Chapter 6
The Effects of Credit Rationing by the Formal Credit Institution to Farm Behavior —— Using the Farm Survey Data Collected in Adana Region in Turkey in 2003 ——

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8.1. Introduction

Rural credit market is important for agricultural production, because agriculture needs time in the process of production[1]. If the supply sides of credit (credit institutions) limit the amount of the loans, or exclude small scale farmers from credit market, rural credit market influences the efficiency of agricultural production, or the equity of rural economy. Government interferes with rural credit market with the aim of improving the efficiency of agricultural production and the equity of rural economy. However, if the loan program provided government does not to fit the rural economic condition and the technology of agricultural production, the intervention will not be able to achieve the objectives.

Turkish government interferes with rural credit markets, establishing Agricultural Bank (GAB) and Agricultural Credit Cooperative (ACC). In addition, the rural credit market in Adana region is formed by Commercial Bank (CB), Cotton producers association, money lenders, Commercial sellers of agricultural inputs, relatives, and friends. ACC targets small farmers, and is the most important suppliers for farmers in Adana region.

The land market in Adana region makes the distribution of land more equitable. In Adana region, there are irrigated areas and rain-fed areas. In irrigated areas, the farmers use hired labors more than the farmers in rain-fed areas. On the bases of these characters of the rural economy in Adana region, I will analyze how ACC influences the efficiency of agricultural production and the equity of rural economy, using farm survey data. This farm survey was conducted from October to November in 2003.

The objectives of this report are following three points. 1. To clarify which farmer meets credit constraint 2. To clarify how farm behavior of credit constrained farmer changes comparing to that of not credit constrained farmers 3. To assess the roles of ACC in the rural credit market in Adana region

8.2. The Institutional Characteristics of ACC and Theoretical Flame Work

8.2.1 The characteristics of ACC

1. *Loans in kind* ACC doesn't provide cash to farmers. ACC provides only agricultural current inputs (seeds, chemical fertilizers and pesticides) in kind.

2. *Preference of small farmers* ACC sets the limit of loan amount, which is applied to all members (in 2003, 6 bil TL[2]). When farmers want to borrow more amount, they must apply to GAB. So, we can say that ACC targets small farmers and GAB targets big farmers. Furthermore, ACC permits members to sublease the agricultural inputs that were lent out from ACC, to other farmers.

3. *Exclusion of small farmers* In the first place, farmers need to own land with TAPU (cadastral certificate) to become a member of ACC. In the second place, farmers must present owned land as collateral to ACC, when they borrow agricultural inputs. Furthermore, ACC rations the amount of loans by owned land size of borrowers (credit rationing) within the limit amount (in 2003, 6 bil TL).

8.2.2 Theoretical analysis of ACC

As I have mentioned before, ACC provides only current inputs in kind as credit. This system implies that the borrowers must use the loans to agricultural production[3]. How this characteristic influences farm

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behaviors? Using household models[4], we can know the behaviors of farmers under credit rationing.

We consider a household who has access to ACC and the two period household model. The objective of the household is the maximization of his utility, which is defined as consumption of goods. The total amount of initial liquidity assets of household is W_0. The agricultural inputs are fertilizer and labor, and we assume that the market of each goods is perfect. To assume the agricultural production technology, which is constant to scale, the production function can be written as

$$Q = A \cdot F(x_1, x_2),$$

(8.1)

with A the managed land size of household, x_1 the input of fertilizer per land, x_2 and the input of labor per land. Here, the first partial differentiation is plus, the second partial differentiation $F_{x_1 x_2}$ is minus, and the cross partial differentiation is plus.

ACC provides fertilizer in credit and rations the amount of fertilizer by the owned land size of household (V). The amount of rationing ($\bar{L}$) is shown as follows,

$$\bar{L} = S(V), (S'(V) > 0).$$

(8.2)

The household decides the amount of consumption of first period (c_0), the input of agricultural inputs (x_1, x_2), and the amount of consumption of second period (c_1). When the land market exists, the managed land size is generally assumed as the choice variables of household. However, in this model, to focus on the relationship of fertilizer input and labor input, we regard the managed land size as the given variables. Then, the maximization problem can be written as

$$\max_{(c_0, c_1, x_1, x_2, L)} U = U(c_0, c_1)$$

(8.3)

$$s.t. \ L + W_0 = qc_0 + vAx_1 + wAx_2 + r(A - V)$$

(8.4)

$$AF(x_1, x_2) - (1+i)L = qc_1$$

(8.5)

$$vAx_1 \geq L$$

(8.6)

$$\bar{L} = S(V) \geq L.$$

(8.7)

Here, is the amount of borrowing money from any credit institutions in first year. is the unit price of input . is the unit price of input . is the unit price of consumption goods . Equation (8.4) and (8.5) mean income cash constraints. The former is at first period and the later is at second period. Equation (8.6) means that the amount of fertilizer, which the household input in agricultural production must be over and above the amount of fertilizer, which he borrowed from ACC. Equation (8.7) means that the household cannot borrow fertilizer from ACC over the amount of rationing determined by ACC ($\bar{L}$). Then, the Lagrangian function can be written as follows,

$$\xi = U(c_0, c_1) + \lambda_1 \{L + W_0 - qc_0 - vx_1 - wx_2 - r(A - V)\}$$
$$+ \lambda_2 \{AF(x_1, x_2) - (1+i)L - qc_1\} + \lambda_3 (vAx_1 - L) + \lambda_4 (S(V) - L).$$

(8.8)

Here, $\lambda_i (1 \leq i \leq 4)$ mean the Lagrangian multipliers of each constraint.

To find the first-order conditions of this problem, we need to categorize the Kuhn-Tucker conditions, whether or not the each of Eq.8.6 and Eq.8.7 is binding[5].

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4) For details of Household Models, see Sadoulet and de Janvry (1995).

5) The Kuhn-Tucker conditions of this problem are written in Appendix.

Case 1) When the both of Eq.8.6 and Eq.8.7 are not binding.

In this case, the first-order conditions are same as in case that the credit market is perfect. The first-ord-

$$Fx_1 = v(1+i)$$ (8.9)

$$Fx_2 = w(1+i)$$ (8.10)

The inputs of two production factors (fertilizer and labor) to agriculture are decided at the levels where fill the above equations. The decisions of agricultural production by the household are divided from the decisions of consumption. In other words, in this case, the separability of Household model holds. Furthermore, the marginal rate of substitution is decided by only proportion of the price of fertilizer and labor. The

$$Fx_1 = v\left(1+i+\frac{\lambda_4}{\lambda_2}\right)$$ (8.11)

$$Fx_2 = w\left(1+i+\frac{\lambda_4}{\lambda_2}\right)$$ (8.12)

These first-order conditions contain λ_2 (the Lagrangian multiplier of the cash constraint in second period) and λ_4 (the Lagrangian multiplier of the credit constraint). The decision of production is influenced by the consumption side. The separability of Household model does not hold any more, and the input of production factors is not efficient. However, the marginal rate of substitution is still decided by the proportion of prices of production factors. These points

$$Fx_1 = v(1+i)$$ (8.13)

$$Fx_2 = w\left(1+i+\frac{\lambda_3}{\lambda_2}\right)$$ (8.14)

In this case, the input of fertilizer (x_1) is decided at a point, which the marginal productivity of fertilizer equals to the market price of fertilizer. In contrast, the endogenous decision price of labor rises, because it is influenced by the Lagrangian multipliers λ_3 and λ_2 (The former means the subjective value for the constraint Eq.8.6 within the household, and the later

er conditions about agricultural production can be written from the Kuhn-Tucker conditions, as follows[6].

household who is categorized in this case can do the effective agricultural production.

Case 2) When Eq.8.7 is binding, but Eq.8.6 is not

From the Kuhn-Tucker conditions, the optimal input of and are decided to fill the following two equations.

mean that the total investment money to production is influenced by the consumption side, but the proportion of distribution of this investment money is not influenced.

Case 3) When Eq.8.6 is binding, but Eq.8.7 is not

From the Kuhn-Tucker conditions, the optimal input of and are decided to fill the following two equations.

means the subjective value for the constraint Eq.8.5). Then, the decision price of labor is higher than the market price of labor ($w(1+i)$), and the marginal productivity of labor does not equal to the market price of labor. The substitution effect of production factors is plus, so when Eq.8.6 is binding, the input of fertilizer is excess against the input of labor.

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6) The first-order conditions of consumption sides can be find from the Kuhn-Tucker conditions. However, in this analysis, the focus point is the decisions of agricultural production by the household, under ACC's institutional conditions. So, the conditions of consumption sides are omitted.

Furthermore, the marginal rate of substitution is also not decided by the market prices, so the both of total investment money to production and the distribution of this investment is influenced by the consumption side. If ACC does not limit the use of credit, the household who is categorized in this case will be able to approve his utility.

The household who is categorized in this case voluntarily makes a choice that the amount of borrowed fertilizer from ACC does not reach to the rationing amount. However, he cannot achieve the maximization of his profit. Under ACC's institution, if the credit amount borrowed by a household does not reach to the rationing amount (decided exogenously), he may meet with the similar effect under the ordinal credit rationing (this effect is suitable for Case 2).

From the above discussion, we can say three important points about the farm behaviors under ACC's institution.

1. The farmers who are influenced by this system can't do effective agricultural managements. They will invest current input goods (seeds, chemical fertilizers and pesticides) excessively in agricultural production comparing to the efficient input. On the contrary, other inputs (e.g. hired labor) will be input insufficiently.

2. There are credit-constrained farmers under ACC, since ACC rations the amount of loans by owned land size. These farmers also can't do effective agricultural managements. They will invest all agricultural input goods insufficiently. Under ACC's institutions, we can see two types of farmers who can't do efficient agricultural production. From this view point, we term these two types of farmers credit-constrained households or farmers.

3. I cannot specify what kind of farmers loses their efficiency of agricultural production, using comparative statics. Since the type of farmers who are influenced by this ACC's institution are not specified by this model, suggestions to the influence of ACC from equity aspect are not implied.

Now, we can say two hypotheses. Firstly, The institutions of ACC may resist the soundness of the land market in Adana region. Secondly, it may be difficult to deal with the changes of the kind of credit which farmers want to get, because ACC only provide current input goods.

8.3. The Effect of ACC to Rural Credit Market

8.3.1 General information of Adana region

In Adana region, irrigated area lies at plain field and non irrigated area lies at upland and mountain area. In irrigated area, farmers cultivate mainly maize and wheat as food crops, and furthermore citrus, watermelon, cotton, soybean, and vegetables as cash crops. In non irrigated area, farmers mainly cultivate wheat as food crops and barley as feed for livestock. Livestock production is not made in irrigated area, but in non irrigated area. Food crop production less needs to use hired labor forces because mechanization of production was prevailed from 60's. However, cash crop production needs to use many hired labor forces for irrigation activity, hoeing, harvesting, and etc. Because of that, there are many migrate worker who settled in irrigated area. Some of them rent in agricultural land and make on-farm activity. So, in irrigated area, there are more landless farmers than non irrigated area.

8.3.2 Rural credit market in Adana

As mentioned above, from the farm survey, we found that the credit market in Adana region was formed by Agricultural Bank (GAB) and Agricultural Credit Cooperative (ACC), Commercial Bank (CB), cotton producers association, money lenders, commercial sellers of agricultural inputs, relatives, and friends. In this section, we will show the condition of the rural credit market, using the data from farm surveys in 2003. From these data, it will be clear that ACC plays important ones in the rural credit market and ACC has problem with the distribution of credit.

Table 8.1 shows the condition of credit transactions in irrigated areas and non-irrigated areas in Adana. Here, Org means Cotton producers association, T & R means money lenders and commercial sellers of agricultural inputs, and R & F means relatives and friends. The rate of borrowing households is higher in irrigated areas than in non-irrigated areas. In both of irrigated areas and non-irrigated areas, households mainly offer credit from formal credit institutions. In these institutions, ACC is the main credit institution of the households, especially in non-irrigated areas. In irrigated areas, the average size of agricultural management is bigger than in non-irrigated areas. Furthermore,

GAB targets bigger farmers comparing to ACC. So, in irrigated areas, GAB is also the important supplier of credit to farmers.

Table 8.1 The number of borrowing households and the sources of borrowing in Adana region

	HHs Number	Number of borrowing HHs	% of borrowing HHs	Formal					Informal		
				ACC	GAB	CB	Org	Total	T & R	R & F	Total
IR	107	46	43	19	16	1	1	36	10	3	16
				(35.8)	(30.2)	(1.9)	(1.9)	(67.9)	(18.9)	(11.3)	(30.2)
NIR	103	51	50	40	6	0	0	46	10	4	14
				(66.7)	(10.0)	(0.0)	(0.0)	(76.7)	(16.7)	(6.7)	(23.3)
Total	210	97	46	59	22	1	1	82	20	10	30
				(52.2)	(19.5)	(0.9)	(0.9)	(72.6)	(17.7)	(8.8)	(26.5)

Sources) Farm surveys in 2002 and 2003
IR is irrigated areas and NIR is non-irrigated areas.
CB is commercial bank. Org is cotton producers association.
T & R is money lenders and commecial sellers of agricultural products R & F is relative and friends
The figures in parentheses are the rate of each institutions against total credit transactions.

Table 8.2 Average amount of borrowing money in a year and average interest rates per month

unit: 1 bil TL, in parentheses %

	Formal					Informal			Total
	ACC	GAB	CB	Org	Total	T & R	R & F	Total	
IR	8.69	9.78	-	2.50	8.84	5.16	6.09	5.51	7.54
	(6.83)	(5.28)	-	(5.00)	-	(8.29)	-	-	-
NIR	2.58	2.12	-	-	2.50	3.62	1.85	3.11	2.68
	(6.01)	(6.40)	-	-	-	(10.00)	-	-	-
Total	4.67	6.71	-	2.50	5.17	4.39	4.52	4.43	4.92
	(6.35)	(5.76)	-	(5.00)	-	(8.80)	-	-	-

Sources) Farm survey in 2002 and 2003
IR is irrigated areas and NIR is non-irrigated areas.
CB is commercial bank. Org is cotton producers association.
T & R is money lenders and commecial sellers of agricultural products R & F is relative and friends

Table 8.2 shows the average amount of borrowing money of surveyed households and the average interest rates of each credit institutions. The average amount of borrowing money is higher in irrigated areas than in non-irrigated areas. In irrigated areas, the average amount of borrowing money from ACC exceeds the limit amount decided by ACC in every year (6 bil TL in 2003). This implies that a farmer can get credit more than once in a year from ACC, using another person's name when he contracts credit with ACC. Then, we look the average interest rates. Commercial sellers of agricultural inputs and money lenders imposes the highest interest rates to farmers, and

ACC comes next. GAB imposes the lowest interest rates[7]. Commercial sellers and money lenders usually do not impose the collateral to farmers. Furthermore, when farmers purchase the agricultural inputs by a loan from commercial sellers, the procedure of transaction is almost same with the case which farmers purchase in a lump sum. ACC asks owned land as collateral, although ACC does not forfeit collaterals when the farmer cannot pay back credit. Furthermore, ACC imposes the application of guarantees. GAB judges the details of loans and the condition of farmers, and actually forfeits collateral when borrowing farmers cannot pay back loans. Then, we can assume

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7) In Table 8.2, there are some blank sells in the line of interest rates, although the sell of amount of credit is filled. These blank sells show that we could not calculate the average interest rate because of the lack of information.

that farmers can easily borrow money from commercial sellers and money lenders, comparing to ACC and GAB, when we consider the collateral problem, the limitation of participation, and other transaction costs, and ACC may come next. It is reasonable that the difference of the interest rates among these credit institutions reflects the difference of facility of borrowing money.

Table 8.3 shows the credit access by owned land size groups in Adana region. Owned land size rank (1-4) was categorized separately in irrigated areas and non-irrigated areas by fourth quantile method. Owned land size rank 1 is the smallest farmers group, and rank 4 is the biggest farmers group. In irrigated areas in Adana region, there are many landless farmers, so the all of farmers categorized in rank 1 doesn't own agricultural land.

Firstly, we analyze the condition of irrigated areas. In owned land size rank 1, a farmer who is membership of ACC does not exist, because ACC impose the ownership of agricultural land for membership. However, some farmers borrow agricultural inputs from ACC. As mentioned in Section 8.2, ACC permits members to sublease the agricultural inputs that were lent out from ACC, to other farmers. Thus landless farmers can borrow from ACC, if they have acquaintances who allow to sublease the agricultural inputs borrowed from ACC to them. The actual data also shows this institution is utilized by landless farmers. The data shows that in small farmers groups (land rank 1 and 2), the importance of informal credit institutions are higher than in big farmers groups (land rank 3 and 4). The importance of GAB increases as

owned land size rank increases. However, in rank 4, the rate of borrowing from GAB is same as the rate of borrowing from ACC. For big farmers, ACC is also the important supplier of credit.

In irrigated areas, big farmers also borrow agricultural inputs from ACC. Furthermore, in irrigated areas, the average amount of borrowing excesses the upper limit (6 bil TL). It will be reasonable that big farmers utilize the institution that ACC permits to sublease the agricultural inputs that were lent out from ACC, to other farmers. This institutional feature of ACC increases a risk of the default of loans, because this precludes supervision of use of the loans after transaction. We recognize the value of this institution, that this allows landless farmers to borrow agricultural inputs under the situation that they cannot to be the membership of ACC. Then, if big farmers also can utilize this institution, the value of this institution will decrease from the aspect of effectiveness and equity of ACC.

In non-irrigated areas, through the all owned land size ranks, the rate of borrowing from ACC is the highest comparing to the other institutions. In non-irrigated areas, the main crop is wheat which is less need to use hired labor comparing to cash crops in irrigated areas. Thus wheat is the crop that the relative importance of current inputs to hired labor is higher than cash crops. The institution of ACC that provides only current inputs in kind is more suitable for non-irrigated areas. Unlike with irrigated areas, the farmers in rank 1 borrow from ACC. This difference stems from the difference of land distribution that in non-irrigated areas the rate of landless farmers is smaller

Table 8.3 Access to each credit institutions by land rank in Adana region

	Owned Land Size Rank	General Information of each land rank			The source of credit (% of each credit institutions against total credit transactions)							
		HHs Number	% of membership to ACC	% of borrowing HHs	Formal					Informal		
					ACC	GAB	CB	Org	Total	T & R	R & F	Total
IR	1	35	0.0	22.9	27.3	9.1	0.0	0.0	36.4	36.4	27.3	63.6
	2	18	18.2	38.9	37.5	25.0	0.0	0.0	62.5	12.5	25.0	37.5
	3	27	41.2	59.3	29.4	29.4	0.0	5.9	64.7	29.4	5.9	35.3
	4	26	30.8	53.8	47.1	47.1	5.9	0.0	100.0	0.0	0.0	0.0
	Total	106	26.5	42.5	35.8	30.2	1.9	1.9	69.8	18.9	11.3	30.2
NIR	1	29	61.5	51.7	66.7	0.0	0.0	0.0	66.7	22.2	11.1	33.3
	2	24	12.5	29.2	62.5	25.0	0.0	0.0	87.5	0.0	12.5	12.5
	3	24	50.0	41.7	80.0	0.0	0.0	0.0	80.0	20.0	0.0	20.0
	4	25	62.5	72.0	63.6	18.2	0.0	0.0	81.8	13.6	4.5	18.2
	Total	102	51.0	49.0	67.2	10.3	0.0	0.0	77.6	15.5	6.9	22.4

Sources) Farm Survey in 2002 and 2003

IR is irrigated areas and NIR is non irrigated areas.

CB is commercial bank. Org is cotton producers association. T & R is money lenders and commecial sellers of agricultural products R & F is relative and friends

IR and NIR were categorized separately in four land ranks by three quantile method.

than in irrigates areas.

In this section, we pointed out that ACC allows small farmers to participate in the credit market, but not fully because of the institutional characters. However, only from the data of borrowing (the construction of the credit market), we cannot correctly the effect of ACC to the farmers in Adana region. We may say that landless or small farmers don't participate in the rural credit market, because they don't need to borrow money or agricultural inputs. In the next section, we will examine what-like farmers meet the credit-constraints (they cannot do the effective agricultural management).

8.3.3 The determinants of credit-constrained household

Whether a farmer meets credit constraint is directly determined his excess demand function to credit. If his demand to credit exceeds the supply of credit from credit institutions to him, he meets credit constraint and is not able to manage efficiently his agricultural activity. On the contrary, if the supply of credit to him exceeds his demand to credit, he does not meet credit constraint and is able to manage efficiently his agricultural activity. However, this excess demand to credit is not observed by farm survey.

We included some questions about credit constraint in the questionnaires[8]. In these questions, we can observe whether the farmer meets credit constraint, though his excess demand is not observed. Logit analysis was conducted, using the responses against these questions as dependent variable (CRDCST)[9]. If a farmer meets credit constraints, the dependent variable is 1. If a farmer does not meet credit constraints, the dependent variable is 0. The objective of this analysis is which variables influence credit-constraints. The explanatory variables are owned land size with TAPU (TAPLAND), management scale (5 rank variables) (MNGGRP), number of men adults (NOMADLT), age of household head (AGE_H), education level of household head (EDUC_H), size of owned building size (VLDSIZE), off-farm income (OFFINC), total value of livestock (TLIVVLU), number of tractor (TRCTRN), owned irrigated land dummy (OWNIRCD) and village dummies (VLDM01-03, 01=Kaisli, 02= Abdioglu, 03=Kilcli). The results of the logit estimates are presented in table 8.5.

Table 8.4 The definition of expaining variables

Explaining Variables	The definition of variables	Average value
TAPLAND	Size of owned land with TAPU	79.49 (da)
MNGGRP	Management scale (5 rank variables)	
NOMADLT	Number of men adults in a family	1.74 (person)
AGE_H	Age of household head	47.12 (age)
EDUC_H	Education lebel of household head (6 rank variables)	
VLDSIZE	Size of owned building	241.12 (m^2)
OFFINC	Off-farm income	2.76 (1 bil TL)
TLIVVLU	Total value of livestock	2.44 (1 bil TL)
TRCTRN	Number of tractor	0.88 (number)
OWNIRCD	Dummy of owned irrigated land (if ownes = 1, if not = 0)	
VLDM01-03	Dummy of village (Kaisli = 01, Abdiougle = 02, Kilcli = 03)	

Main results of this analysis are following three points. Firstly, the probability that a farmer meets credit constraint will increase, if his owned land declines. Secondly, the probability that a farmer meets credit constraints will increase, if his management scale becomes upper class. Finally, the probability that a farmer meets credit-constraints will decrease, if his off-farm income increases. This result implies that liquidity position influences credit-constraints.

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8) These questions are conducted only on the farm survey in 2003.

9) For the details of Logit regression models, see Maddala(1983).

Table 8.5 The logit estimation of determinants of credit-constraints

	Estimated coefficients	t-Statistic		dp/dx 1	dp/dx 0
TAPLAND	-0.0175	-2.3417	**	-0.0018	0.0018
MNGGRP	0.5361	1.8670	*	0.0542	-0.0542
NOMADL1	-0.0835	-0.2765		-0.0084	0.0084
AGE_H	-0.0017	-0.0536		-0.0002	0.0002
EDUC_H	-0.2385	-0.6852		-0.0241	0.0241
VLDSIZE	-0.0015	-0.8458		-0.0002	0.0002
OFFINC	-0.2024	-2.1602	**	-0.0205	0.0205
TLIVVLU	-0.0227	-0.3234		-0.0023	0.0023
TRCTRN	0.5068	1.1676		0.0512	-0.0512
OWNIRCD	-0.5736	-0.8289		-0.0412	0.0412
VLDM01	-2.2868	-2.7800	***	-0.1291	0.1291
VLDM02	-0.5396	-0.6826		-0.0421	0.0421
VLDM03	-1.4328	-1.8245		-0.1266	0.1266
C	1.4958	0.8636			

Log of likelihood	-49.3991
Number of observations	97
Percentage correct predictions	81.4

*Significant at 10% level, **Significant at 5% level,
***Significant at 1% level
dp/dx are marginal effects evluated by mean values

8.3.4 The determinants of borrowed money

In the logit estimations, ACC members and non ACC members were not distinguished. However, as reported in table 8.6, ACC members are more apt to meet credit constraints comparing to non ACC members. The borrowed money may be decided by different factors between ACC members and non ACC members.

Table 8.6 Farmers' responses to the questions about credit-constraints (Household numbers)

		Credit constraint NC-HHs	Credit constraint C-HHs	Total
ACC	Members	18	21	39
	Non members	40	20	60
Total		58	41	99

Sources) Farm survey in 2003.
NC-HHs are not credit constrained farers and
C-HHs are credit constrained farmers.

The borrowing functions of ACC members and non ACC members were estimated separately, using Tobit regression models[10]. The dependent variable is borrowed money (including agricultural current inputs borrowed from ACC or commercial sellers) of each farmer in 2003. The explaining variables are owned land size with TAPU (TAPLAND), management scale (5 rank variables) (MNGGRP), off-farm income (OFFINC) and village dummies (VLDM01-03). The results of the Tobit estimates are presented in table 8.7.

10) For the details of tobit regression models, see Maddala(1983).

Table 8.7. The tobit estimation of determinants of borrowing money

	ACC Members		Not ACC Members	
	Estimated coefficients	t-Statistic	Estimated coefficients	t-Statistic
TAPLAND	6.84E+07	2.06807 **	-3.93E+07	-1.46535
MNGGRP	9.71E+08	0.497623	2.78E+09	2.4025 **
OFFINC	4.79E+08	0.862052	1.31E+08	0.461785
VLDM01	2.14E+09	0.508454	2.43E+09	0.745799
VLDM02	1.74E+10	4.02419 ***	1.74E+09	0.54221
VLDM03	-1.17E+09	-0.305091	-1.65E+09	-0.382373
C	-9.42E+09	-1.72459	-1.10E+10	-2.53493 **
Number of observations	36		53	
Number of positive observations	25		12	
Log of likelihood	-611.42		-299.782	

**Significant at 5% level, ***Significant at 1 % level

Main results of these estimates are following two points. Firstly, for ACC members, the amount of loans is mainly decided by owned land size, not his management scale. If his owned land size increases, his amount of borrowing money will increase. Secondly, for not ACC members, the main determinant of borrowing money is his management scale. If his management scale becomes upper class, his amount of borrowing money will increase.

8.3.5 Implications of the logit regression and the tobit regressions

From the logit regression and the tobit regressions, we can say two points.
1. The characteristics of the rural credit market in Adana region lead to the distribution of credit against small farmers. This means that the institution that ACC allows farmers to sublease loans does not fully help small farmers to borrow money from credit market. Thus, the small farmers are apt to struggle with credit constraints and lose the efficiency in his agricultural production.
2. Because ACC rations the maximum amount of loans by owned land size of borrowers who are members of ACC, the amount of borrowing money is decided by owned land size. Moreover, since ACC

provides only agricultural current input goods, the demand of a borrower for credit does not correspond well to the management scale. The amount of borrowing money is decided by his owned land size, not his management scale. This situation means that the borrowed money of ACC members is apt to be decided by the supply side of credit[11]. Thus, ACC members are apt to face credit constraint comparing to not ACC members.

8.4. The Changes of Farm Behavior by Credit-Constraints

8.4.1 Comparison some indices of agricultural production

To capture the farm behavior of credit-constrained farmers, some indices of agricultural production of credit-constrained farmers and not credit-constrained farmers were compared. Firstly, these indices were compared in each village. However, except Kaisli, the results were not consistent with the theory of credit-constraints. For paying attention only to credit-constraints, we need to set several strict assumptions. For example, we need to assume that the agricultural technology is constant to land size and same between credit-constrained farmers and non credit-constrained farmers. These

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11) Owned land size will influence strongly the amount supplied of loans. On the other hand, management scale will influence strongly the demand sides of loans.

Table 8.8. Some indices of farm economy and agricultural production (average indices)

Cash Crop Rank		HHs Numbers	Managed Land	Owned Land	Off-firm Income	Rate of Owned Labor	Land Productivity	Labor Productivity
0	NC-HHs	13	78	49	4,238,615	0.89	42,528	21,863
	C-HHs	14	49	25	1,534,286	0.99	8,333	7,198
1	NC-HHs	9	155	113	4,745,556	0.80	44,561	18,999
	C-HHs	12	124	51	1,252,500	0.78	36,171	8,512
2	NC-HHs	5	184	120	5,900,000	0.14	346,871	83,466
	C-HHs	6	333	120	1,850,000	0.46	264,263	63,495

Source) Farm survey in 2003.

1. Cash crop ranks are categorized by each farmer's proportion of cash crop area to managed land size. Only data of three villages in Adana (Abdiogle, Kilicli and Beloren) was used for this categolization.

2. Rank 0 is the proportion of cash crops is 0 %. Rank 1 is 0% to 40%. Rank 2 is more than 40%.

3. The measure of land size is da.

4. The measure of money is 1000TL.

5. NC-HHs are non credit-constrained farmers, and C-HHs are credit-constrained farmers.

assumptions may not be approved in Adana region, because farmers in Adana region cultivate several crops.

For relaxing the strictness of technological assumptions, the farmers in Abdioglu, Kilcli and Beloren were classified by the proportion of cash crop to managed land size. Then, the comparing of the indices was compared in each group (see Table 8.8).

The results were still not consistent with the theory of credit-constraints. However, we can see some patterns of credit-constrained farmers from this comparison. Firstly, in all ranks, the proportion of owned land to managed land of credit-constrained farmer is lower than that of not credit-constrained farmer. Furthermore, off-farm income of credit-constrained farmer is also lower than that of non credit-constrained farmer. Thus, we can affirm that the household economy of credit-constrained farmer is apt to get low in his household's liquidity. Except Cash crop rank 1, own labor ratios of credit-constrained farmer are higher than that of not credit-constrained farmers. Finally, in all ranks, both land productivity and labor productivity of credit-constrained farmer is lower than that of not credit-constrained farmer.

From these patterns, we may say that credit-constrained farmers tend to depend on own labor which is no need for cash expenditure, because of lack of liquidity. However, this behavior cannot maintain the agricultural productivity in Adana region. This implies that farmers have strong needs for hired labor force for their agricultural production.

8.5. Conclusion

In this chapter, we analyzed rural credit market in Adana region. In section 8.2, we analyzed institutions of ACC which is the most important credit institution in Adana region, using simple theoretical model. In this section, we showed that there are two types of constraints under ACC. One is that a farmer cannot borrow desired amount from ACC, because ACC rations the maximum amount of loans by his owned land size. Another one is that a farmer does not borrow upper limit of loans, because ACC provides only current inputs and not money. In this case, if ACC provides money, the farmer will borrow more money and approve his utility.

In section 8.3, we introduced the overview of rural credit market in Adana region, using farm survey data. In this section, it was affirmed that ACC is the most important credit institutions in rural area. ACC permits members to sublease their loans. The data showed that both landless and big farmers use this institution. This means that this institution influences positively and adversely equity of credit distribution. So, total effect of this institution cannot be clarified from some tables showed in this section.

In section 8.3, furthermore, we conducted econometrical analysis using logit regression and tobit regression. Logit regression showed that the probability that a farmer meets credit constraint increases, if his owned

land declines. Thus, if the institution of subleasing influences positively equity of credit distribution, it is clear that the distribution of credit in Adana region goes against to small farmers. Tobit regression showed the amount of loans of farmer who is membership of ACC is decided by his owned land size. This means that members of ACC are more apt to face credit constraints, because their amount of loans are decided supply condition of loans.

In section 8.4, we analyzed farm behavior of credit-constrained farmers, comparing to non credit-constrained farmers. In this section, we showed that agricultural productivities of credit-constrained farmers are lower than non credit-constrained farmers because of lower hired labor inputs. So, the institution that ACC provides only current inputs.

ACC rations the amount of loans by owned land size of borrowers, and excludes landless farmers from the membership. Because of this, landless or small farmers tend to meet credit constraints than big farmers. The land market in Adana region makes the distribution of land more equitable. ACC need to approve the way of credit rationing, considering the characteristic of the land market.

Since ACC does not provide cash, but agricultural inputs in kind, farmers cannot use credit effectively for their agricultural management. If the technology of agricultural production is intensive one for current input goods (fertilizer and chemicals), to limit the kind of credit to agricultural inputs may be reasonable, because ACC can reduce the supervision of the way of use of the credit. However, in Adana region, hired labor input is needed for agricultural production. As mentioned in Section 8.4, the credit-constrained farmers can't use sufficiently hired labor force, and because of this, their productivities are lower than not credit-constrained farmers. The institution that ACC provides only agricultural input is another factors that farmers meet credit constraints. If the irrigation project is gone on, the necessity of hired labor will be higher than now. ACC need to readjust the loan program, which only provides agricultural input in kind.

Finally, I point out the relationship of rural credit market to climate change in Adana region. As mentioned above, although hired labor has important roles in agricultural production, ACC doesn't provide cash. Because of that, credit-constrained farmers suffer from lack of liquidity for hired labors. This means that the rural credit market does not fully support the agricultural production system in Adana region. When climate change happens, agricultural production system will change subject to climate condition. Rural credit market needs to continue to respond the change of agricultural system to support farmers' efficient agricultural behaviors.

$$\frac{\partial \xi}{\partial c_0} = U_{c_0} - \lambda_1 q = 0$$

$$\frac{\partial \xi}{\partial x_1} = -\lambda_1 v + \lambda_2 F x_1 + \lambda_3 v = 0$$

$$\frac{\partial \xi}{\partial x_2} = -\lambda_1 w + \lambda_2 F x_2 = 0$$

$$\frac{\partial \xi}{\partial L} = \lambda_1 - \lambda_2 (1+i) - \lambda_3 - \lambda_4 = 0$$

$$\frac{\partial \xi}{\partial \lambda_1} = L + W_0 - q c_0 - v A x_1 - w A x_2 - r(A - V) = 0$$

$$\frac{\partial \xi}{\partial \lambda_2} = A F(x_1, x_2) - (1+i) L - q c_1 = 0$$

$$\frac{\partial \xi}{\partial \lambda_3} = v A x_1 - L \geq 0$$

$$\frac{\partial \xi}{\partial \lambda_4} = S(V) - L \geq 0$$

$$\lambda_3 \xi_{\lambda_3} = 0 \qquad \lambda_3 \geq 0$$

$$\lambda_4 \xi_{\lambda_4} = 0 \qquad \lambda_4 \geq 0$$

Appendix

The Kuhn-Tucker conditions of the theoretical analysis in section 2 are as follows.

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