Chapter 15
Entrepreneurship and Credit Rationing: How to Screen Successful Projects in this Current Crisis Period

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Abstract The current credit rationing heavily influences entrepreneurship and, more dramatically, the viability of innovation projects. In this context, mechanisms to screen successful projects are of paramount importance for both lenders and entrepreneurs. We present an experiment to test the collateral-interest mechanism of credit screening. Our results confirm that incentive-compatible pairs of collateral-interest rate can distinguish between projects of different success probability, even in moral hazard settings.

15.1 Introduction

The current collapse of credit markets has left entrepreneurs facing severe credit rationing, which affects the viability of its projects (Carmona et al. 2012; Cuervo et al. 2007). If lenders could screen borrowers by their success probability (risk level), a separating equilibrium that reveals information would arise and credit rationing would be overcome. Thus, mechanisms to screen investment projects by their success probability become of paramount importance for both lenders and entrepreneurs (Arzubiaga et al. 2012, 2013).

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In credit markets with asymmetric information, lenders can formulate sets of incentive-compatible contracts that consider collateral and interest rates simultaneously as a mechanism to reveal the borrower's ex ante risk level. Early theoretical studies considered collateral and interest rates in an isolated manner. These studies showed that adverse selection resulted in riskier credit applicants selecting high interest rates or high collateral (see Stiglit and Weiss (1981); Wette (1983); Boot et al. (1991)). Later analyses by Bester (1985, 1987) and Chan and Kanatas (1985), however, considered contracts that lead to separation of types by offering rates of interest and collateral simultaneously. Bester (1985) showed that by offering pairs of incentive-compatible contracts with different interest rate-collateral combinations, lenders are capable of indirectly distinguishing between borrowers of different risk levels, which in turn reduces credit rationing. In his later work, Bester (1987) also considered the possibility of moral hazard due to ex ante asymmetric information and showed that the demanded collateral softens the effects of moral hazard, since higher collateral gives incentives to borrowers to choose projects involving a smaller risk ex post.

Notwithstanding the relevance of these results, the hypothesis that contracts combining pairs of collateral and interest rates are incentive compatible for projects with different risk levels, with or without moral hazard, has not yet been tested experimentally. In addition, this hypothesis is difficult to be tested by field data. Indeed, there is a scarcity of microdata on the contractual terms of commercial bank loans, which are usually confidential. Just Comeig et al. (2013) have tested empirically the screening role of loan contracts that consider collateral-interest margins simultaneously. Given the difficulties inherent with field data, laboratory experiments offer an attractive "complementary" approach, because they make it possible to control, isolate, and vary the factors of interest while keeping all others constant.

In this chapter, we present an experiment designed to test Bester's hypothesis that contracts that combining collateral and interest rates are incentive compatible and that these contracts can also smooth moral hazard. We find that pairs of contracts that combine interest rates and collateral allow lenders to separate borrowers by their success probability; in addition, we also find that contracts with higher collateral make subjects less likely to increase the probability of failure of their projects in an environment with moral hazard. Thus, we provide evidence that supports Bester's hypothesis.

There are only a few experimental papers on screening; most of them have examined screening in insurance and labor markets and have focused on the principal's behavior (see Shapira and Venezia (1999), Posey and Yavas (2004), and Kübler et al. (2008)). This is the first experiment on credit screening that focuses on the self-selection mechanism and not on the principal's behavior. (This experiment was first presented in Spanish in Capra et al. (2001) working paper, and then in English in Capra et al. (2005) working paper.) Later works by Bediou et al. (2013) and Comeig et al. (2012) have used the incentive-compatible contracts designed here to analyze framing and gender effects in self-selection and credit screening mechanisms.

The remainder of the chapter is organized as follows. The next section presents the experimental design and hypotheses. Section 15.3 presents the results; and Sect. 15.4 summarizes the main conclusions.

15.2 Experimental Design and Procedures

We use experimental methods to analyze incentive compatibility in loan contracts that combine collateral and interest rate requirements under two different environments: first without moral hazard, and then with moral hazard due to ex ante asymmetric information. We design ad hoc contracts following Bester (1985, 1987) to test the following hypotheses:

> Hypothesis 1: By offering two incentive-compatible contracts, borrowers can be separated by their risk levels. Lower risk borrowers choose contracts with higher collateral (separating effect of contracts).

> Hypothesis 2: When there is moral hazard generated by ex ante asymmetric information, higher collateral incentive borrowers choose lower risk projects (positive incentive effect of collateral).

We design a setting with N_i subjects who can have one of the two types $i = \mathrm{s}$ (safer) or r (riskier), according to the risk level of their projects. Subjects in the experiment can acquire an asset in order to develop their projects with some expected future return. The project of a type s borrower has a return of 600 monetary units in case of success with a probability of 0.9 and a return of zero in case of failure. Type r can develop a project that provides a return of 1,080 monetary units in case of success and zero in case of failure, each with equal probability.

We offered two contracts for the purchase of the asset. Each contract includes two features: the price to be paid and a security deposit, representing the collateral. In this experimental market, the buyers do not pay for the asset at the time the contract is signed, but at the end of the round when the buyer learns about the return the asset yields. If the project succeeds, they earn the asset's return and pay the contract price. However, if the project fails, they pay the security deposit. Each individual starts each market round with an initial wealth of 300 units; any amount equal to 300 or less can be used as a security deposit. There are five rounds in the market and each subject makes five independent decisions (one for each round) in which only the contracts (price and security deposit) change. Each subject must choose one or none of the two offered contracts in each round, whichever he/she prefers. The subjects who do not choose any contract in the round receive a return of 30 monetary units at the end of the round from a risk-free investment. The expected returns for each individual s and r for acquiring the asset are given as follows:

$$ER_{\mathrm{s}} = 0.9(300 + 600 - \text{Price}) + 0.1(300 + 0 - \text{Deposit})$$

$$ER_{\mathrm{r}} = 0.5(300 + 1{,}080 - \text{Price}) + 0.5(300 + 0 - \text{Deposit})$$

In each of the rounds, we offered a pair of theoretically incentive-compatible contracts (C_1, C_2) with: $ER_s(C_2) \geq ER_s(C_1)$ and $ER_r(C_1) \geq ER_r(C_2)$.

Table 15.1 Treatment A: pairs of offered contracts and expected returns

					Treatment A			
	C_1		C_2		Safer project		Riskier project	
Round	Price	Dep.	Price	Dep.	$ER_s(C_1)$	$ER_s(C_2)$	$ER_r(C_1)$	$ER_r(C_2)$
1	360	0	166	300	516 (72)	660.6 (220.2)	660 (360)	607 (607)
2	335	25	169	275	536 (87)	660.4 (211.8)	660 (385)	618 (593)
3	310	50	172	250	556 (102)	660.2 (203.4)	660 (410)	629 (579)
4	285	75	175	225	576 (117)	660 (195)	660 (435)	640 (565)
5	260	100	177	200	596 (132)	660.7 (186.9)	660 (460)	651.5 (551.5)

ER(·) Expected returns for each contract under each treatment. Standard deviations are in parenthesis

Table 15.1 shows the pairs of contracts offered to the subjects in each round; it also shows the expected returns and the standard deviations of each of the contracts in each round. The later information was not given to the subjects. Subjects made their choices based on their own risk tolerance, the price, and security deposit of each contract.

Treatment A is devoted to test whether the pairs of contracts designed, which combine prices and security deposits, permit the separation of heterogeneous individuals by their risk level. After making their decisions in Treatment A, all subjects read the instructions for Treatment B. In Treatment B, we introduced moral hazard due to ex ante asymmetric information to test the effectiveness of these contracts as a mechanism to separate borrowers with different risk levels. We started within the same previously described context, the only change being that subjects had the opportunity to make another decision before learning about the project's success or failure. This second decision was whether to modify the original project, which entailed an increase in the projects' expected return and probability of failure. Thus, moral hazard originated from the lack of control that sellers had on the buyers' project choice. Note that in our design, if the buyer was successful, he automatically paid the contract price; thus, we excluded moral hazard derived from the ex post asymmetric information between buyers and sellers.

The second treatment also contained several rounds in which each subject $i = \text{s, r}$ was offered a pair of incentive-compatible contracts shown in Table 15.1. Subjects chose one of these contracts or a risk-free investment, exactly as in Treatment A. The pairs of contracts were identical to those in Treatment A (pairs 1–5 in Tables 15.1 and 15.2) and consequently the expected results, too, in case individuals did not modify original projects. However, when individuals modified original projects, they also modified their expected returns.

Table 15.2 shows the contracts 1–5 expected returns and standard deviations.

The modified project of s individuals provided a return of 1,200 monetary units in case of success, with a probability of 0.6, and zero in case of failure. For subjects r, modifying the original projects had a success probability of 0.3 and resulted in a return of 2,160 monetary units; failure resulted in a payoff equal to zero. Hence, the expected returns for each s and r subjects for modifying the initial project are given as follows:

$$ER_{sm} = 0.6(300 + 1{,}200 - \text{Price}) + 0.4(300 + 0 - \text{Deposit})$$

Table 15.2 Treatment B: pairs of offered contracts and expected returns

	Initially safer project				Initially riskier project			
	Keep initial project		Change		Keep initial project		Change	
Round	$ER_s(C_1)$	$ER_s(C_2)$	$ER_s(C_1)$	$ER_s(C_2)$	$ER_r(C_1)$	$ER_r(C_2)$	$ER_r(C_1)$	$ER_r(C_2)$
1	516 (72)	660.6 (220.2)	804 (411.5)	800.4 (653.5)	660 (360)	607 (607)	840 (824.9)	688.2 (1,051.2)
2	536 (87)	660.4 (211.8)	809 (436)	808.6 (639.8)	660 (385)	618 (593)	830 (847.8)	704.8 (1,038.4)
3	556 (102)	660.2 (203.4)	814 (460.5)	816.8 (626.1)	660 (410)	629 (579)	820 (870.7)	721.4 (1,025.6)
4	576 (117)	660 (195)	819 (485)	825 (612.4)	660 (435)	640 (565)	810 (893.6)	738 (1,012.7)
5	596 (132)	660.7 (186.9)	824 (509.5)	833,8 (599.1)	660 (460)	651.5 (551.5)	800 (916.5)	754.9 (1,000.4)

ER(·) Expected returns for each contract under each treatment. Standard deviations are in parenthesis

$$ER_{rm} = 0.3(300 + 2{,}160 - \text{Price}) + 0.7(300 + 0 - \text{Deposit})$$

Thus, a situation was created in which both types of individuals experienced an increase in their expected return, if they changed the original project.

We are interested in testing Bester's (1987) hypothesis that contracts with higher co-payment have a positive incentive effect in agents, making higher risk projects less attractive. If this hypothesis is not rejected in the experiments, the s subjects who choose to increase the risk of the project must choose Contract C_1, with the lower security deposit. However, the s subjects who choose not to increase the risk of the project must also choose Contract C_2, with the higher security deposit (as in Treatment A). Individuals r obtain higher returns and lower standard deviations with Contract C_1 than with Contract C_2 either by modifying the initial contract or not. Thus, the r subjects are also expected to choose Contract C_1, with the lower security deposit.

We organized four experimental sessions with students recruited from the Washington and Lee University (USA) and from the University of Valencia (Spain). There were 10 participants in each experimental session except the second, which had 14 participants; no single subject participated in more than one session. Each session lasted for 1 h and 30 min and consisted of ten rounds. After randomly and privately assigning their types, riskier or safer, we read the instructions and answered questions. The subjects, in each round, had an initial wealth of 300 monetary units and made their choices privately. During the experiment they were not allowed to communicate with the rest of the participants and each subject only knew their own project success and failure probabilities as well as their returns. After ending the five rounds of Treatment A, the subjects read instructions for the five rounds of Treatment B. At the end of the session we paid in cash each subject's amount made during five randomly chosen rounds from Treatments A and B. Subjects made on average $45.

15.3 Results

The results of the experiment are summarized in Table 15.3. Also, Fig. 15.1 shows the distribution of subjects' responses by treatment and round. There were a total of 440 observations; 220 corresponded to Treatment A. As shown in Table 15.3, most of the subjects endowed with the safer project chose Contract C_2 (85.5 %), whereas most of the subjects endowed with the riskier project chose Contract C_1 (63.6 %). The hypothesis that the mean number of C_1 choices is the same among the two risk types is rejected. In Treatment B, we observe that type s subjects who choose to change their projects mainly chose Contract C_1. Subjects endowed with a risky project mainly chose Contract C_1 and changed their project, as predicted.

To test for significance of differences in contract choice, we run logit regressions. For this analysis, we excluded from the total of the observed subject choices

Table 15.3 Experimental results

	Subjects with safer projects			Subjects with riskier projects		
Contracts	Numbers and percentages					
Treatment A						
C_1	14	12.7 %		70	**63.6 %**	
C_2	94	**85.5 %**		35	31.8 %	
None	2	1.8 %		5	4.5 %	
Total	110	100 %		110	100 %	
	Subjects with initial safer projects			Subjects with initial riskier projects		
	Numbers and percentages					
Contracts	Initial choice	Change project (%)		Initial choice	Change project (%)	
Treatment B						
C_1	48	48	100	87	49	56.3
C_2	57	38	66.7	22	4	18.2
None	5	–	–	1	–	–
Total	110	–	82	110	–	49

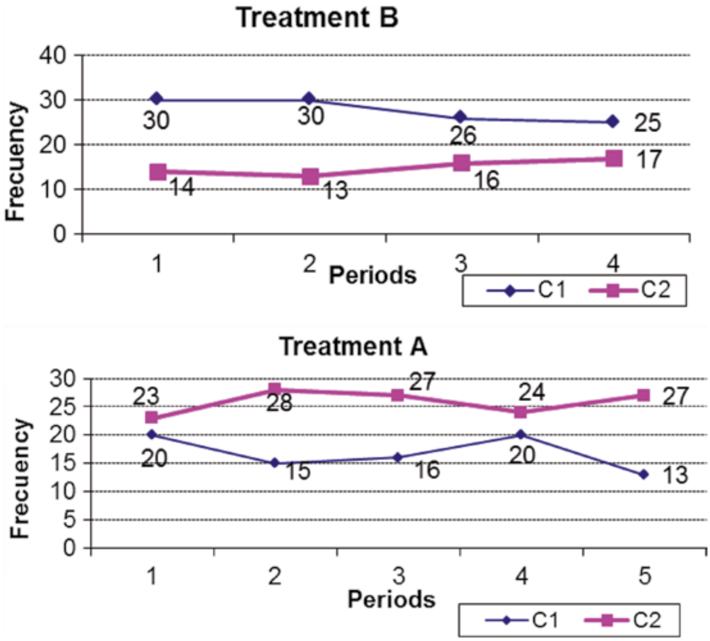

Fig. 15.1 Offered contracts and experimental results

risk-free investment decisions. Hence, we analyzed 427 choices only, 219 of Contract C_1 and 208 of Contract C_2. The variable selection method was the forward stepwise process of the likelihood ratio. Table 15.4 summarizes the results.

The positive coefficient for the variable PROJECT indicates that the safer the project, the greater the probability of choosing Contract C_2. This result confirms the

Table 15.4 Test for differences based on contract choice

Const.	−0.4761 (7.1822)
PROJECT (risky = 0; safe = 1)	2.0037*** (75.4433)
TREATMENT (Keep Initial Project = 0; Change = 1)	−1.2396*** (28.7929)
−2Ln λLR	113.912***
Cox-Snell R2	0.234
Nagelkerke R2	0.312
Correct classification	71.66 %

CONTRACT is the endogenous variable (value 0 given to Contract C_1 (219 observations) and value 1 given to Contract C_2 (208 observations))
***Significant at the 1 % level. Wald statistics are in parenthesis

significance of the differences between subjects with safer projects and subjects with riskier projects mentioned above. Hence, we find support for Hypothesis 1 that predicts high collateral combined with an adequate low rate of interest (i.e., Contract C_2) principally attracts subjects with safer projects, resulting in separation of borrowers by their risk level. On the other hand, the negative coefficient for the variable TREATMENT shows that in Treatment B (with moral hazard), the likelihood of choosing C_2 (the high collateral contract) is lower than in Treatment A. Subjects willing to increase their project risk prefer to switch to contract 1 (no collateral). This result confirms Hypothesis 2.

Upon confirmation of the hypothesis, in both treatments, it is observed that can be used to solve (or improve) the credit problems (especially in this current crisis period) in relation to its demand by entrepreneurs.

15.4 Conclusions and Discussion

The current financial crisis has left entrepreneurs facing severe credit rationing, which endanger the viability of its projects. Thus, mechanisms to screen successful projects are needed by entrepreneurs and also by banks. We conducted an experiment based on models of contracting under asymmetric information that closely follows Bester (1985, 1987). The main prediction of these models is that by offering a menu of contracts that combine different levels of interest rates and collateral, projects can be separated by their success probability (risk level). In addition, the separating effect of this menu of contracts holds also under moral hazard.

Despite of the important implications of these theoretical models on the reduction of credit rationing, empirical studies, so far, have been limited in their ability to examine the incentive compatibility of this menu of contracts. Just Comeig et al. (2013) have tested empirically the screening role of loan contracts that consider collateral-interest margins simultaneously. Individualized information on loan contract features is unusual and does not include a direct and objective approximation to the ex ante unobservable borrower risk. In contrast, in the lab, the experimenter is able to control the variables that are unobserved in the field. This control provides a unique advantage for empirically testing predictions of the above-mentioned models.

Consistent with theory and with the empirical results found by Comeig et al. (2013), our experimental results show that by appropriately combining collateral with the interest rate, projects with different risk levels are separated. Projects with higher risk tend to be financed without collateral and with higher interest rates. Hence, we provide support for the predictions of screening models of Bester (1985, 1987) and Chan and Kanatas (1985). Moreover, our experimental results showed that the separating effect of this menu of contracts remains even in moral hazard settings.

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