# The Hong Kong University of Science and Technology

## Department of Mathematics

## MPhil THESIS EXAMINATION

# *Real Signaling Games under Asymmetric Information and Finite Option Life*

***By***

## Mr. Qiuqi WANG


***ABSTRACT***

In this thesis, I analyze the real option signaling game models of financing of a risky project under information asymmetry, where the firm quality is only known to the firm management but not outsiders. The firm decides on the optimal investment timing of the risky project that requires upfront fixed funding cost and subsequent operating costs. The fixed funding cost is financed via either equity or debt. The thesis contains my work in two papers, described in two main parts of the thesis separately. The first part of the thesis focuses on equity financing. The firm chooses the optimal time to issue equity to raise capital for the investment project. The number of shares of equity issued to fund the project depends on the outside investors' belief on the firm quality. The low-type firm has the incentive to sell overpriced securities through mimicking the investment strategy of the high-type firm in terms of investment timing and number of equity shares. On the other hand, the high-type firm may adopt the separating strategy by imposing mimicking costs on the low-type firm. Unlike the usual assumption of perpetuity of investment opportunity, the time window of the investment opportunity is assumed to have a finite horizon. I examine the incentive compatibility constraints faced by the firm under different quality types and discuss characterization of the separating and pooling equilibriums. I also explore how the separating and pooling equilibriums evolve over the time span of the investment opportunity. The information costs and abnormal returns exhibit interesting time dependent behaviors, in particular, at time close to expiry of the investment opportunity.

The second part of the thesis extends the signaling game model in the first part into debt financing. The fixed funding cost is financed via either direct bank loan or entering into a three-party equity guarantee swap that involves a bank granting the loan and third party guarantor. Under the guarantee swap agreement, the guarantor is obligated to pay all the future coupon stream to the bank upon default of the firm. In return for the provision of the guarantee, the guarantor obtains certain proportional share of equity of the firm at the time when the swap agreement is signed. The share of equity demanded by the guarantor depends on the outside investors' belief on the firm quality. I characterize the separating and pooling strategies of the firm and discuss the investment and financing choice of the firm between the equity guarantee swap and direct bank loan by comparing the corresponding information costs and real option values.


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| **Date** | **:** | **10 July 2019, Wednesday** |
| **Time** | **:** | **2:30 p.m.** |
| **Venue** | **:** | **Room 3494 (near lifts 25-26)** |
| **Thesis Examination Committee** | **:** | **Prof. Ning CAI (Chairman)**<br>**Prof. Yue Kuen KWOK (Supervisor)**<br>**Prof. Lixin WU** |

***(Open to all faculty and students)***

**The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).**