

Booth, G. Geoffrey; Dalgic, Orkunt; Young, Allan

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The Entrepreneur's Choice: Venture Capital Debt Financing with Adverse Selection

G. Geoffrey Booth^{*}
Michigan State University,

Orkunt Dalgic^{**}
State University of New York at New Paltz

and

Allan Young^{***}
Curtin University, Perth, Western Australia
& Whitman School of Management, Syracuse University

This paper studies the consequences of using a debt contract to raise venture capital for an entrepreneurial project in an adverse selection setting with different quality venture capitalists. The paper considers not only the likelihood of success of a one-time project being

^{*} G. Geoffrey Booth is the Frederick S. Addy Distinguished Chair in Finance and serves as the Department of Finance Chairperson at Eli Broad School of Management at Michigan State University. He received his Ph.D. from the University of Michigan in 1971 and joined MSU in 1998. Before coming to the Broad School, Booth taught at the University of Rhode Island, Syracuse University and, most recently, Louisiana State University. He is an active researcher, having published more than 100 journal articles, monographs, and professional papers. Booth serves on several journal editorial boards and has been the president of the Multinational Finance Association and the Eastern Finance Association.

^{**} Orkunt Dalgic is an Assistant Professor at the State University of New York at New Paltz. He teaches Fundamentals of Corporate Finance at the undergraduate level, International Financial Management at the undergraduate and the MBA levels, as well as Financial Markets and Institutions at the MBA level. His research interests include financial markets and institutions, market microstructure.

^{***} Allan Young is a University Research Professor of Finance and Entrepreneurial Finance at Curtin University, Perth, Western Australia, as well as a Professor of Finance at the Martin J. Whitman School of Management, Syracuse University. He is the Editor-in-Chief of The Journal of Entrepreneurial Finance and Business Ventures, and has authored or co-authored nine books and monographs, over 90 articles and chapters in leading academic and professional publications and books, and given over 150 lectures outside the university setting for business and professional groups on each of the world's continents. His current research interests include, among other areas, developmental finance, micro lending, valuation, privatization, emerging and developing financial markets and entrepreneurship and other related topics.

dependent on the quality of the venture capitalist, but also the problem of a reduced ownership value of future rents from the venture if the venture capitalist takes it over as the result of default of the entrepreneur. Expressions for the face value of debt required for pooling and separating equilibria are also derived. The existence of a separating equilibrium with bad quality venture capitalists is used to show how less reputable venture capitalists can survive in the marketplace. Finally, the paper uses a numerical example to demonstrate why the entrepreneurs of more profitable entrepreneurial firms may prefer to do business with bad quality venture capitalists.

I. Introduction

Venture capitalists normally do considerably more than invest passively in entrepreneurial ventures. They also offer extensive project monitoring and provide expertise continuously through their involvement in crucial areas such as strategic decision-making, technology assessment, market analysis, risk/return determination, and management recruiting. In fact venture capitalists frequently provide value-added services for the emerging company well beyond the funds they generate (Schilit, 1996). A venture capitalist's value to the entrepreneurial firm therefore depends in part on the value the capitalist can bring to the entrepreneurial firm in terms of such valued-added services. In addition, there is strong empirical evidence to suggest that high quality added venture capitalist activities are greatly needed, as Dorsey (1977) and Huntsman and Hoban (1980) report failure rates of 18% and 16% respectively for companies with venture capital investments in their first five to seven years of existence, whereas Schilit (1996) states that the *success* rate for all new companies is about 10% to 20%.

It is only natural to expect that the value of these added venture capitalist services beyond providing financing would vary with the quality and experience of the venture capitalist. Whereas the ability of the reputable venture capitalist to provide superior services of this kind to the entrepreneur may not be in much doubt, the efficacy of younger and less established venture capitalists in providing these services may not be as clear. Thus we may envisage a population of young venture capital firms with an unproven track record of success, who can provide no clear signal as to their abilities. This is supported by Gompers (1996), who finds that younger and, therefore, less established venture capitalists bring IPOs earlier to the market than do more reputable venture capitalists in order to signal their quality to the market and to attract investment more easily for follow-on venture projects.

This paper examines the consequences of raising venture capital using a debt contract when the quality of the venture capitalist is subject to adverse selection. We consider not only the likelihood of success of a one-time project being dependent on the quality of the venture capitalist, but also the future rents from the venture being dependent upon the project's ownership after the proceeds from the one-time project are realized.

When an entrepreneur considers a young venture capitalist firm for external debt financing, it is unable to observe the quality of the venture capitalist. One good and one bad type of venture capitalist are considered in our model. With a good type venture capitalist, the project of the entrepreneur has a greater chance of success than with a bad type venture capitalist. In practice, a reputable venture capitalist belonging to the *good* type would

eventually separate out to a certain degree, since her abilities would be publicly known.¹ An adverse selection model that includes reputable venture capitalists would be uninteresting, and, as a result, we can envisage our adverse selection model as containing only young and inexperienced venture capital firms who can belong to what eventually will become either the good or the bad type depending upon the number of years of their eventual existence. But why should we study young and inexperienced venture capital firms? Gompers (1996) mentions that it would be interesting to study why entrepreneurs do business with younger venture capitalists who, as noted above, would likely rush them into an early IPO, rather than contracting with older and more reputable venture capitalists who are more likely to bring about firm value maximizing IPOs. So why would entrepreneurs who have a choice between a reputable firm of proven skill and ability and a young firm, whose abilities are as yet unproven, choose to do business with the latter? While the present study does not explicitly model an entrepreneur's choice between older and more reputable venture capitalist firms (whose quality is publicly known) and younger and less reputable capitalist firms, by examining the contractual implications of an entrepreneur selecting young venture capital firms under adversity, it derives the conditions under which bad quality venture capitalists may survive in the market place (in a separating equilibrium).² This in turn may help explain how less reputable (or younger) venture capital firms can survive in the marketplace. We also use a numerical example to explain how more profitable entrepreneurial firms may prefer to (debt) finance their projects with bad quality venture capitalists rather than with good quality ones.

The rest of this paper is organized as follows. Section II reviews some of the important related literature in the area of venture capital financing. Section III discusses the setup of the model. Section IV considers the conditions under which a pooling equilibrium might be feasible. Section V examines separating equilibria and Section VI looks at social welfare maximization. Section VII discusses the viability of less reputable (bad quality) venture capitalist firms in the marketplace, and uses a numerical example to explain how entrepreneurial firm profitability can affect the viability of such venture capitalists. Finally, Section VIII provides concluding remarks.

II. Literature Review

This section reviews some of the literature related to venture capitalist quality and the quality of venture capital investments, and presents a short summary of some literature on moral hazard problems in venture capital.

Lerner (1994) looks at the syndication of venture capital investments, and finds that reputable venture capitalists syndicate first-round investments to venture investors with similar levels of expertise. In later rounds, the reputable venture capitalists syndicate the venture to both their peers, as well as to less-experienced venture capital investors. Gompers (1998) finds that the booming market for venture-backed IPO's, coupled with recent reductions in the capital gains tax-rate, led to an increase in the profitability of venture capitalism and caused venture capitalists to dramatically increase their capital commitments to new ventures. Also, an increase in the level of new funds raised by venture capitalists forced many of them to seek an even greater number of venture investment opportunities, which helps explain the shift by

¹ According to Gompers (1996) the age of the venture capitalist proxies for reputation, implying that disreputable venture capitalists (belonging to a bad type) would not survive a long time in the marketplace; i.e., eventual bankruptcy would remove a potentially disreputable venture capitalist from the market.

² Specifically, under a debt contract.

venture capitalists to later stage investments. Studies of the incentives of venture capitalists to engage in value reducing behavior have concentrated on the premature abandonment decision. Sahlman (1990) argues that premature abandonment (through an IPO) may come about due to the fact that the venture capitalist holds a more diversified portfolio of opportunities and has a higher opportunity cost of time (as more profitable ventures may become available) than the entrepreneur. According to Gompers (1996), the venture capitalist may also bring about a premature IPO in order to both signal her reputation and cause a revision of the market value of her investments. Chevalier and Ellison (1995) find empirically, that premature IPOs allow the venture capitalist to more easily attract new investment capital. Furthermore, Gompers (1996) finds that the IPO's of younger venture capitalists suffer greater underpricing on average than those of reputable venture capitalists.

Finally, the literature on venture capital moral hazard problems include the following: Trester (1998) studies the incentives of the entrepreneur to steal from the project under preferred equity and debt financing; Landskroner and Paroush (1995) show how an entrepreneur's own capital investment can make the venture capitalist more willing to equity-finance the venture; Bergemann and Hege (1998) develop the optimal equity contract in a dynamic agency setting; and Casamatta (2003) examines the joint provision of effort by the entrepreneur and advisor (venture capitalist) to improve the productivity of the venture capital investment.

III. Model Setup

In this model, a risk-neutral entrepreneur who owns a firm and a one-time project, contracts with a risk-neutral venture capitalist who provides the project with external debt capital. The venture capitalist, the agent in this model, operates in a perfectly competitive market for venture funding. At time 0, nature chooses the type of the venture capitalist. The venture capitalist can be of *good* type with probability p , or she can be of *bad* type with probability $1-p$. The entrepreneur, who is the principal in this model, offers a debt contract to the venture capitalist, while not knowing the venture capitalist's type. The venture capitalist can either accept or reject the entrepreneur's debt contract.

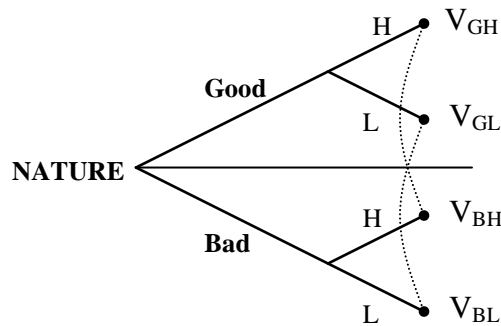
If the venture capitalist accepts the contract, she is required to invest a certain amount ' I ' in the project, as the project can only proceed if an investment of I is made. In this model, the project returns R_L if unsuccessful and R_H if successful, where $R_H > R_L$. To make the analysis clearer, R_L is assumed to equal 0, with no loss of generality, and R_H is more simply denoted as R . Therefore, at time 2, if the venture capitalist is of the good type, the project will return R with probability q_G and 0 with probability $1-q_G$. If the venture capitalist is of the bad type, the project will return R with probability q_B and 0 with probability $1-q_B$. We assume $1 > q_G > q_B > 0$, so that the project has a greater probability of success under the good type venture capitalist than under the bad type.

At time 2, the project returns are realized and the venture capitalist receives a fixed wage, $W(I)$, if the project has been successful, meaning that there is no default (i.e., $R > W(I)$), and obtains full ownership of the future rents of the venture if the project fails, when default occurs with certainty.

A timeline for the project would look as follows:

t=0	t=1	t=2
Nature chooses venture capitalist type (<i>unobserved by entrepreneur</i>)	Entrepreneur offers venture capitalist a debt contract. The project can move forward only if the capitalist accepts the contract and invests 'I' in the venture.	Outcome of the project is realized (R or 0). If the outcome is R , the capitalist is paid a fixed wage $W(I)$ and the entrepreneur continues to own the firm. If the project returns 0 , the entrepreneur defaults with certainty and ownership of the entrepreneurial firm goes to the venture capitalist.

The extensive form of the game is shown below, where the dashed lines denote the entrepreneur's information sets and project returns are realized at these information sets. The values ' V_{TX} ' represent the total value of the entrepreneurial firm when the venture capitalist is of type T and the project return is X .³



The model also considers the value of future rents ' Z ' that may come as a result of the ownership of the entrepreneurial firm. Since we are concentrating our study on a simple adverse selection model, an assumption is made that the value of future rents is independent of the project outcome, and dependent only on the owner of the entrepreneurial venture at time 2.

Thus:

$$V_{GH} = V_{BH} = R - I + Z,$$

$$V_{GL} = -I + \delta_G \times Z,$$

$$V_{BL} = -I + \delta_B \times Z.$$

We further note that $1 > \delta_G > \delta_B$, meaning that the value of future rents is greater when the venture capitalist is of the good type than when she is of the bad type, but this value is

³ Here, T denotes either G or B, and X denotes either H or L.

greatest when the entrepreneur maintains ownership.⁴ Therefore, we are explicitly modeling the impact of firm ownership on the value of the future profitability of the firm, much the same way that we consider the impact of venture capitalist type on the chance of success of the one-time project. If the venture capitalist is of the good type and the project is successful, then ownership of the firm remains with the entrepreneur and, consequently, the value at date 2 of the future rents from the firm is higher than if the project were unsuccessful and the good type of venture capitalist owned the firm. This is due to the entrepreneurial skill and knowledge possessed by the entrepreneur (and not possessed by the venture capitalist) that add value to the future rents of the firm. Also, if the venture capitalist is of the bad type, and the project is unsuccessful, ownership passes to the venture capitalist, and the value of the firm's future rents is strictly less than had the venture capitalist been of the good type, *ceteris paribus*. Therefore, as long as ownership remains with the entrepreneur, maximum social value is preserved. This is evident in the relationship: $V_{GH} = V_{BH} > V_{GL} > V_{BL}$.

Moreover, if a non-debt contract were used, the ownership of the firm would always remain with the entrepreneur, and this would ensure the maximization of social wealth. Also, since the entrepreneur does not observe the type of the venture capitalist at the time of contracting, if the entrepreneur does not default, the fixed wage paid to the venture capitalist cannot depend upon the venture capitalist's type. Under default, however, the venture capitalist receives the ownership value of the future rents of the firm, and these do depend upon the venture capitalist's type, through factors δ_G and δ_B .

In this paper, we investigate whether or not pooling and separating equilibria exist with a debt contract as outlined above. We therefore derive the contracts the entrepreneur needs to offer the venture capitalist, $W(I)$. We observe that under a debt contract the entrepreneur has a greater probability of default if she contracts with a bad type venture capitalist than if she contracts with a good type.

IV. Pooling Equilibrium

In this section we consider the values of $W(I)$, the compensation for the venture capitalist when there is no default, that gives us a pooling equilibrium, i.e., one in which both types of venture capitalists agree to a debt investment in the entrepreneurial project.

The ex-ante expected profit for the *good* type venture capitalist is calculated as follows: The project returns R , with probability q_G , and the venture capitalist receives the full amount of the compensation $W(I)$, so the expected profit of the venture capitalist without default is:

$$q_G (W(I) - I).$$

The project returns 0 with probability $(1-q_G)$, and the expected profit of the venture capitalist with default is:

$$(1-q_G) (\delta_G \times Z - I).$$

Therefore, the rationality constraint implies:

$$\Pi_G = q_G (W(I) - I) + (1-q_G) (\delta_G Z - I) \geq 0.$$

⁴ Here δ_G and δ_B can be thought of as discount factors that reduce the value of future rents at time 2. In our model, the discount factor under entrepreneurial ownership is normalized to one.

Rearranging the above equation gives the participation wage, $W(I)$, for the good type of venture capitalist:

$$W(I) \geq (I - (1 - q_G) \delta_G Z) / q_G. \quad (1)$$

The ex-ante expected profit for the *bad* type venture capitalist is calculated in the following way. The project returns R , with probability q_B , and the venture capitalist receives the full amount of the compensation, $W(I)$, so the expected profit of the venture capitalist without default is:

$$q_B (W(I) - I).$$

The project returns 0 with probability $(1 - q_B)$, and the expected profit of the venture capitalist with default is:

$$(1 - q_B) (\delta_B \times Z - I).$$

Thus the ex-ante profit at date 0 for the bad type of venture capitalist is:

$$\Pi_B = q_B (W(I) - I) + (1 - q_B) (\delta_B Z - I) \geq 0.$$

Similarly, rearranging the above equation gives the participation wage, $W(I)$, for the bad type of venture capitalist:

$$W(I) \geq (I - (1 - q_B) \delta_B Z) / q_B. \quad (2)$$

We know that $\delta_G > \delta_B$, since future rents are assumed to be greater under a good type venture capitalist than under a bad one. We also know that $q_G > q_B$. Therefore, a pooling equilibrium exists if both types of venture capitalists break even in equilibrium. This implies that equations (1) and (2) hold with equality. Hence, in order to have participation from both types of venture capitalists in equilibrium, the entrepreneur must offer a wage:

$$W(I) = \text{Max} (W_1(I), W_2(I)),$$

where $W_1(I)$ refers to $W(I)$ in equation (1), and $W_2(I)$ refers to $W(I)$ in equation (2).

We can now maximize the objective function, i.e., the expected wealth of the entrepreneur in a pooling equilibrium with respect to $W(I)$:

$$\begin{aligned} \Pi_E &= pq_G (R + Z - W(I)) + (1 - p)q_B (R + Z - W(I)) + p(1 - q_G)(0) + (1 - p)(1 - q_B)(0) \\ &= (pq_G + (1 - p)q_B) \times (R + Z - W(I)) \end{aligned}$$

subject to the venture capitalist's constraint,

$$W(I) = \text{Max} (W_1(I), W_2(I)),$$

and the entrepreneur's rationality constraint,

$$(pq_G + (1-p)q_B) \times (R + Z - W(I)) \geq Z,$$

which yields

$$W(I) \leq R - Z [(1 - (pq_G + (1-p)q_B)) / (pq_G + (1-p)q_B)].$$

In equilibrium, since $W(I)$ satisfies the rationality constraint of the entrepreneur, $R > W(I)$ (the condition which ensures that no default occurs when the project is successful), and $Z \geq 0$ (the future rents that the entrepreneur receives), the expected wealth of the entrepreneur is maximized when $W(I)$ is minimized. Thus, in a pooling equilibrium, the wage offered by the entrepreneur must satisfy the following expression:

$$W(I) = \text{Max}(W_1(I), W_2(I)) \leq R - Z [(1 - (pq_G + (1-p)q_B)) / (pq_G + (1-p)q_B)].$$

We also observe that this pooling equilibrium is only Nash when $W(I) = W_1(I) = W_2(I)$. Thus if $W_1(I) \neq W_2(I)$, the pooling equilibrium breaks down, and the entrepreneur chooses to offer the venture capitalist the lower of the two wages $W_1(I)$ or $W_2(I)$, which maximizes the entrepreneur's wealth function. There is another pooling equilibrium in which neither one of the two venture capitalist types participate in the project, but it is easy to see that this equilibrium is Nash only when the entrepreneur's participation constraint is not satisfied. This pooling equilibrium will exist if and only if

$$(pq_G + (1-p)q_B) \times (R + Z - W(I)) < Z,$$

where $W(I) = \min (W_1(I), W_2(I))$. Otherwise, the entrepreneur always wants to pursue the project and this second pooling equilibrium breaks down.

V. Separating Equilibria

In the previous section we considered the conditions under which a pooling equilibrium exists in an adverse selection setting. Here we consider the conditions under which separating equilibria may exist. If $W_2(I) > W_1(I)$, then in equilibrium the entrepreneur offers a wage $W(I) = W_1(I)$ in return for an initial investment of ' I ' by the venture capitalist. This implies that only the good type venture capitalist will accept the contract.

The wealth of the entrepreneur given that only the good type venture capitalist accepts the contract is:

$$\begin{aligned}\Pi_{E|G} &= q_G (R + Z - W_1(I)) + (1-q_G)(0) \\ &= q_G (R + Z - W_1(I)).\end{aligned}$$

In order for the separating equilibrium to exist with only the good type venture capitalist accepting the contract, we must have:

$$W(I) = W_1(I) < W_2(I)$$

and

$$q_G (R + Z - W_1(I)) \geq Z \quad (\text{to satisfy the rationality constraint of the entrepreneur}).$$

Since the wage $W(I) = W_1(I)$ does not satisfy the participation constraint of the bad type venture capitalist in equilibrium, only the good type venture capitalist accept the contract. Therefore, we have a separating equilibrium in which only the good type venture capitalist provides debt capital to the entrepreneurial firm. Similarly if $W_1(I) > W_2(I)$, then the entrepreneur offers a wage $W(I) = W_2(I)$ in return for an initial investment of 'I' by the venture capitalist. This implies that only the bad type venture capitalist accepts the debt contract offered by the entrepreneur. The wealth of the entrepreneur given that only the bad type venture capitalist accepts the contract is:

$$\begin{aligned}\Pi_{E|B} &= q_B (R + Z - W_1(I)) + (1-q_B)(0) \\ &= q_B (R + Z - W_2(I)).\end{aligned}$$

In order for the separating equilibrium to exist with only the bad type venture capitalist accepting the contract, we must have:

$$W(I) = W_2(I) < W_1(I)$$

and

$$q_B (R + Z - W_2(I)) \geq Z \quad (\text{to satisfy the rationality constraint of the entrepreneur}).$$

VI. Maximizing Social Wealth

The ex-ante social wealth in a pooling equilibrium provided the project is undertaken is given by:

$$\begin{aligned}\Pi_{SW} &= pq_G V_{GH} + (1-p)q_B V_{BH} + p(1-q_G)V_{GL} + (1-p)(1-q_B)V_{BL} \\ &= (pq_G + (1-p)q_B) \times (R + Z) + [p(1-q_G) \times \delta_G + (1-p)(1-q_B) \times \delta_B] Z - I.\end{aligned}$$

Since $q_G > q_B$ and $\delta_G > \delta_B$, we can see that Π_{SW} is maximized when $p=1$, i.e., when only the good type venture capitalist supplies debt financing. This implies that if $W_2(I) > W_1(I)$, the social wealth of the firm is maximized. Therefore, social wealth is not maximized under a

pooling equilibrium where both types of venture capitalists participate. This happens in a separating equilibrium in which the entrepreneur offers a wage $W(I) = W_1(I) < W_2(I)$, which only the good type venture capitalist accepts.

VII. Discussion

The preceding analysis shows that under certain conditions, an entrepreneur may prefer to offer a contract to a bad quality venture capitalist (the second separating equilibrium). In order to better understand the different equilibrium outcomes, we plot in Figure 1 the participation wages for both bad and good venture capitalists against the future profitability of the firm (i.e. future rents, Z) for a given numerical example. The parameter values used for the numerical example are, $I=20$, $R=100$, $q_G=0.8$, $q_B=0.5$, $\delta_G=0.8$, $\delta_B=0.5$. As can be seen from Figure 1, the reservation wages required by the good and bad venture capitalists, W_1 and W_2 , respectively, decrease at different rates as the future profitability of the firm (Z) increases, and are equal when $Z=50$. Since the entrepreneur can maximize her payoff by choosing to pay the lower of the two wages, this implies that for values of Z less than 50 the entrepreneur pays a wage $W_1 < W_2$, which only the good quality venture capitalist accepts (good separating equilibrium), for $Z=50$ the entrepreneur pays a wage $W_1=W_2$ which is accepted by both good and bad venture capitalists (pooling equilibrium), and for $Z>50$ the entrepreneur pays a wage $W_2 < W_1$ accepted only by the bad quality venture capitalist (bad separating equilibrium).⁵ Thus, as the future profitability of the firm, Z , increases, the entrepreneur finds it increasingly more attractive to choose the bad quality venture capitalist. The reason for this is that under a bad quality venture capitalist, the project is less likely to be successful (i.e. $q_B < q_G$) and the bad quality venture capitalist will therefore be more likely to take over the firm. This means that when the firm has greater future profits, Z , the bad quality venture capitalist benefits more from the project than does the good quality venture capitalist, and therefore when the firm has sufficient future profitability, the bad quality venture capitalist requires a smaller wage than does the good quality one. Therefore, the example shows that with a debt contract more profitable ventures may be more likely to be funded by bad quality venture capitalists.

The more general implication of this analysis is that it is possible to have only bad quality venture capitalists operating in the venture capital market. This is consistent with the finding of Gompers (1996) that IPOs performed by younger venture capitalists have greater underpricing, such that this underpricing may represent the reaction of an efficient market to IPOs of venture capitalists more likely to be of bad quality. Furthermore, the analysis indicates that entrepreneurs may not necessarily prefer venture capitalists that can maximize the success of a project and thus IPO proceeds (the good quality venture capitalists), if those venture capitalists are too expensive, i.e. if the good quality venture capitalists require higher wages than the bad quality ones ($W_1 > W_2$). This also helps explain why in the presence of more established venture capital firms, entrepreneurs may prefer to do business with lesser known, and possibly bad quality venture capital firms. In any case, the analysis indicates that bad quality venture capitalists may not necessarily disappear from the market due to natural selection, as Gompers (1996) implies.

⁵ For the values used in the numerical example, the rationality constraint of the entrepreneur was satisfied under both the bad and good venture capitalists. Thus, the entrepreneur could choose to pay the venture capitalist whatever wage maximized the entrepreneur's payoff (the smaller of W_1 and W_2).

VIII. Conclusion

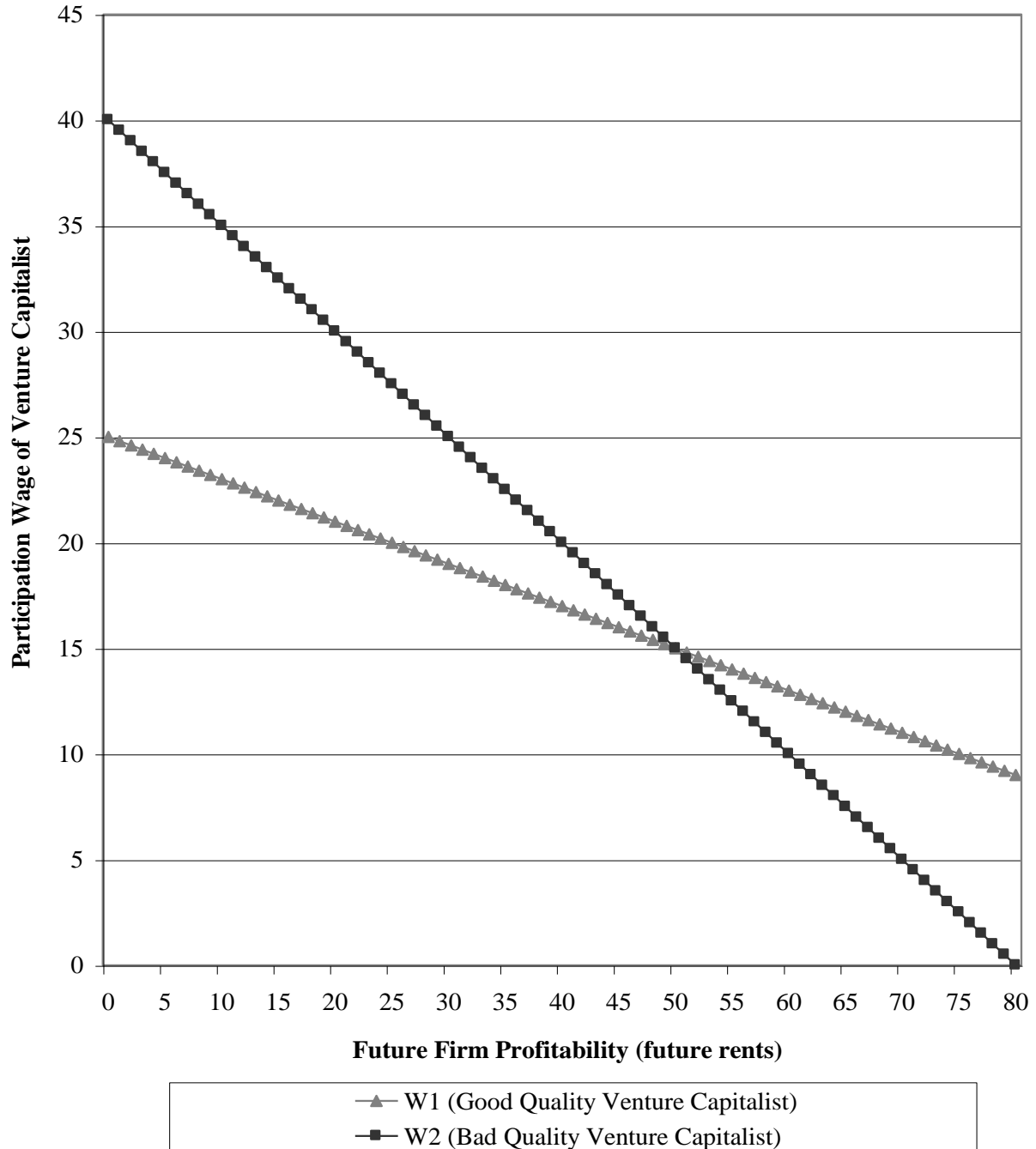
In this paper, we examine the problem of debt contracting in an adverse selection environment involving an entrepreneur who plans to finance a project using venture debt capital. We find that a pooling equilibrium under which both good and bad types of venture capitalists participate requires that the 'fixed' wages satisfying the rationality constraint of both types of venture capitalist be equal. When the rationality constraint satisfying wages are not equal, the pooling equilibrium breaks down and one of two separating equilibria obtain. The social wealth maximizing equilibrium is a separating one under which only the good type of venture capitalist provides debt capital to the entrepreneurial project. Furthermore, the existence of a separating equilibrium with bad quality venture capitalists is used to explain the survival of less reputable venture capital firms in the marketplace. Finally, a numerical example demonstrates how the entrepreneurs of more profitable ventures may prefer to do business with bad quality venture capitalists.

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Figure 1

Future Firm Profitability and Entrepreneur's Choice of Venture Capitalist



Note: The parameter values used for this example are: investment (I) = 20, project return (R) = 100, probability of project success under good quality venture capitalist (q_G) = 0.8, probability of project success under bad quality venture capitalist (q_B) = 0.5, discount factor for good quality venture capitalist (δ_G) = 0.8, discount factor for bad quality venture capitalist (δ_B) = 0.5.