and VCs for their initial single security. In this paper, I focus on firms that start with bank financing. Several recent papers have examined the IPO decision of VC backed firms. The basic intuition of this paper carries forward to firms that choose either bank borrowing or private equity (VC) financing as their initial security. For firms that choose private equity first, there are other issues that need to be considered such as the liquidity needs and monitoring incentives of inside shareholders[12]. It can be argued that the information spillover hypothesis proposed in this paper is particularly interesting for firms that could have financed the entire project using debt with lower lemons cost. This paper shows that even firms that could borrow entirely from banks, may find it optimal to go public and add public equity to their capital structure. For the rest of the paper, I make the

[12] Agion, Bolton, and Tirole (2000) and Faure-Grimaud and Gromb (2004) examine the impact of an informative stock price on the ex ante incentives of the venture capitalist and Myers (2000) examines the impact of going public on the incentives of the entrepreneur and bargaining between the VC and the entrepreneur.

following assumption:

Assumption 8 *Let $\Delta < \Delta^*$ and therefore the firm optimally chooses bank borrowing in the single security context.*

Berger and Udell (1998) document that banks constitute a significant portion of external financing for firms in their initial stages. Using data from the 1993 National Survey of Small Business Finances (NSSBF) they find that about 27% of external financing is raised from banks and about 8% from Angel and Venture Capital sources. While there has been significant growth in the venture capital industry since the time of the survey, bank borrowing continues to remain an very important source of financing for young firms. Bolton and Freixas (2000) also model the security choice of firms and show that firms that are not too risky and yet benefit from monitoring, optimally pick bank financing.

4 Single Project : Multiple Securities

In the single security case bank borrowing involved the lowest financing cost for the entrepreneur by minimizing the adverse selection cost while mitigating the moral hazard problem. If the entrepreneur is not constrained to pick a single security would the optimality of pure bank financing remain? In this section, I allow the firm to choose two securities, i.e. add a second security to the bank borrowing.

The entrepreneur will prefer the multiple security financing option over pure bank borrowing if the entrepreneur's payoff is higher under the multiple security case. Since the cost of bank borrowing is lower than the cost off all other securities considered, the cost of multiple securities can be lower than the minimum cost of all the securities considered only if the claims interact with each other resulting in some savings in financing costs.

4.1 General Framework for Multiple Securities Case

The financing options now considered by the entrepreneur are (i) bank and private equity, (ii) bank and public equity and (iii) bank and public bonds. The bank debt is assumed to have priority over any second security, including public debt. Since there is value to early liquidation, the entrepreneur will preserve the incentives of bank monitoring even under multiple securities. Therefore the payoffs from the two types of firms are X for the G firm and L for the B firm with probability δ. Let λ be the share of the initial investment ($I_1 = \$1$) raised from the bank for a face value B^{vc}, B^{ipo} or B^D respectively when the second security is private equity, public equity or public bonds. Let $(1 - \lambda)$ be the amount raised from the second source. Since there are two securities that need to be paid off in each state, there are two cases that need to be considered based on the face value of the bank debt:

Case (i) : $L \geq B$ and therefore both securities receive payoffs in both states.

Case (ii) : $L \leq B$ and therefore the second security gets paid only if the firm turns out to be of the G type.

Since there are only two states in the model, under (ii), the second security receives payoffs only if the firm is a G firm and therefore, we cannot distinguish between debt and equity as the second security and the results are not particularly interesting. Therefore in this section, I focus on Case (i) where both the bank and the second security have payoffs from the G firm for sure and the B firm with probability δ. While main results in terms of benefits of public securities hold under Case (ii), Case (i) is richer and therefore that will be the base case in this section.

4.2 Contracts under the Multiple Securities Case

4.2.1 Bank Borrowing and Private Equity

Let λ be the share of the initial investment ($I_1 = \$1$) raised from the bank for a face value B^{vc} and $(1-\lambda)$ be the amount raised from private equity. The private equity investor is given a share $\alpha^{vc+bank}$ in the firm in return for the $(1-\lambda)$.

Assuming costless communication of firm type between the two investors, only one of them (bank in this case) spends m. The implications of any coordination costs between the bank and the VC will be discussed later. Since I assume here that $L \geq B$, the bank's individual rationality (I.R.) and incentive compatibility (I.C.) conditions are now,

$$\lambda + m = \phi B^{vc} + (1-\phi)\delta B^{vc} \; ...I.R.$$

$$[\phi + (1-\phi)\delta]B^{vc} - \lambda - m \geq \phi B^{vc} - \lambda \; ...I.C.$$

The I.C. implies a lower bound on the fraction of the investment that has to raised from the bank,

$$\underline{\lambda} \geq \frac{\phi m}{(1-\phi)\delta}$$

$$B^{vc} = \frac{\lambda + m}{[\phi + (1-\phi)\delta]} \tag{4.9}$$

The VC's I.R. and I.C. constraints are given as,

$$1 - \lambda + c(e) = \alpha^{vc+bank}[\phi(X + p\Delta - B^{vc}) + (1-\phi)\delta(L - B^{vc})] \; ...I.R.$$

$$\alpha^{vc+bank}[\phi(X + p\Delta - B^{vc}) + (1-\phi)\delta(L - B^{vc})] - (1-\lambda) - c(e)$$
$$\geq \alpha^{vc+bank}[\phi(X - B^{vc}) + (1-\phi)\delta(L - B^{vc})] - (1-\lambda) \; ...I.C.$$

$$\alpha^{vc+bank}_{I.C.} = \frac{c(e)}{\phi p\Delta}$$

This implies a cutoff Δ_{1c} such that $\forall \Delta \geq \Delta_{1c}$, the VC's incentive compatibility constraints are satisfied, where,

$$\Delta_{1c} = \frac{c(e)}{\alpha^{vc+bank}\phi p}$$

Since $\alpha^{vc+bank} < \alpha^{vc}$, it can be easily shown that $\Delta_{1c} \geq \Delta^*$ and therefore violates Assumption 8.

$$\begin{aligned} Entrepreneur_{G,Bank+VC} &= (1-\alpha^{vc+bank})(X + p\Delta - B^{vc}) \\ = X + p\Delta - 1 - m - c(e) - &\frac{(1-\lambda+c(e))(1-\phi)(X+p\Delta-(1-\delta)B^{vc}-\delta L)}{\phi(X+p\Delta-B^{vc})+(1-\phi)\delta(L-B^{vc})} \end{aligned} \tag{4.10}$$

However there may be a $\Delta < \Delta_{1c}$ where the entrepreneur may offer the VC $\alpha_{I.C.}^{vc+bank}$ and induce the VC to undertake the effort if the payoff to the entrepreneur exceeds that under pure bank financing.

Optimality of Bank and VC financing

The entrepreneur chooses the optimal capital structure to maximize his own payoff and will choose the Bank + VC option only if $Entrepreneur_{G,Bank+VC} \geq Entrepreneur_{G,Bank\ only}$, where the entrepreneur's payoffs are given in equations (4.10) and (3.2) and assumptions (1) through (8) still hold. Further, I assume so far that given two active investors, they can costlessly communicate information regarding the firm type between each other and therefore, the monitoring cost, m, is only borne by one of them. If there are any coordination costs then the financing option which involves both the bank and the VC will have higher costs than the pure bank financing case.

Proposition 2 *It is weakly suboptimal to have more than one monitoring investor since there could be duplication of monitoring without any mechanism for the exchange of information and it dilutes the monitoring incentives of private investors.*

Proof in Appendix B.

The basic intuition here is that if the bank is the optimal monitor, including some VC financing could result in additional lemons costs, excessive monitoring cost and dilution of incentives of the

VC and therefore pure bank borrowing is optimal. When combining the bank with the VC is preferable to pure bank borrowing, then the VC is the superior monitor and the entrepreneur is better of with pure VC financing and passive (non-monitoring) bank debt. This way the lemons cost is lower while retaining the VC's incentives. Therefore even when VC financing adds value, it is never optimal to combine bank borrowing and VC financing beyond a level of bank debt with face value δL where the bank's payoff is invariant to firm type.

4.2.2 Bank Borrowing and Public Equity

Before evaluating the contracts under this option, the trading of public equity needs to be explicitly examined. When the firm issues equity, a secondary market is created for the stock and trading in the security occurs between liquidity traders and speculative traders.

Trading in the Public Equity

As in the case of private equity, $(1-\lambda)$ is raised at t=0 through an IPO. Trading in the outside equity (not including the entrepreneur's share) occurs at $t = 1a$ before the bank spends m and makes the continuation-liquidation decision. The fraction of speculative traders and liquidity traders are fixed. A very simple trading mechanism[13] at the interim date with all risk neutral agents has been assumed, in order to illustrate the impact of having an informative stock price on the financing costs of the firm.

Liquidity Traders

Liquidity traders constitute a fraction z of total shareholders, T. The liquidity traders get a random liquidity shock and they either buy or sell the security. The total demand from the liquidity traders is zT where $z \sim U[-z*, +z*]$, and $z*$ is a fixed constant.

[13] A more standard model set-up such as Kyle's with normally distributed terminal values becomes cumbersome with truncated claim as is the case with the levered equity here and does not add to the basic intuition.

Speculators

The fraction of total outside shareholders who become speculators is N. Speculators generate noisy signals about the firm quality at a cost c. It is assumed that $c \ll m$ since c is the cost of the noisy signal where as m is the cost of the perfect signal. It has to be noted that speculators do not have access to the bank's monitoring technology that perfectly reveals the firm type and therefore the bank can be considered to be unique in its monitoring abilities[14]. The speculators are wealth constrained and based on the signal they receive, they buy or sell 1 share. A fraction $q \geq 0.5$ of the speculators generate the correct signal and a fraction $(1-q)$ generate the wrong signal regarding firm type. The net speculative demand for a G type firm is therefore $(2q-1)NT$ (buys) and the net demand for the B firm is $-(2q-1)NT$ (sells). The speculators trading gains in the public equity markets are denoted π^E and their expected net profit is $E(\pi^E) - NTc$.

Alternatively, we can set up the model such that each signal has an independent probability q of being correct. All the results go through under this specification of signals and this set up is outlined in Appendix C. For a continuum of speculators, this is equivalent to q fraction of all speculators getting the correct signal. However with finite speculators, as is the case here, the two are not equivalent.

Market price of the stock and Speculative Profits

The market maker sets the price of equity equal to the expected value of the stock, conditional on the total quantity of trades. The total trades, Q, is the sum of the liquidity and speculative trades, i.e. $Q = (2q-1)NT + zT$. If total trades $zT + (2q-1)NT \in [-z * T, +z * T]$, then the market maker is unable to infer the speculators' information and sets the share price at the unconditional expected value of equity, $\overline{E} = \phi(X - B^{ipo}) + (1-\phi)\delta(L - B^{ipo})^+$ and the speculators hide their trades and make profits denoted π^E. If total trades > z*T, then price is the value of

[14]While the information technologies of private versus public investors are assumed to differ only in precision and cost, it is consistent with a more elaborate set up where the two investor groups use very different signals from different sources to arrive at the same information, i.e. firm quality.

equity of the G firm, $E_G = X - B^{ipo}$ and if total trades < -z*T, then price is the value of equity of the B firm, $E_B = \delta(L - B^{ipo})^+$. Here the share price reveals the speculator's information. Given that the support of liquidity traders is limited and the liquidity traders are uniformly distributed , the price is either fully revealing or completely uninformative[15]

Prob(speculator hides the trades and makes profit) $\equiv P(\pi^E)$ and

$$P(\pi^E) = 1 - \frac{(2q-1)NT}{2z^*T}$$

Therefore the speculator's expected payoff is given by,

$$E(\pi^E) = [Pr(G) * P(\pi^E) * (2q-1)NT * (E_G - \overline{E})] + [Pr(B) * P(\pi^E) * (2q-1)NT * (\overline{E} - E_B)]$$

$$E(\pi^E) = k\alpha[(X - B^{ipo}) - \delta(L - B^{ipo})] \tag{4.11}$$

where $k = 2P(\pi^E)(2q-1)N\phi(1-\phi)$ and $(L - B^{ipo})^+ = (L - B^{ipo})$ since we are considering the case where $L \geq B^{ipo}$. Overall the speculators make a net profit of $= E(\pi^E) - NTc$

Contracts (Bank + IPO)

Bank Debt

The bank lends the firm λ and the loan has a promised face value of B^{ipo}. The bank now observes the stock price at time $1a$ and learns about the firm's true value with some positive probability $(1 - P(\pi^E))$ and spends m at time $1b$ to verify firm type only when the stock price is not informative, i.e. with probability $P(\pi^E)$. The contracts for bank and IPO will depend on their payoffs under the two types of firms. This will depend on the value of L relative the face value of bank debt, which has priority over the public equity. As mentioned earlier, I will assume that $L \geq B^{ipo}$ here. The bank's I.R. and I.C. conditions are,

$$\lambda + P(\pi^E)m = \phi B^{ipo} + (1-\phi)\delta(B^{ipo}) \quad ...Bank\ I.R.$$

[15] Here the model setup yields the result that the price is fully informative some of the time. Alternatively, we can think of a model where prices are partially informative all of the time. Both have similar intuition but the former is simpler.

$$\Rightarrow \quad B^{ipo} = \frac{\lambda + P(\pi^E)m}{\phi + (1-\phi)\delta} \tag{4.12}$$

Public Equity

The entrepreneur sells a fraction α^{ipo} of the equity at the initial public offering and raises $(1-\lambda)$. The initial equity holders are compensated for the losses of the liquidity traders against the speculative traders $E(\pi^E)$, which in equilibrium equals the dead weight cost of information production in the market (NTc) by speculators[16]. The value of α^{ipo} is determined by the IPO shareholders' I.R.,

$$1 - \lambda + E(\pi^E) = \alpha^{ipo}[\phi(X - B^{ipo})]$$

Substituting for $E(\pi^E)$ from equation (3.11), we get

$$\alpha^{ipo} = \frac{1-\lambda}{\theta(X - B^{ipo}) + (1-\theta)\delta(L - B^{ipo})} \tag{4.13}$$

where $\theta = \phi - k$. The entrepreneur's payoff is given by, $Entrepreneur_{G,Bank+IPO} = (1-\alpha^{ipo})(X - B^{ipo})$

$$= X - 1 - P(\pi^E)m - \frac{(1-\lambda)(1-\theta)[X - B^{ipo} - \delta(L - B^{ipo})]}{\theta(X - B^{ipo}) + (1-\theta)\delta(L - B^{ipo})} \tag{4.14}$$

Optimal Mix of Bank and Public Equity (λ) The optimal λ requires that the following

conditions are satisfied. These conditions ensure the optimality for the three players: entrepreneur, speculators, and the bank.

(i) The **entrepreneur** maximizes his payoffs, $Entrepreneur_{G,Bank+IPO}$

(ii) **Speculators** are induced to participate and gather information, i.e. they make non-negative net profits.

[16] Under an alternative specification of the model, we can assume that the initial shareholders randomly become liquidity traders or speculators at the interim date. Therefore at time 0, the expected gross profits for each shareholder is zero but the expected costs as a group is NTc and therefore the firm has to compensate the initial shareholders directly for these expected information costs.

(iii) The **bank** should continue to monitor, i.e. their incentive compatibility constraints with respect to spending m should be satisfied.

(i) Entrepreneur's objective

The entrepreneur chooses the λ that maximizes his own profits. However his payoffs are increasing in λ since $\frac{\partial(Entrepreneur_{G,Bank+IPO})}{\partial\lambda} \geq 0$. Also in the current setup for all non-negative net profit levels of the speculators, the informativeness of the price or $(1-P(\pi))$ is the same and therefore the entrepreneur can pick the least cost level that drives down the expected net profits of speculators to zero. Similarly for the bank if it is incentive compatible to monitor, then the level of monitoring is fixed and invariant to changes in λ. Therefore the entrepreneur chooses the highest value of $\lambda\epsilon(0,1)$ that satisfies the constraints in the optimization.

$$Max_{\lambda} \;\; (1-\alpha^{ipo})[X-B^{ipo}]$$

$$subject\ to \;\; E(\pi^{E}) \geq NTc \;\; ...Speculators' I.R.$$

$$(\phi+(1-\phi)\delta)B^{ipo} - P(\pi^{E})m - \lambda \geq \phi B^{ipo} - \lambda \;\; ...Bank's\ I.C.$$

(ii) Speculators' Participation Constraint

The speculator's I.R. condition for information gathering and trading in the interim date require that $E(\pi^{E}) > NTc$. This implies,

$$k\alpha[(X-B^{ipo}) - \delta(L-B^{ipo})] - NTc \geq 0 \tag{4.15}$$

The expected net profits, equation (4.15), are quadratic in λ however it can be shown that under certain conditions on the cost of information acquisition, c, there exists a unique solution $\bar{\lambda}$ such that the speculators' I.R. condition is satisfied for all $\lambda \leq \bar{\lambda}$. First, the expression $[E(\pi^{E}) - Ntc]$ is decreasing in λ for the relevant range of $\lambda\epsilon[0,1]$. Further if $\exists$ a $\lambda\epsilon[0,1]$ such that $E(\pi^{E}) \geq NTc$, then it can be shown that there is a unique $\bar{\lambda}\epsilon[0,1]$ such that $E(\pi^{E}) = NTc$

Lemma 1 *For all $c \leq c*$, there exists a unique solution $\bar{\lambda}\epsilon[0,1]$, such that $E(\pi^{E}) = Ntc$ and $\forall\lambda < \bar{\lambda}$, $E(\pi^{E}) > Ntc$, where $c^{*} = \frac{(X-\delta L)2P(\pi)\phi(1-\phi)(2q-1)}{\theta X+(1-\theta)\delta L}$.*

Proof in Appendix B.

(iii) Bank's Incentive Compatibility Constraint

In order to preserve the bank's incentives to monitor and make the efficient continuation-liquidation decision, the bank's contract should be incentive compatible with respect to spending m on monitoring the firm. This implies,

$$[\phi + (1-\phi)\delta]B^{ipo} - P(\pi^E)m - \lambda \geq \phi B^{ipo} - \lambda$$

This corresponds to a lower bound for λ, which specifies the region for bank's monitoring,

$$\lambda \geq \frac{\phi P(\pi^E)m}{(1-\phi)\delta} = \underline{\lambda} \tag{4.16}$$

Lemma 2 ***Feasibility of Public Equity*** *The combination of public equity and bank borrowing is feasible when there exists a $\overline{\lambda}$, such that $\overline{\lambda} \geq \underline{\lambda}$ and the feasible region is $[\underline{\lambda}, \overline{\lambda}]$.*

Proof in Appendix B.

Optimality of Going Public

The entrepreneur will choose to issue public equity to finance part of the project if his payoffs under this option as given by equation (4.14) exceed his payoffs under the pure bank case, which is specified in equation (3.2), provided of course that the speculators' I.R. and the bank's I.C. constraints are met. Satisfying the entrepreneur's profit maximization objective yields the condition, $Entrepreneur_{G,Bank+IPO} - Entrepreneur_{G,Bank} \geq 0$

$$\Rightarrow [1 - P(\pi^E)]m - NTc - Incremental\ Lemons\ Cost \geq 0 \tag{4.17}$$

This implies that the savings in bank monitoring exceeds the total cost of information production in the public equity markets and the additional lemons cost by issuing equity[17]. This implies a lower bound on λ.

[17]An alternative argument for why a firm with public equity would face lower costs of bank debt is that going public is a pre-commitment by the entrepreneur to disclose more information. Therefore the increased disclosure

Lemma 3 *For high enough costs of bank monitoring relative to costs of information production in markets, i.e. for* $m > \underline{m}$ $\exists$ *a* $\widehat{\lambda}$ *such that* $\forall \lambda > \widehat{\lambda}$, *equation* (4.17) *is satisfied. The entrepreneur optimally chooses* $\lambda^* \geq \widehat{\lambda}$ *as the fraction of bank debt, which is the maximum* $\lambda \epsilon [\widehat{\lambda}, 1]$ *that satisfies the constraints of the speculators and the bank.*

Proof in Appendix B.

Proposition 3 ***Optimality of IPO***

The combination of public equity and bank borrowing is optimal and preferred to pure bank financing when there exists a $\overline{\lambda}$, *such that* $\overline{\lambda} \geq max(\underline{\lambda}, \widehat{\lambda})$ *and the optimal* λ^* *that maximizes the entrepreneur's wealth is given by* $\lambda^* = \overline{\lambda}$.

Proof in Appendix B.

The feasible region and optimality of the IPO are shown in Figure 3. The firm therefore moves from pure bank financing to a mix of bank borrowing and public equity when it is able to satisfy the conditions given in Proposition 3. The optimal initial capital structure is given by a debt-equity mix of $\lambda^* : (1 - \lambda^*)$. Here the optimal fraction of equity that is sold to outsiders is determined by what is required to ensure an active secondary market for the stock. This is an alternative model to explain the size of external equity issue, (in contrast to Leland and Pyle (1977)). The likelihood of an IPO are given in the following Corollary.

by the firm reduces the costs of information production by external investors including the bank and trading in public equity is not required to reveal information. However in this model, that hypothesis does not work since the good firm would reveal its type readily but is unable to do so credibly. So where the asymmetric information regarding the firm type does not enable the market to distinguish them both types of firms will declare that they are good and the disclosure has no value to the external investor. Whereas in the presence of public equity markets, speculators either verify the firm's disclosure or produce new information and trade on it thereby noisily revealing the firm type

Corollary 1 *The likelihood of an IPO increases as $\overline{\lambda}$ increases and $\widehat{\lambda}$ decreases. Therefore the probability of an IPO is*

(i)increasing in the precision of the speculators'noisy signal, q.

(ii)increasing in the cost of bank monitoring, m.

(iii)decreasing in the range of liquidity trades, $z*$ since $\widehat{\lambda}$ increases faster than $\overline{\lambda}$ which increases indirectly through an increase in the bank loan face value.

4.2.3 Information Production by Markets versus Banks

The optimality of the going public depends on the ability of markets to produce information that can be used by banks to make their own monitoring more efficient. The reason such an outcome is feasible is because markets are unique mechanisms that aggregate disperse noisy signals that may ultimately arrive at the same conclusion regarding the firm type as the bank does with the superior monitoring technology. However the markets are able to achieve this only with some positive probability whereas the bank can achieve it for sure. Therefore the bank can substitute the noisy market mechanism for it's own perfect technology when the stock price is informative. In states where the stock price conveys no information, the bank can undertake its costly monitoring effort and learn the firm type. Therefore under this capital structure, while the bank ultimately learns the firm type, with probability $(1 - P(\pi))$, the bank learns the information from the stock price, without undertaking any effort. It can be argued that this may be true in market based economies which have developed active markets and enjoy lower costs of information production by dispersed shareholders.

However, there may be economies where the combination of market and bank monitoring technologies may be more expensive than relying entirely on the bank. In such a case, going public to establish a mechanism for information aggregation which can then be used by active inside investors (bank, in this case), will never be optimal. This case will be discussed in Section

2.4 after the sequence of projects model has been developed. The basic intuition in that case is that while the cost of information production in markets is high, the information is reusable since it is reflected in observable stock prices. Therefore future investors use the stock price to reduce mispricing of securities issued by the firm for financing future projects. This mitigates the adverse selection costs of the firm in the future and the gains from reduction in adverse selection costs justifies the establishment of a market for the stock even though it may be costlier than the bank. In contrast, the information produced by the bank is private information of the bank and cannot be easily used by other investors. In this scenario, once the firm issues public equity to save on adverse selection costs of future financing rounds, the bank will ex post use the information in stock prices to save on its own monitoring costs and the interaction between bank monitoring and stock market information production will occur as in the first case.

4.2.4 Bank Borrowing and Public Debt

The entrepreneur raises λ from the bank with face value B^D and $(1-\lambda)$ through the sale of public bonds with a face value D. Trading at t=1 occurs in the same manner as for public equity. The probability that the speculators can hide their trades and make a profit, $P(\pi) = 1 - \frac{(2q-1)NT}{2z^*T}$, is the same as with public equity. Therefore the probability of price being informative is the same under both cases. This is because the number of speculative traders and the units of security that they can trade in is kept fixed here. However the security that is traded is debt and consequently this yields different profits for the speculators.

Trading and Speculative Profits

As in the case of public equity, the market maker sets the price as the expected value of bonds conditional on the total trades. Therefore there are three possible outcomes:

(i)If $Q = (2q-1)NT + zT\epsilon[-z^*T, +z^*T]$, the total trades are not informative and the per bond price is set at the average value of $\bar{D} = \frac{1}{T}[\phi D + (1-\phi)\delta(L - B^D)]$.

(ii)If $Q > (2q-1)NT + zT\epsilon[-z^*T, +z^*T]$, the firm is of G type and the bond price is $D_G = \frac{D}{T}$.

(iii)If $Q < (2q-1)NT + zT\epsilon[-z^*T, +z^*T]$, the firm is of B type and the bond price is $D_B = \frac{1}{T}[\delta(L - B^D)]$.

Corresponding to these three outcomes, the speculators make profits only in case (i) since they are able to hide their informed trades. Therefore the expected payoff to speculators is

$$E(\pi^D) = k[D - \delta(L - B^D)], where \quad k = 2P(\pi)(2q-1)N\phi(1-\phi) \tag{4.18}$$

Contracts under Bank + Bonds

Bank I.R. condition yields a face value that is the same as in (3.12),

$$B^D = \frac{\lambda + P(\pi)m}{[\phi + (1-\phi)\delta]} \tag{4.19}$$

The face value of public debt, D, is determined by the I.R. condition for debt-holders,

$$1 - \lambda + E(\pi^D) = \phi D + (1-\phi)\delta(L - B^D)$$

Substituting for $E(\pi^D)$ from equation (3.18) and setting $\theta = \phi - k$, we get,

$$D = \frac{1 - \lambda - (1-\theta)\delta(L - B^D)}{\theta} \tag{4.20}$$

The entrepreneur's payoff under this financing option is, $Entrepreneur_{G,Bank+Bonds} = X - B^D - D$

$$= X - 1 - P(\pi)m - \frac{(1-\theta)}{\theta}(1 + P(\pi)m - \delta L) + \frac{k(1-\delta)}{\theta}B^D \tag{4.21}$$

Optimal λ

As with public equity, the optimal λ is chosen by maximizing the payoffs to the entrepreneur subject to satisfying the individual rationality conditions for the speculator and incentive compatibility constraints for the bank. The entrepreneur's payoff's are increasing in the relevant range of $\lambda\epsilon[0,1]$ therefore the entrepreneur can maximize his payoff by picking the maximum λ that satisfies the two constraints. The speculator's participation constraint implies

$$E(\pi^D) \geq NTc$$

$$\Rightarrow \lambda \leq \overline{\lambda} = [1 - \delta L + \frac{\theta P(\pi)m}{\phi + (1-\phi)\delta} - \frac{NTc}{k}] \frac{[\phi + (1-\phi)k]}{[(\phi - k) + (\phi - \delta k)]}$$

Bank monitoring requires that the bank's contract should be incentive compatible with respect to the monitoring activity and the bank's IC constraint, which is similar to the public equity case. This corresponds to a lower bound for λ,

$$\lambda \geq \frac{\phi P(\pi^E)m}{(1-\phi)\delta} = \underline{\lambda} \tag{4.22}$$

Feasibility of Public Bonds

The feasibility region is derived in the same manner as in the case of public equity. Feasibility requires that the speculators' and bank's constraints are satisfied.

Lemma 4 *Public bonds are feasible if* $\overline{\lambda} \geq \underline{\lambda}$ *and the feasible region is the set of all* $\lambda \epsilon [\underline{\lambda}, \overline{\lambda}]$.

Proof is on the same lines as Lemma 2 and is therefore omitted.

Optimality of Bank and Bonds

The entrepreneur optimally issues bonds in combination with bank debt if his payoff under this capital structure (given by equation (4.21)) exceeds that under the pure bank case (given in equation (3.2)), i.e.

$Entrepreneur_{G,Bank+Bonds} - Entrepreneur_{G,Bank} \geq 0$

$$\Rightarrow \lambda \geq \hat{\lambda^D}, where\ \hat{\lambda^D} = \frac{(\phi + (1-\phi)\delta)}{(1-\delta)}[\frac{(1+m-\delta L)}{\phi} - \frac{(1-P(\pi))m}{k}] - P(\pi)m$$

Optimal mix (λ^{D*})

The combination of bonds and banks are preferred to pure bank financing if the entrepreneur's payoffs are maximized and the feasibility conditions are met.

Lemma 5 *Firms issue bonds in addition to bank debt if there exists a* $\overline{\lambda}$ *such that* $\overline{\lambda} > max(\underline{\lambda}, \widehat{\lambda})$ *and the optimal* $\lambda^{D*} = \overline{\lambda}$.

The proof is similar to that of Proposition 3 and is therefore omitted.

The intuition for picking the λ^{D*} is the same as with public equity. At λ^{D*}, the speculator's net profits are zero and the losses against liquidity traders are minimized ($= NTc$) therefore this is the λ in the feasible region that maximizes the entrepreneur's payoff by minimizing the dead weight costs of information production.

4.3 Public Equity versus Public Bonds

The relevant λ cutoffs under the public equity and public bonds are different except in the case of the bank's incentive related cutoff, $\underline{\lambda}$. The main difference between debt and equity here is that the payoffs to equity are more sensitive to the private information and therefore the potential profits to speculators from producing information and trading are higher than in the case of bonds. Therefore it is easier to satisfy the participation constraint of speculators under public equity than under public debt.

Corollary 2 *The feasibility region of public equity is greater that of public debt making it easier for the firm to issue public equity. The likelihood that public equity is the first public security that a firm issues is*

(i) increasing in (X-L)

(ii)increasing in c, for all $c \in (0, c^*)$ where c^* is as per Lemma 1.

(iii)increasing in ϕ

Proposition 4 *When both public debt and public equity are feasible, there are two cases: (i) when $L >$ face value of bank loan (B), public bonds is optimal since it results is lower lemons costs and (ii) when $L < B$, the entrepreneur is indifferent between public equity and bonds.*

Proof in Appendix B.

For any given λ, it can be shown after some algebra that $E(\pi^E) > E(\pi^D)$. Also since $E(\pi^E)$ and $E(\pi^D)$ are both decreasing in λ, therefore when $E(\pi^E) = E(\pi^D) = NTc$, $\lambda^E > \lambda^D$. However the λ at which the net speculative profits are zero is the λ that determines the cutoff for the speculators' participation and therefore $\overline{\lambda^E} > \overline{\lambda^D}$. Basically what this means is that to generate a given level of speculative profits, the size of the debt issue $(1 - \lambda)$ needs to be larger than that of the equity issue since debt is less information sensitive. Now, feasibility requires that $\overline{\lambda} \geq max(\underline{\lambda}, \widehat{\lambda})$ and therefore given a fixed $\underline{\lambda}$, the feasibility of public equity is more easily satisfied than that of public bonds.

In this section, since the market trading mechanism for bonds and public equity is identical, when both securities are feasible, there is no difference in information production between the two securities even though the size of the bonds and equity issues are very different. In later sections, the number of liquidity traders is allowed to change as the size of the issue changes and the differences between debt and equity are more striking.

4.4 Comparison of Public Equity and Bonds with Endogenous Liquidity Traders

So far the players in the securities market were kept fixed. However it is reasonable to assume that the larger the size of the issue, larger the group of liquidity traders while the speculative traders may not change as much. This framework is useful to distinguish the features of public equity versus public debt and bring out the intuition that equity prices are more informative than bond prices and therefore equity markets provide a better mechanism for information production and revelation.

Assumption 9 *The speculative traders are fixed and the liquidity traders increase with the size of the issue or equivalently z^* is decreasing in λ, the size of the bank loan. Let $z^*(\lambda) = z^*(1 - \lambda)$ and the total speculative traders equal N (note that in this section they do not denote fractions of shareholders).*

4.4.1 Trading in public securities

Since z^* is increasing in the size of the public issue, the larger the public issue, the speculators can hide their trades better and $P(\pi)$ is higher and is given by,

$$P(\pi^E) = 1 - \frac{(2q-1)N}{2z^*(1-\lambda^E)} \quad and \quad P(\pi^D) = 1 - \frac{(2q-1)N}{2z^*(1-\lambda^D)}$$

The speculators' profits under public equity, $E(\pi^E)$ and under bonds, $E(\pi^D)$ are,

$$E(\pi^E) = 2P(\pi^E)\phi(1-\phi)(2q-1)N\alpha^{ipo}(X - B^{ipo} - \delta(L - B^{ipo})/T \tag{4.23}$$

$$E(\pi^D) = 2P(\pi^D)\phi(1-\phi)(2q-1)N(D - \delta(L - B^D)/T$$

4.4.2 Public Equity versus Public Bonds

Under Proposition 4, the feasibility region for equity is higher implying that it is easier to establish an actively traded market for public equity with a smaller issue size and without impairing the bank's monitoring incentives. However, when both public equity and public bonds are feasible, under the assumption of fixed speculative and liquidity traders, at equilibrium the expected costs of bank monitoring and the costs of information production in markets are the same under both debt and equity. The only potential difference in the entrepreneur's payoffs arises because of differences in the lemons costs, making bonds optimal relative to equity. In this section, $P(\pi)$ is a function of λ and this has implications for financing costs. The higher the λ, lower the probability that the speculators can hide their trades and more informative the security price. This in turn results in lower expected bank monitoring costs and consequently lower overall financing costs.

Proposition 5 *When both public equity and public bonds are optimal in combination with bank borrowing relative to pure bank debt, the equity price is more informative resulting in lower financing costs than bonds as long as the incremental lemons cost is not too high.*

Proof in Appendix B

The entrepreneur bears the total dead weight cost arising from the asymmetric information since all the outside investors have zero-NPV claims. The dead weight costs associated with financing are the costs of information production in markets (equivalently, the expected losses to the liquidity traders), the expected costs of bank monitoring and the initial lemons cost. The optimal λ for both securities are such that the speculators make zero profits ($E(\pi) = Nc$) and therefore the only difference in the dead weight cost depends on the expected bank monitoring costs under the two securities. The expected cost of bank monitoring ($P(\pi)m$) depends on $P(\pi)$ which in turns depends on λ. The higher the λ, the lower the liquidity traders and therefore lower the probability of speculative profits which imply informative prices and lower expected bank monitoring costs. It can be shown that $\lambda^{E*} \geq \lambda^{D*}$, thereby making equity more informative. However equity entails higher lemons cost than debt which makes it less attractive. Therefore, the choice between public equity and public debt involves a trade-off between the greater informativeness of equity and lower lemons cost of bonds.

Corollary 3 *If there are $t \geq 1$ rounds of information production and continuation decisions by the bank, then there exists a t^* such that for all $t > t^*$ public equity always dominates public bonds.*

Proof in Appendix B.

The intuition here is that the additional lemons cost of equity is a one-time cost, whereas in each trading round, the information spillover from equity markets to more informative prices is higher than in the case of bonds. Therefore with multiple rounds of information production, the comparative advantage of equity dominates the lemons cost. For instance if the liquidation value of the project is uncertain and varying over time, then the bank may wish to monitor the firm and ascertain the liquidation value more than once during the life of the project. In such situations, a stock market signal can significantly reduce the bank's monitoring cost as the trading in the stock will noisily reveal the firm's value. This result has interesting empirical implications and implies that firms in industries where there is a lot of uncertainty regarding the continuation-liquidation decision should be more likely to go public. This is consistent with the intuition in Allen (1990) that suggests that there is greater value to aggregation of information in securities markets when there is higher uncertainty regarding the optimal action that a firm should take.

For the rest of the paper, I assume that when the firm wishes to issue a public security to induce information aggregation into prices, the firm chooses public equity and for simplicity, when public debt is issued, there is no information production and trading in public debt.

4.5 Optimal Capital Structure using Multiple Securities

Firms that optimally choose bank borrowing as the cheapest single security can reduce their overall financing costs (due to excessive bank monitoring) if conditions in Proposition 6 are satisfied. Combining risky bank and private equity leads to excessive monitoring by private investors and is not optimal. Between public equity and public bonds, public equity provides better incentives for information production by speculators and results in a more informative price. The basic intuition of the multiple securities results arises from a reduction in the dead weight costs of monitoring. Under a single security case, bank borrowing is the cheapest form of financing. However when bank borrowing is combined with public equity, the stock prices affords an alternative mechanism for determining the firm type. The stock price as a mechanism for aggregating information is cheaper but noisier than the perfect monitoring by the bank. Therefore the bank can use stock prices (cheaper information technology) when it is informative and undertake its own costlier information production at all other times. This substitution with a cheaper source of information helps reduce the overall information production cost and therefore financing cost for the firm and since all financial claims are zero NPV claims, the entrepreneur gains from this reduction in financing costs.

5 Sequence of Projects

In Section 3 and 4, the advantage to issuing public equity was that it reduced the financing costs by having an information spill-over into a concurrently issued security. I now examine the case where the firm has multiple projects and the issuance of public securities has an impact on future financing costs of the firm. The question is whether the potential for future instances of asymmetric information between the firm and outside investors improves the likelihood of the initial offering of public equity.

5.1 Basic Structure

Projects Description : Two Projects

All firms in the economy have access to the first project as detailed in Sections 3 and 4. The G type firms which constitute ϕ_1 fraction of all firms will further have access to a second project. At the end of the first project, the G firms learn about their type with respective to the second project. A fraction ϕ_2 will be of type GG and succeed at the second project and $(1 - \phi_2)$ will be of type GB for whom the second project is a negative NPV project (See Figure 2). The ϕ_2 shock is private information and the GG entrepreneur who tries to raise money for the second project faces lemons costs since the entrepreneurs of the GB firms get private benefits from undertaking the second project, resulting in a pooling equilibrium.

Assumption 10 $X_2 \geq I_2 \geq L_2$

Assumption 11 *The residual profits that accrue to equity at the end of the first project are distributed as dividends.*

If the firm is unable to precommit to a dividend policy of paying out the entire profits of the first project, the investors at time 0 will rationally assume that these proceeds will be applied towards I_2, the investment for the second project which would be bad with probability $(1 - \phi)$.

This reduces the expected payoff from the good project and the share of the firm that the initial investors demand will accordingly change. However since at time 0, even the G firm does not know if it is a GG or a GB firm, there is symmetric uncertainty regarding how the first period proceeds will be used. Therefore the dividend policy does not change the basic results and a full payout policy is assumed here for simplicity. In this multi-project setting, I compare the benefits of going public by issuing public equity at time 0 with pure bank borrowing at time 0.

5.2 Contract Choice for the Second Project

Under the current model setup with asymmetric information but no default costs, equity is costly because of the lemons problem. Therefore the firm issues either arms-length or monitored debt to raise I_2. It can be shown that in a model with uncertainty and default costs, equity could be an optimal contract when the uncertainty is high.

When the firms needs to raise I_2 from external investors, it chooses between bank with face value B_2, bonds with face value D_2 and a seasoned equity offering (SEO), with share α_2, there are two alternative situations.

(i) The trading at time $2b$ reveals the firm type

(ii) The trading does not reveal the type and the firm faces a lemons cost.

Contracts when firm type is revealed by the stock price

If the firm issues bonds or bank loans, these will be riskless loans with face value given as

$$B_2^{GG} = D_2^{GG} = I_2$$

and the seasoned offering will involve a sale of equity to the extent of,

$$\alpha_2^{GG} = \frac{I_2}{X_2}$$

When the type of the firm is known the firm is indifferent between these alternatives since there is no asymmetric information and the value of the firm given to the external investors in the second project is exactly equal to I_2.

Contracts when firm type is not revealed through trading

Bonds with face value $D_2^{GG/GB}$

$$D_2^{GG/GB} = \frac{I_2}{\phi_2}$$

Bank Borrowing with face value $B_2^{GG/GB}$

$$B_2^{GG/GB} = \frac{I_2 + m - (1-\phi_2)\delta L_2}{\phi_2}$$

Seasoned equity offering The fraction of the equity that has to be sold to raise I_2 is

$$\alpha_2^{GG/GB} = \frac{I_2}{\phi_2 X_2}$$

Optimal Contract for the second project

It can be easily shown that an SEO is never optimal because of the dilution due to the asymmetric information. Between bank and bonds the tradeoff is between the additional cost of bank monitoring and the benefit of liquidating the GB firm early. The firm will issue bonds if

$$m \geq (1-\phi_2)(\delta)L_2$$

and bank debt otherwise. Assume that the above condition is satisfied and the firm optimally issues bonds for the second project. This is just a simplifying assumption and the firm could also issue bank debt and contracts in the second project will be similar to the first project.

Second Round Trading in the Public Equity

This round of trading occurs after the ϕ_2 shock occurs. N_2 speculators spend c and a fraction $q > 0.5$ obtain the correct signal (GG or GB) and $(1-q)$ get the wrong signal. Again with probability $(1 - P(\pi))$, the type of the firm is revealed and there is no asymmetric information. Due to Assumption 11, the value of equity depends solely on the value of the second project and the method of financing. If the firm type is revealed, the stock price of the GG firm is $X_2 - I_2$ and the speculators make no profits. Similarly, the price of the GB firm is zero and this firm will not be able to raise money for the second project since $L_2 < I_2$ by Assumption 10. If the firm type is not revealed, all firms will finance the second project with bonds of face value, $D_2^{GG/GB}$ and the stock price is set at the average equity value of $\phi_2(X_2 - D_2^{GG/GB})$. This yields gross trading profits to speculators of,

$$E(\pi_2) = 2P(\pi)(2q-1)N_2\phi_2(1-\phi_2)\alpha(X - D_2^{GG/GB}) \tag{5.24}$$

Since the equity outstanding is fixed at the time of the second trading round, the profit potential in the equity markets, $\alpha(X_2 - D_2^{GG/GB})$ is also fixed and therefore to meet the zero profit condition of competitive speculators, the number of speculators, N_2 emerges endogenously to make $E(\pi_2) = N_2 c$.

$$\Rightarrow N_2 = [1 - \frac{c}{2(2q-1)\phi_2(1-\phi_2)\alpha(X_2 - D_2^{GG/GB})}]\frac{2z^*(1-\lambda)}{(2q-1)}$$

5.3 Optimality of the IPO at time 0

If the IPO was viable for the single project case, it will certainly be viable if it can be shown that the costs for the second round of trading is less than the benefits due to a reduction in the asymmetric information. This requires,

$$\phi_2(1-P(\pi))(D_2^{GG/GB} - I_2) \geq \; E(\pi_2)$$

which reduces to the condition,

$$\frac{(1-P(\pi))}{P(\pi)} \geq 2(2q-1)\frac{N_2}{T}\alpha\frac{\phi_2 X_2 + (1-\phi_2)L_2 - I_2}{I_2 - L_2} \tag{5.25}$$

In equation (5.25), the LHS can be thought of as an Informativeness Index of the stock price, higher the value, more informative the stock. The condition in equation (5.25) implies that the benefit of public equity accrues to the firm at future dates if the index exceeds a minimum threshold. Assume that the condition holds for now. I will explore the case when the condition does not hold later in this section.

Impact on Time 0 Decisions

The minimum information threshold (the RHS in equation (5.25)), is decreasing in λ and depending on whether the liquidity traders are fixed or endogenous, the LHS is fixed or increasing in λ respectively. Therefore the condition is more easily satisfied as λ increases. At the optimum λ^* in Section 3.3, the entrepreneur already picks the highest λ in the feasible region and therefore the second round of trading does not impose additional constraints on the optimal time 0 λ^*.

However the optimality of the IPO relative to the pure bank case could improve with the second round of trading. Earlier the optimality involved a tradeoff between savings in bank monitoring costs on one hand and the cost of information production in markets and the incremental lemons cost at time 0 on the other. Now the condition for the optimality of IPO can be rewritten as,

$$[1 - P(\pi)]m + \phi_2[1 - P(\pi)](D_2 - I_2) \geq N_1 c + N_2 c + \mathit{Incremental\ Lemons\ Cost} \tag{5.26}$$

Here the gain includes the expected savings in bank monitoring costs in the first project and the expected savings in adverse selection costs for the second project. The overall gains have to exceed the cost of information production in each round trading and the one-time incremental lemons cost of equity. If equation (5.25) holds, then the gains to going public are higher with the second project.

5.3.1 Costly Market Mechanism and Reusability of Market Information

In Section 3.3, we analyzed the optimality of the IPO decision for firms when the combination of bank monitoring and market information production was cheaper than pure bank monitoring. While this could be a reasonable assumption in market-based economies with well-developed stock markets, it may not hold universally. Therefore if the only benefit of public equity is through the interaction with bank borrowing then $[1 - P(\pi)]m \leq N_1 c + \mathit{Incremental\ Lemons\ Cost}$ and therefore IPO is never optimal. However if the gains from future financing events is high enough, it may offset the cost of information production in markets and equation (4.25) would hold thus making IPO optimal at time 0. However once the firm issues public equity at time 0, the bank will ex post use the information in stock prices and the expected costs of bank monitoring are $P(\pi)m$ resulting in a lower cost of bank debt. In this case even though bank has the cheaper technology, the advantage with information that is produced in markets is that it is reusable by future investors whereas the information produced by the bank is private and therefore there is no direct spillover benefits.

Lemma 6 *For positive net savings in the future adverse selection costs* $[1-P(\pi)](D_2-I_2)-N_2c$*, the optimality conditions for the time* 0 *IPO decision are strengthened. Further, if the savings are large enough, even when the initial condition under Proposition 3 are not met, the gains from IPO could now dominate making it optimal to issue equity at time*0*.*

Proof in Appendix B

5.3.2 Seasoned Equity Offerings and Buybacks

In the model so far, once public equity is issued and information is produced in stock markets, there is no advantage with issuing more equity since it entails lemons costs. However since the number of speculators and the informativeness index both depend on the value of outstanding public equity, firms may choose to alter the level of public equity by either issuing more equity or buying back some shares with the proceeds of a debt issue. Therefore while it may not be possible to achieve the ideal market conditions for information production at all future dates, the firm can use subsequent equity issuances to alter the trading dynamics in the market for public equity.

5.4 Optimal Sequence of securities

In the single project setting, firms either choose bank borrowing or combine bank debt with public equity by choosing an optimal fraction of bank debt, λ^*. Even this single project result can be interpreted in a dynamic sense. The single project setting can be extended to a sequence of independent projects. As long as bank debt is optimal and the firm finances each project with short term bank debt, there is no dynamic implications for capital structure. If the parameters of the project change such that at some point in time, issuing public equity is optimal, then the firm may choose costly equity in order to gain from the information spillover on the bank's monitoring effort and the adverse selection costs of future financing events. This now ties in with the single project with multiple securities case and the sequence of projects case in Sections 2.3 and 2.4. Using results from these two sections, it can be shown that firms that satisfy Assumption 8 use the following sequence of financing:

(1) bank financing, as the optimal initial single security choice.

(2) As and when they meet the feasibility and optimality conditions for going public, they issue public equity as per Proposition 5.

(3) Bonds or Bank, since the market for public equity is already established and in the absence of default costs and given adverse selection costs , debt is optimal.

(4) Seasoned Equity Offerings (SEO) can be included with bonds or bank above if bankruptcy costs are considered or in situations when the firm can improve the endogenous liquidity in the market for its stock by issuing more equity.

6 Conclusion

This paper explores the role of information spillovers from public securities on the long-run financing costs of firms and derives implications for the optimal sequencing of securities and the optimality of the going public decision. Information spillovers across securities results in interaction among the financing costs of different securities and results in lower overall financing costs for the firm. In a dynamic setting with asymmetric information, I characterize the conditions for the optimality of the IPO decision and derive a sequence of securities that a firm issues over its life that is commonly observed in practice.

In a departure from existing literature, I allow the menu of securities from which firms choose the optimal security to vary on two dimensions; payoff structure, i.e. debt versus equity and second, privately held versus publicly traded securities. Firms choose securities to maximize the information spillovers from publicly traded securities, in particular, public equity. This results in a sequence of securities that deviates from the static pecking order. Firms issue bank debt initially to reduce the lemons costs and enable efficient liquidation/ continuation decisions. However, when the feasibility conditions for public equity are met, firms add public equity to their capital structure. Public equity interacts with bank monitoring and makes it more efficient and then going forward, firms use information production in public equity markets to partially mitigate the adverse selection costs of future financing events. Therefore once equity markets are established, subsequent projects are financed with some form of debt, either bank or bonds, to reduce the residual lemons cost. I derive the optimal capital structure at the time of the IPO and firms issue the minimum equity that is required to sustain a market for their stock and provide incentives for endogenous information production. Therefore in the model, firms issue information sensitive equity and bear the lemons cost initially in order to gain from reduced bank costs and future adverse selection costs.

This paper contributes to the existing literature in several ways. It provides an alternative explanation for security choice which is the interaction in the information production mechanisms of different securities. Second, it examines the sequencing of securities and the optimality of going public in a single framework thereby providing an explanation for why most firms issue the most information sensitive security as their first public security. Finally, it complements the banking literature that has emphasized the uniqueness of banks.

7 Appendix: Extensions, Proofs and Figures

Appendix A : Private Equity and Passive Bank

In the case where the firm finances the project with an active VC, the firm can reduce the lemons cost associated with equity by adding a passive bank to the capital structure so long as the VC's incentives to monitor are not impaired. The level of passive bank that minimizes the overall lemons cost, is a bank loan whose expected payoff is invariant to the firm type i.e., $B^{vc+pb} = \delta L$. There is no benefit to increasing the share of passive bank beyond a face value of δL since that the level which achieves the maximum savings in lemons cost. After that debt and equity have the same lemons cost. Therefore the contracts are given by,

$$1 - \delta L + m + c(e) = \alpha^{vc+passive\ bank}[\phi(X + p\Delta - \delta L)] \ ...I.R.$$

$$\alpha^{vc+passive\ bank}[\phi(X + p\Delta - \delta L)] - 1 - m - c(e) \geq \alpha^{vc+passive\ bank}[\phi(X - \delta L)] - 1 - m \ ...I.C.$$

$$\Rightarrow \Delta \geq \frac{c(e)}{\alpha^{vc+passive\ bank}\phi p} = \Delta_1$$

$\forall \Delta \geq \Delta_1 a$, the VC's contract and Entrepreneur's payoff are given as,

$$\alpha^{vc+passive\ bank} = \frac{1 - \delta L + m + c(e)}{\phi(X + p\Delta - \delta L}) \tag{7.27}$$

$$Entrepreneur_{VC+Passive\ Bank} = (1 - \alpha^{vc+passive\ bank})(X + p\Delta - \delta L)$$

$$Entrepreneur_{VC+Passive\ Bank} = X + p\Delta - 1 - m - c(e) - \frac{1-\phi}{\phi}(1 - \delta L + m + c(e)) \tag{7.28}$$

Similar to the pure VC case, for $\Delta \epsilon [0, \Delta_1]$, there could be a Δ such that the entrepreneur would be willing to offer a higher share of equity to the VC to restore the incentives of the VC to monitor which we will discuss later. Such an incentive compatible share would be $\alpha_{I.C.}^{vc+pb} = \frac{c(e)}{\phi p \Delta}$ provided the entrepreneur's payoff exceeds the pure bank case.

Appendix B : Proofs

B.1 **Proof of Proposition** 1

In the single security case, the firm chooses from bank, VC, public equity and bonds. In the proof, I compare the entrepreneur's payoffs under each of the alternatives with that under bank borrowing to arrive at he conditions under which a particular security is an optimal initial security.

(i) Bank versus Public Equity : The entrepreneur prefers bank if his payoff in equation (2.2) exceeds that in equation (2.6), which implies that,

$X - 1 - m - \frac{(1-\phi)}{\phi}(1 + m - \delta L) - X + 1 + E(\pi^E) + \frac{(1-\phi)}{\phi}(1 + E(\pi^E)) \geq 0$

$\Rightarrow \frac{(1-\phi)\delta L - m + E(\pi^E)}{\phi}$ which is always ≥ 0 by Assumption 5. Therefore the entrepreneur always prefers bank over public equity. Q.e.d.

(ii) Bank versus Public Bonds : Similarly the entrepreneur prefers bonds if the payoff in equation (2.2) exceeds that in equation (2.8), which implies that, $\Rightarrow \frac{(1-\phi)\delta L - m + E(\pi^D)}{\phi}$ which is always ≥ 0 by Assumption 5. Therefore the entrepreneur always prefers bank over bonds. Q.e.d.

(iii) Bank versus VC : The entrepreneur will choose VC financing if his wealth is higher under that option, i.e. equation (2.2) − equation (2.8) exceeds 0. This implies that,

$p\Delta - c(e) - \frac{(1-\phi)}{\phi}[\frac{(\delta L + c(e))\phi(X + p\Delta - \delta L) - \delta L(1 + m - \delta L)}{\phi(X + p\Delta - \delta L) + \delta L}]$

$\Rightarrow \Delta \geq \frac{c(e)}{\phi p} + Incremental\ lemons\ cost = \Delta_2.$

In section 3.2.1, the incentive compatible Δ for the VC was denoted Δ_1. If $\Delta_2 > \Delta_1$, then $\forall \Delta \epsilon [0, \Delta_2]$, the entrepreneur chooses bank borrowing and VC $\forall \Delta > \Delta_2$. If $\Delta_2 < \Delta_1$, then $\forall \Delta \epsilon [\Delta_2, \Delta_1]$, the VC's I.C. constraint is not met. However the entrepreneur may be willing to offer the VC, $\alpha_{IC}^{vc} = \frac{c(e)}{\phi p \Delta}$ if the entrepreneur's payoff exceed the pure bank case,

$\Rightarrow (1 - \alpha_{IC}^{vc})(X + p\Delta) - X + 1 + m + \frac{(1-\phi)}{\phi}(1 + m - \delta L) \geq 0$

$\Rightarrow \Delta \geq \frac{c(e)}{\phi p} + \frac{c(e)X}{\phi p^2} - \frac{1 + m - (1-\phi)\delta L}{\phi} = \Delta_3.$

When $\Delta_2 < \Delta_1$, if $\Delta_3 \epsilon [\Delta_2, \Delta_1]$, then $\forall \Delta > \Delta_3$, the entrepreneur chooses VC financing. Let $\Delta_{vc}^* = max(\Delta_2, min(\Delta_3, \Delta_1)$, then $\forall \Delta > \Delta_{vc}^*$, the entrepreneur's payoff is higher under VC financing and he chooses bank borrowing otherwise.

In a similar manner when comparing VC + Passive Bank with pure Bank borrowing, we can derive a cutoff, Δ_{vc+pb}^* such that $\forall \Delta \leq \Delta_{vc+pb}^*$, the entrepreneur chooses bank borrowing. Finally if $\Delta^* = min(\Delta_{vc}^*, \Delta_{vc+pb}^*)$, then $\forall \Delta > \Delta^*$, the entrepreneur chooses the VC as the active investor.

The basic intuition is that since there is value to early liquidation by Assumption 5, the entrepreneur would prefer some inside monitoring investor. Between the Bank and the VC, the bank has lower lemons cost but the VC has better incentive to undertake the intervention effort, e. Therefore if the additional payoff from intervention, Δ is high enough, the entrepreneur optimally chooses private equity (VC) as the initial security as the gains offset the lemons cost. For low Δ, bank borrowing is the optimal initial security. ... Q.e.d.

B.2 **Proof of Proposition** 2

To show that firms that satisfy Assumption 8 will never choose a combination of bank and VC, need to show that any Δ for which the combination is optimal, exceeds Δ^*. To distinguish between active bank and VC versus passive bank and active VC as seen earlier, the bank here, $B^{vc} \geq \delta L$.

First assuming costless communication regarding the firm type between the two private investors, bank and VC, $\alpha_{IC}^{vc+bank} \geq \alpha_{IC}^{vc+passive\ bank}$ which implies that $\Delta \leq \Delta_{vc+pb}^* \geq \Delta^*$, which violates Assumption 8. Further, for $B^{vc} \geq \delta L$, if the VC's I.C. is still satisfied, the payoff to the entrepreneur from VC + Bank is the same as under VC + Passive Bank since there is no difference in lemons cost and since we assume no duplication in monitoring costs.

However, if there are any coordination costs or the two investors are unable to perfectly communicate their private information, then there may be duplication in monitoring costs and then the indifference result disappears. It can be easily shown that now the combination of VC and Bank makes it costly for the firm to have two active monitors for all $m > 0$ and as long as Assumption 8 is satisfied, the firm prefers pure bank borrowing. ...Q.e.d.

B.3 **Proof of Lemma** 1

To show that there exists a unique $\overline{\lambda}$ such that $E(\pi^E) = NTc$ and $\forall \lambda < \overline{\lambda}, E(\pi^E) \geq NTc$, we need to show the following:

(a) $E(\pi^E)$ is decreasing in $\lambda \epsilon [0, 1]$.

$\frac{\partial E(\pi^E)}{\partial \lambda} = \frac{-k}{A^2}\{(X - \delta L - (1-\delta)B)[A - (1-\lambda)\frac{\theta + (1-\theta)\delta}{\phi + (1-\phi)\delta}] + \frac{(1-\lambda)(1-\delta)}{\phi + (1-\phi)\delta}\}.$

Since the term inside the [ ] are positive for any positive NPV project, the whole expression is negative for $\lambda \epsilon [0, 1]$.

(b) At $\lambda = 0$, $E(\pi^E) \geq NTc$ implies that

$c \leq \frac{(x - \delta L)2P(\pi)\phi(1-\phi)(2q-1)}{\theta X + (1-\theta)\delta L} = c^* > 0.$

Therefore $\forall c \leq c*$, At $\lambda = 0$, $E(\pi) \geq NTc$.

(c) At $\lambda = 1$, there is no public equity therefore let $\lambda = (1 - \varepsilon)$, Now it can be easily shown that $E(\pi^E) = 2P(\pi)(2q-1)N\alpha^{\varepsilon}(X - \delta L - (1-\delta)B^{1-\varepsilon})$ decreases as ε decreases and therefore for any value of NTc, there exists a $\varepsilon > 0$ such that $E(\pi^E) < NTc$.

Therefore since $E(\pi^E) \geq NTc$ for λ close to 0 provided $c \leq c^*$ and $E(\pi^E) < NTc$ for λ close to 1 and $E(\pi)$ is strictly decreasing in λ, therefore $\exists$ a unique crossing point $\overline{\lambda}$ such that $E(\pi^E) = NTc, \forall c \leq c*$. ... Q.e.d.

B.4 **Proof of Lemma** 2

The gain from combining bank + IPO requires that the bank monitor and the speculators produce information. Therefore the bank's I.C. and the speculators' I.R. constraints need to be satisfies. $\forall \lambda \geq \underline{\lambda}$, the bank monitors and $\forall \lambda \leq \overline{\lambda}$, $E(\pi^E) \geq NTc$. Therefore the speculators generate the signals.

If $\overline{\lambda} < \underline{\lambda}$ then the speculators and the bank cannot both be satisfied for any $\lambda \epsilon [0, 1]$

If $\overline{\lambda} \geq \underline{\lambda}$, the $\forall \lambda \epsilon [\underline{\lambda}, \overline{\lambda}]$ both constraints are satisfied and therefore this is the feasible region where the entrepreneur can issue public equity. However the optimality of issuing public equity will depend on his own payoff relative to that under bank borrowing. ... Q.e.d.

B.5 **Proof of Lemma** 3

Need to show that $Entrepreneur_{Bank+IPO}$ is increasing in λ and that for some $m \geq \underline{m}$, $Entrepreneur_{Bank+IPO} \geq Entrepreneur_{Bank}$. After some tedious algebra, it can be shown that

$\frac{\partial Entrepreneur_{Bank+IPO}}{\partial \lambda} \geq 0$ for $\lambda \epsilon [0,1]$. Now, $Entrepreneur_{Bank+IPO} \geq Entrepreneur_{Bank}$ implies that, $[1-P(\pi)]m - NTc - (1-\phi)\{(1-\delta)B + \frac{(1-\lambda+NTc)(X-B-\delta(L-B))}{\phi(X-B-\delta(L-B))+\delta(L-B)} - \frac{(1+m-\delta l)}{\phi}\} \geq 0$

$\Rightarrow [1-P(\pi)]m - NTc - Incremental\ Lemons\ Cost\ of\ equity \geq 0$

$\Rightarrow m \geq \frac{NTc+Incremental\ Lemons\ Cost\ of\ equity}{(1-P(\pi))} = \underline{m}.$

$B.6$ **Proof of Proposition** 3

Need to show that when there exists a $\overline{\lambda} geqmax(\underline{\lambda}, \widehat{\lambda}$, then there is a unique solution to the entrepreneur's optimization and his payoffs are higher than in the pure bank case.

From Lemma2, we have the feasibility region of public equity and bank debt as $[\underline{\lambda}, \overline{\lambda}]$ where both the bank's I.C. and the speculators' I.R. conditions are met. From Lemma 3, we have the region $[\widehat{\lambda}, 1]$ where the entrepreneur prefers bank and public equity. Combining the two regions, we get $[max(\underline{\lambda}, \widehat{\lambda}), \overline{\lambda}]$ as the intersection and this defines the region where bank and IPO is feasible and preferable to pure bank. Potentially any λ in this region will work but since the entrepreneur pick the λ to maximize his own payoff, the optimal $\lambda^* = \overline{\lambda}$. ... Q.e.d.

$B.7$ **Proof of Corollary** 2

The binding constraint for the entrepreneur is $\overline{\lambda}$ since the entrepreneur prefers the highest feasible λ. Further we need $\overline{\lambda} \geq \underline{\lambda}$. Given a fixed $\underline{\lambda}$, the higher the value of $\overline{\lambda}$, the more likely that the feasibility conditions will be met.

Therefore need to show that $\overline{\lambda^E} \geq \overline{\lambda^D}$. At $\overline{\lambda}$, $E(\pi) = NTc$ and therefore $E(\pi^E)_{\overline{\lambda^E}} = E(\pi^D)_{\overline{\lambda^D}} = NTc$.

Now for any given λ, $E(\pi^E) - E(\pi^D)$ is given by,

$\frac{(1-\lambda)(X-\delta L-(1-\delta)B^{ipo})}{\phi(X-\delta L-(1-\delta)B^{ipo})+\delta(L-B^{ipo})} - \frac{1-\lambda-\delta(L-B^D)}{\theta}$

After some algebra, it can be shown that the above expression is positive. Therefore since for any $\lambda \epsilon [0,1]$, $E(\pi^E) > E(\pi^D)$ and since $E(\pi)$ is decreasing in λ, when $E(\pi^E) = E(\pi^D)$ at $\overline{\lambda}$, $\overline{\lambda^E} > \overline{\lambda^D}$. Therefore $\overline{\lambda^E}$ exceeds $\underline{\lambda}$ more often than $\overline{\lambda^D}$.

Further the likelihood that equity is feasible while bonds are not is increasing in $E(\pi^E) - E(\pi^D)$ and taking the derivative with respect to different parameters of the model shows that it is increasing in (X-L) and increasing in ϕ and the attractiveness of equity also depends on c since higher the c the less likely that $E(\pi^D) > NTc$

$B.8$ **Proof of Proposition** 4

When both bonds and public equity are feasible, the difference in the net benefits are given by,

$[1-P(\pi)]m - NTc - Incremental\ Lemons\ Cost\ of\ equity - [1-P(\pi)]m + NTc \leq 0$

Therefore when the Incremental Lemons cost is positive, i.e. $L > B^{ipo}$, the above expression is negative and the entrepreneur prefers bonds. Otherwise he is indifferent.

$B.9$ **Proof of Proposition** 5

When any public security, equity or bonds is feasible, the entrepreneur chooses the maximum λ that is feasible, i.e. $\overline{\lambda^E}$ and $\overline{\lambda^D}$ respectively. Similar to the proof for Lemma 1, it can be shown that for $\lambda\epsilon[0,1]$, $\frac{\partial E(\pi)}{\partial\lambda} < 0$ and as was shown in the proof for Proposition 4, it can be shown that for any λ, $E(\pi^E) > E(\pi^D)$ and therefore $\overline{\lambda^E} > \overline{\lambda^D}$.

At equilibrium, $E(\pi^E) = E(\pi^D) = NTc$. Now since $\overline{\lambda^E} > \overline{\lambda^D}$ and since

$\frac{\partial P(\pi)}{\partial\lambda} = \frac{-(2q-1)N}{2z^*(1-\lambda)^2} < 0$.

Therefore $P(\pi^E) < P(\pi^D)$. Now comparing the gains from public equity versus bonds, equity is preferred if,

$[1 - P(\pi^E)]m - Nc - Incremental\ Lemons\ Cost\ of\ equity - [1 - P(\pi^D)]m + NTc \geq 0$

$\Rightarrow [P(\pi^D) - P(\pi^E)]m \geq Incremental\ Lemons\ Cost\ of\ equity.$

For the case where $L < B^{ipo}$, equity has no additional lemons cost and the above condition is always satisfied. Therefore only if the incremental lemons cost of equity is very high, it will swamp out the benefits of a more informative equity and the entrepreneur will choose bonds. But now this result shows that unlike Proposition 4, here even when bonds are feasible, the entrepreneur may prefer equity since it is more informative than bonds thereby increasing the savings in bank monitoring costs.

$B.10$ **Proof of Corollary** 3

In t rounds, the savings in bank monitoring is,

$\sum_{i=1}^{t}[P(\pi^D)_i - P(\pi^E)_i]m_i - IncrementallemonsCost$

It can be shown that while the lemons cost also increases with t, the overall expression is increasing in t and therefore there exists a t^* such that for all $t > t^*$, the expression is positive implying that if there are multiple rounds of information production, the comparative advantage of equity in each round dominates the one-time incremental lemons cost and the entrepreneur will issue public equity rather than bonds.

$B.11$ **Proof of Lemma** 6

If condition (5.24) is satisfied, it implies that there is a positive net benefit for the second project from having public equity. Therefore at the optimal λ^*, the entrepreneur's payoffs under Bank + IPO is now higher with the second project than under the single project case. This reduce the entrepreneur's cutoff $\widehat{\lambda}$. From Proposition 4, it is clear that for fixed $\underline{\lambda}$ lower the $\widehat{\lambda}$, the more likely that optimality conditions for public equity are met. therefore, we get equation (5.25),

$$[1 - P(\pi)]m + \phi_2[1 - P(\pi)](D_2 - I_2) \geq N_1c + N_2c + Incremental\ Lemons\ Cost$$

Further if the conditions under Proposition 4 are not satisfied, since the $\widehat{\lambda}$ under the sequence of projects is less than the $\widehat{\lambda}$ under the single project case, the optimality of pure bank financing could be overturned in favor of the optimality of Bank + IPO.

Appendix C : Alternative specification for speculators' signals

In the paper, it is assumed that in each trading round, a fraction q of the speculators receive the correct signal and the rest receive the wrong signal. However, if we treat each signal as independent and with precision q, then with finite N, there is a distribution of signals that the group of speculators could potentially receive. Here I model the case with the independent signals.

Assumption 12 *Every speculator generates an independent signal which reveals the firm type with probability q and contains no information with probability* $(1 - q)$.

Here it is assumed that if the speculator does not learn the firm type, he learns nothing as opposed to getting the wrong signal. This assumption simplifies the model since we can rule out the small probability outcome where the number of speculators who generate the incorrect signal is so large that their trades are in the wrong direction resulting in a price that reveals the firm type though erroneously. In such a case, if the bank relies on the market price and does not monitor, then the model needs to take into account the expected cost of all actions that are based on an incorrect price, even if these events occur with low probability. Where under Assumption 12, when the price is informative, it is always correct as was the case earlier.

Now, each of the N speculators generates a signal of precision q and buys one stock if the signal is G and sells one stock if the signal is B. Therefore the total speculative trades are i with probability, $P(i) = \binom{N}{i} q^i(1-q)^{N-i}$. For each i, the probability that the total trades exceed z^*T and the market maker discovers the speculators information is $P(zT + i \geq z^*T) = \frac{i}{2z^*T}$. Therefore the total probability that the speculators' information is revealed is $\sum_{i=0}^{N} Probability(i) * Probability(zT + i \geq z^*T)$ and is given by,

$$[1 - P(\pi)] = \sum_{i=0}^{N} \frac{i}{2z^*T} \frac{N!}{i!(N-i)!} q^i (1-q)^{N-i}$$

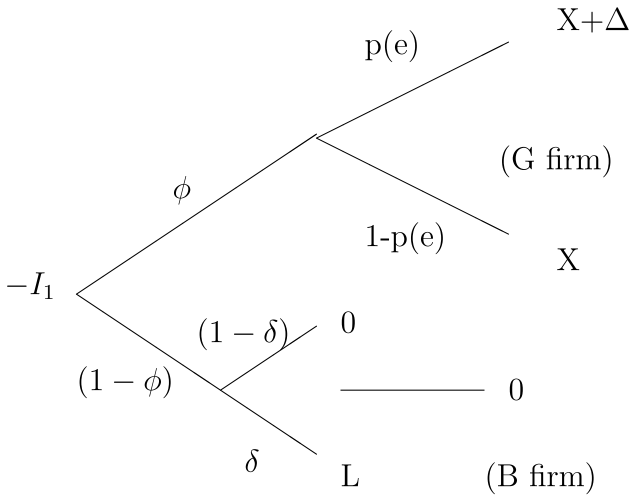
$$\Rightarrow [1 - P(\pi)] = \frac{1}{2z^*T} \sum_{i=1}^{N} \frac{N!}{(i-1)!(N-i)!} q^i (1-q)^{N-i}$$

Since N, z^* and q are constant, $P(\pi)$ here is also a constant and the rest of the analysis follows as in the earlier case. In the case with endogenous liquidity traders (see Section 4.4), also the expression for $P(\pi)$ is slightly modified and can be written as

$$P(\pi) = 1 - [\frac{1}{2z^*(1-\lambda)} \sum_{i=1}^{N} \frac{N!}{(i-1)!(N-i)!} q^i (1-q)^{N-i}]$$

Figure 1 : Single Project

(a) Technology



(b) Time Line

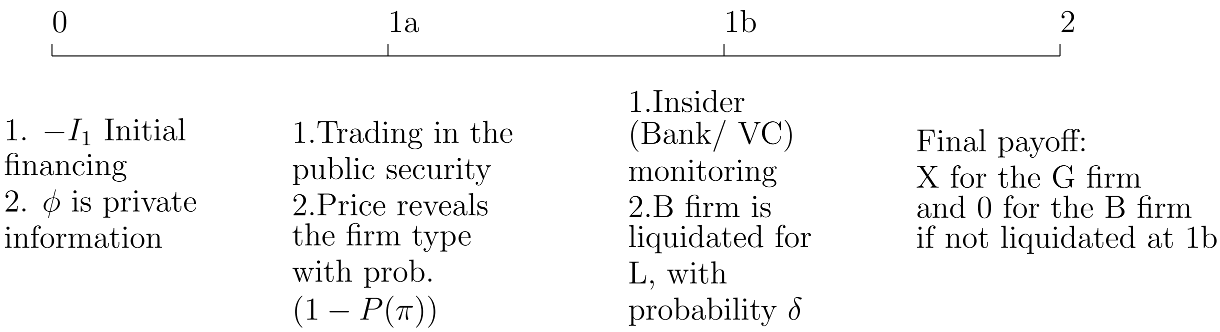
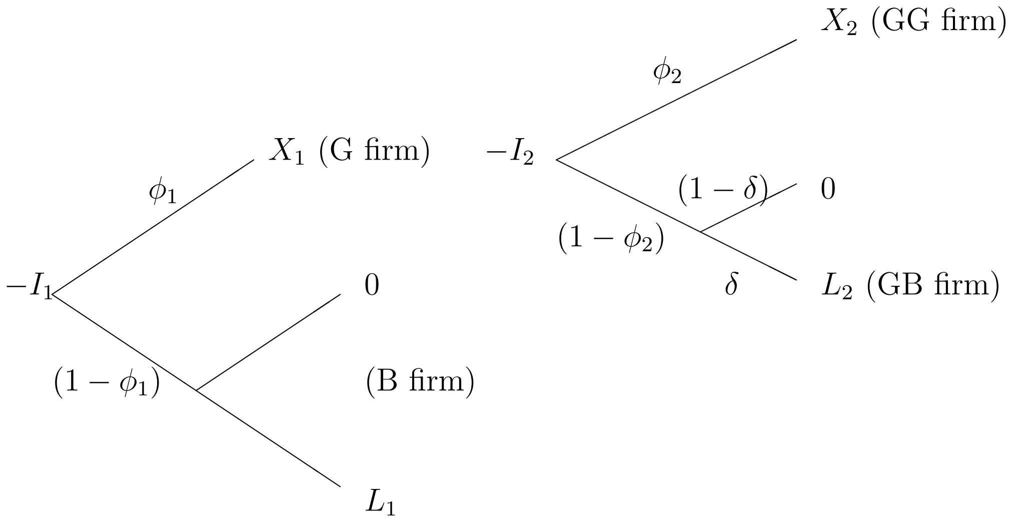


Figure 2 : Multiple Projects

(a) Technology



(b) Time Line

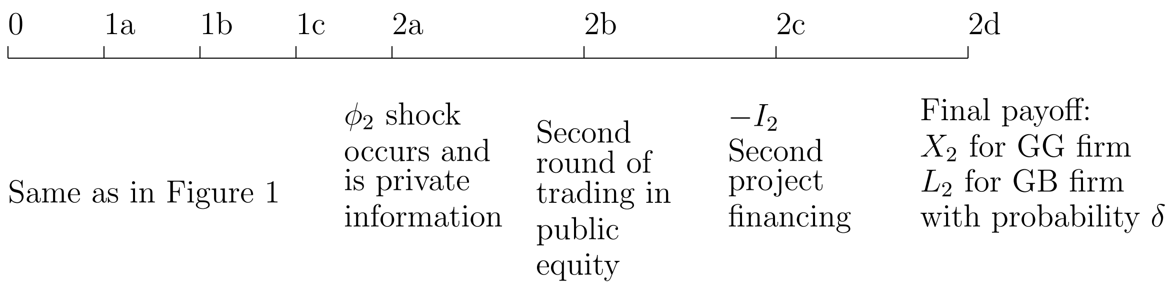
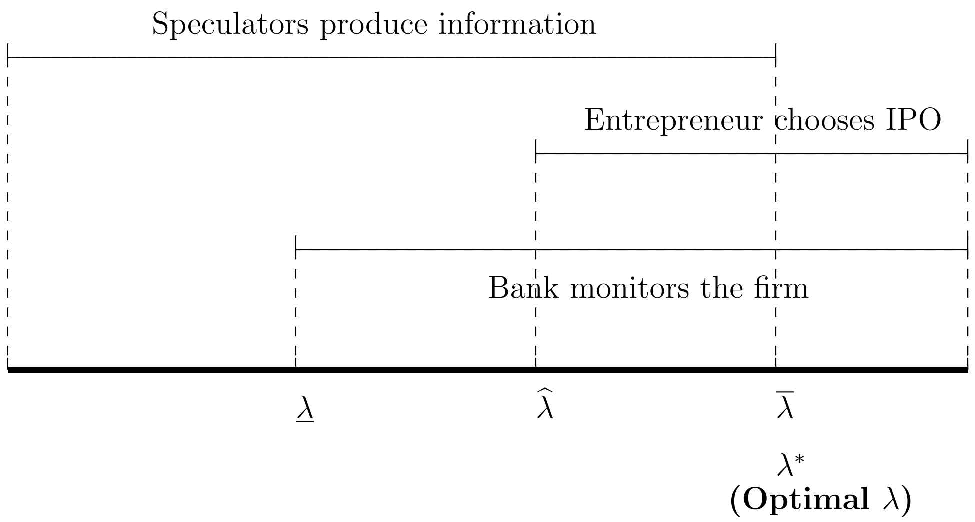


Figure 3 : Optimality of IPO

Optimal region is $[\max(\underline{\lambda}, \widehat{\lambda}), \overline{\lambda}]$



λ is the fraction of the loan than is financed using bank debt

References

Aghion, Philippe, Bolton, Patrick and Tirole, Jean, 2004, Exit Options in Corporate Finance: Liquidity versus Incentives, *Review of Finance*, Vol 8, pp $327 - 353$.

Allen, Franklin, 1993, Stock Markets and Resource Allocation, *Capital Markets and Financial Intermediation,Vives,-Xavier, eds. Cambridge University Press*, pp. 81-108.

Allen, Franklin, and Gale, Douglas, 2000, Information and Resource Allocation, *Comparing Financial Systems, The MIT Press*, pp. $191 - 230$.

Amihud, Yakov and Mendelson, Haim, 1988, Liquidity and Asset prices: Financial Management Implications, *Financial Management*, Spring 1988, pp. $5 - 15$.

Bayless,M. and Chaplinsky,S., 1991, Expectations of security type and the information content of debt and equity offers, *Journal of Financial Intermediation*, Vol 1, pp $195 - 214$.

Berger, Allen and Udell, Gregory, 1998, The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle, *Journal of Banking and Finance*, Vol 22, pp.$613 - 673$.

Bolton, Patrick and Freixas, Xavier, 2000, Equity, Bonds, and Bank Debt: Capital Structure and Financial Market Equilibrium Under Asymmetric Information, *The Journal of Political Economy*, Vol. 108, pp.$324 - 351$.

Boot, A. and Thakor, A., 1993, Security Design, *Journal of Finance*, Vol.48, pp.$1349-78$.

Boot, A. and Thakor, A., 1997, Financial System Architecture, *Review of Financial Studies*, Vol.10, pp.693-733.

Chemmanur, Thomas J. and Fulghieri, Paolo, 1999, A Theory of the Going-Public Decision, *The Review of Financial Studies*, Vol 12, No.2, pp. $249 - 279$.

Choe,H., Masulis, Ronald, Nanda, Vikram, 1993, Common stock offerings across the business cycle, *Journal of Empirical Finance*, Vol 1., $3 - 31$.

Daniel, K, and Titman, S., 1995, Financing Investment Under Asymmetric Information, *Handbooks in OR and MS, Volume 9, R. Jarrow et al,Eds.*, pp. 721-766.

-Diamond, D., 1991, Monitoring and Reputation: The Choice Between Bank Loans and Directly Placed Debt, *Journal of Political Economy*, August 1991.

Faure-Grimaud, Antoine and Gromb, Denis, 2004, Public Trading and Private Incentives, *Review of Financial Studies*, Vol 17, pp. 985-1014.

Fluck, Zsuzsanna, 2000,Financial Contracting in Start-ups and Ongoing firms: A Life-Cycle Theory, *Working Paper.*

Fulghieri,P. and Lukin, D., 2001, Information Production, Dilution Costs, and Optimal Security Design, *Journal of Financial Economics*, Vol.61, pp.$3 - 42$.

Gorton, Gary and Pennachi, George, 1993, Security Baskets and Index-Linked Securities, *Journal of Business*, 66, pp.$1 - 23$.

Grossman, S.J. and Stiglitz, J.E., 1980, On the Impossibility of Informationally Efficient Markets, *The American Economic Review*, Vol. 70, Issue 3., pp. 393-408.

Harris,M. and Raviv,A., 1991, The Theory of Capital Structure, *Journal of Finance*, Vol.46, pp.$297 - 355$.

Holmstrom, Bengt and Tirole, Jean, 1993, Market Liquidity and Performance Monitoring, *Journal of Political Economy*, 101, pp. $678 - 709$.

Jung, K., Kim, Y.C. and Stulz, R., (1996), Timing, Investment Opportunities and Managerial Discretion, and the Security Issue Decision, *Journal of Financial Economics*, 42, pp.159-185.

Leland,H. and Pyle,D., 1977, Information Asymmetries, Financial Structure and Financial Intermediation, *Journal of Finance*, Vol 32, pp.$371 - 388$.

Maksimovic, Vojislav and Pichler, Pegaret, 2001, Technological Innovation and Initial Public Offerings, *The Review of Financial Studies*, 14(2), 459-494.

Maug, Ernst, 2001, Optimal Ownership Structure and the Life-cycle of the firm: a Theory of the Decision to Go Public, *Eurpean Finance Review*, Vol.5.

Mazumdar, S., Sarin, A., and Sengupta, P., (2000), To Tell or Not to Tell: The Value of Corporate Disclosure, *Working Paper.*

Myers, Stewart, 1984, The Capital Structure Puzzle, *Journal of Finance*, Vol. 39, pp. $575 - 592$.

Myers, Stewart, 2000, Financial Architecture, *European Financial Management*, Vol.5, pp.$133 - 141$.

Myers,S. and Majluf, N.,1984, Corporate financing decisions when firms information investors do have, *Journal of Financial Economics*, Vol 13, pp. $187 - 221$.

Pagano, Marco, Panetta, Fabio and Zingales, Luigi, 1998, Why do Companies Go Public? An Empirical Analysis, *The Journal of Finance*, Vol. 53, pp. $27-64$.

Pagano, Marco, and Roell, Ailsa, 1998, The Choice of Stock Ownership Structure: Agency Costs, Monitoring and the Decision to Go Public, *The Quarterly Journal of Economics*, February 1998.

Pichler, Pegaret, and Maksimovic, V., 2001, Technological Innovation and Initial Public Offerings, *The Review of Financial Studies*, 14(2), 459-494.

Rajan, Raghuram, (1992), Insiders and Outsiders: The Choice between Informaed and Arm's-Length Debt, *Journal of Finance*, Vol 47, pp. $1367-1400$.

Ramakrishnan, S., and Thakor,A., 1984, Information Reliability and a Theory of Financial Intermediation, *Review of Economic Studies*, Vol.51, pp.$415-432$.

Saunders, Anthony, 1998, *Credit Risk Measurement : New Approaches to Value at Risk and Other Paradigms, John Wiley and Sons, Inc.*

Shyam-Sunder, Lakshmi and Myers, Stewart, 1999, Testing static tradeoff against pecking order models of capital structure, *Journal of Financial Economics*, Vol 51, pp. $219-244$.

Strahan, Philip E., 1999, Borrower Risk and the Price and Nonprice Terms of Bank Loans, *Working Paper.*

Stoughton,N., Wong, K.P., and Zechner, J., 2001, IPOs and Product Quality, *Journal of Business*, Vol. 74, pp.375-408.

Subrahmanyan, Avanidhar, 1991, A Theory of Trading in Stock Index Futures, *Review of Financial Studies*, 4, pp. $17-51$.

Subrahmanyam, Avanidhar and Titman, Sheridan, 1999, The Going-Public Decision and the Development of Financial Markets, *The Journal of Finance*, Vol 54, No.3, pp. $1045-1082$.

Sunder, Jayanthi, 2004, Information Production in Stock Markets and Cost of Bank Debt, *Working Paper.*

Zingales, Luigi, 1995, Insider Ownership and the Decision to Go Public, *Review of Economic Studies*, 62, pp. $425-448$.