

# Exploring the Signaling Effect of Equity Offering in Venture Capital Investment

## 1. Introduction

As is noted in Vrankić and Skoko (2021), when raising funds for growth and development, the relationship between a firm and its potential investors could be depicted by the model of signaling game. The existing asymmetry of information in market would not give investors clear pictures about the potential of their investments. To support their investors' confidence and secure the funds they need; one possible method of firms could be using their equity offering as signals to convince investors about their profitability. According to Leland and Pyle (1977), firms with higher qualities and potentials would be more willing to retain their equity as much as possible. This project will contend that the lower equity offer in venture capital investment would provide positive signals about the firms' profitability and facilitate investment success, while the contribution of this signaling effect might not have substantial significance in empirical raise funding. It will first by assess this signaling effect by revising and visualizing the Gibbons' mathematical model. It will then discuss the significance of this equity offering signal by and analyzing the investment transaction data of the United States venture capital market.

## 2. Revising Gibbons' Signaling Model.

As is noted in Gibbons (1992), suppose there were two types of firms with different profitability  $\pi$ : H and L. To raise fund  $I$  for a project with potential revenue  $R$ , firms could incentivize their investors by offering equity stake  $0 \leq s \leq 1$  as a signal for their profitability. It could be assumed that the revenue  $R$  would be more attractive than the profit reaping from using this fund  $I$  to invest in other fields, which could be depicted as  $R \geq I(1 + r)$ , where  $r$  is the rate of return of firm by investing in its alternative projects. Hence, for firms, to maintain the space for their profit, the highest acceptable equity stake for firm to undertake the project should secure a positive profit after the equity offering.  $(1 - s)(\pi + R) \geq \pi$ ;  $s \leq \frac{R}{(\pi + R)} = \text{benchmark}_{\text{firm}}(\pi)$  Correspondingly, for investors, the minimum value of their acceptable equity stake to accept the offer should ensure their income exceeding the profit from alternative investments. In light of the information asymmetry, the investor could only evaluate investees' quality by their expectation about the probability  $q$  that firm has low profitability  $L$ , which would constitute their investment confidence. Hence, according to Gibbons (as cited in Vrankić & Skoko, 2021), for investors, their lowest acceptable equity stake could be denoted as  $s \geq \frac{I(1+r)}{(qL+(1-q)H+R)} = \text{benchmark}_{\text{investor}}(q)$ . Given that both investors and investees would pursue the highest profit with lower cost, the investors' lowest acceptable equity stake would determine the equilibrium state of this signaling game. By incorporating the two agents' strategies into Clojure language, we could derive a visualization of this signal model.

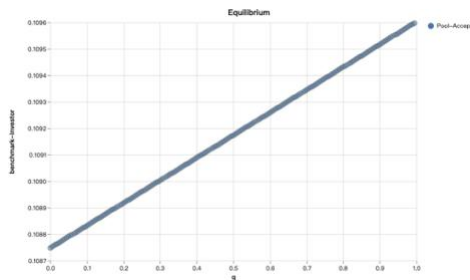


Fig.1

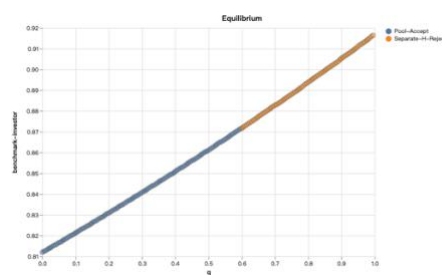


Fig.2

As is manifested in Fig. 1 and Fig. 2, it is indicated from the model of Gibbons (1992) that the equilibrium equity stake would have a positive correlation with investors' expectation about the probability of investing in a low profitability firm. In other words, the higher equity stake in investing game would be correlated with a lower investment confidence, which would also be correlated with lower opportunities for investment success. In Fig.2 where the equity benchmark of a high profitability firm is lower than the expected investor benchmark for a low-type firm:  $\text{benchmark}_{\text{firm}}(H) < \text{benchmark}_{\text{investor}}(1)$ , there would be possibility for high-type firms to reject to undertaking investment upon a higher equilibrium  $s$  and  $q$  (Vrankić & Skoko, 2021). This rejection would further support the negative correlation between equity stake and investment success.

### 3. Data Analysis and Discussion

It is maintained by Perloff, Karp, and Golan (2007) that, to make the decision of investment, rational firms and investors would consider all their available information apart from the outcome of their competition game. To conduct empirical analysis, we retrieved transaction detail of 231 venture capital investment in US over the past 10 years from Refinitiv Eikon (2022). Given that the investor confidence would be hard to measure, we would evaluate the investment success by using the number and dollar amount of investment the firm received to date. Since the amount of a typical investment would be up to million dollars, we use their logarithm values as dependent variable to better manifest their variations. We included the offer size (*Investor\_Equity\_Total*) to avoid the scale problem of equity offering. Given that investors would have different estimation about the development situation of different industries (Vismara, 2016), the dummy variable *Industry\_Sector* was incorporated to control this bias of investors' preference. To control the market fluctuation in different year, the time-series variable *years* was also included. According to the studies conducted by Vismara (2016), we controlled the firm's location advantage by invoking a dummy variable *Location* to indicate whether the firm is in New York. Furthermore, following the method of the studies conducted by Busenitz, Fiet, and Moesel (2005), we also incorporated variables to control the impact of firms' age (*Age*), and the duration of investment round (*Duration*).

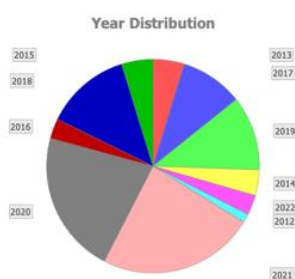


Fig. 3

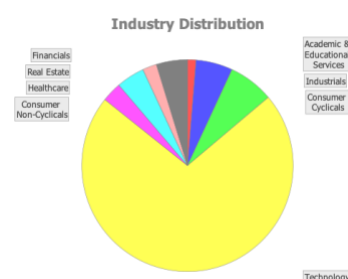


Fig.4

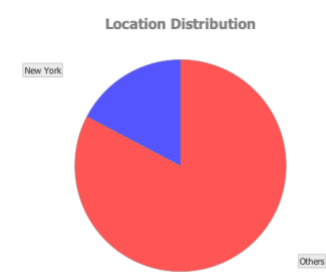


Fig.5

Apart from the investment amount and number, the Refinitiv Eikon (2022) also provided firms' current operating status, which would also illustrate the success of investments. When comparing firms' status with their investment share ratio, it would be manifested that the firms maintaining an active status would normally propose a lower average equity offer ratio while the firms going bankruptcy or defunction would have a higher ratio. This property would help support the signaling effect of the lower equity offering on investor confidence.

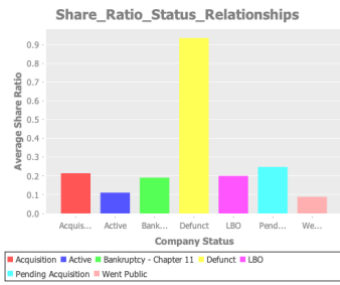


Fig.6

|                       | Investment Amount (log) | Investment Number (log) |
|-----------------------|-------------------------|-------------------------|
| Round                 | 0.6151***               | 0.3453***               |
| Industry_Sector       | -0.0191                 | 0.0020                  |
| Investor_Equity_Total | 0.8554***               | 0.04949***              |
| Duration              | 0.0003**                | 3.65119E-05             |
| Location              | -0.1806                 | -0.0259                 |
| Age                   | -0.0053                 | 0.0054***               |
| years                 | -0.0155                 | -0.0749***              |
| Share_Ratio           | -1.8477***              | -0.1377                 |
| R-square              | 0.741635561             | 0.732474618             |

Table.1

We did OLS regression of investment number and dollar amount on equity offer. Following the study methods in Vismara (2016), we also used the machine learning function in Clojure to conduct logistic regression of company's status and Poisson regression of investment number on equity ratio as a robustness check. The results of the robustness test went align with the original OLS regression. When analyzing the regression statistics, it is found that the higher equity ratio would contribute to a negative variation in investment number and amount. Nevertheless, its contribution to explaining the variation in investment amount and number would be modest considering the lower coefficient, high p-value in t-test (Table. 1), and the lower importance value in the outcome of machine learning (Table. 1). Hence, in this statistical test, we might not find a sufficiently robust statistical support for the significant contribution of signaling effect to investment success.

#### 4. Conclusion and Limitation

In conclusion, this project would help testify the signaling effect of equity offering in venture capital investment. It would support the argument that the lower equity offer would contribute to signaling the investor with a higher potential of firms and facilitate the investment success, while the significance of this effect might not be manifested in empirical data. Nevertheless, the number of samples and control variables in this project would be limited, which would undermine the persuasiveness of regression outcome. In addition, we did not further explore into link between investors' confidence and investment amount, whose robustness would be uncertain. Hence, there needs to be further research with larger sample size and more feasible measures about investors' confidence.

#### 5. References

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