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Double-decker Monitoring, Capital Squeezes and Entrepreneur's Welfare

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Abstract: Basing on the external financing analysis framework of asymmetric information, the study establishes an general equilibrium model which contains double-decker monitoring and capital squeezes. First of all, the paper studies that how the double-decker monitoring impacts on different classes of entrepreneurs' investment activities and welfare, proves that the double monitoring helps the entrepreneurs with weak financial strength to obtain financing; Secondly, the study proves that the entrepreneurs whose financial strength are very weak without any shadow ring; Finally, the study researches into that capital squeezes has different effects on entrepreneurs with different financial strength, entrepreneurs whose financial strength are in the borderline of system are given the greatest effect from capital squeezes; Entrepreneurs with strong financial strength are benefit from capital squeeze, their net revenue is increased.

Key words: Double-decker monitoring, capital squeezes, welfare effect

INTRODUCTION

Firms in the productive sector may not be hit solely by their own capital shortage but also by a weakness in the balance sheets of the financial institutions that lend to them. At the microeconomic level, firms with weak balance sheets depend on monitoring and certification by financial intermediaries to secure access to funds. In fact whenever borrowers need to resort to investors who play a monitoring or certification function, a weakness in the balance sheet of the latter translates into difficult times for the former, they are thus hurt when banks' real or regulatory solvency declines.

Because there is asymmetric information between banks and borrowers, to ensure the safety of their own funds, Banks are bond to paid attention to the borrower's operating conditions. When the borrowers' business are unfavorable, in order to pass their willingness and pressure, the bank will consider adopting stringent lending policies, conversely, given the loose lending policy. These actions of the banks, are actually a concrete manifestation of the loan supervision.

Bank monitoring plays an important role in the financial literature. Existing foreign literature on banking monitoring, Diamond (1984) first put forward the "entrust monitoring theory", the theory thought about that borrower from the bank has private information, proved that bank monitoring has higher efficiency than the general creditor monitoring; Repullo and Suarez (2000) develops a model of the choice between bank and market finance by entrepreneurial firms that differ in the value of their net worth. The monitoring associated with bank finance ameliorates a moral hazard problem between the entrepreneurs and their lenders. The review article of Gorton and Winton (2003) researched on the microscopic mechanism of bank loans and the incentive mechanism of bank monitoring incentives; Demiroglu and James (2006), Bertrand *et al*. (2007) had done the empirical analysis on bank monitoring and how the loan contract settings affect the firm's future performance. The research of Akhigbe and McNulty (2011) showed that bank invest more monitoring cost, its yield is greater, the monitoring effect is better.

In China, Hu and Xie (2005) through exploring the relationship between interest rate of bank lending and the financial situation of borrowing enterprises, proved that the banks have playing a monitoring role on the business activities of borrowers in China. Zhu and Zhang (2006) analysis the competition among banks impact on bank monitoring enterprises and the opening of banking industry will likely force state-owned commercial banks to provide the monitoring services. The study of Hu *et al*.

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(2008) showed that the banks in China do monitor their borrowers as the great creditors which could be observed through the loan interest rates and the loan renewals only reflect the bank financing effect, not the monitoring effect. Lei (2010) analyzed the bank monitoring of listed firms earning management by game theory, pointed out banks can enhance its monitoring efficiency and reduce the degree of listed firms earning management by increasing punishment for listed firms' earning management, improving its corporate governance and ameliorating relationship banking between the bank and listed firms.

The above literature classified financial institutions as a class, that is only considered bank's monitoring, however, in real life, different type of financial institutions (in this study, we main consider the commercial banks and private financial) has different monitoring intensity, they have different monitoring cost and demand different rate of return on their investment. Then, the monitoring of different types of financial institutions will have what kind of impact on entrepreneur financing? the capital squeeze will produce what kind of impact on financial institutions and entrepreneurs.

The research of this study is to solve those problems. The contribution and work of the study is that: First, follows Holmstrom and Tirole (1997), we introduce second kind of monitor (private financial) to monitor the entrepreneur's financing activities, basing on the external financing analysis framework of asymmetric information, the study establishes an general equilibrium model which contains double-decker monitoring. Second, discusses the double-decker monitoring will impact on the welfare and the financing activities of entrepreneur. Last, basing on the double-decker monitoring model, our conclusion shows that capital squeezes has different effects on entrepreneurs with different financial strength.

BASIC ASSUMPTIONS

We adopt the fixed-investment model, the basic assumptions are as follows:

Participants: Entrepreneurs, banks and the private lenders (monitors) and ordinary investors (uninformed investors). Consider a set of risk-neutral entrepreneurs, technically a continuum of mass 1 of them. Uninformed investors are individually small, they therefore free-ride in the monitoring activity and remain uninformed, they demand expected rate of return γ. We will assume that both banks and private lenders are composed of a continuum of members. Banks with total net worth K_{m_1}, they demand rate of return χ_1 on their investment; private lenders with total net worth K_{m2}, they demand rate of return χ_2 on their investment. $K_m = K_{m_1} + K_{m_2}$, $\chi_2 > \chi_1 > \gamma$. All the banks, private lenders and ordinary investors are risk neutral. The entrepreneurs are protected by limited liability and so their income cannot take negative values. We allow for one dimension of heterogeneity: Entrepreneurs differ in their assets A. Namely, A which recall is an index of a firm's strength of balance sheet, is distributed in the population of entrepreneurs according to the continuous cumulative distribution function G(A) with support [0, +∞] and density g(A).Where the total entrepreneurial capital is:

$$K_b = \int_0^{+\infty} A dG(A)$$

A project requiring fixed investment I and entrepreneur owns assets or net worth A. In order to implement the project, the entrepreneurs must financing to banks or ordinary investors. Investment has risk, if undertaken, the project either succeeds, that is, yields verifiable income R, or fails and yields no income. The probability of success depends on the entrepreneur's behavior, it is equal to p_H if the entrepreneur works and p_L if she shirks (Table 1). Shirking yields a private benefit B>0 or b_1, b_2 ($B>b_1>b_2>0$), to the entrepreneur, the entrepreneur's behavior is unobservable. Where $\Delta p = p_H - p_L > 0$. When she borrows solely from uninformed investors, we assume that the project has positive NPV if and only if the entrepreneur behaves, i.e., $p_H R - \gamma I > 0 > p_L R - \gamma I + B$.

Commercial banks can at monitoring cost c_1 rule out the B project, the private lenders can at monitoring cost c_2 rule out the b_1 project, $c_1 < c_2$. As for the entrepreneur's private benefit, the monitor's cost c_1, c_2 if any, is incurred in the second period 2.

We assume $p_H R - \gamma I < p_H B/(\Delta p)$. Interest rate divided into two cases: one is exogenous, uninformed investors have access to a "storage facility" yielding γ units of good for each unit of investment. Their savings are completely elastic at interest rate $r = \gamma - 1$. The other is endogenous, the uninformed investors' savings are equal to $S(\gamma)$, where $S'(\gamma) > 0$. Lenders behave competitively in the sense that the loan, if any, makes zero profit.

Table 1: Fixed investment model for different participants

	G	b_1	b_2	B
Probability of success	p_H	p_L	p_L	p_L
Probability of failure	$1-p_H$	$1-p_L$	$1-p_L$	$1-p_L$
Private benefit	0	b_1	b_2	B

UNINFORMED FINANCING

Uninformed financing refers to that the entrepreneur borrows solely from uninformed investors, it is easy to see that one optimal contract will have the following simple structure.

Suppose that ordinary investors are willing to finance the project of a representative entrepreneur, The entrepreneur contributes A and the investors I-A. The optimal contract allocates the profit R in the case of success between representative entrepreneur R_b and investors R_u and gives 0 to both in the case of failure.

The optimal compensation contract is then:

$$\begin{cases} \max_{R_b} \quad p_H R_b - \gamma A \\ \text{s.t.} \quad (1)(\Delta p)R_b \geq B \\ \qquad (2)p_H(R - R_b) \geq \gamma(I - A) \end{cases} \tag{1}$$

According to the conclusion of Holmström and Tirole (1997), we have following lemma:

Lemma 1: In the maximization problem 1, if and only if $A \geq \bar{A}(\gamma)$, the representative entrepreneur with owns assets A is able to finance to ordinary investors, where:

$$\bar{A}(\gamma) = I - \frac{p_H}{\gamma}[R - \frac{B}{\Delta p}]$$

This time, the ordinary investor and entrepreneur's net utility is then:

$$U_u^*(A) = 0; \quad U_b^*(A) = p_H R - \gamma I$$

UNINFORMED FINANCE

Commercial bank lending channel: We will say that the entrepreneur resorts to "indirect or informed" finance if a monitor is enlisted as well. When $A < \bar{A}(\gamma)$, the entrepreneur cannot obtain uninformed financing. The representative entrepreneur can obtain informed financing through banks. This study only focus on a pure matter of accounting of investment flows and has no real economic implication.

The representative entrepreneur, commercial banks and investors are the participants of informed financing. We may assume contract form is: On the investment side, the borrower brings A, commercial banks I_{m_1} and the uninformed investors $I_u = I - A - I_{m_1}$. The optimal contract allocates the profit R in the case of success between borrower R_b, uninformed investors R_u, commercial banks R_{m_1} and gives 0 to all in the case of failure.

The representative entrepreneur and the investors' optimal compensation contract is then the solution to the following maximization problem:

$$\begin{cases} \max\limits_{R_b, R_{m_1}} \quad p_H R_b - \gamma A \\ \text{s.t.} \quad (1)b_1 \leq (\Delta p)R_b < B \\ \qquad (2)p_H R_{m_1} - c_1 \geq \gamma I_{m_1} \\ \qquad (3)p_H R_{m_1} - c_1 \geq p_L R_{m_1} \\ \qquad (4)p_H(R - R_{m_1} - R_b) \geq \gamma(I - A - I_{m_1}) \end{cases} \tag{2}$$

where the objective function is the representative entrepreneur's expected net revenue. Because the lenders behave competitively in the sense that the loan, if any, makes zero profit, so:

$$p_H R_{m_1} = \chi_1 I_{m_1}; \quad p_H R_u = \gamma I_u$$

The representative entrepreneur's net utility is then:

$$U_b(\gamma, \chi_1) = [p_H R - (\chi_1 - \gamma)I_{m_1}] - \gamma I$$

Constraint (1) is the representative entrepreneur's incentive compatibility constraint.

Constraint (2) stands for the monitors' individual rationality constrain:

$$p_H R_{m_1} - c_1 = \chi_1 I_{m_1} - c_1 \geq \gamma I_{m_1} \Leftrightarrow (\chi_1 - \gamma)I_{m_1} \geq c_1$$

So that, when monitored, the monitors' incentive compatibility constraint is then:

$$p_H R_{m_1} - c_1 \geq p_L R_{m_1} \Leftrightarrow (\Delta p)R_{m_1} \geq c_1$$

Constraint (4) stands for the ordinary investor's individual rationality constrain.

Proposition 1: if and only if:

$$c_1 < \frac{B - b_1}{1 - \gamma/\chi_1}$$

there is $\underline{A}_1(\gamma, \chi_1) < \bar{A}(\gamma)$ where:

$$\underline{A}_1(\gamma, \chi_1) = I - \frac{p_H(R - (b_1 + c_1)/(\Delta p))}{\gamma} - \frac{p_H c_1}{\chi_1 \Delta p}$$

Proof: Assume $\underline{A}_1(\gamma, \chi_1) < \bar{A}(\gamma)$, i.e.:

$$I - \frac{p_H(R - (b_1 + c_1)/(\Delta p))}{\gamma} - \frac{p_H c_1}{\chi_1 \Delta p} < I - \frac{p_H(R - B/(\Delta p))}{\gamma}$$

so:

$$c_1 < \frac{B - b_1}{1 - \gamma / \chi_1}$$

Proposition 2: The optimization problem 2 has three possible solutions:

- If $A \geq \bar{A}(\gamma)$, $I_{m_1} = 0$
- If $\underline{A}_1(\gamma, \chi_1) \leq A < \bar{A}(\gamma)$, $I_{m_1} = p_H c_1 / (\chi_1 \Delta p)$
- If $A < \underline{A}_1(\gamma, \chi_1)$, the optimal solution does not exist

Proof: First, if without a monitor, the borrower, when financed, obtains net utility $U_b^*(\gamma) = p_H R - \gamma I$, with a monitor, the entrepreneur's net utility, is then:

$$U_b(\gamma, \chi_1) = [p_H R - (\chi_1 - \gamma) I_{m_1}] - \gamma I < p_H R - \gamma I$$

So, the entrepreneur is better off dispensing with a monitor if she can afford to, i.e., if $A \geq \bar{A}(\gamma)$, there is $I_{m_1} = 0$.

Second, when $A \geq \bar{A}(\gamma)$, the entrepreneur cannot obtain uninformed financing. She will want to minimize the monitor's capital involvement I_{m_1}. This minimum stake in turn requires a minimum investment:

$$I_{m_1} \geq I_{m_1}(\chi_1) = \frac{p_H R_{m_1}}{\chi_1} = \frac{p_H c_1}{\chi_1 \Delta p}$$

Therefore, the necessary and sufficient condition for that the optimization problem 2 has solution is then $p_H[R - (b_1 + c_1)/(\Delta p)] \geq \gamma(I - A - I_{m_1})$ i.e.:

$$A \geq \underline{A}_1(\gamma, \chi_1) = I - \frac{p_H (R - (b_1 + c_1)/(\Delta p))}{\gamma} - \frac{p_H c_1}{\chi_1 \Delta p}$$

Third, when $A < \underline{A}_1(\gamma, \chi_1)$, the entrepreneur cannot obtain informed financing from commercial banks, so the optimal solution does not exist.

Private lending channel: When $A < \underline{A}_1(\gamma, \chi_1)$, the entrepreneur cannot obtain informed financing from commercial banks. So, the entrepreneur had to seek alternative private lenders. The representative entrepreneur, private lenders and investors are the participants of informed financing. We may assume contract form is.

The borrower brings A, private lenders I_{m2} and the uninformed investors $I_u = I - A - I_{m_1}$. The optimal contract allocates the profit R in the case of success between borrower R_b, uninformed investors R_u, private lenders R_{m_2} and gives 0 to all in the case of failure. The representative entrepreneur and the investors' optimal compensation contract is then the solution to the following maximization problem:

$$\begin{cases} \max\limits_{R_b, R_{m_2}} & p_H R_b - \gamma A \\ \text{s.t.} & (1) b_2 \leq (\Delta p) R_b < b_1 \\ & (2) p_H R_{m_2} - c_2 \geq \gamma I_{m_2} \\ & (3) p_H R_{m_2} - c_2 \geq p_L R_{m_{21}} \\ & (4) p_H (R - R_{m_2} - R_b) \geq \gamma (I - A - I_{m_2}) \end{cases} \quad (3)$$

Because the lenders behave competitively in the sense that the loan, if any, makes zero profit, so:

$$p_H R_{m_2} = \chi_1 I_{m_2}; \quad p_H R_u = \gamma I_u$$

The representative entrepreneur's net utility is then:

$$U_b(\gamma, \chi_2) = [p_H R - (\chi_2 - \gamma) I_{m_2}] - \gamma I$$

Similar analyzes with Proposition 2, we have the following propositions:

Lemma 2: If and only if:

$$c_2 < \frac{(1 - \gamma / \chi_1) c_1 + (b_1 - b_2)}{1 - \gamma / \chi_2}$$

there is $\underline{A}_2(\gamma, \chi_2) < \underline{A}_1(\gamma, \chi_1)$. Where:

$$\underline{A}_2(\gamma, \chi_2) = I - \frac{p_H (R - (b_2 + c_2)/(\Delta p))}{\gamma} - \frac{p_H c_2}{\chi_2 \Delta p}$$

Proposition 3: The optimization problem (3) has three possible solutions:

- If $A \geq \underline{A}_1(\gamma, \chi_1)$, $I_{m_2} = 0$
- $\underline{A}_2(\gamma, \chi_2) \leq A < \underline{A}_1(\gamma, \chi_1)$, $I_{m_2} = p_H c_2 / (\chi_2 \Delta p)$
- If $A < \underline{A}_2(\gamma, \chi_2)$, the optimal solution does not exist.

Proof: First, if monitored by commercial banks, the entrepreneur obtains net utility:

$$U_b^*(\gamma, \chi_1) = p_H R - (\chi_1 - \gamma) I_{m_1} - \gamma I$$

if monitored by private lenders, the entrepreneur's net utility, is then:

$$U_b^*(\gamma, \chi_2) = [p_H R - (\chi_2 - \gamma) I_{m_2}] - \gamma I$$

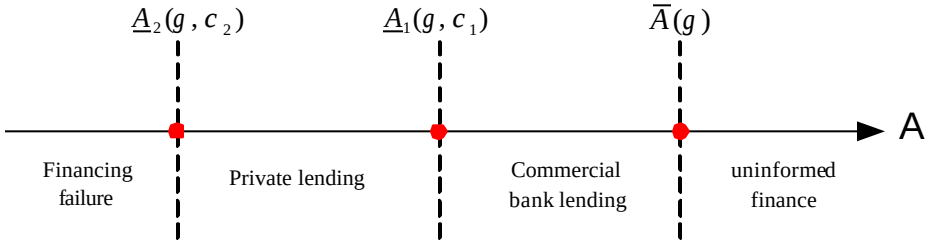

Fig. 1: Financial strength and financing way

When $I_{m_1} = I_{m_2}$, there are $U_b^*(\gamma, \chi_1) > U_b^*(\gamma, \chi_2)$, so the entrepreneur finance to commercial banks or ordinary investors instead to private lenders, i.e., if $A \geq \underline{A}_1(\gamma, \chi_1)$, there is $I_{m_2} = 0$.

Second, when $\underline{A}_2(\gamma, \chi_2) \leq A < \underline{A}_1(\gamma, \chi_1)$ the entrepreneur can obtain neither uninformed financing nor commercial banks' financing. She will want to minimize the monitor's capital involvement I_{m_2}. This minimum stake in turn requires a minimum investment:

$$I_{m_2} \geq I_{m_2}(\chi_2) = \frac{p_H R_{m_2}}{\chi_2} = \frac{p_H c_2}{\chi_2 \Delta p}$$

the necessary and sufficient condition for that the optimization problem (3) has solution is then:

$$p_H[R - (b_2 + c_2)/(\Delta p)] \geq \gamma(I - A - I_{m_2})$$

i.e.:

$$A \geq \underline{A}_2(\gamma, \chi_2) = I - \frac{p_H(R - (b_2 + c_2)/(\Delta p))}{\gamma} - \frac{p_H c_2}{\chi_2 \Delta p}$$

Third, when $A < \underline{A}_2(\gamma, \chi_2)$, the entrepreneur cannot obtain informed financing from commercial banks, so the optimal solution does not exist.

Proposition 2, Proposition 3 and Fig. 1 show the relationship between the representative entrepreneur's financial strength and their financing model.

CAPITAL MAEKET EQUILIBRIUM

The interest rate is exogenously given when we discuss the necessary and sufficient conditions of uninformed financing and informed financing. We will determine the equilibrium interest rate thought the capital market equilibrium. Because the banks obtain no rent from monitoring, the monitoring capital of commercial banks is $I_{m_1}(\chi_1) = c_1/(\chi_1 - \gamma)$, the monitoring capital of private lenders is $I_{m_2}(\chi_2) = c_2/(\chi_2 - \gamma)$. Net demand of uninformed capital is:

$$\begin{aligned} D_u(\gamma, \chi_1, \chi_2) &= \int_{\bar{A}(\gamma)}^{\infty} (I - A) dG(A) \\ &+ \int_{\underline{A}_1(\gamma, \chi_1)}^{\bar{A}} (I - A - I_{m_1}(\chi_1)) dG(A) \\ &+ \int_{\underline{A}_2(\gamma, \chi_2)}^{\underline{A}_1(\gamma, \chi_1)} [I - A - I_{m_2}(\chi_2)] dG(A) - \int_0^{\underline{A}_2(\gamma, \chi_2)} A dG(A) \end{aligned}$$

we equate demand for informed capital:

$$D_m(\gamma, \chi_1, \chi_2) = D_{m_1}(\gamma, \chi_1) + D_{m_2}(\gamma, \chi_1, \chi_2)$$

Where:

$$D_{m_1}(\gamma, \chi_1) = [G(\bar{A}(\gamma)) - G(\underline{A}_1(\gamma, \chi_1))] I_{m_1}(\chi_1)$$

is informed capital borrows from commercial banks:

$$D_{m_2}(\gamma, \chi_1, \chi_2) = [G(\underline{A}_1(\gamma, \chi_1)) - G(\underline{A}_2(\gamma, \chi_2))] I_{m_2}(\chi_2)$$

is informed capital borrows from private lenders.

Proposition 4: In the fixed-investment model, a increase in the rate demanded by commercial banks will lead to a smaller informed capital borrows from commercial banks but will increase informed capital borrows from private lenders; a increase in the rate demanded by private lenders will lead to a smaller informed capital borrows from private lenders but has no impact on informed capital borrows from commercial banks, aggregate demand of informed capital is decrease.

Proof: According to the expression of aggregate demand of informed capital, we have:

$$\frac{\partial D_{m_1}(\gamma, \chi_1)}{\partial \chi_1} = [G(\bar{A}(\gamma)) - G(\underline{A}_1(\gamma, \chi_1))] \frac{\partial I_{m_1}(\chi_1)}{\partial \chi_1} - \frac{\partial G(\underline{A}_1(\gamma, \chi_1))}{\partial \chi_1} I_{m_1}(\chi_1)$$

Where:

$$\frac{\partial I_{m_1}(\chi_1)}{\partial \chi_1} = -\frac{c_1}{(\chi_1 - \gamma)^2} < 0$$

$$\frac{\partial G(\underline{A}_1(\gamma,\chi_1))}{\partial \chi_1} = g(\underline{A}_1(\gamma,\chi_1))\frac{p_H c_1}{\Delta p \chi_1^2} > 0$$

$$G(\overline{A}(\gamma)) - G(\underline{A}_1(\gamma,\chi_1)) > 0$$

so:

$$\frac{\partial D_{m_1}(\gamma,\chi_1)}{\partial \chi_1} < 0$$

On the other hand:

$$\frac{\partial D_{m_2}(\gamma,\chi_1,\chi_2)}{\partial \chi_1} = g(\underline{A}_1(\gamma,\chi_1))\frac{c_1}{\Delta p \chi_1^2} > 0$$

Like wise:

$$\frac{\partial D_{m_1}(\gamma,\chi_1,\chi_2)}{\partial \chi_2} < 0, \qquad \frac{\partial D_{m_1}(\gamma,\chi_1)}{\partial \chi_2} = 0$$

Proposition 5: In the fixed-investment model, a increase in interest rate γ will lead to a smaller net demand of uninformed capital. Contrarily, a decrease in interest rate γ will increase the net demand of uninformed capital.

Proof: On the one hand, due to the increase of γ, the $\underline{A}_1(\gamma,\chi_1)$, $\underline{A}_2(\gamma,\chi_2)$ increased at the same time, so that part of the entrepreneur lost financing ability, thus squeezing the number of entrepreneurs who acquire the indirect loans; On the other hand, the increase of γ makes $\overline{A}(\gamma)$ also increased, so that, more entrepreneurs gain not uninformed financing but informed financing. These two effects will lead to reduce aggregate demand the uninformed capital.

COMPARATIVE STATIC ANALYSIS

We can consider the impact of two types of recession:

- Credit crunch (lending channel), K_{m_1} or K_{m_2} decreases
- Shortage of savings. γ increases (in the perfectly elastic case) or S(•) decreases.

We are easy to draw the following proposition:

Proposition 6: In the fixed-investment model, in the three types of capital squeeze, the threshold $\underline{A}_1(\gamma,\chi_1)$ and $\underline{A}_2(\gamma,\chi_2)$ over which firms can raise financing increases, so the marginal firms with weak balance sheets (with A just above $\underline{A}_1(\gamma,\chi_1)$) will unable to financing to commercial bank, the firms with very weak balance sheets (with A just above $\underline{A}_2(\gamma,\chi_2)$) will be squeezed out.

Proof: We use the reduction to absurdity, first to prove that capital squeeze makes the threshold $\underline{A}_2(\gamma,\chi_2)$ increase. Assume capital squeeze makes the threshold $\underline{A}_2(\gamma,\chi_2)$ decrease. the decrease of A^e and $\underline{A}_2(\gamma,\chi_2)$ will increase the aggregate investment demand but the increase in aggregate investment demand can only come from uninformed capital, so S(•) and γ will increase, so the uninformed capital has become more expensive, this reduced demand for uninformed capital. According to $\underline{A}_1(\gamma,\chi_1)$, the increase in γ will make $\underline{A}_1(\gamma,\chi_1)$ rise. Because $\underline{A}_2(\gamma,\chi_2)$ goes down and $\underline{A}_1(\gamma,\chi_1)$ increases, the number of entrepreneurs through private financing institutions for financing strictly increases, the rate of return χ^2 increases simultaneously, both the informed capital and uninformed capital has become more expensive, according to expression of $\underline{A}_2(\gamma,\chi_2)$, we know that $\underline{A}_2(\gamma,\chi_2)$ can't drop. This contradiction with the original assumption, so $\underline{A}_2(\gamma,\chi_2)$ increases.

Similarly, the capital squeeze makes $\underline{A}_1(\gamma,\chi_1)$ rose.

NUMERICAL CALCULATION

The numerical simulation of the theoretical model as follows. There all of γ and χ_1, χ_2 are exogenous.

Assume $p_H = 0.8$, $p_L = 0.4$, $R = 1200$, $B = 300$, $b_1 = 250$, $b_2 = 200$, $c_1 = 50$, $c_2 = 60$, $I = 800$, $\gamma = 1$, $\chi_1 = 1.1$, $\chi_2 = 1.14$.

Form 2 shows that the representative entrepreneur with cash on hand A in different interval, their financing model is also different. If $A<262.5$, the representative entrepreneur can't gain financing; If $252.5 \le A < 359.6$, the representative entrepreneur access to the private lenders in order to raise financing; If $359.96 \le A 450.5$, the representative entrepreneur access to commercial banks in order to raise financing; If $A \ge 450.5$, the representative entrepreneur can get direct financing.

As form 2 shown, the representative entrepreneur get maximum utility in direct financing but get minimum utility when they finance to the private lenders.

Form 2: The representative entrepreneur's financing and welfare under exogenous rate

A	I_{m1}	I_{m2}	I_u	R_{m1}	R_{m2}	R_u	U_b
260	0.0	0.0	0.0	0.0	0.0	0.0	0.0
263	91.0	0.0	446.0	125.0	0.0	574.0	130.0
300	91.0	0.0	409.0	125.0	0.0	527.0	130.0
350	91.0	0.0	359.0	125.0	0.0	462.0	130.0
359	91.0	0.0	350.0	125.0	0.0	451.0	130.0
360	0.0	105.0	335.0	0.0	150.0	431.0	124.0
390	0.0	105.0	305.0	0.0	150.0	392.0	124.0
420	0.0	105.0	275.0	0.0	150.0	354.0	124.0
450	0.0	105.0	245.0	0.0	150.0	315.0	124.0
451	0.0	0.0	349.0	0.0	0.0	449.0	136.0
550	0.0	0.0	250.0	0.0	0.0	322.0	136.0
650	0.0	0.0	150.0	0.0	0.0	193.0	136.0
750	0.0	0.0	50.0	0.0	0.0	64.4	136.0
800	0.0	0.0	0.0	0.0	0.0	0.0	136.0

CONCLUSION

Based on the information asymmetrical external financing analysis framework, the study in-depth analysis the relationship between double-decker monitoring, capital squeezes and entrepreneur's welfare, The main conclusions are:

- Compared with one monitoring, double-decker monitoring can help the firms with weak balance sheets to obtain financing, so they become entrepreneurs and obtain a positive utility
- For the firms with very weak balance sheets $(A \in [0, \underline{A}_2(\gamma,\chi_2))$, capital squeeze will have no effect on them, because whether capital squeeze or not, they can only become ordinary investors and get zero profit
- Firms with weak balance sheets $(A \in [\underline{A}_1(\gamma,\chi_1), \bar{A}(\gamma))$ which need access to commercial banks in order to raise financing, are hurt by a credit crunch, because as monitoring capita K_{m_1} shrinks, the commercial banks demand a higher rate of return, χ_1 which squeezes out the marginal firms (with A just above $\underline{A}_1(\gamma,\chi_1)$), so they have to turn to private financing, their welfare is reduced. Firms with very weak balance sheets $(A \in [\underline{A}_2(\gamma,\chi_2), \underline{A}_1(\gamma,\chi_1))$ which need access to private lenders in order to raise financing, are hurt deeply by a credit crunch, because as monitoring capital K_{m_2} shrinks, the private lenders demand a higher rate of return, χ_2 which squeezes out the marginal firms (with A just above $\underline{A}_2(\gamma,\chi_2)$), thus they become ordinary investors and get zero profit
- In the fixed-investment model, in any types of capital squeeze, aggregate investment goes down and the threshold over which firms can raise financing increases, so credit crunch squeezes out the marginal firms and hurts the others

Of course, there are some unsolved problems in this study, such as we don't consider the open economy and the dynamic relationship between the monitoring capital and business capital, etc. For the factors which are not involved in this study, we also can think deeply about in the framework of this study.

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