CENTER FOR INSTITUTIONAL REFORM AND THE INFORMAL SECTOR

University of Maryland at College Park

Center Office: IRIS Center, 2105 Morrill Hall, College Park, MD 20742
Telephone (301) 405-3110 • Fax (301) 405-3020

FINANCIAL INTERMEDIARIES, RATIONING AND SPILLOVER IN A RURAL CREDIT MARKET IN CHILE: A THEORETICAL AND EMPIRICAL ANALYSIS

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Jonathan Conning

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Authors: Jonathan Conning, Universite de Montreal and Williams College.

Financial Intermediaries, Rationing and Spillover in a Rural Credit Market in Chile: A Theoretical and Empirical Analysis

by

Jonathan Conning
Université de Montréal
and Williams College

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IRIS Summary

Chilean agriculture provides a useful case study of the rise of new intermediary structures, the development of markets for financial contract forms, and their impact on economic growth and distribution. Following a far reaching agrarian reform ending in the mid seventies Chile embarked on a radical program of economic and financial liberalization that has been maintained to date. These changes forced deep adjustments in production organization and property ownership in the countryside but also gave led to new trade and production opportunities. In some sub-sectors -- most notably in fresh fruit exports and agroindustry processing -- very rapid export growth and technological modernization took place leading several observers at the time to describe these as a showcase success story for the country's free market policies.

A network of new and existing private intermediary structures emerged to facilitate and respond to these changes. Contract farming arrangements (outgrower schemes) spread rapidly and to profound effect in this period. In these arrangements an intermediary -usually an export firm or agroindustry trader -- contracts to purchase a farmer's crop in advance of harvest through an interlinked contract that may also provide credit, technical assistance, tied farm input sales, and other services. The use of interlinked contract terms, heavy monitoring of the farmer's activities, and other devices, allows these intermediaries to provide typically provide finance that uses substantially less collateral than bank loans, and at times no collateral other than a crop pledge. However, these economic transformations and the reach of these new intermediary structures have not been evenly felt, and some commentators characterize the period as one of"exclusionary" growth. While part of the agricultural economy modernized and led the export boom, another important segment of farmers remained in the production of less profitable traditional crops or chose, or was forced to, abandon farm production entirely.

Using data and findings from a fieldwork case study of the agricultural county of San Clemente in central south Chile I analyze the determinants of credit rationing and market fragmentation in this highly competitive and deregulated market for farm finance in a random sample of one hundred farm households. I extend the theoretical framework presented in a theoretical companion paper to construct and estimate an empirical model of rationing and spillover in a two sector credit market in which two types of intermediary lenders coexist and compete: formal lenders such as banks that offer collateralized loans at competitive market interest rates, and product market traders and contract farming firms who lend against less collateral but actively monitor borrowers during the course of the growing season and lend at higher implicit interest rates. Depending on access and choice, farm units borrow from either, neither or both lending sources. Interestingly, the model predicts that the most rationed in the were not the non-borrowing

households, but rather those who had access to trader loans but not as much as they would have liked, and who could not access cheaper bank credit. This suggests two conclusions. (1) Many non-borrowing households owe their non-participation to the fact that they have preferable altematives for self-finance or that they do not have sufficiently profitable projects in which to invest. Rather than credit, these households are better served by programs that provide assistance in the form of outright grants or subsidies to technical assistance and other services or investments that help raise their productivity and access to new projects. (2) While monitoring financial intermediaries such as traders and contract farming firms are able to identify the best farmers in a given area and provide credit against less collateral, this finding reinforces the view that this form of finance is itself limited and subject to rationing and also becomes an increasingly expensive alternative. The results point to the need for a more differentiated approach to credit

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JONATHAN CONNING

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ABSTRACT. Using a case study of the highly competitive and deregulated market for farm finance in Chile I describe the operating practices of different lenders and financial intermediaries and examine the determinants of credit market fragmentation. Based on these observations and a theoretical framework laid out in Conning (1996) I then estimate an empirical model of rationing and spillover in a two sector credit market in which two types of intermediary lenders: formal lenders such as banks that offer collateralized loans at competitive market interest rates, and product market traders and contract farming firms who lend against less collateral but actively monitor borrowers during the course of the growing season and lend at higher implicit interest rates. Depending on access and choice, farm units borrow from either, neither or both lending sources. Interestingly, I find that rationing is more often a constraint to expansion for the mid segment of farm units in the sample who have access to finance from traders but not banks than it is even for the non-borrowing and poorest households. The results point to the need for a more differentiated approach to credit analysis and policy.

1. INTRODUCTION

Rural credit markets in developing countries are often described as fragmented or segmented in the sense that entrepreneurs in the same market appear to have unequal levels of access to the observed available set of financing instruments because of collateral requirements and other non-price contract terms (McKinnon, 1973; Hoff et al, 1994). Depending on access and choice farm households employ a variety of financial instruments separately or in combination to construct an overall financing strategy. Farmers may for example use a mix of self-finance, bank credit, loans from product market traders or contract farming firms,[1] deferred payment arrangements

[1]Farm product traders and contract farming firms are intermediaries who contract to receive all or a portion of a farmer's expected produce at harvest in exchange for credit advances and other services such as technical assistance delivered earlier in the season. In Chile, as in many other parts of the world tied credit of this sort is the main source of production finance for agriculture.

with input suppliers, informal and/or implicit credit from moneylenders, landlords, production partners, etc.

An important but less noted observation is that, while different lenders usually do compete with each other with these instruments for a share of a borrower's loan business, they often also complement each other's activities in very fundamental ways. A bank lender may for example be more willing to lend to a farmer who receives credit advances from farm product traders because traders can often gather information on the borrower and often enforce contract terms at lower cost than the bank. The trader's willingness to acquire a financial stake in the borrower's project then signals or certifies to the bank that the borrower's project has been pre-screened (diminishing adverse selection problems) and that the borrower's production actions will likely be closely monitored during the course of the growing and harvest season (lowering the scope for ex-ante moral hazard in the use of borrowed funds and ex-post moral hazard or opportunism in reporting true crop project outcomes). The presence of a trader lender (or equivalently in some circumstances, a cosigner) may lead the bank to provide additional finance to the farmer directly, or perhaps indirectly by lending to the trader or other monitoring intermediary lender who then on-lends to (or in the case of a cosigner assumes liability for) the farmer.[2]

Formal and informal trader lenders hence often play an important role as financial intermediaries by using some of their own capital (to create a stake) and their specialized information and enforcement advantages over a particular segment of borrowers in the market (to certify and monitor), to transform the illiquid project claims owned by entrepreneurs in the economy into more liquid claims that can be more readily sold to less informed investors, and hence affect the real production and exchange possibilities in the economy.

This paper uses findings and data from a 1994 case study and farm household survey of the competitive market for farm finance in San Clemente county in southern central Chile to investigate the operating practices of banks, traders, contract farming firms and other lenders on the market, the relationships established between amongst them, and their success in creating financial contract forms to deliver and recover credit from different segments of borrowers. Of particular interest in this period

[2]In trading and contract farming situations this sort of relationship is often underpinned by and/or leads to the development of a system of bills of exchange. In contract farming schemes in Chile for example, farmers are typically asked to sign bills of exchange for the amount to be loaned by the trader. Using these bills, the trader then turns to a bank or other creditor as proof or a form of security for obtaining credit for it's own operations. Although technically by law these bills could be traded on secondary discount markets, in practice in Chile these bills are rarely traded individually. This is because the value of the claims that the bill represents depends crucially on the monitoring activity of the intermediary (in this case a contract farming firm or trader that holds the bill). The bill has less value in the hands of another who cannot monitor the farmer to protect the value of these claims as effectively as the initial monitoring intermediary. Trader's are however in effect securitizing a large portfolio of these bills when they raise credit from the capital market.

are the interesting contractual practices of contract farming firms and their rising importance as financial intermediaries in Chilean agriculture.

Contract farming firms act as product buyers or processors who contract to receive claim to a part of the farmer's crop at harvest in exchange for credit and other services provided by the firm early in the growing season. These arrangements are often referred to as contract farming[3]. In other parts of the world, and in certain other sectors of Chilean agriculture, more informal product traders have carried out similar arrangements more informally for centuries. A defining characteristic of these lending relationships is that the intermediary is often heavily engaged in the activities of the farm borrowers during the course of the growing season in part as a consequence of the fact she is also transacting with the farmer on other markets. This and other aspects of the contractual relationships can be interpreted as serving the role of "collateral substitutes": improving upon contract enforcement and lowering the collateral required relative to other types of lending.

It is interesting to note in fact that while interlinked and monitored credit provided by contract farming firms through formal (i.e. legally established) contracts rose very dramatically in several crops during the period of economic and financial liberalization initiated in 1975, and especially in the newly profitable export activities, informal trader-moneylending operations diminished or entirely dissappeared in other crops, especially several of the less profitable traditional crops produced by small farmers. I offer one explanation for this apparent puzzle in Conning (1995).[4]

In Chile, as elsewhere the issue of the small farmer has dominated public debates over contract farming and the growth path of the economy more generally. Following a far reaching agrarian reform that ended in the mid seventies, Chile embarked on a radical program of free market reform that has been maintained to date. A period of deep adjustment in production organization and property ownership in the countryside followed but eventually several sub-sectors experienced very rapid export growth and technological modernization. By the late eighties Chile's chronic food trade balance deficit had been transformed to large trade surpluses and Chile

[3]The recent volume by Little and Watts (1994) provides a comprehensive bibliography of the literature on contract farming in the export sectors of many developing countries and in the agriculture of the United States and other developed countries.

[4]In Conning (1995) I describe evidence and a theoretical model to interpret this apparent puzzle. The explanation points to how the country's economic and financial liberalization measures brought such increased competition in the marketing sector where informal traders had operated that it rendered several of the traditional mechanisms these intermediaries had used to enforce exclusive claim over the farmer's harvest more costly or inoperable. In other words, increased competition diminished the value of crop collateral and this resulted in a fall in tied lending. In several of the sectors where contract farming firms emerged these problems where not so severe because these product market sectors where more concentrated and the type of farmer involved meant that legal enforcement mechanisms could frequently be used to enforce crop liens to preserve the value of crop collateral.

had become, arguably, the world's most important fresh fruit exporter. Many observers then heralded the agricultural sector as the showcase success story for the country's free market policies.

A number of other authors and commentators however have characterized the period of the last two decades as one of "exclusionary" growth and modernization (Carter et al., 1993; Cox, 1990; Jarvis, 1991; Ortega, 1987). In this view the rural resource poor appear to have participated in the export boom indirectly: as hired laborers rather than as direct producers (Carter et al, 1993). While part of the agricultural economy modernized and expanded and experienced the export boom and the rise of new markets, another sector of producers remained in less profitable traditional crops and scaled back or abandoned production. The fate of the agrarian reform sector is frequently discussed in this context: according to one study over one half of the estimated 52,000 beneficiary families from the agrarian reform period had lost their land by 1986 (Rolando and Echeñique, 1990).

Empirically it is quite difficult to establish whether these distributional outcomes been the result of, as some commentators in the public debate would suggest, to the sad but inevitable replacement of less skilled and less 'efficient' farm units by better skilled new entrepreneurs, or, because as critics of this position would suggest, because these farmers have been locked out, not so much because of a lack of ability or entrepreneurship but because the markets in which they transact operate imperfectly, leaving them with unequal access to credit, technical assistance, and other factors of production necessary to carry forth their production projects.

Organizational forms such as contract farming are at the center of these debates because to the extent that they are understood as mechanisms which develop to substitute or replace missing competitive markets as is frequently suggested in the theoretical literature, they might be expected to help mitigate several of the information and enforcement problems that hamper small farmers in their access to credit market and other factor markets that operate imperfectly because of information asymmetries and costly enforcement.

In this paper I attempt to provide some empirical evidence on these questions. Motivated by a theoretical model of financial intermediation and credit market fragmentation developed in a companion paper (Conning, 1996a), I employ the survey data to estimate an empirical model of the credit market in San Clemente county. The model takes into account potential spillovers or complementarities in the supply and demand for different financing instruments described above, and helps to measure the extent of credit rationing faced by different borrowers in the market.

In the model, depending on their level of access and choice borrowers use up to two, possibly complimentary, lending instruments: loans from non-monitored sources such as banks and other formal lenders who require full collateral guarantees to enforce their loans, and monitored loans from traders and contract farming firms who lend against less physical collateral per peso loaned but who actively monitor and attempt

to control the borrower's use of borrowed funds. Because these monitoring activities are costly, this form of finance carries a higher explicit or implicit interest rate cost[5] A borrower who is unable to obtain a bank loan or is quantity rationed to obtain a smaller loan amount than he would like at market rates, may spillover some of his loan demand onto the more expensive monitored loan market, for instance by taking cash advances from a trader or contract farming firm or by buying a larger fraction of his inputs through more expensive tied and/or in kind loans from this same source. When a borrower has very few assets at all, or is judged by the lender to have a very poor project, he may not be unable to obtain a loan from either source even at a high interest rate, and will be excluded from the formal lending market entirely.

Two recent papers, by Bell, Srinivasan and Udry (1995) and Kochar (1995), are highly relevant to the analysis in this paper. Both apply different versions of a restricted two market disequilibrium model to analyze the market for rural credit in Punjab. Bell et al. argue that demand for credit from the informal market (tied and untied loans from traders and moneylenders) arises as a spillover from unsatisfied demand in a government controlled and subsidized institutional market (a credit cooperative in their analysis, bank loans in my terms). The model I examine is in some ways similar in structure except that I argue that rationing and spillover arises even where there are no distortionary government interventions. Credit rationing can arise on both the informal and formal market in my analysis, while for these authors rationing occurs only on the formal market.

My approach is more similar to Kochar (1995) and to Bloom et al. (1981) in that I estimate the model using participation decisions rather than the more detailed information contained in actual amounts transacted and interest rates, as discussed above. However, while Kochar estimates a model that divides households somewhat narrowly between those who borrow either from the formal sector or the informal sector, but not both, and Bloom et al. consider only one sector, the model examined here allows households to borrow from either, both or neither bank and trader loans.

Although the estimation results should be interpreted with some care, the model's predictions are suggestive. Over two-thirds of all farmers in the sample are found to be credit constrained in one way or another, either through exclusion, or more simply because they could not obtain as much bank or monitored finance at the lowest market rate as they might have desired suggesting that rationing persists as a very real problem even on highly competitive and deregulated market's such as Chile's. Contrary to what might have been expected however, the highest proportion of credit constrained farmers in the sample is found to be not amongst the poorer non-borrowing households (although 60 percent of these were classified as constrained), but rather among the group of borrowing households that borrowed from traders

[5] An important contribution of the theoretical model which makes the costs of monitoring explicit is to motivate the existence of an upwardly sloping supply schedule that operates at the level of each individual borrower and not just at the level of the market.

but could not obtain bank loans (82 percent constrained). I interpret this result as evidence for the view that while new and existing financial intermediaries such as contract farming firms do play an important role in identifying and financing the most able among the small and medium farmers in a region, this form of finance is nonetheless limited and becomes increasingly expensive.

The results also suggest however that many of the poorer and small and medium farms on this market do not face binding credit constraints, either because they have cost preferable alternatives for self-finance, or because they do not have sufficiently profitable projects within which to invest. If a policy lesson can be drawn from this observation, it may be that farmers in the poorest segment would be better served by assistance in the form of outright grants to improve their access to technical assistance, marketing and other services, or public investments in the form of long term investments in health, education, infrastructure and other projects to help raise their productivity and access to new projects over time than better credit to credit at market or subsidized rates as some have argued.

The rest of the paper is organized as follows: Section 2 describes the structure of the credit market analyzed and extends the theoretical framework presented in Conning (1996) to motivate the upward sloping joint loan supply schedule at the level of each individual borrower that will be used in the empirical model. Section 3 presents the actual econometric specification to be estimated. Section 4 describes the data used in the analysis and Section 5 reports the estimation results and concludes.

2. Financial Intermediaries in Chilean Agriculture

The analysis of this paper is based on a fieldwork case study in the agricultural county of San Clemente in the Chilean countryside, approximately 4 hours drive south of Santiago. Activities included conducting a farm household survey which involved personal interviews with 96 randomly selected farm enterprises and dozens of interviews with bank lending agents, traders and contract farming firms, input suppliers and other formal and informal financial intermediaries. The purpose of these interviews was to understand how financing strategies and production decisions vary across farms and the contract terms, collateral requirements and enforcement mechanisms that lenders employ[6].

Traders and contract farming firms typically contract to market or process a farmer's harvest in exchange for credit and often other services like technical assistance and farm input sales. An important characteristic of this form of lending is that the loan contract typically involves much less collateral than a bank would require, and at times, no collateral other than a crop pledge. These loans are usually quite heavily monitored in the growing season and prior to repayment. For instance,

[6] A more complete descriptive and empirical analysis of the market for farm finance in Chile, and details of the survey and sampling procedure can be found in the chapters of my doctoral dissertation (Conning, 1996b).

firms typically advance credit in installments timed to match the farmer's likely needs in different tasks through the crop season. The release of an installment can be held up or sized down in response to the actions by the farmer up to that date as perceived by the monitor.

A significant fraction of these loans are also in-kind. Seed, fertilizer, or a voucher for transport services will be delivered to the farmer rather than cash. Consistent with the model elaborated below, the purpose of these practices seems clearly aimed at limiting the scope the farmer might have to divert resources or effort away from the project financed and toward other activities over which the lender does not have an easily established claim. Traders are more likely to become financial intermediaries because in the normal course of their activities as product buyers they acquire knowledge of the farmer and the crop technology. While a separate specialized lender and separate trader might both incur costs to monitor a farmer's compliance in meeting the terms of a loan, and in meeting quality standards on delivered produce, a combined trader-lender economizes on these costs through economies of scope in monitoring[7].

Banks by contrast aren't really in the business of making frequent field visits to check up on how their farmer clients are using their loans – their comparative advantage lies elsewhere. Banks are very often located in regional centers far from the farmer's fields which makes regular visits expensive.

Table 1 gives an idea of how different farm borrowers in San Clemente county were matched to different types of loans in the 1993-94 agricultural season. The table divides the 96 farm households in the sample into four different asset categories, where total asset values are calculated by summing quality adjusted estimates of farm land value, the value of farm implements and machinery, and off-farm assets belonging to each farmer. This is an approximate measure of the farmer's available collateralizable wealth. The first thing to note from the table is that farmers use a fairly large variety of different formal and informal lending sources to finance their projects, and often use different instruments simultaneously. At the same time however it is evident that the loan market is quite fragmented according to the farmer's asset position: farmers in the higher asset classes are much more likely to have access to, and to use bank finance, trade credit from input suppliers and other instruments backed by collateral or legal means as an important component in their total finance package than are farmers with fewer assets while farmers with intermediate levels of asset holdings typically rely much more heavily on monitored credit and credit tied to transactions on other markets such the credit advances provided by farm product traders. Significantly, a large fraction of borrowers in the low and middle asset categories reported using no formal external finance source whatsoever (the "None" category)[8]. For these

[7]They are also often able to better value some of the items a farmer might provide as collateral. A trader for instance will be much more willing to accept a farmer's crop as collateral than a bank.

[8]Farmers reporting no loans from any of the categories in the first six loan categories are entered

last borrowers retained earnings and informal financing arrangements predominate. Informal loans include those from family or friends, smaller and shorter term loans from informal traders, and (not very commonly in Chile, but quite frequently in other countries) loans from specialized moneylenders. Retained earnings might include items such as income from past crop sales, renting out land, selling animals, labor remittances from family members, income from other businesses, etc.[9].

Sources of Farm Finance

Number of Farmers in each category borrowing from listed Source

Asset Category	n	Bank	Input Suppliers	Dealers	Traders	State Lender	Electric Coop	Informal	None
1	24	0	0	0	10	3	7	13	10
2	24	1	1	0	7	5	2	10	14
3	24	4	5	4	13	2	5	7	5
4	24	19	19	10	20	2	0	1	2
All	96	24	25	14	50	12	14	31	31
% of Respondents in each category									
1	100	0	0	0	42	13	29	54	42
2	100	4	4	0	29	21	8	42	58
3	100	17	21	17	54	8	21	29	21
4	100	79	79	42	83	8	0	4	8
All	100	25	26	15	52	13	15	32	32

Source: 1994 Field Survey

Notes: See Table 2 for a definition of the asset categories employed

The first six loan categories in the table correspond to what might be labeled formal external financing categories. The last column labeled "None" reports on the number of farmers reporting no loans from any of these six categories. The other

in this column. The percentages from adding this to the other columns may add up to more than 100% because borrowers who do borrow often do so from more than one source at the same time.

The other categories in the table are as follows: "Dealers" refers to leasing companies and farm machinery dealers. The electrical cooperative, which makes trade credit available to smaller farmers usually payable in ninety days or at harvest, is an interesting and relatively new lending source and powerfully illustrates the importance of having an effective enforcement mechanism: borrowers who do not pay threaten having their electricity turning off. The state lending agency is meant to provide low interest loans to small and poor farmers but, at least in the county I studied, its reach was relatively limited – more poorer farmers obtained loans from traders or from the electrical cooperative.

[9]Tied, or implicit credit relationships are also of course embedded in sharecropping arrangements, deferred rentals, labor sharing arrangements, the borrowing of tools and farm implements, etc

categories are as follows "Bank" refers to bank loans, "Input suppliers" refers to farm input sellers who provide trade credit, "Dealers" refers to leasing companies and farm machinery dealers, the electric cooperative is a rural electricity provider that makes trade credit for farm inputs available to smaller farmers usually payable in ninety days or at harvest.[10] The state lending agency INDAP is charged with providing loans to small and poor farmers at only slightly subsidized interest rates, although by my measure of farm household assets they lent to farmers in the middle and high ranges as well. Informal loans include primarily loans from family and friends. Percentages may add up to more than 100% because borrowers who do borrow often do so from more than one source at the same time.

Two facts are immediately stand out immediately from this Table. The first is the very high number of households that report to have obtained no form of external finance whatsoever. These households operate entirely out of retained earnings and drawing down saved assets including items such as income from past crop sales, renting out land, , labor remittances from family members, income from other businesses, and very importantly selling animals.[11]. Another evident fact is that farmers who do borrow do so using a variety of different formal and informal lending sources, often simultaneously, to finance their projects.

A cursory glance at the data might suggest that initial wealth position is an important determinant of access to credit. Farmers in the higher asset classes are much more likely to have access to, and to use bank finance, trade credit from input suppliers and other instruments backed by collateral or legal enforcement as an important component in their total finance package than farmers with fewer assets. Farmers with intermediate levels of asset holdings typically rely much more heavily on monitored credit and credit tied to transactions on other markets such the credit advances provided by farm product traders.

Although monitoring and linked contracts may successfully act as collateral substitutes and hence facilitate access to credit for smaller, collateral resource poor households, this form of finance is often limited and comes at an increasing cost because lenders must be compensated for their monitoring and enforcement efforts. These costs will be reflected in implicit interest rates that rise with the size of the loan requested relative to available collateral. Credit rationing may occur because after a point the benefits of additional monitoring and enforcement expenses may not compensate the costs. This line of reasoning delivers an upward sloping loan supply schedule at the individual borrower's level that eventually becomes vertical.

[10]The coop has what appears to be a very effective enforcement mechanism: delinquent borrowers are threatened with having threatened with having their electricity supply cutoff.

[11]Tied, or implicit credit relationships are however often embedded in sharecropping arrangements, deferred rentals, labor sharing arrangements, the borrowing of tools and farm implements, etc. which are not recorded in these tables.

3. Theoretical Framework

In Conning (1996) I have presented a simple model of financial intermediation built around the problem of ex-ante moral hazard in the use of borrowed funds. By imposing some additional structure, the model can be extended to allow for variable investment scale and multiple outcome projects without altering the main predictions of the analysis. Innes (1990) first derived the optimal contract under limited liability for the continuous action level and multiple outcome model but without monitoring. The extension of his argument to include monitored lending is conceptually straightforward but involves several technical details that need not distract us here. Since the primary purpose of this section is to motivate the reduced form loan supply and demand schedules to be estimated, the discussion below will be kept very general.

As before the farmer's expected project returns depend both on his chosen observable level of investment I, and on an unobservable action level or input choice now denoted by a. A farm production function can be represented as a probability distribution function over project outcomes x_i denoted $f(x_i|a, I; Z_j)$ and parameterized by the borrower's action level a, the investment scale I, and by other exogenous variables that describe the household that are summarized in the vector Z. The vector Z might include variables such as the household member's education levels, farming skills, and ownership of difficult to trade factor inputs such as self-supervising family labor. These are all variables that one expects affect the productivity of the farmer's investment, and hence the position of his demand for loans.

The production function (expected project returns) is given by $E(x_i|a, I; Z) = \int x_i f(x_i|a, I; Z) dx_i$. The borrower's private benefits from taking the lower actions, or equivalently his opportunity cost of taking higher actions a on the funded project, are assumed to be proportional to the scale of investment and are given by $B(a, c) \cdot I$, where it is assumed that $B_a \leq 0, B_{aa} > 0$ $B_c \leq 0, B_{cc} > 0$ and $B_{ac} \geq 0$.[12] This seems a natural enough assumption since one would expect that the larger the loan amount, the more the borrower might stand to gain by diverting or misusing funds.

A *fixed debt contract* (FDC) is a loan contract which specifies that the borrower should make a fixed repayment $I(1+\rho)$ regardless of the project outcome x_i. As is well known, in the absence of limited liability constraints an FDC contract implements the first best action level (Harris and Raviv, 1979) and also leads the borrower to the first best investment scale. To see this, note that under a not-monitored FDC the borrower receives a return of $s(x_i) = x_i - I(1 + \rho)$ under each project outcome x_i. The borrower then chooses his optimal action and level of investment to maximize

[12]This last assumption implies that the marginal private benefit from taking lower actions is lowered by increased monitoring c. More general specifications regarding how the private benefit changes with the investment scale could be adopted but would not alter the main conclusions from the analysis.

his expected return:

$$\max_{a,I} \int s(x_i) f(x_i|a, I; Z) dx_i + B(a, 0) \cdot I$$
$$= \max_{a,I} \int x_i f(x_i|a, I; Z) dx_i - I(1+\rho) + B(a, 0) \cdot I$$

This is maximized with respect to a when the marginal product of action is set equal to the marginal private benefit foregone

$$\int x_i f_a(x_i|a^*, I^*; Z) dx_i = -B_a(a^*, 0) \cdot I^* \tag{3.1}$$

and will be maximized with respect to I when the marginal product of capital invested is equal to it's marginal cost, or when

$$\int x_i f_I(x_i|a^*, I^*; Z) dx_i = (1+\rho) + B(a^*, 0) \tag{3.2}$$

where a^* and I^* are the optimal input choices.[13] These two first order conditions are precisely the same as those that characterize a first best optimal action and investment level. This last condition defines the borrower's optimal loan demand schedule which will be denoted by $I^* = D^*(\rho \mid Z)$.

If a FDC contract is offered and the lowest x_i outcome possible is zero, then the borrower will be required to post collateral assets worth at least $A = I(1+\rho)$ in order to collateralize this loan. Innes(1990) demonstrates that when a borrower does not have enough collateral to cover a first best FDC contract because of limited collateral, then the optimal financial contract will be a *standard debt contract* (SDC).[14] Under a SDC a borrower makes a fixed debt repayment $R(A)$ on his loan only for all realized project outcomes above a given threshold level $\widehat{x}$, and "defaults" if the outcome is below this threshold. Default involves turning over the available project outcome in that state $x_i < \widehat{x}$ plus any available and previously pledged collateral assets A. An FDC is just an SDC without any default zone. These two contracts are depicted in figure 1.

Note that a no monitoring SDC implements a lower input action level than the first best optimal action a^*. This is because while an FDC rewards a borrower with the full incremental reward to taking higher action choices, under an SDC the borrower receives incremental rewards only from shifting probability mass to outcomes above

[13]This last condition looks more familiar if, by appropriate choice of units, we normalize the private benefits received by the borrower at the first best investment and action level a^* and I^* to be zero. When this is done $B(a^*, 0) \cdot I^* = 0$ and the second term on the right hand side of (3.2) vanishes and we have the marginal product of investment equaling the opportunity cost of funds.

[14]And not a sharecropping contract as has been argued by Shetty (1988), Basu(1992), and Laffont and Mattousi (1995). Each of these authors has been misled by restricting attention to linear contracts of the form $s(x_i) = \alpha + \beta x_i$. If they had allowed even just one piece-linear break in their contract they would arrive at the SDC result of Innes (1990).

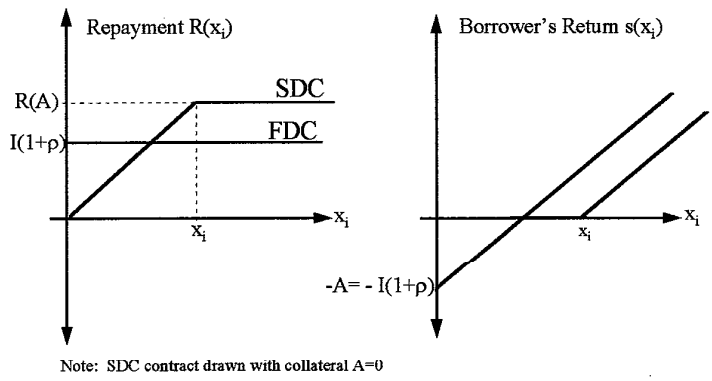

FIGURE 2.

the threshold $\widehat{x}$. The less collateral the borrower has to post, the larger the default region, and the more dull will be the incentives which can be provided.

Monitoring provides another way to raise the optimally chosen action level on a loan. Monitoring aimed at lowering the marginal private benefits $B_a(a,c)$ that a borrower stands to obtain from lower action levels lowers the scope for moral hazard and hence lowers the loan collateral requirement. Such monitoring/helping will in general be possible whenever $B_{ac} \neq 0$. Because they involve less collateral for equal sized loans, monitored loan contracts are always SDCs. While an SDC has a larger default zone which potentially dulls the relative incentives the borrower has to take higher actions, the intermediary uses monitoring in a compensating way to sharpen the incentive the borrower has to take higher actions . With enough effective monitoring the lender can in principle implement the same high action level a^* through an SDC as through an FDC although the contract will clearly charge a higher implicit interest rate to recover the monitoring cost.[15]

Under quite reasonable assumptions about the monitoring technology $B(c)$, the optimal monitoring intensity function $c(A,I)$ will be concave non-increasing in the collateral resources A that the borrower can post for any given project scale I as it was

[15]An optimal contract would tradeoff increasing the monitoring expense c against choosing to implement an action intensity a that is stricly lower than the first best a^* in order to lower collateral requirement on a loan of given size I. This additional tradeoff should not however alter the main result presented in the text needed to justify the shape of the loan supply and loan demand schedules, namely that the optimal monitoring intensity is decreasing in the borrowers collateral A.

in the simple model. Similarly, for any given A, the monitoring intensity required is an increasing function of the investment scale. The (expected) cost of funds on a loan of size I to a borrower with collateral resources A is given by $r(A, I) = \rho + c(A, I)$. In other words borrowers who have little collateral relative to their desired loan size will be required to pay higher implicit interest rates. The trader loan supply schedule to a borrower with collateral assets A can therefore be represented as the schedule $r(A, I)$ up to the ration $S^T(r, A)$ as depicted in figure 2b. The curve $S^T(r, A)$ represents the locus of r and maximum loan amount pairs that a borrower can obtain against collateral assets A from a monitoring lender. This curve is at first flat as the borrower can fully collateralize his loan, but as he tries to borrow more and more against the same level of collateral assets A the contract will switch from not monitored to more and more monitoring, raising the cost of funds $\rho + c(A, I)$.

In contrast to traders, bank lenders do not in general monitor their borrowers during the course of the growing season and instead rely on collateral to attenuate the moral hazard problem. I assume that banks offer only FDC contracts and never SDC contracts.[16] The bank lender's loan offer to a borrower of characteristics Z including the level of collateral assets A can therefore be depicted as a horizontal line extending to the upper ration $S^B(r, A)$ at height ρ as drawn in figure 2a. Under the assumption that the bank offers only FDC contracts and A is all that affects the loan $S^B(\rho, A) = \frac{A}{(1+\rho)}$.

As in the simpler case the borrower may obtain loans from neither loan source, from traders only, or from both the bank and a trader. The farmer in effect faces a single joint supply loan offer curve as depicted by $S(\rho, A)$ in figure 2c. $S(r, A)$ is the combined bank and trader loan amounts a farmer with collateral assets A can obtain at different levels of the implicit cost of funds $r = \rho + c(A, I)$. At different points along this locus the farmer is using different mixes in the proportion of monitored to un-monitored finance.[17]

Because of the rising monitoring costs, the model delivers an upward sloping loan supply schedule at the level of each individual farmer. In other words, a borrower must pay a higher interest rate for larger loans from traders. There is ample evidence that this happens in practice. Although the written agreements between contract

[16]In principle, a bank lender would be willing to offer SDC contracts to borrowers with less than full collateral to implement a^*. The lender would continue to earn $I(1+\rho)$ in expected terms but the observed interest rate when there is no default would be higher than ρ. Due to the default zone the borrower would choose to implement a lower action level, prefering to earn somewhat higher private benefits rather than work hard to keep the expected output as high. It should be clear however that even in this case there will be an upper ration $S^B(A; Z)$, so the analysis below would require little modification if banks were assumed to also use SDCs. The restriction to FDC sacrifices little realism since bank loans are almost always fully or more than fully collateralized, and bank lenders appear do very little actual monitoring during the course of the growing season.

[17]Note that $S(r, A)$ is not the simple linear summation of $S^T(r, A)$ and $S^B(r, A)$ because a bank lender may be willing to lend more to borrowers who borrow from a trader than those who do not.

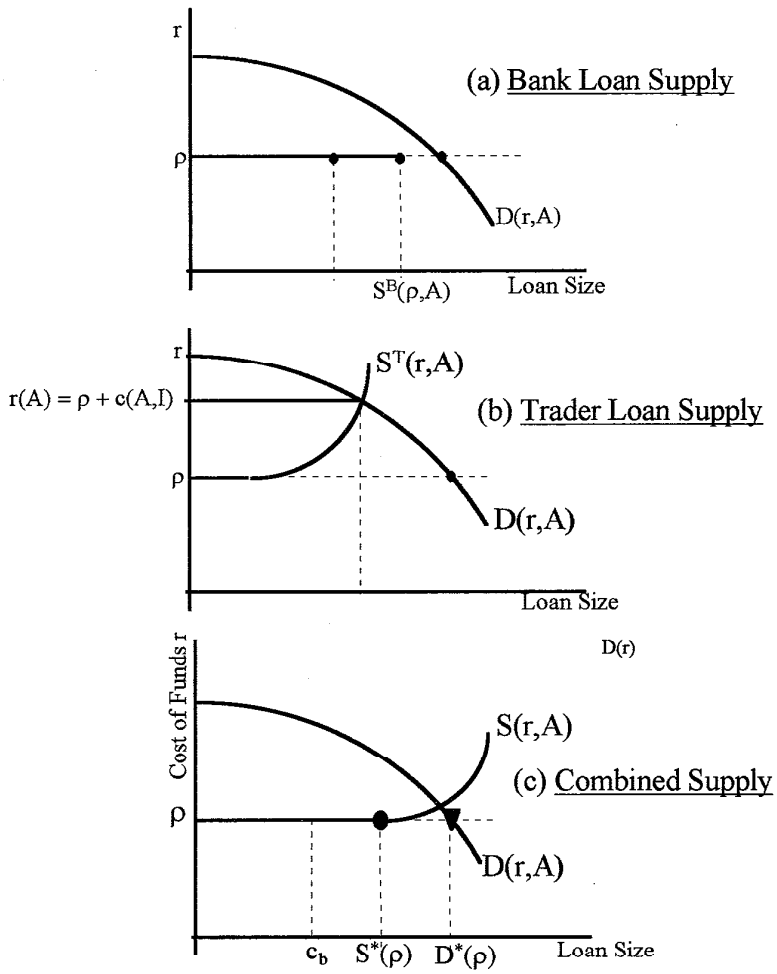
r
(a) Bank Loan Supply
ρ
D(r,A)
S^B(ρ,A)
Loan Size
r
S^T(r,A)
r(A) = ρ + c(A,I)
(b) Trader Loan Supply
ρ
D(r,A)
Loan Size
D(r)
Cost of Funds r
S(r,A)
(c) Combined Supply
ρ
D(r,A)
c_b
S*(ρ)
D*(ρ)
Loan Size

FIGURE 3.

farming firms and farmers typically state a fixed interest rate charge (typically the bank rate plus 1.5-3 percent) to be applied on all loan advances, the contracting firm has many ways of charging a rising implicit interest rate. For example through the price at which it contracts for the farmer's output or more likely through the price at which it sells tied inputs. Farmers who cannot obtain credit elsewhere will very often willingly pay inflated prices for inputs bought from the contract farming firm while their better capitalized neighbors are able to shop around for the best price using cheaper bank finance.

The model does not clearly distinguish between the terms of a loan from a single monitoring intermediary, and the terms from a combination of loans from both a bank lender and a monitoring intermediary for the same total loan amount. From the borrower's perspective they appear like the same thing: the same amount of collateral is required and the expected value of the repayments is the same under either case. I need one further element in the story to distinguish when borrowers will be in trader only or trader and bank financing regimes in order to arrive at an empirical model. Since banks in practice usually have larger minimum loan sizes than traders[18] it is reasonable to assume that for small loan sizes, borrowers at first obtain all of their finance through traders until they reach a loan size threshold c_b, assumed to be fixed across households, above which they will start using both bank and trader finance combined. This formulation implies a natural ordering in the loan access rule: borrowers will graduate from no loan access, to trader loans only, to bank and trader loans combined. I will also assume that there is no bank-only loan category. This is a reasonable assumption for the data used below in which there were only four households that used bank loans only in the season they were interviewed, and all of these farmers reported to have borrowed from traders in the past and said they would do so again in the future.

Given the shape and placement of the bank and trader loan supply and the farmer's demand schedule, the borrower may fall into any of the following observable regimes: (1) borrows from neither of the two sources, (2) borrows through trader loans but not bank loans, or (3) borrows through both loan sources[19]. As depicted in figure 3, each of these regimes is subdivided in turn into (a) not-rationed and (b) rationed sub-cases to yield a total of six possible regimes. For example Panel (2.a) shows a farmer who borrows only from a trader even though bank finance is available at a

[18]As a general rule banks will not even consider making agricultural production loans below a given size. In Chile this amount was mentioned at $250,000 chilean pesos or approximately US$650 for the 1993-94 season on bank loans. I was also told that a first time agricultural borrower has to fill out paper work and pay legal fees that can easily cost over $100,000 pesos. Technically, a fixed cost to borrowing would deliver a downward sloping supply curve not a flat one, at least over certain ranges. In the econometric analysis I abstract from this possibility and instead assume a minimum loan size.

[19]This last subcase may include bank loans alone.

large scale, while panel (2.b) shows a farmer who would like to borrow from the bank but cannot obtain a bank loan and is thus forced to borrow on the more expensive trader loan market.

Let $S^*(\rho \mid Z)$ represent the maximum level of combined finance that a borrower of characteristics Z can borrow at the bank market rate ρ, where Z includes the borrower's level of collateralizable wealth A. Geometrically $S^*(\rho \mid Z)$ corresponds to the point where the combined loan schedule $S(r; A)$ begins to curl up from the horizontal at ρ. Beyond this point the farmer increases his proportionate reliance on ever more expensive monitored trader credit. Let $D^*(\rho \mid Z)$ be the borrower's notional demand for credit given by the borrower's optimal choice of project scale at the lowest market interest rate ρ as defined by (3.2).

Note that whether or not a borrower is rationed or not is entirely summarized by whether or not $D^*(\rho \mid Z)$ is to the right or left of $S^*(\rho \mid Z)$ within each observable regime, in other words whether or not the borrowers loan demand at the lowest market interest rate ρ exceeds the largest loan supply at that rate. In panel (3.b), for instance, $D^*(\rho \mid Z)$ is to the right of $S^*(\rho \mid Z)$ so we know that the borrower's demand for credit has spilled into the market for more expensive trader credit. This is the basis for the model's latent variable estimation procedure. Let the latent variables $D_i^*(\rho \mid Z)$ and $S_i^*(\rho \mid W)$, be described by the following reduced form equations:

$$D_i^*(\rho \mid Z) = \alpha Z_i + v_{di} \tag{3.3}$$

$$S_i^*(\rho \mid W) = \beta W_i + v_{si} \tag{3.4}$$

where Z_i is a vector containing household i's household characteristics and environmental variables that affect demand for credit and W is a vector containing the farm household characteristics and whatever variables lenders consider relevant in setting the loan ration. Both vectors Z and W should of course include the market interest rate ρ, but since this is assumed to be the same across the market and constant within the period, it is subsumed within the constant term.

The disturbance terms on each of these equations are assumed to be have a joint bivariate normal distribution with zero means and covariance matrix Σ. Since I will use data only on participation decisions – which indicates only the financing regime a farm household belongs to but not the actual loan amounts transacted – the model to be estimated is a bivariate probit only that it is somewhat non-standard in that the loan supply equation is modeled as an ordered probit. If $S_i^*(\rho|W_i) < 0$ then no loan is offered, if $0 \leq S_i^*(\rho|W_i) \leq c_b$ then trader loans only are offered, and if $S_i^*(\rho|W_i) > c_b$ then both trader and bank loans are offered. Demand is given by a simpler probit equation: if $D_i^*(\rho|Z_i) < 0$ then there is no loan demand, otherwise loan demand is positive.

Given this specification, we cannot separately estimate the coefficients and all the

elements of Σ, so we adopt the following conventional normalization

$$= \begin{bmatrix} 1 & \gamma \\ \gamma & 1 \end{bmatrix}$$

where γ is the correlation coefficient on the standard bivariate normal distribution $BVN(-\alpha Z, -\beta W, \gamma)$ and therefore constrained to lie between -1 and 1.

Given this structure, the underlying latent variables D_i^* and S_i^* are jointly distributed according to a stochastic distribution induced from the joint distribution of the disturbance terms. The model's parameters can be estimated by maximum likelihood methods. The likelihood function to be estimated can be understood with the aid of figures 3 and 4.

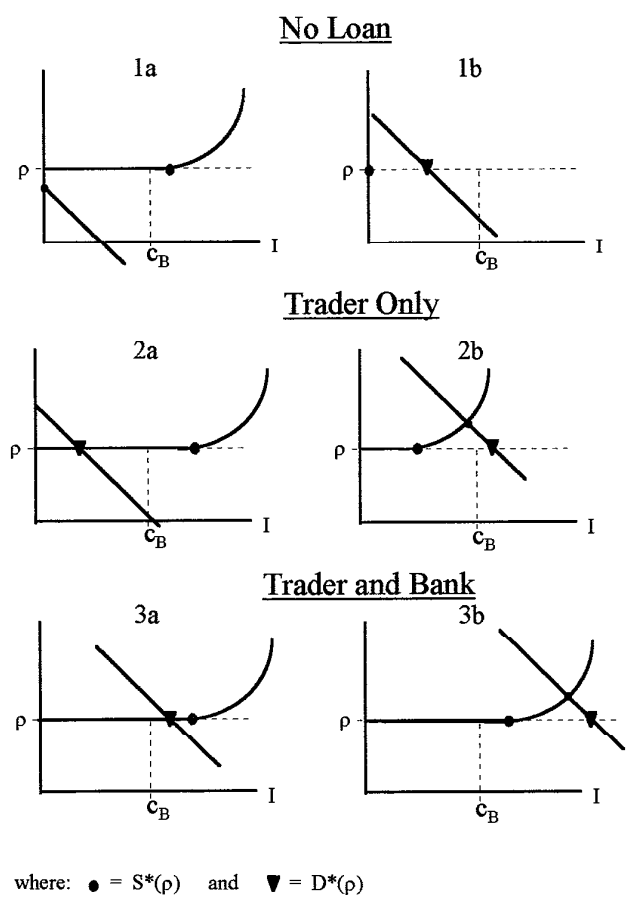

FIGURE 4.

Figure 4 is a four quadrant representation of the support of $D_i^*(\rho\,|Z_i)$ and $S_i^*(\rho\,|\,W_i)$. To start with, the probability that the farmer does not borrow at all P(None) is given by the probability that he has no loan demand, P(No Loan, Not Rationed), plus the probability that he is excluded, P(No Loan, Rationed). Denoting $D_i^*(\rho\,|Z_i)$ by D^* and $S_i^*(\rho|W_i)$ by $S^*$the probability for each of these regime events (cases 1.a and 1.b in figure 3) is given by:

$$P(\text{No Loan, Not Rationed}) = P(D^* \leq 0) \tag{3.5}$$

$$P(\text{No Loan, Rationed}) = P(0 < D^*, S^* \leq 0) \tag{3.6}$$

The probability that a household is observed to borrow from a trader only (cases 2.a and 2.b) is given by:

$$\begin{aligned} P(\text{Trader, Not Rationed}) &= P(0 < D^* \leq S^*, 0 < S^* \leq c_b) \\ &\quad + P(0 < D^* \leq c_b, c_b < S^*) \end{aligned} \tag{3.7}$$

$$\begin{aligned} P(\text{Trader, Rationed}) &= P(0 < D^* \leq c_b, 0 < S^* \leq D^*) \\ &\quad + P(c_b \leq D^*, 0 < S^* \leq c_b) \end{aligned} \tag{3.8}$$

Finally, the probability that the farmer borrows from both loan sources (cases 3.a and 3.b) is given by:

$$P(\text{Both, Not Rationed}) = P(c_b < D^* \leq S^*, S^* > c_b) \tag{3.9}$$

$$P(\text{Both, Rationed}) = P(c_b < D^*, c_b < S^* \leq D^*) \tag{3.10}$$

Using these expressions we can construct a log likelihood function as :

$$\log L(\alpha, \beta, c_B, \Sigma) = \sum_{i \in None} P(\text{None}) + \sum_{i \in Trader} P(\text{Trader}) + \sum_{i \in Both} P(\text{Both}) \tag{3.11}$$

The actual expression to be maximized can be simplified by using the geometry of the problem and the fact that each of the sub-regimes in each borrower status class is not observationally distinguishable . For instance, while the probabilities P(Both, Not Rationed) and P(Both, Rationed) are each separately given by an integral over a triangular region, their sum is an integral over a square:

$$P(\text{Both}) = \int_{c_b - \beta W}^{\infty} \int_{c_b - \alpha Z}^{\infty} \phi(\upsilon_d, \upsilon_s; \gamma) d\upsilon_d d\upsilon_s$$

where $\phi(\upsilon_d, \upsilon_s; \gamma)$ is the standard bivariate normal with correlation coefficient γ. Labeling the upper right quadrant in figure 4 corresponding to $D^*(r) \geq 0, S^*(r) \geq 0$

as Q1, we have

$$P(\text{Q1}) = \int_{-\beta W}^{\infty} \int_{-\alpha Z}^{\infty} \phi(\upsilon_d, \upsilon_s; \gamma) d\upsilon_d d\upsilon_s$$

from which it is then easily to calculate $P(\text{None}) = 1 - P(\text{Q1})$ and $P(\text{Trader}) = P(\text{Q1}) - P(\text{Both})$. The log likelihood can therefore be more compactly expressed as:

$$\sum_{i \in None} \log(1 - P(\text{Q1})) + \sum_{i \in Trader} \log(P(\text{Q1}) - P(\text{Both})) + \sum_{i \in Both} \log P(\text{Both})$$

I refer to this as the bivariate model or Model II.

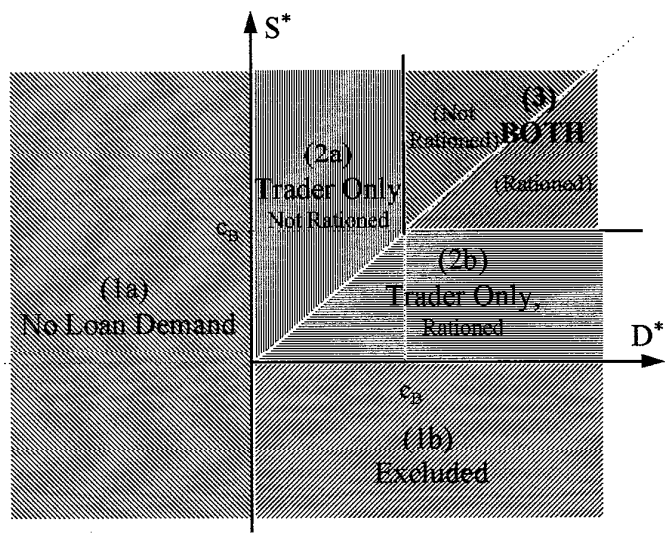

FIGURE 5.

3.1. A Simpler Comparison Model. It is useful to compare the bivariate model just described to a simpler and more standard model of contract choice. Many empirical studies of rural credit have approached the contract choice problem with single equation, multinomial choice models. For instance Esguerra et al. (1993) estimated a multinomial logit model to predict the probability that borrowers of different characteristics would be matched to a number of different formal and informal lending sources (including no loan).

Rather than use a multinomial logit, I estimate an ordered probit of an equation similar to $S^*(\rho\,|W)$ in (3.4) which I refer to as Model I. Depending then on the value of a single underlying latent variable S^* borrowers are allocated into one of the three categories: (1) no borrowing, (2) trader loans, (3) both loans. The probability that a borrower is found in each of these three financing categories is then given by:

$$\begin{aligned} P(\text{None}) &= \Phi(-\beta Z_i) \\ P(\text{Trader}) &= \Phi(-\beta Z_i + c_b) - \Phi(-\beta Z_i) \\ P(\text{Both}) &= 1 - \Phi(-\beta Z_i + c_b) \end{aligned}$$

where $\Phi(\cdot)$ is the standard normal and the threshold c_b is estimated along with parameters in β (σ has been set to unity because we can only estimate β/σ and not β and σ separately).

In this univariate it of course not at all clear whether the estimated equation corresponds to a demand curve, a supply curve or a confluence of both, unless one is willing to make strong identifying restrictions. For example, one might assume that the probability of borrowing from a particular sector is determined exclusively by the lender's access rule S^* (i.e. $D^* \geq S^*$ so all borrowers are rationed).

3.2. Estimation Issues. The bivariate formulation of Model II is in the general class of disequilibrium models first analyzed in a one market setting by Fair and Jaffee (1972). Treatments of how to extend the model to a multi-market situation with spillover between markets have been theoretically described by Gourieroux et al. (1980), Ito (1980) and others, but there have been very few attempts to date to implement full versions of these models empirically.

In the absence of a reliable external rationing indicator to allow us to determine whether any given observed loan transaction corresponds to a point on the loan supply or loan demand schedule, the model derived above is in the general class of switching regression models with endogenous sampling. Estimation of this type of model can involve quite considerable sacrifice in estimation efficiency compared to a situation where a sample separation indicator is available. More seriously, the likelihood function may be ill defined for certain parameter ranges (Maddala, 1983; Quandt, 1988). The traditional response to this problem has been to add additional structure to the problem, usually by imposing restrictions on the variance-covariance matrix of error terms that are very difficult to justify on economic grounds. The badly behaved nature of these likelihood functions and the highly arbitrary nature of the restrictions usually imposed has lead Maddala (1983) and others to express serious doubts about the validity of several published results in this literature.

The approach I have adopted here is rather than impose more structure on the problem to impose less; thus the (slightly augmented) bivariate probit specification which uses data only on credit market participation (whether or not a borrower is observed in a particular regime or not) and not the more detailed information

contained in loan amounts and interest rates. While this approach obviously leads to less efficient estimates than might be obtained from a more fully specified model, it has the virtue of delivering a somewhat better behaved likelihood function without resorting to arbitrary restrictions[20]. I would also argue that this approach avoids the mis-specification biases and measurement errors that I believe will be inherent to this class of problem until we can construct theoretically more complete and coherent models of credit market behavior, and are able to measure interest rates and loan transactions on these markets with much more precision.

4. Data

Tables 1 and 2 present a data summary of financial contract choices and household characteristics for the ninety six farm units interviewed in the survey. The first table describes the different types of loans used by household in the 1993-94 agricultural season. The table divides the households into four equally sized categories according to asset holdings, where total asset values are calculated by summing quality adjusted estimates of farm land value, the value of farm implements and machinery, and off-farm assets belonging to each farmer. This is an approximate measure of the farmer's available collateralizable wealth.

Farmers reporting no loans from any of the categories in the first six loan categories are entered in the "None" column. Percentages may add up to more than 100% because borrowers who do borrow often do so from more than one source at the same time. The other categories in the table are as follows: "Dealers" refers to leasing companies and farm machinery dealers. The electrical cooperative is a rural electricity provider that makes trade credit available to smaller farmers usually payable in ninety days or at harvest.[21] The state lending agency provides slightly subsidized low interest loans to small and poor farmers, although by my measure of farm household assets they lent to farmers in the middle and high ranges as well.

It is evident that farmers use a fairly large variety of different formal and informal lending sources, often simultaneously, to finance their projects. A cursory glance at the data might suggest that initial wealth position is an important determinant of access to credit. Farmers in the higher asset classes are much more likely to have access to, and to use bank finance, trade credit from input suppliers and other instruments backed by collateral or legal enforcement as an important component in

[20] I have explored several more elaborate model specifications that employ data on actual loan amounts transacted, and in each case ran into the sort of estimation problem described in Maddala (1983). I ultimately decided that it was more straightforward to work with the simpler model presented here than to bend to the temptation of mining for the set of arbitrary restrictions that delivered a local maximum and the most suitable looking parameter estimates.

[21] The coop has what appears to be a very effective enforcement mechanism: delinquent borrowers are threatened with having threatened with having their electricity supply cutoff.

Sources of Farm Finance

Number of Farmers in each category borrowing from listed Source

Asset Category	n	Bank	Input Suppliers	Dealers	Traders	State Lender	Electric Coop	Informal	None
1	24	0	0	0	10	3	7	13	10
2	24	1	1	0	7	5	2	10	14
3	24	4	5	4	13	2	5	7	5
4	24	19	19	10	20	2	0	1	2
All	96	24	25	14	50	12	14	31	31
% of Respondents in each category									
1	100	0	0	0	42	13	29	54	42
2	100	4	4	0	29	21	8	42	58
3	100	17	21	17	54	8	21	29	21
4	100	79	79	42	83	8	0	4	8
All	100	25	26	15	52	13	15	32	32

Source: 1994 Field Survey

Notes: See Table 2 for a definition of the asset categories employed.
Column totals add up >100% because borrowers often use more than one source.

their total finance package than farmers with fewer assets. Farmers with intermediate levels of asset holdings typically rely much more heavily on monitored credit and credit tied to transactions on other markets such the credit advances provided by farm product traders. A large fraction of borrowers in the low and middle asset categories reported using no formal external finance source whatsoever (the "None" category). For this last group of borrowers retained earnings and informal financing arrangements predominate. Informal loans include those from family or friends, smaller and shorter term loans from informal traders, and (not very commonly in Chile, but quite frequently in other countries) loans from specialized moneylenders. Retained earnings might include items such as income from past crop sales, renting out land, selling animals, labor remittances from family members, income from other businesses, etc.[22].

Table 2 suggests however that other factors might also be at play. For instance, household heads in non-borrowing households are on average substantially less educated than the heads of borrowing households (variables YRED and Illiteracy Rate in the table). This suggests the hypothesis that these households may perhaps choose not to borrow because they have fewer and less profitable projects in which to invest

[22]Tied, or implicit credit relationships are also of course embedded in sharecropping arrangements, deferred rentals, labor sharing arrangements, the borrowing of tools and farm implements, etc

because educational attainment might for influence management ability for instance. Non-borrowing households also leased out on average 25% of the land they owned, while farmers who were observed to borrow mainly from traders leased in land on average 23% as much as they already owned, and farmers who borrowed from both sources leased in 43 percent. It is not clear whether these farmers rent out this land to finance other plots because they face credit constraint or because they simply do not have the capacity to profitably bring that land into production at market factor prices even in the absence of such a constraint. By attempting to sort out demand side effects from supply considerations, the empirical model attempts to disentangle the relative influence of these different factors, at least to a first approximation. A more complete analysis would of attempt to consider the farm household's joint and simultaneous land, labor, and credit market choices.

It would be difficult to construct a theoretical or empirical model that could account for all of these different loan sources simultaneously[23]. As a first approximation however, it is possible to group these different loan sources into the three broad categories considered in the empirical model: no loan, trader loan only, both bank and trader loan together. The last three columns of table 2 shows that of 96 households in the sample, 24 borrowed from both a bank and a trader[24], 27 borrowed from a trader only, and 45 farmers did not borrow from either a bank or a trader. The high number of borrowers in this last category does not mean that these farmers did not borrow externally at all, since some (5) of the households in this group borrowed from the state lending agency and almost half of them reported small informal loans from family or friends. For the most part however the farmers in this group appear to have less access to credit and relied more heavily on self-financing strategies including hiring out labor, animal sales, renting out land, etc.

Table 2 also describes the other variables that will be used in the loan demand and supply. Exogenous variables taken to affect the farm production profits, and hence the demand for credit include LANDV, the value of the household's land holdings[25], and NONLAND the value of non-land assets which is a measure of the farm's ownership of farm machines and equipment. The regressors also include HLAB, a measure of the male family labor (>15 years of age) in the household , HAGE, the age of

[23]Even if one could construct such a model it would be difficult to estimate on a sample with only 100 observations. What makes matters even more complicated, is that the terms of loan contracts (even bank loan contracts) appear to vary quite substantially from crop to crop, so a trader loan for say a barley crop is in practice very different from a trader loan for tobacco or sugar beet, and as such should be treated as a different sort of instrument.

[24]Four of these households borrowed only from a bank, but as explained above it makes sense to collapse these into the Both category.

[25]The variable LANDV was constructed by taking a soil quality adjusted measure of the household's land holdings and pricing that at market prices (also adjusting for distance from town and a main road). This value therefore gives a measure of the collateral value of land to a lender, and a factor of production to the farmer.

the household head and YREDUC, his or her years of formal education. The table indicates both the overall average values for these variables and the average for households in each of the three observed financing regimes.

In order to achieve parameter identification the vector Z must differ from W at least one element. It is often hard to argue for what might be excluded because the lender will in general base his supply decision on factors that determine farm productivity, and hence also determine loan demand. I have chosen to exclude the variable HLAB representing available male household labor, on the argument that this variable is unlikely to be observed by banks and only imperfectly observed and monitored by traders.

5. Estimation Results and Conclusion

Estimation results for the simpler univariate ordered probit model are reported in table 3. Because this simple model does not distinguish between loan access and choice, to meaningfully interpret the results, we must proceed under the identifying assumption that all households are rationed, so borrower status is determined entirely by the access rule, or the opposite assumption, that all households have full access and borrower status is governed entirely by choice (a more Walrasian view). Under the first interpretation, and focusing on the parameter coefficients that are significant at the 5% level, the probability of access to both trader and additional bank credit is increasing in the value of the farmer's non-land assets NONLAND and in the household's male family labor HLAB. This is as expected because non-land assets include farm equipment and machinery, animals and other fairly liquid assets that are often used as chattel mortgage and in any event assure a lender that the borrower will be in a position to payoff outstanding loan obligations. The availability of self-supervised family labor HLAB on the other hand is expected to raise the profitability of investment projects, and therefore the loan amount a lender would be willing to provide against a given level of collateral.

As one measure of the model's performance, the lower panel in Table 3 shows how well the simpler univariate model predicts farmers' borrowing status. In 60 out of 96 cases, or 63 percent of the time, the model assigns the household to the correct borrowing status. This compares well to the 36 percent predicted by a naive model which assigns households to borrower status randomly using the actual proportions of borrowers in each status as the assignment probability. Model I however substantially overpredicts the number of non-borrowing households, mis-classifying 16 borrowers out of 27 who should have been placed in the trader class into the no borrowing class.

The bivariate formulation of Model II disentangles loan access rule from loan demand or choice and therefore can in principle distinguish between rationed and non-rationed farmers within each financing regime. Estimation results are reported in table 4. The main determinant of credit access is the farmer's level of non-land assets NONLAND, which are liquid assets that assure a would be lender that the

borrower is more likely to be able to meet repayments in the event of a project failure. The main determinant of credit demand on the other hand appears to be the household's endowment of male family labor HLAB. The larger this endowment, the larger the farm household's loan demand. This also makes sense, considering that many of the crops for which trader finance is available are highly labor intensive and usually involve using family labor alongside hired labor. The cutoff level c_b that marks the threshold between trader finance only and bank finance is also positive and significant. Under the bivariate probit formulation this threshold cannot be given a peso or dollar value interpretation.

Several of the other variables that one might have expected to affect loan demand, such as the head of household's years of age and years of formal education are not significant in the regression although they appear to be correctly signed. It might appear as somewhat of a puzzle that LANDV, a measure of the farmer's land wealth does not enter significantly in the loan access equation. One might have expected land wealth to act as collateral and therefore to be positively signed and significant. One possible explanation is that, although land mortgages are in fact used for certain types of bank loans, many of the bank loans in the sample where backed by farm machinery and vehicles, and in general traders do not use land as collateral. Also, as already noted, non-borrowing households on average lease out land so the coefficient on this term in the reduced form demand equation might also have been expected to be negatively signed.

The first of the two lower panels in Table 4 show the actual and model predicted counts for placement of borrowers into different financing regimes. The bivariate model improves over the predictive performance of model I by correctly assigning households to borrower status 74 percent of the time (71 out of 96 cases). It overpredicts the number of borrowers in the trader borrowing class and somewhat underpredicts non-borrowing and bank borrowing households. As for overall performance, this model easily passes the likelihood ratio test that all coefficients except the constants and correlation term are zero.

The estimation results in principle allow us to distinguish whether or not households in each borrowing regime are rationed. As a first approximation we could just compare the model predicted values of $D^*(\rho)$ and $S^*(\rho)$. If $D^*(r)$ exceeds $S^*(r)$ then the household might be said to be rationed, otherwise not. A problem with this procedure however is that it does not account for the fact that the estimated model mis-classifies the borrowing status of some households. A somewhat more satisfactory approach is to calculate the probability that a household is rationed conditional on it's borrowing status and then use these probabilities to classify borrowers according to their actual borrowing status. For example, the probability that a household is rationed conditioned on the fact that it is observed not to borrow at all is given simply by $P(\text{No Loan, Rationed})/P(\text{No Loan})$ while the probability that it is not rationed conditional on the same event is given by $P(\text{No Loan, Not Rationed})/P(\text{No Loan})$.

Then conditional on being observed not to borrow, the household will classified as rationed if:

$$\begin{aligned} P(\text{No Loan, Rationed}) &> P(\text{No Loan, Not Rationed}) \\ P(D^*(r) &> 0, S^*(\rho) \leq 0) > P(D^*(\rho) \leq 0) \\ \Psi(-\alpha W, \beta Z, -\rho) &> \Phi(-\alpha W) \end{aligned}$$

and as not rationed otherwise, where Ψ is the c.d.f. of the standard bivariate normal with correlation coefficient γ and Φ is the c.d.f. of the standard normal. It can be easily shown that the test of whether or not the household is rationed for borrowers in the two borrowing regimes comes down to whether $P(D^*(r) > S^*(r)) > 0.5$ or not[26].

As summarized in table 5, using this procedure seventy percent of the farmers in the sample were classified as being rationed in one way or another, either because they were excluded from loans, or because they could not obtain as much finance at the lowest market rate as they would have desired. It is interesting to note that the most rationed group of borrowers was not amongst farmers who did not borrow from either source but rather within the group that obtained access to credit from traders but not from banks. Over eighty percent of farmers borrowing from traders alone were estimated to be constrained compared to sixty percent of those not borrowing at all. This last number means that forty percent of the non-borrowing households were classified as being there because they did not have a positive loan demand for either instrument.

Table 5: The Extent of Rationing

	Rationed	Not Rationed	Total
None	27 (60%)	18 (40%)	45
Trader	22 (82%)	5 (18%)	27
Both	13 (54%)	11 (46%)	24
Total	67 (70%)	29 (30%)	96

Although these findings should be interpreted with care, they are consistent with several of the interpretations that I heard from farmers and lenders during interviews. Private traders and monitoring intermediaries typically do a very good job of finding the most enterprising and skilled farmers in their area of operation and are often willing to lend these farmers resources against relatively little collateral. But this form of finance has it's limits, and many farm households will find insufficient credit relative to their optimal loan demands. Table 2 suggests that borrowers in the trader only group were on average much better educated than non-borrowing households and on average younger and with larger family labor endowments than farmers in

[26]The test $P(D^*(r) > S^*(r)) = P(\alpha Z + v_d \geq \beta W + v_s) \geq 0.5$ can be reexpressed as $P(v_s - v_d \leq \alpha Z - \beta W) = \Phi\left(\frac{\alpha Z - \beta W}{2(1-\gamma)}\right) \geq 0.5$ where $\Phi(\cdot)$ is the c.d.f. of the standard normal.

both other categories. Compared to farmers who borrow from banks, however they have far fewer accumulated liquid assets on average.

While the high fraction of farmers predicted as being rationed is broadly in line with the numbers on the extent of rationing in the market for farm credit in rural India obtained by Bell et al. (1994) and Kochar (1995). It is important to note however that while these authors place the blame for most of the rationing that they found on the effects of government mandated subsidized interest rate loans, it is hard to argue that this is the case in Chile. In recent history Chilean agriculture has in fact been characterized by competition, the entry of new financial intermediaries and the relative absence of government interference or regulation. The findings of this paper suggest therefore that the phenomenon of credit rationing is likely to persist as an important issue even on competitive and deregulated markets because of information asymmetries and the low net worth of borrowers.

At the same time, the results also suggest that many of the poorer small and medium farms do not in fact face a binding credit constraint, either because they have preferable alternatives for self-finance, or because they do not have sufficiently profitable projects within which to invest. This suggests that many of the farmers in the poorest segments of households might be better served if the same money that many countries spend on targeted credit programs were instead given to them in the form of outright grants or subsidies to improve their access to technical assistance, marketing and other services, or invested in long term investments in health, education and infrastructure that helped farmers to raise their productivity and access to new projects. The state also has an important role to play by providing and supporting a clear, impartial and efficient institutional and regulatory environment which promotes the entry of new efficiency enhancing forms of private intermediation and helps private parties to establish and enforce at low cost the contractual arrangements that make new investment and trade possible. More direct interventions to support smaller and poorer farmers are also possible but need to be analyzed carefully. The state is unlikely to be able to match the private sector in financial intermediation services unless it can effectively use some sort of information or enforcement advantage not already available to private lenders.

While monitoring financial intermediaries are able to offer monitored lending and linked financial contracts that serve the purpose of lowering collateral requirements, and may also help borrowers obtain additional finance from less informed outside lenders, these strategies substitute, but do not perfectly or costlessly replace the need for collateral resources to enforce loans in situations characterized by information asymmetries. The development of the financial market therefore depends in fundamental ways on the rising net worth of borrowers in the economy. When the average net worth of households and firms is low agents will find it difficult to obtain external finance and will tend to rely on internal financing solutions and turn to expensive and often restricted informal and monitored lending alternatives. As the

economy grows and entrepreneurs and intermediaries are able to accumulate liquid assets that serve as collateral they will be increasingly able to graduate to new forms of lending and leverage larger and cheaper types of external finance.

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Table 2
Farm Enterprise Characteristics

		All Farmers		By Asset Category				By Financing Category		
		Mean	(S.D.)	1	2	3	4	None	Trader Only	Bank + Trader
	Asset Bracket (million ch$ *)			<7.5	7.5-13	13-35	>35			
N	Farmers in each Asset Bracket	96		24	24	24	24	45	27	24
RB	Reform Beneficiaries (**)	58		15	21	17	5	31	20	7
Variables in Empirical Model										
VAL	Mean Asset Value (Millions of ch$)	54.3	(124.8)	4.4	9.9	21.9	180.9	11.5	25.2	167.1
Landv	Estimated Land Value	13.0	(20.4)	2.1	7.1	9.3	33.6	7.0	8.8	29.2
Nonland	Value of Non-Land Assets	41.2	(109.7)	2.3	2.8	12.6	147.2	4.5	16.5	137.9
HLAB	Male Family Labor (Man Months)	39.1	(38.0)	24.5	33.0	29.5	69.5	25.4	31.4	29.2
HAGE	Mean Age Household Head	53.8	(12.2)	54.3	55.5	53.3	52.0	57.3	48.3	53.4
YRED	Years of Formal Education	5.2	(4.2)	3.3	4.4	3.5	9..5	3.5	5.1	8.4
	Illiteracy Rate	21%		38%	17%	25%	4%	33%	11%	8%
Other Variables										
RCUL	Owned Cultivable Land (Has.)	22.1	(27.2)	7.1	12.5	16.1	52.8	13.2	15.1	46.5
SOIL	Soil quality index	0.582	(0.289)	0.401	0.710	0.553	0.665	0.550	0.610	0.600
RIN	Land Rented In	7.0	(20.4)	1.2	0.2	2.9	23.6	0.7	3.5	22.6
ROUT	Land Rented Out	2.9	(8.9)	0.7	2.4	1.5	6.8	3.7	1.0	3.5
SIN	Sharecropped In	0.6	(2.6)	0.4	0.0	0.6	1.6	0.1	1.0	1.3
SOUT	Sharecropped Out	0.3	(1.0)	0.3	0.3	0.2	0.3	0.4	0.1	0.3
NET	Net Land Leased In	4.5	(21.0)	0.6	-2.5	1.8	18.2	-3.3	3.5	20.2
CULT	Cultivable Land (Owned+Net)	26.6	(38.6)	7.7	10.0	17.9	71.0	9.9	18.6	66.7
	Ratio Net Leased to Owned (***)	20%		9%	-20%	11%	34%	-25%	23%	43%

Notes: * At the time of the survey one US dollar bought approx. ch$400 pesos.
** Refers to landholding households that received or inherited agrarian reform land.
*** Ratio of mean NET over mean RCUL in each class.

Table 3

Model I: Simple Ordered Probit of Credit Access

Variable	Coeff.	S.E.
Const	-1.0015*	0.3065
landv	-0.0246	0.1730
nonland	0.0280*	0.0078
hlab	0.0195*	0.0394
educ	0.0482	0.4035
c_B	1.2020*	0.2083
Log Likelihood	-69.95	
Sample Size	96	

Note: (*) significant at the 5% level

Actual And Predicted Counts

	None	Trader	Both	Predicted Total
None	37	16	2	55
Trader	8	8	7	23
Both	0	3	15	18
Actual Total	45	27	24	96

Table 4

Model II: Bivariate Probit Credit Access and Demand

	Supply		Demand	
Variable	Coeff.	S.E.	Coeff.	S.E.
Const	-0.2983	3.4281	-0.0552	16.4224
landv	-0.0144	0.8224	-0.0290	0.0873
nonland	0.0481*	0.0188	0.0068	0.0619
educ	0.0644	0.4532	0.0405	1.2906
hlab			0.0821*	0.0328
age			-0.0181	0.1071
c_B	1.2376*	0.5978		
γ	-0.0563	2.9852		
Log Likelihood	-64.85			
Sample Size	96			

Note: (*) Significant at the 5% level.

Actual And Predicted Counts

	None	Trader	Both	Predicted Total
None	29	9	1	39
Trader	16	15	6	37
Both	0	3	17	20
Actual Total	45	27	24	96