

Credit Rationing as Another Cause of Financial Crisis: Evidence from Thailand

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Abstract

This paper examines the credit market to determine whether slow growth was caused by problems in credit markets as many scholars have suggested. In particular, the question of how a rise in interest rates affects behaviors of the banks and the firms, and how and to what extent credit restriction affects sales and growth were investigated. The model developed in the paper suggests that when loan terms are not restricted, lenders will statistically discriminate against small firms. In other words lenders will charge small firms higher interest rates. When loan contract terms are restricted, lenders might ration credit by not lending to small firms that have higher risks. However, when interest rates are high, large firms might self-select out of the loan markets because they have other alternatives to cope with credit problem. The analysis from Thai data during the financial crisis reveals that Thailand faced mild credit rationing problems before the crises. The problem became stronger, but not severe, during the crises. Trade credit-borrowing ratio and the results from our regression equation suggest that the self-selection problem was more pronounced during the crises. However, even though problems of credit rationing and adverse selection did occur, the importance of trade credits and borrowing on sales declined during the crises.

JEL Classification: O4, R3

Key Words: Credit Rationing; Small Farm Agriculture, Capital Control, Financial Crisis.

1. Introduction

Since the mid 1997, Asian financial crises have resulted in extensive economic downturns in the crisis economies. Countries such as Thailand, Indonesia, and Korea, responded to the crises by letting its domestic currencies float, imposing capital controls, and raising interest rates. A devaluation of domestic currency should, in theory, improve competitiveness of domestic goods in the world markets. With a reduction in imports, we should observe an increase in export growth. Contrary to expectations after the currencies were devalued current account deficits decreased only because import growth declined. Export growth, which was expected to increase, actually decreased. *The question here arises as to whether any trade theory can explain the decrease in export growth of these crisis economies. Did other factors contributed to the observed decline in export growth?*

In this paper, I attempt to answer the question by looking at credit markets to study how an increase in interest rate, another important policy implemented during the crises, affect

behaviors of the banks and the firms. This is my first attempt to understand how and to what extent credit restriction affects sales and growth.

The model developed here in this paper is an adaptation of the Cater (1988)'s model "Equilibrium Credit Rationing of Small Farm Agriculture", which draws on Stiglitz and Weiss (1981) and Tybout (1984). Here I adapt the model to study the behaviors of lenders and borrowers both when loan contract terms are and are not restricted. What I have found from the theoretical analysis is that an increase in interest rates can substantially affect firms' production and profitability through credit markets. An increase in interest rates may result in credit rationing against small firms, which could cause a decrease in aggregate production of export goods when firms under study are exporting firms. When borrowers are allowed to change their behavior in response to changes in loan contract terms, more productive, safer borrower may self-select out of the credit markets, leaving only less productive, riskier borrowers in the credit markets. An increase in interest rates, therefore, could cause a decrease in production, sales, and growth.

2. The Model

There are 3 key assumptions used in this model:

- (1) Loans are always undercollateralized. In other words, the net value of the collateral to the lender is less than the principal plus interest.
- (2) A lender cannot distinguish between individuals within a class of borrowers, and the lender cannot monitor individual behavior.
- (3) Small firm production is riskier than large firm production because small firms have less diversified resources.

Although these are very strong and general assumptions, which are defendable, these assumptions are consistent with the nature of credit markets to some extent.

2.1 Production and Information

This section proposes a representation of the production and information environment. As assumed earlier, the bank faces observationally distinguishable groups of borrowers. The bank knows average characteristics of each borrower group, but cannot distinguish between members of a group. Further, the bank is assumed to be unable to monitor individual behavior. The bank offers a loan of a fixed amount per borrower' production unit. Here the bank loan is assumed to be 1\$ per production unit (i.e. per unit of machine, per unit of labor require, etc.).

per-production unit production is

$$Q_{ij} = \theta_{ij} g_i(K).$$

where Q_{ij} = per-production unit production revenue for the j^{th} firm in the i^{th} firm group. Q_{ij} is defined to be revenue after factor payments to labor and other obligations. Q_{ij} is therefore a measure of the firm's repayment capacity. The function g_i , which is specific to each firm group, is assumed to be concave with first derivative being positive and second derivative being negative. K is the price aggregated value of purchased inputs, which is less than or equal to the \$1 loan amount. θ_i is a stochastic term which reflects

the impact of uncontrollable natural events and inputs on production. Here, it is assumed that θ_i varies in the range $[0, m]$, where m is the optimal production condition. Why each borrower knows the specific distribution of his/her θ_{ij} , but lenders know only the average distributions of θ_{ij} of borrower groups. Probability distributions between groups are assumed to differ by mean preserving spreads. Let $f_i(\theta)$ be the average probability density function for the i^{th} group, the cumulative density function, $F_i(\theta)$, is defined as

$$F_i(x) = \int_0^x f_i d\theta$$

where $F_i(m) = 1$

Assume further that lenders can without any cost segregate borrowers into large and small firm groups. They also can correctly perceive two differences in the average characteristics of large versus small firms:

First, the pdf of the risk parameter θ of small firms differs from the pdf of θ of large firms by a mean preserving spread, $f_1(\theta) = f_2(\theta) + s(\theta)$,

where subscript 1 indexes small firms and subscript 2 indexes large firms. s is defined so that

$$\int_0^m s d\theta = \int_0^{\theta} \theta s d\theta = 0$$

and

$$\int_0^y (F_1 - F_2) d\theta \geq 0$$

for $y < m$.

The greater variation in small firm revenues implied by the mean preserving spread equation above implies that small firms are less diversified than large firms. Some micro-environment events can easily affect the entire small firms' production. Large firms, in contrast, are assumed to have diversified their productions, thus there are several ways large firms can diversify their productions given their resources such as product differentiation, multiple subcontractors, multiple alternative suppliers, and various consumer groups.

Second, average per production unit revenues of small firms are lower than those of large firms. $g_1(K) \leq g_2(K)$ for all K . This assumption can be justified using the assumption of increasing return to scale in production. By having economy of scale in the production process, large firms can obtain better quality and more timely input. The assumption might also reflect the greater experience and skills of large firms in using modern techniques.

2. 2 Credit allocation when group characteristics are fixed

This section examines credit allocation under the following assumptions:

- 1) The composition and the average characteristics of borrower groups are fixed to the lender
- 2) The composition and the average characteristics of borrower groups are invariant to contract terms.
- 3) Firms apply all loans received on their production.

Lender behavior

Banks are interested in maximizing their profits over loan contracts for the fixed \$1 amount per production unit loan purchase. In this model, let's limit contract terms have only two variable terms: the interest rate, i , and per-production unit collateral requirements, c . Hence loan contracts can be described using two parameters, c and r , where $r = (1 + i)$.

Lender profit per \$1 loan can then be written as

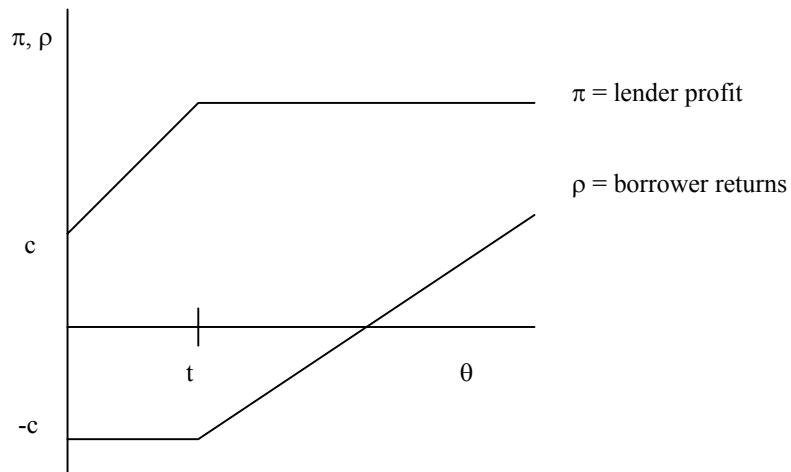
$$\pi(r, c) = \min(Q + c, r) = \begin{cases} Q + c & \text{if } \theta < (r - c)/g(1) \\ r & \text{if } \theta > (r - c)/g(1) \end{cases}$$

Note that the \$1 loan is completely repaid and lender profit is r .

The profit function, which follows Stiglitz and Weiss (1981), contains two implicit assumptions:

- 1) A loan is always repaid if production is high enough to pay back the loan. This assumption does not allow for voluntary default.
- 2) The value of collateral to the lender, c , is less than r (the \$1 principal and interest on the loan). This assumption is crucial in this particular model and also will also be crucial when we discuss adverse self-selection later in the paper. Note that this assumption is consistent with developing economies with high growth. Generally, loans given to producers in developing economies are under collateralized. (This can easily be shown empirically by comparing the growth of borrowing and lending with the growth in a firm's asset over the emerging economies in the past decades).

The following graph shows lender profit and borrower returns as a function of θ under an assumption that there is no transaction cost involved in borrowing and lending.



Note that there is a kink point, t , where $\theta = (r - c)/g$. Recall that θ is the parameter representing riskiness and g is the parameter representing productivity.

From our model, we can now answer the question whether large firms or small firms are more preferable to lenders given the same contract terms. Given fixed contract terms, c'

and r' , and our previous assumption, that small firms have higher risk and lower productivity than large firms, one can expect banks to favor large firms. This proposition can be written in the form

$$E\pi(c', r' | g_2, f_2) - E\pi(c', r' | g_1, f_1) \geq 0$$

This conclusion is drawn from two separable comparative analyses of impact of risk and productivity differences on lender profits.

First, when risk is held constant across small and large firms, expected lender profit is higher on loans to large firms.

$$E\pi(|g_2, f'|) - E\pi(|g_1, f'|) \geq 0$$

where $g_2 \geq g_1$.

Second, when productivity is the same across small firms and large firms, lender profit is higher on loans to lower risk firms than that on loan to higher risk firms:

$$E\pi(|g', f_2|) - E\pi(|g', f_1|) \geq 0$$

where $f_1 = f_2 + s$ and s is a mean preserving spread. If ξ indexes pdf is made more risky through the consecutive addition of mean preserving spreads, then $\partial E\pi / \partial \xi \leq 0$, where the index ξ increases with risk.

This result is intuitive. Expected lender profits decrease when the mean preserving spread is higher. When risk increases, the probability of low production is higher, Thus increasing the possibility of a return below r . This decrease in return is not offset by an increase in lender profits when production is high since the upper bound or profit is fixed by the contract term r . This means even with exceptionally good production circumstances, the highest the lender can receive is only r . Hence, the higher the risk, the lower the lender's expected profit. This relationship becomes clear also when we refer back to graph 1, where the increase in risk reduces expected lender's profit since the profit function is concave in θ .

Aggregate the above two facts, the initial proposition of expected return to lender can be rewritten as

$$[E\pi(|g_2, f_2|) - E\pi(|g_2, f_1|)] + [E\pi(|g_2, f_1|) - E\pi(|g_1, f_1|)]$$

We can conclude that expected lender's profit is higher on loans to large firms than that on loans to small firms given the same contractual terms on loans to both groups. This suggests that under unrestricted loan terms, there should be a way for lenders to realize the same profits on loans to small firms as on loans to large farms. One way to accomplished is to offer different loan terms to different groups of borrowers.

Different loan terms and lender behavior

This section presents a model of lender behavior. I will use this model to study lender behaviors when loan terms are not restricted.

Let $E\pi(\bar{r})$ be the opportunity cost of loanable funds to the bank. Being a profit maximizer, the bank will offer to lend its funds to members of group i only when there exists group specific contract term such that

$$E\pi(r_i, c_i | g_i, f_i) \geq E\bar{\pi}$$

Such contract terms are always possible, as can be seen and by inspecting the total differential of the iso-expected profit condition,

$$dE\bar{\pi} = \frac{\partial E\pi}{\partial \xi} d\xi + \frac{\partial E\pi}{\partial g} dg + \frac{\partial E\pi}{\partial r} dr + \frac{\partial E\pi}{\partial c} dc = 0$$

where

$$\frac{\partial E\pi}{\partial g} > 0, \quad \frac{\partial E\pi}{\partial \xi} \leq 0, \quad \frac{\partial E\pi}{\partial r} = 1 - F(t) > 0 \quad \text{and} \quad \frac{\partial E\pi}{\partial c} = F(t) > 0$$

Expected profits can be maintained by offsetting higher risk and/or lower productivity with a higher interest rate, r , or collateral requirement, c , as $\partial r/\partial \xi$, $\partial c/\partial \xi > 0$, and $\partial r/\partial g$, $\partial c/\partial g < 0$. From this we can also see that expected profit, can also be maintained by offsetting a lower collateral requirement with an increase in interest rate. The converse is also true, a lower interest rate can be offset by an increase in collateral requirement as $\partial r/\partial c < 0$. From the lenders' perspective, as long as borrowers' behavior stays fixed and contract terms are not restricted in term of interest rate and collateral requirement lenders can freely write different contracts to different groups of borrowers to fulfill the iso-expected profit condition.

Unrestricted Equilibrium credit allocation and statistical discrimination

A direct implication of the above argument is that there will be no quantity rationing in credit market equilibrium, when the contractual terms are unrestricted. As long as every borrower is willing to accept the contractual terms necessary to maintain the bank's expected profits, every borrower should be able to obtain credit from the bank. Note that to maintain the same expected profit, the bank has to offer less favorable (to borrowers) contract terms (e.g. higher interest rate and/or higher collateral requirement) to small firms than it does to large firms since small firms are assumed to have higher risk and lower productivity.

Careful attention should be paid to the fact that this model assumes banks are unable to distinguish individual firm within the same group. Firms with the same productivity and risk characteristics might be offered different contractual terms if they have different units of production (e.g. number of machines), which is the main criteria used to segregate firms into different size groups. This inability to distinguish suggests that

banks might ‘statistically discriminate against small firms when they use production unit as an indicator of a firm’s characteristics. Thus, small firms with high productivity and low risk might be discouraged from using credit, eventually shifting credit allocation toward large firms.

Contractual restriction and credit market equilibrium

In this section, I examine the impacts of two possible types of contractual restrictions that apply to the model here: restriction on collateral requirements and restriction on interest rates.

In credit markets of developing economies, small firms may have limited access to collateral. It is therefore an unfeasible assumption that collateral can be used as a free variable contract terms when loan contracts are made. Small firms are usually new firms entering an emerging market. As such these firms may offer limited net collateral value to the bank. This limitation would then impose a collateral ceiling on small firms, which acts as a restrictive feasible loan term. To keep the same expected profit, a bank would have to increase the interest rate on the contractual loan terms. Collateral ceiling does not change the mechanics of the credit market equilibrium discussed earlier as long as the bank can demand a higher interest rate from small firms to compensate for low collateral. Once there is an exogenously imposed interest rate restriction, lenders’ behaviors can differ from the mechanics described earlier. In the case where there is a collateral binding for small firms, the bank, as a profit maximizer, would demand a higher interest rate. If the interest rate restriction becomes binding (i.e. the bank cannot legally raise interest rates to be higher than a certain rate, or interest ceiling), small firms might not be offered any loan contract at all. Inequitable non-price credit rationing, therefore, applies. The bank would refuse to lend to small firms, and might shift to lending to better collateralized, and on average, safer and more productive large firms. If the same collateral ceiling applies to both small and large firms, the bank would still prefer lending to large firms than to small firms because large firms, on average, have higher productivity, which yields higher expected profits to the bank.

The following section and the rest of the paper assumes collateral limits that equally constrain both large and small firm contracts, and that the analysis will consider only cases of interest rates variation.

2.3 Credit allocation with borrower autonomy and endogenous group characteristics

In this section, the analysis focuses on borrower behavior. Borrowers are allowed to autonomously and systematically choose whether or not to apply for credit. They can also decide how to allocate credit received for different uses. Contract terms affect borrowers in two ways:

- 1) Changes in contract terms have acts as an incentive. Contract terms affects a borrower’s choice of technique and allocation of credit between production and other uses of funds that unrelated to consumption (e.g. portfolio investment, payback matured debts, etc.)

2) Changes in contract term induce ‘adverse selection.’ As contractual terms are raised, i.e. the interest rate is higher, borrowers self-select out of the market, leaving riskier firms in the credit markets, thus worsening the average borrower characteristics.

Adverse borrower self-selection and incentive effects

This section models incentive and self-selection effects under the assumption that borrowers are risk neutral.

Since the objective here is to model borrower self-selection and incentive effects, borrower behavior is modeled as a two step sequence. The first step is to model incentive effects: the borrower decides how to optimally allocate the loan received between production and other usages of funds given loan contract terms. The second step models self-selection: the borrower decides whether or not to apply for the loan by comparing expected utility that results from optimal credit use with expected utility attainable without the loan.

With specific contract terms, returns to borrower from a loan, ρ , are defined as

$$\rho = \max(Q - r, -c) = \begin{cases} -c & \text{if } \theta \leq t \\ Q - r & \text{if } \theta \geq t \end{cases} \quad (*)$$

where $Q = \theta g(K)$ and $t = (r-c) / g(K)$. Recall our assumption that each individual borrower knows the distribution of θ specific to his/her individual firm. Note here that it is assumed borrowers will pay back their loans when production is high enough, thus ruling out the possibility of voluntary default which was examined by Allen (1983) and Jaffee and Russell (1976).

In the second step, the borrower must choose K , the amount out of the \$1 loan used to invest in production in order to maximize his expected income. Assume K amount is used for production that produces income after only one-period interval. For simplicity, the borrower’s income is defined to be the sum of income in period zero, when the loan is made, and income in period one, when products are produced. Period zero income is defined to be prior saving, y_0 , plus the amount of credit diversion, $1-K$. Period one income is simply the borrower’s return from production, ρ , as defined earlier.

Note that we previously assumed that the bank can segregate borrower only into small and large firms. It cannot distinguish individual within a borrower group. The same loan contract terms, therefore, are offered to every individual within a group. The borrowers who face loan contract terms offered to his group choose K in order to maximize income:

$$\max_K E\{y_0 + (1 - K) + \rho\}, \quad (i)$$

subject to equation (*) where $K \leq 1$.

The maximization problem yields the following first order condition:

$$\int_t^m g' \theta f d\theta \geq 1 \quad (ii)$$

where $K = 1$ if strong inequality holds. The first order condition can also be written as

$$[1 - F(t)]E(\theta g' | \theta > t) \geq 1$$

When interest rates increase, the kink point, $t = (r-c)/g$, shifts out, resulting in an increase in the level of θ and production needed for the borrower's return to exceed $-c$. As a result, the expected return to investment decreases, as the left hand side of (ii) declines, and the incentive for credit diversion rises. This shows the incentive effect of a higher interest rate on borrower behavior. When the solution to (i) is an interior solution, $K < 1$, borrowers actually divert their credit use. Assume other things equal, increase in credit diversion, lower K , decreases $g(K)$ and expected lender profit. Lenders can lower the incentive effect by offering smaller loans so that the marginal return to investment, the first derivative of g , is high. This result is from our earlier assumption that the g function is concave and that we have diminishing marginal returns to investment. The fact that lenders might offer smaller loans to borrowers who are prone to divert their credit use when interest rates are high suggests that when a country implements capital control policy, banks tends to restrict loan size to borrowers. To test this empirically we have to go to the data to see whether this is the case for southeast Asian countries when interest rates increased during the crises.

To understand borrower behavior when interest rates increase, we also need to understand borrower decisions on whether to apply for the loan. As describe in the borrower decision process, after deciding on credit use given loan contract terms, borrowers or potential borrowers compare the potential income attainable with and without credit use. Denote the optimum value function, which solves the borrower's maximization problem in (i) as $V^*(r)$. Borrowers compare V^* with their alternative opportunity, denoted V' . Potential borrowers self-select out of the market when their $V^* < V'$. We can see that as the interest rate in contract terms rises, V^* declines. When compare to V' , there is a higher probability that the potential borrowers self-select out of the market.

Borrower self selection can be viewed as a form of adverse selection. Adverse selection in the credit market means that a higher interest rate, firms with high return and risky projects are more likely to apply for loans even though safer project with lower return is more favorable to lenders. In this model, for any given r , maximized expected income is

always higher for a borrower with a riskier distribution of θ than for a safer borrower everything else being equal. If we assume that V' is the same across all borrowers, when V^* declines as r rises, less risky borrowers will self-select out of the market first, leaving only less favorable (to lenders) borrowers in the market.

Formally, the proof to the proposition is provided by Carter:

Let subscript 1 indicate the riskier borrower, and 2 the safer borrower such that $f_1 = f_2 + s$, where s is the mean preserving spread. By above argument, adverse selection occurs when

$$V_1^*(r) - V_2^*(r) >= 0 \quad (\text{iii})$$

Condition (iii) can be written as

$$[V_1^*(r) - E(y_0 + (1-K) + \rho_1 \mid K = K_2^*(r))] + [E(y_0 + (1-K) + \rho_1 \mid K = K_2^*(r)) - V_2^*(r)] >= 0. \quad (\text{iv})$$

The first term in the square brackets is non-negative by the definition of V^* as an optimal value function. The sign of the second term in square brackets can be seen by examining the difference in expected income between the riskier and the safer at some arbitrary K . Let this arbitrary K be $K_2^*(r)$. Then the difference in expected income between borrowers, given arbitrary $K = K_2^*(r)$, is

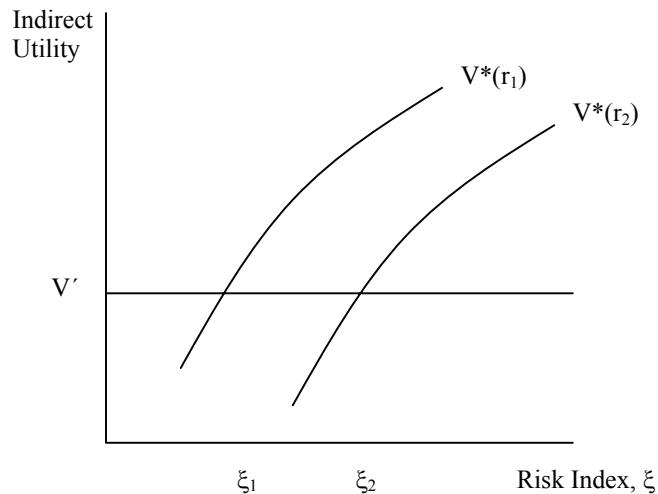
$E[y_0 + (1 - K_2^*(r) + \rho_1)] - E[y_0 + (1 - K_2^*(r) + \rho_2)]$, which can be written as

$$\left\{ -cF_1(t) - r[1 - F_1(t)] + g \int_t^m \theta f_1 d\theta \right\} - \left\{ -cF_2(t) - r[1 - F_2(t)] + g \int_t^m \theta f_2 d\theta \right\}.$$

After integration by parts, this expression reduces to

$$g \int_0^t [F_1 - F_2] d\theta \geq 0$$

Which is non-negative by our earlier assumption. Thus the second term in square brackets in (iv) is non-negative, and (iv) is always non-negative. This implies that adverse selection occurs when interest rates rise. The adverse effects of borrower self-selection as the interest rate increases can also be shown graphically.



If all borrowers have the same V' , at interest rate r_1 , only borrowers with risk greater than ξ_1 apply for loans. If the interest rate is increased to r_2 , V^* , the optimal value function shifts downward, leaving only borrowers with risk greater than ξ_2 in the loan applicant pool. This results in higher riskiness of average loan application.

3. Summary

In the context of small versus large firms, the theoretical analysis given in this paper has shown that when credit markets are unrestricted and borrowers behaviors is invariant to lender behavior, lenders may offer different contract terms to different groups of borrowers to maintain the same expected profits. The model has shown that, if different contract terms are offered to different groups of borrowers, small-firm borrowers are offered loans with higher interest rates and/or higher collateral requirement. Given this practice, lenders may statistically discriminate against small firms (that has low risk or high productivity) due to the assumption that lenders assign individual borrowers into groups of lenders using number of production units (not individual risk or productivity). When contractual restrictions exist on loan terms such as collateral limit or interest rate ceiling, small firms may be rationed out of credit markets.

When the assumption of fixed behavior of borrowers is relaxed, the credit allocation equilibrium changes as borrowers alter their behaviors in response to changes in loan contract terms. The model shows that when the interest rates rise, there is an incentive for borrowers to divert the credit use. Moreover, a higher interest rate may influence a borrowers' decision to apply for a loan. The model shows that higher interest rates result in borrowers self-selecting out of credit markets as the their optimum value function from the maximization problem becomes lower than their value function of the alternative opportunity. Consequently, an adverse-selection problem occurs when there is a pool of riskier loan applicants as more productive, safer borrowers self-select out of

the markets. Thus, an increase in interest rates may result in a decrease in investment and an increase in non-performing loans, leading to lower GDP growth.

4. The Data

The data used in this paper are extracted from financial statements of 270 Thai companies that were listed in the Stock Exchange of Thailand (SET) from 1995 to 1997. The actual number of companies that provided both balance sheets and income statements during the three years is more than 270. In 1996, the peak of the boom era, more than 400 companies were listed on the SET. This number declined in 1997 and dropped sharply to less than 200 in 1998. Given the purpose of my paper and the fact that during 1995 to 1997 many firms entered and exited the SET, it is reasonable to study only companies that stayed in the SET throughout 1995-1998. Further, since this study I emphasizes trade credits, companies in real estate, banking, financial, and insurance sectors are not included here. Companies in the banking sector are excluded in this paper because detailed data about bank lending to different types of borrowers are not available. In addition, if only the year 1998 were included, the number of firms that would have survived the process of elimination would be too small. Thus I decided to include only 1995-1997 in this paper giving a total of 270 companies for analysis.

The variables used include trade credit, net sales, total debts, borrowing less than one year, net interest charges, and total assets. Trade credit is how much a company owes its creditors. Borrowing less than one year is the best variable I can obtain for short-term borrowing. Net interest charges, however, are my biggest concern. To study credit rationing of the banks, the ideal data to have is the interest charged on debts to the banks or other financial companies. However, the data available are the net interest charges, which include all interests paid to banks, financial companies, and other creditors and the interests received from the company's debtors. If we assume that the interest received is small and that the companies only borrowed from banks and financial companies, the net interest charges should be a good estimate of interest paid.

5. Empirical Models

5.1 Tests for Different loan terms and lender behavior

This section tests our model of lender behavior when loan terms are not restricted. Our theory states that from the lenders' perspective, as long as contract terms are not restricted in term of interest rate and collateral requirement and borrowers' behavior is fixed, lenders can freely write different contracts to different groups of borrowers to fulfill the iso-expected profit condition.

a. Under unrestricted equilibrium credit allocation, our model implies that there will be no quantity rationing in credit market equilibrium given that the contractual terms are exogenously unrestricted. As long as borrowers are willing to accept the contractual

terms necessary to maintain the bank's expected profit, they should be able to obtain credit from the bank. To maintain the same expected profit, the bank has to offer less favorable (to borrowers) contract terms (e.g. higher interest rate and/or higher collateral requirement) to small firms than it does to large firms since small firms are assumed to have higher risk and lower productivity. This suggests a problem that banks might 'statistically discriminate' against small firms when they use production unit as an indicator of a firm's characteristics.

The following is a simple regression equation to test for the credit discrimination. Throughout all of our estimations, "total asset" is used as an indicator of a firm's characteristics instead of "production unit." This assumption is consistent with banks' behavior of using total assets as a basis of lending.

$$\text{Interest Charged}_{it} = \beta_1 + \beta_2 \text{ Total Asset}_{it} + \varepsilon_{it} \quad (I)$$

b. Under contractual restriction and credit market equilibrium, there are two possible types of contractual restrictions that apply to our model here: restriction on collateral requirements and restrictions on interest rates. In the credit markets of developing economies, credit markets, collateral may be limited to small firms. It is therefore an infeasible assumption that collateral can be used as a free variable contract terms when loan contracts are made. Small firms, which are usually new firms entering emerging markets, may offer limited net collateral value to the bank. This limit would then imposes a collateral ceiling on small firms, which acts as a restrictive feasible loan term to firms with low collateral. To keep the same expected profit, the bank would have to increase interest rate on the contractual loan terms. Collateral ceiling does not change the mechanics of credit market equilibrium discussed earlier as long as the bank can demand a higher interest rate from small firms to compensate for low collateral. Once there is an exogenously imposed interest rate restriction, lenders' behaviors can differ from the mechanics described earlier. Assuming the case where there is collateral binding for a small firm, the bank, as a profit maximizer, would demand a higher interest rate. If the interest rate restriction becomes binding (i.e. the bank cannot legally raise the interest rate to be higher than a certain rate, i.e. interest ceiling), small firms might not be offered any loan contract at all. In such a case inequitable non-price credit rationing applies.

Under inequitable non-price credit rationing, the bank would refuse to lend to small firms, and might shift to lending to better collateralized, and on average, safer and more productive large firms. If the same collateral ceiling applies to both small and large firms, the bank would still prefer to lend to large firms rather than to small firms because large firms, on average, have higher productivity, which yields higher expected profits for the bank. However, these results should not apply to credit markets in emerging economies especially those in southeast Asian countries during the boom period of 1994-1996. A reason is that during the 1980s and 1990s, a high volume of capital inflow was drawn into the economies mainly from Japan and the United States. After these flows, capital liberalization became the key factor in the high growths of the emerging economies. Capital liberalization was supported by government and central bank officials. Lending rates became very low due to competition in lending markets and the

influx of cheap funds from Japan. As a result, interest rate ceiling never became binding even though collateral ceiling still applied. Small firms who were denied from a bank could turn to small trusts or financial firms to borrow. To stay competitive, banks relaxed their contractual terms, reducing credit rationing against small firms. Consequently, we should have been a small degree of credit rationing during the boom period of 1995-1996, and a higher degree of credit rationing in 1997, when credit became more constrained.

The following regression equation can be used to test the degree of credit rationing during 1995-1997.

$$\text{Borrowing}_{it} = \beta_1 + \beta_2 \text{ Total Asset}_{it} + \varepsilon_{it} \quad (\text{II})$$

Due to limited data, assume that a crucial variable in the lending decision is the total assets of the borrowing firms. In the ideal case, our equation should include other indicators of creditworthiness of the firms such as current assets, net working capital, and expected future cash flow.

5.2 Tests for credit allocation with borrower autonomy and endogenous group characteristics

In this section, we assume that collateral limits equally constrain both large and small firm contracts, and that the analysis will be only in cases of interest rates variations. As mentioned earlier, because of the lack of detailed data on the banks' loan approvals, we will focus only on borrower behaviors. Borrowers are allowed to autonomously and systematically choose whether or not to apply for credit. They can also decide how to allocate the credit received for different uses. From our theory, as contractual terms are raised, i.e. the interest required is higher, borrowers self-select out of the market leaving riskier firms in the credit markets. As a result lenders might offer smaller loans to borrowers who are prone to divert their credit use when interest rates are high. In the case of southeast Asian countries, interest rates increased at the time of crises.

Borrower self selection can be viewed as form of adverse selection. In a credit market with a higher interest rate, firms with high return and risky projects are more likely to apply for loans, even though loans safer project with lower return is more favorable for lenders.

To further explain the result of borrower self-selection in this context, it is useful to understand how firms finance their production. The alternatives available to firms for financing can be categorized as follows:

- 1) Financial institutions, mainly
 - Domestic commercial banks and foreign banks
 - Export-import Banks (if firms import or export)
- 2) Trade credit. (i.e. credits from suppliers)
- 3) Informal private lending
- 4) Self financing

In this paper, we will test for importance of trade credit to firm borrowing. As stated by Peterson and Rajan (1996), trade credit may provide access to capital for firms that are unable to raise it through more traditional channels. Trade credits exist for several reasons. First, evidence suggests that borrowing firms may be sources of future business, and suppliers are more willing to offer credit in anticipation of capturing this business. Second, suppliers may be better than specialized institutions at evaluating and controlling the credit risks of their buyers. Two crucial findings of Peterson and Rajan (1996) are that 1) suppliers offer more trade credit to firms of higher credit quality and 2) suppliers might continue extending credit to those firms when financial institutions do not. The reasons for this are that i.) suppliers may continue to hold over the firm (so long as it continues production) while financial institutions' control may be diminished by bankruptcy filings. ii.) suppliers are in a position to liquidate the goods they have sold to the firm.

Peterson and Rajan (1996) provide some evidence to support our result of credit rationing by large firms, when banks increase interest rates. Combining our results and those from Peterson and Rajan (1996), it is of no surprise that large firms are most likely to self-select out of the credit markets when banks increase interest rates.

In this section we test whether changes in contract terms induce 'adverse selection' in the Thai credit markets. The degree of self selection problem can be estimated by the following regression equations.

$$\text{Trade credit}_{it} = \beta_1 + \beta_2 \text{ Total Asset}_{it} + \varepsilon_{it} \quad (\text{IIIa})$$

$$\text{Trade Credit}_{it} = \beta_1 + \beta_2 \text{ Trade Credit}_{it-1} + \text{Total Asset}_{it} + \varepsilon_{it} \quad (\text{IIIb})$$

Note that it would be desirable to have in our regression equation variables that suggest creditworthiness of the firms. Let us assume that, in every period, suppliers make decision on trade credits based on firms' current total assets. Equation IIIb uses lagged trade credit to control for the firms' creditworthiness. We expect to see a positive coefficient on these two variable.

5.3 Test the effect of the bank's statistical discrimination and adverse selection on firms' sales.

$$\text{Net Sales}_{it} = \beta_1 + \beta_2 \text{ Total Asset}_{it} + \varepsilon_{it} \quad (\text{IV})$$

Our model suggests that if we have evidence supporting our hypothesis of statistical discrimination by the bank (in section 1) and the adverse selection problem (in section 2), small firms would be worse off at the time of financial crises. In other words, in the time of crises, the combining results of section 1 and 2 should give a negative estimated coefficient of total assets when regressing net sale on total assets.

6. Results

Table 1: Total Assets

	Obs	Mean	Std. Dev.	Min	Max
1995	279	5838594	1.35e+07	301834	1.28e+08
1996	279	7068826	1.76e+07	270615	1.80e+08
1997	279	8864816	2.74e+07	260626	1.80e+08

Table 2: Total Debts

	Obs	Mean	Std. Dev.	Min	Max
1995	279	2687659	7505640	0	8.17e+07
1996	279	3524531	1.04e+07	0	1.19e+08
1997	279	5875268	2.00e+07	0	2.47e+08

Table 3: Borrowing < 1 year

	Obs	Mean	Std. Dev.	Min	Max
1995	279	1088453	2193719	0	2.86e+07
1996	279	1429968	3922375	0	5.57e+07
1997	279	2459616	7679622	0	9.30e+07

Table 4: Trade Credit

	Obs	Mean	Std. Dev.	Min	Max
1995	279	357,000.2	842,703.4	0	5338301
1996	279	422,899.7	1,060,040	0	7748816
1997	279	615,914.7	1,717,094	0	1.55e+07

Table 5: Trade Credit-Debt Ratio

	Obs	Mean	Std. Dev.	Min	Max
1995	275	.6956919	3.701295	0	56.71429
1996	275	3.68675	48.05939	0	796.1795
1997	275	17.24419	252.6847	0	4186.571

Table 6: Trade Credit - Borrowing Ratio

	Obs	Mean	Std. Dev.	Min	Max
1995	275	5.231228	62.18497	0	1022.582
1996	275	4.129644	48.13647	0	796.1795
1997	273	35.08165	322.2195	0	4186.571

The summary of the data in table 1-4 suggests that during 1995-1997 total assets grew at a lower rate than those of total debts, short-term borrowing, and trade credits. In the three-year period, the average total assets increased by approximately 50% while total

debts and short- term borrowing increased by more than 200%. Along with a growth rate of 73% during the three-year period, the average trade credit increased by 18 % from 1995 to 1996 and 45% from 1996-1997. This particular observation implies that firms relied more on trade credits during financial difficulties. Table 5 and table 6 show that the average trade credit-debt ratio increased from 3.69 in 1996 to 17.24 in 1997, and the average trade credit-short term borrowing ratio increased from 4.12 in 1996 to 35.08 in 1997. The results in table 5 and table 6 nicely support the theory, reaffirming the hypothesis that during the financial crises firm relied more on trade credits.

Table7 : Estimated β_2 in Equation I

Year	Estimated β_2
1995	0.00000005070 (0.00000015000)
1996	-0.00000000480 (0.00000001230)
1997	0.00000009160 (0.00000029600)

* Standard error in parentheses.

Table 8 : Estimated β_2 in Equation II

Year	Estimated β_2
1995	0.1175711 (0.0067671)
1996	0.1790589 (0.0079635)
1997	0.2346012 (0.0092184)

* Standard error in parentheses.

Table 9 : Estimated β_2 in Equation IIIa

Year	Estimated β_2
1995	0.0454468 (0.0025816)
1996	0.0448876 (0.0024108)
1997	0.0392920 (.00293390)

* Standard error in parentheses.

The regression results from table 7 do not show a statistically significant (high p-values) degree of discrimination against small firms. According to our theory, the bank has to offer less favorable (to borrowers) contract terms (e.g. higher interest rates and/or higher collateral requirements) to small firms than it does to large firms since small firms are assumed to have higher risk and lower productivity. Our results show that the coefficient

on total assets is very close to zero in every period, suggesting that banks do not offer different loan terms to different types of borrowers.

Note that these results require careful interpretation. Since we have no information on loan collateral, we do not know whether banks required a greater percentage of collateral from small borrowers to compensate for the low interest offered or not.

Table 8 suggests that credit rationing occurred in bank lending, especially in the time of financial crisis. The data show that in 1995 credit rationing was a slight problem. The coefficient of the total asset is estimated to be positive and statistically significant, but small in magnitude (0.118). During 1997, credit rationing worsened; the coefficient rose to 0.235. Thus big firms with high total assets were more likely to obtain bank approved loans.

As discussed earlier, since data on loan approvals are unavailable, we cannot estimate the degree of credit rationing through the supply side of the loans. Therefore estimated coefficients from equation (II) could be biased since we only have ex post data on firms borrowing.

Table 9 provides the results from the regression equation IIIa. Our data suggest that large firms use more trade credit than small firms do. The coefficients on total assets are positive and statistically significant for 1995-1997. Surprisingly, I find no evidence to support the hypothesis that in the time of financial crises total assets should be more important for firms to receive trade credit. The coefficients on total assets are roughly the same in 1995-1997.

When firms' credit worthiness is controlled by adding last period trade credit in the equation, the results seem to support the adverse selection argument. The coefficient of the total asset rises from 0.007 in 1996 to 0.031 in 1997. This increase suggests that during the crisis the ability of firms to receive trade credit is highly dependent on their size. Given earlier results from the summary of data, we cannot reject the hypothesis that firms substantially self-selected out of the loan markets in 1997.

The effects of trade credit and borrowing on sales are shown in table 11a-11c. The data show that both variables have positive effects on firms' sales throughout 1995-1997. In particular, trade credits had a greater effect on firms' sales than did borrowing. However, both variables have lesser effects on firm sales in 1997.

7. Conclusion

This paper is an attempt to seek the explanations for the decline in the Southeast Asian countries' GDPs during the financial crises. This paper examines the credit market to determine whether slow growth was caused by problems in credit markets as many scholars have suggested. In particular, the question of how a rise in interest rates affects

behaviors of the banks and the firms, and how and to what extent credit restriction affects sales and growth were investigated. The model developed here is an adaptation of Carter's 1988 model in "Equilibrium Credit Rationing of Small Farm Agriculture," which predicts that when loan terms are not restricted, lenders will statistically discriminate against small firms. In other words lenders will charge small firms higher interest rates. When loan contract terms are restricted, lenders might ration credit by not lending to small firms that have higher risks. However, when interest rates are high, large firms might self-select out of the loan markets because they have other alternatives to cope with credit problem.

This paper also provides empirical evidence for the theory. Firm-level data from Thailand (1995-1997) were used to test for the degree of credit rationing and self-selection problems before and during the financial crises. The analysis of this data reveals that Thailand faced mild credit rationing problems before the crises. The problem became stronger, but not severe, during the crises. Trade credit-borrowing ratio and the results from our regression equation suggest that the self-selection problem was more pronounced during the crises. However, even though problems of credit rationing and adverse selection did occur, the importance of trade credits and borrowing on sales declined during the crises.

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