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AGRICULTURAL CREDIT UNDER ECONOMIC LIBERALIZATION AND ISLAMIZATION IN SUDAN

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and
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List of abbreviations

NESP: National Economic Salvation Programme
CBC: Commercial Banks Consortium
ABS: Agricultural Bank of Sudan

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Abstract

This study uses survey data to examine the operations of the agrarian credit market, formal and informal, in Sudan under conditions of recent economic liberalization and Islamization; the latter does not allow interest rate fixing. In addition to descriptive analysis, the study specifies and estimates a model of farm household participation in the credit market. The survey results show a substantial increase in formal borrowing in agriculture, but relatively low informal credit. Implicit interest rates are found to be high in the formal segment compared with their previous levels, and the levels of formal and informal agrarian rates of interest are comparable. The research concludes that there is a need for enhanced institutional financial intermediation in the agrarian credit market as well as scope for the promotion of savings and credit associations among farmers.

I. Introduction

The economy of Sudan depends heavily on agriculture for employment, production and consumption. The share of agriculture in Sudan's gross domestic product and exports during the period 1987–1994 was 31% and 85%, respectively. The available resources¹ – in terms of arable land, water and livestock – suggest that agriculture in Sudan provides the best opportunities for future economic growth and development. Yet, the country's agriculture is largely traditional and is characterized by low and fluctuating productivity, which means that modernization and development are imperative. This, as many researchers, notably Binswanger (1989), argue, depends among other things on the availability of funds to make new production inputs and technology accessible to farmers.

The agrarian credit market has recently undergone significant developments in connection with macroeconomic policy reorientation. To correct growing internal and external imbalances and to achieve desirable growth and stability, a medium-term three-year National Economic Salvation Programme (NESP) was launched in 1990. With economic liberalization as an overall objective, the programme sought to reallocate resources to enhance production particularly in agriculture in order to achieve food security and to generate export surplus; to boost the role of the private sector; to remove price and exchange rate controls; to privatize public entities; and to achieve financial stability. By 1992 several price and exchange rate controls were removed. The Islamization² of the financial system, which had started in 1984, implied the full abolition of interest rates by 1990. The explicit interest rate mechanism has been replaced by a profit-and-loss sharing system according to which returns to lenders depend on the unknown profits or losses to be realized by borrowers. (Hence all interest rates referred to hereafter are implicit rather than explicit ones.) However, this policy did not amount to financial liberalization, as many measures of control such as credit ceilings remained intact.

By and large, the most important implication of the recent financial policy is that formal agricultural credit, which between 1970 and 1989 depended almost exclusively on government sources, has since 1990 been assigned to private sources. Indirect measures were taken by the NESP to enhance the involvement of formal financial institutions especially in irrigated agriculture. For example, the activities of the Agricultural Bank of Sudan have been expanded through government support, and a commercial banks consortium (CBC) was set up in order to raise credit availability and lower individual bank exposure by means of risk pooling. Nevertheless, it was difficult in the early 1990s to predict the response of Sudan's the fragmented agrarian credit market to the new macroeconomic environment. There was doubt about the ability of the formal financial system to create efficient financial instruments that are compatible with Islamic principles as well as the nature of agriculture.

Another major question was also raised concerning the impact of the recent macroeconomic and financial policy shifts on farm households' participation in the credit market. This study examines household level survey data in order to evaluate the characteristics and availability of both formal and informal farm credit in the context of these policy shifts.

To examine the issues involved, the study sets out two main objectives:

- To describe the institutional structure, practice and limitations of the agrarian credit market in Sudan.
- To develop and estimate a model of household participation in the rural credit market.

The rest of the study is organized as follows. The next section provides a review of some pertinent theoretical and empirical issues. Section III discusses the nature of agricultural production and the credit market in Sudan. Section IV uses a household survey to give a descriptive analysis of the rural credit market. A type-three Tobit model of agrarian household participation in the credit market is specified and estimated in Section V, where the results are also analysed. Finally, Section VI gives conclusions and some policy remarks.

II. Some theoretical and empirical issues

The literature on farm economics has come a long way from the early focus on the behaviour of individual farmers within a neo-classical framework, and the rudimentary assumptions of flexible land access and absence of a labour market (see Ellis, 1988). In early studies, a production function is normally specified and the marginal conditions for optimal resource use derived, given various consumption and production constraints, and assuming that farmers have choice over the type and quantities of inputs and outputs.

One of the major limitations of early models is the assumption that there is complete certainty so that production and consumption decisions are separable. The household fixes a production level and accordingly decides how much labour to hire in or out, how much to lend or borrow, and how much to consume of home-produced and purchased goods in order to attain a desired utility level. The assumption of a perfect capital market implies that credit supply and demand are easily derivable from the utility maximization model, i.e., given an unconstrained loan supply at a certain interest rate, loan demand is determined at the point of tangency between the utility curves of the borrower and the lender.

However, several recent agrarian household models suggest that farm credit is not only necessitated by the limitations of self-finance but also by uncertainty about the level of output and the time lag between inputs and output, extending by implication to the determinants and nature of farm credit supply and demand. Bell's (1988) analysis, among others, cast serious doubts on the identification of a rural credit demand function. In an agency approach, he demonstrates that either incomplete information or imperfect credit contract enforcement generates the possibility of loan default, and hence an upward-sloping credit supply function. This argument produces loan supply and implicit credit demand functions, but the two functions are simultaneously determined.

There is uncertainty in the agrarian credit market because of incomplete information, which in turn gives rise to the so-called adverse selection and moral hazard problems (see Stiglitz and Weiss, 1981; Udry, 1994; Steel et al., 1997). It is argued that knowledge of the personal attributes of the debtor that have economic significance, normally through repeat business, greatly reduces adverse selection, but moral hazard always remains important. Uncertainty is further heightened by imperfect credit contract enforcement, wilful or strategic default by borrowers, and information asymmetry. In line with Bottomley (1975), Bell (1988) assumes that the lender's cost is composed of the opportunity cost of principal, the cost of administering the loan, the risk premium and the monopoly profit. The borrower obtains a certain amount of credit, which can be used for consumption or production, bearing a fixed interest rate with a single period maturity.

The creditor has a first claim on the borrowers' return and receives a collateral to be used to cover any shortfall in debt services. In his model's closure Bell shows that even under the most stringent formulation,³ incomplete information or imperfect contract enforcement yields an upward sloping credit supply curve, and an endogenous interest rate. In other words, with the presence of lender's risk and administrative costs, the rate of interest will vary with the size of the loan, and the economic characteristics of the borrower that affect the probability of repayment. In this context, if interest rates were in fact observed, they would reflect points on the credit supply schedule alone. The set of variables determining this schedule would then reflect supply side variables only, with demand side variables affecting outcomes only through the household's decision to borrow from any given sector.

Accordingly, in most models where there is a probability of loan default, and hence an upward-sloping loan supply curve, the assumption is that lenders offer borrowers a choice of the various points on this curve, and borrowers are restricted to these points. The borrower's first order optimizing conditions are still relevant, as the interest rates reflect points on the supply schedule only, and do not reflect a point of intersection between the supply and demand schedules. As such, it is impossible to identify the loan demand schedule using information on observed loan amounts. The credit demand function can only be interpreted from the borrower's participation decision, i.e., the decision to borrow, and the decision regarding the sector from which to borrow. This decision or the choice of a credit contract will depend, among other things, on the borrower's economic endowment and opportunities. The credit demand schedule identification problem implies, and is influenced by, the existence of loan rationing, where selection of borrowers by lenders is based on certain credit-worthiness criteria.

In addition to the conceptual difficulties in indentifying credit demand and supply factors, estimates of credit demand are often biased⁴ due to data truncation as a result of omission of non-borrowers, and non-separability of production and consumption decisions among rural households. Moreover, as Nagarajan et al. (1995) note, estimates of loan demand may be biased because of the use of models that do not correct for selectivity bias and/or use of data that do not account for the existence of multiple loans (see, e.g., Olumidu, 1983). Therefore, estimates of loan demand must incorporate methods that adequately correct for data censoring due to the existence of both borrowers and non-borrowers in the sample, credit rationing, and multiple loans borrowed from several types of lenders offering different types of contracts.

The presence of supply constraints and multiple loans per household means that individual loans may not be used to estimate a demand function efficiently. It is important therefore to gather data so that all loans obtained by a household during a given period can be measured. This study argues that while loan demand is usually unobservable it can be estimated consistently and efficiently, provided information on all loans is available. In Section V we outline an econometric framework, similar to that used by Nagarajan et al. (1995), to estimate loan demand from field data collected in Sudan in 1995.

III. Structure of agriculture and the agrarian credit market

In terms of nature of production, agriculture in Sudan comprises three distinct subsectors: irrigated, mechanized rain-fed and traditional rain-fed. However, the distinction between mechanized and traditional rain-fed subsectors is a bit obscure. Almost all farmers use some modern machinery, especially tractors. Hence it is the degree of mechanization that matters; mechanized farms as opposed to traditional ones rely on modern machinery rather than labour for the most part of the process of crop production. The differences between the three subsectors are highlighted below since these may have significant bearing on credit supply and demand.

The nature of agriculture in Sudan

Modern irrigated agriculture was started in 1925 after the completion of the Sennar Dam and the Gezira scheme. Since then this subsector has been expanding, but after the completion in 1980 of the Rahad scheme, the second largest irrigated scheme, this expansion was halted due to scarcity of water and the huge capital investment needed for dam work and the necessary canals. At the present, total irrigated area amounts to about 4 million feddans,⁵ on which cotton, wheat, groundnuts, vegetables, sugar cane and sorghum are the major crops grown. Irrigation systems are combined with the use of modern tractors, harvesters and so on, besides modern production inputs such as fertilizers, improved seeds and insecticides, which are purchased by tenants and mostly come from abroad. In addition to machinery, labour is especially demanded during sowing, weeding and harvest periods.

With the scarcity of resources required for horizontal expansion, efforts to foster agricultural productivity have recently focused on the optimal use of available water, land and human resources, besides technical changes that can shift the production frontier upward. Thus, the irrigated sub sector has been the most productive among all agricultural subsectors. It contributes on average 27% of national agricultural output, produces about 95% of Sudan's cotton, all the wheat, most horticultural products and half of the groundnut output. By virtue of agricultural policy, sorghum production is normally low because it can be produced more efficiently in other subsectors.

All major irrigated schemes are owned by the government and operated in collaboration with tenants according to an individual account system. This system, which is also known as the land and water system, is similar to a fixed contract in the sense that the tenant pays a certain charge for the use of irrigated land and in turn enjoys the full benefit of the

crops. Prior to 1981/82, agricultural policy was tightly drawn and implemented by scheme administrations, but currently tenants have a greater say about inputs as well as output mix. And livestock production has recently been introduced into the crop rotation. Many tenants now operate their farms as multi-business enterprises, where they generate incomes from crops, livestock, off-farm household labour and sometimes trade.

The mechanized rain-fed subsector covers 9 million feddans, with farm size ranging between 1,000 and 1,500 feddans that are privately owned and operated. Mechanized farming started in the late 1940s and extends over the clay plain that stretches across central Sudan from Kassala to Darfur provinces. The soil is difficult to cultivate by hand and therefore modern tractors and machinery are required for land preparation, ploughing, sowing and harvesting. Labour is especially needed for weeding and harvesting and is almost entirely hired. Being relatively capital-intensive, this subsector attracts investment by comparatively wealthy families who make a valuable contribution to food supplies for domestic consumption and exports. About 80% of the mechanized rain-fed area is devoted to sorghum and 20% to sesame, but other cash crops such as sunflower are also cultivated. Production of all crops is market-oriented, hence the profit motive prevails over immediate consumption purposes.

With a crop area of about 11 million feddans divided into small farms, the traditional rain-fed subsector is the mainstay of the majority of the rural population. It produces millet and sorghum, predominantly for consumption, besides gum arabic, sesame and groundnuts as cash crops. It accounts for over 90% of Sudan's livestock. Traditional agriculture relies chiefly on family labour, with low productivity due to absence of modern technology and inputs. Shifting cultivation is the norm and there is little or no scope for modernization. However, in addition to providing food cereals to the majority of the rural population, the livestock output of this subsector accounts for 35% – 45% of agricultural GDP and 15% of agricultural exports, while gum arabic is the second most important agricultural crop in terms of exports.

In spite of its dominance, the performance of agriculture during the 1970s and 1980s was very disappointing, as indicated by production and yield indexes constructed by Hagelamin and Elmak (1995). Compared with 1982/83 as a base year, production levels varied between 90 and 121, while yields ranged between 103 and 147 in irrigated agriculture during the period 1978 – 1985. For rain-fed agriculture, the former index varied between 36 and 86 while the latter was between 51 and 97 during the same period. Both indexes were more stable in the irrigated subsector than in rain-fed agriculture due to fluctuations in rainfall. Hagelamin and Elmak argue that due to the focus of NESP on irrigated agriculture in particular, crop output in this subsector increased substantially during the 1990s, but yield was stagnant. This was attributed to expansion in irrigated areas and removal of price and exchange rate controls. On average, crop output in the rain-fed subsectors has also improved despite wide fluctuations.

Institutional features of the agrarian credit market

The agrarian credit market in Sudan has a dual character in the sense that formal and informal lending and borrowing are carried out simultaneously where the formal sector

exists. As early as 1959 banks started lending to agriculture, but the volume of these loans as a proportion of total bank credit to the private sector was negligible. Hence for many farmers the informal loan market has been the main, if not the only, source of credit.

The formal financial system and agriculture

The financial structure of Sudan is dominated by commercial banks in terms of both deposit-taking and lending. Until 1991 these banks were supported by a relatively small number of branches (about 315), with a marked concentration of both branches and advances in urban centres (Elhiraika, 1996). Up to 1991, commercial banks' advances to agriculture stood at less than 1% of their total advances. As a result of the NESP initiatives to activate agriculture and to achieve food security, the number of bank branches in rural areas was more than doubled, and the ratio of farm credit rose to an average of 18% during the period 1990 – 1993. Moreover, the Bank of Sudan raised the commercial banks' ceiling for operation and non-operation credit to agriculture to 40% of their total advances. Two specialized banks, the Farmers Bank and the Animal Resources Bank have recently been established, and agricultural insurance was introduced for the first time in 1994. But most importantly, the role of the Agricultural Bank of Sudan (ABS) has been considerably expanded; its branches increased from 15 in 1990 to 118 in 1994.

ABS was the only formal agency specializing in farm credit prior to 1990. The bank is owned by the government and it is now the most geographically widespread bank in the country. Previously, the bank was not engaged in deposit-taking and its lending capacity was determined by its capital and support by the central bank. Loans by ABS increased from S£0.33 billion in 1989 to S£7 billion in 1991 and S£13 billion in 1992 with focus on food crops. However, the bank's outstanding debts amounted to S£3.8 billion in 1992, with a loan collection rate of 73% for mechanized farming, 61% for irrigated agriculture and only 18% for traditional rain-fed agriculture.

Agricultural loans are generally viewed by members of the commercial banks' consortium (CBC) as risky, costly to administer and less rewarding as they do not allow quick circulation of funds. Against the background of perceived high demand for operation credit under NESP's policies, and intense moral suasion by the central bank, the consortium was formed in 1990/91 with the objective of raising the volume of formal farm credit supply, while reducing individual bank exposure through risk pooling. In search for financial instruments that are consistent with both the Islamic principles of finance and the nature of agriculture, formal lending in general and CBC's lending in particular has been confined to the mechanism of "purchase with deferred delivery", which is locally known as *elsalam*. Through *elsalam* farmers obtain cash advances on the promise of selling or delivering a certain amount of their future crop to banks at the time of harvest. In other words, in a typical *elsalam* agreement, the borrower receives a money loan by undertaking to deliver to the lender a certain amount of the future crop at an agreed (contract or *elsalam*) price, P_c . Given the size of the loan and the amount (number of sacks) of the crop to be delivered, this price is computed by dividing the former by the

latter and may be significantly different from harvest⁴ or spot price, P_h . Immediately after harvest the lender receives the contract quantity, which can be sold at P_h . Therefore, similar to Saleem (1987), the periodic rate of return on credit to finance crop production (r) is assumed to depend on P_c and P_h . That is:

$$r = [(P_h - P_c)/P_c] * 100 \quad (1)$$

In practice, P_c is determined by CBC in each season, taking into account factors such as expected output levels, as well as transport, marketing and administrative costs, and is always smaller than P_h . It is also the case for all other formal crop credit that the contract price is fixed among farmers in the same locality. In effect implicit interest rates are the same across households within the same locality, where harvest prices are uniform at a given period of time. Differences in interest rates therefore only reflect differences in prices from one locality to another. The respective average compounding monthly (rm) and annual (ra) rates of interest are given by:

$$rm = (1+r)^{1/n} - 1 \quad (2)$$

$$ra = (1+r)^{12/n} - 1 \quad (3)$$

where n is the duration of the loan measured in number of months.

Obviously, the lender faces the risk of a price fall or crop failure, but might be equally rewarded by the prospect of a price rise, which is often the case even in normal harvest seasons. Hence, *elsalam* credit, as a loan denominated in a commodity, is not risk-free. However, since the commodities involved are normally close to the consumption bundle of the borrower, the interest rate given by Equation 1 may represent a close approximation of the true rate of interest from the household perspective. It is nonetheless worth noting that since this rate of interest is not known to lenders and borrowers at the time of borrowing, the relevant rate is the one based on their perception of future harvest price. Unfortunately, in the absence of detailed price information for the different regions, it is not possible to estimate the expected rate of interest.

In keeping with the profit and loss sharing principle of Islamic finance, lenders are not allowed to take collateral to secure debt services when project returns are insufficient, but they insist on providing some sort of warranty to ensure that the person taking *elsalam* credit is a genuine farmer, and they also seek to reduce the costs of administering *elsalam* transactions. Scheme administrations in the case of irrigated agriculture and farmers' unions in others have generally been able to provide such guarantees. In most cases they negotiate with banks the terms of *elsalam* credit, namely the contract price and size of the loan per unit of a specific crop's land, and assist in loan disbursement as well as delivery of crops to collection centres that belong to banks. On the one hand such arrangements considerably reduce loans' administrative cost although banks still have to meet the costs of crop storage and marketing. On the other hand, *elsalam* advances become less accessible to small individual farmers who cannot prove their credit-worthiness to banks.

At the time of the survey there were no formal credit cooperatives or credit programmes for agriculture that had the desirable features of wider outreach and sustainability (in the sense of Gurgand et al., 1996). Meanwhile, the nature of the agricultural production system, which is subject to various environmental hazards and yield and price uncertainties, might represent a major factor influencing bankers' attitudes towards agriculture and hence constraining the supply of formal farm credit. This proposition is particularly robust when interest rates are not free to adjust sufficiently enough to make farm loans profitable.

Comparing returns on agricultural loans with those on non-agricultural credit, we observe that the central bank fixes the share of formal lenders at 36% of borrowers' realized profits/losses for agricultural investment, and 48% for non-agricultural investment. The actual return is the product of the fixed percentage and the actual profit or loss realized by the borrower. Thus returns on farm loans will be lower than returns on non-farm credit unless farm investment is more profitable than non-farm investment by at least 34%.

The informal loan market

In the absence of institutional loans, farmers resort either to share-cropping or *shail* credits to meet their financing needs. The *shail* system is essentially a system of crop mortgage under which the borrower sells in advance a certain part of the future crop in exchange for a loan from a village trader, a landlord, a relative or a friend; sufficient knowledge about the borrower is a prerequisite and hence there is no collateral.⁷ Lenders may not operate across villages (Saleem, 1987), and lending units do not engage in mobilization of saving. Informal borrowers normally determine the projects or purposes for which loans are used, and contracts are not exclusive. There is no direct monitoring of borrowers, but information gathered through observation and social contacts is useful in following up and, when necessary, renegotiating contract terms.

Informal loans could be in cash or kind, but repayment is usually made in kind at lender-set prices that are significantly lower than harvest prices. In other words, although subject to negotiation, the lender has the upper hand in determining the amount of cash to be received by the borrower and the amount of future crop to be delivered. In this process the present (contract) price of the future crop is also specified. According to Saleem (1987), informal lenders enjoy monopoly power, and there is no risk-sharing as the borrower is obliged under all circumstances to honour the commitments. But it is not unusual for contract terms to be renegotiated to allow cash or delayed repayment in which case additional interest may be charged. Both economic and social factors influence the creditworthiness of borrowers, and a credit rationing in favour of "safer" farmers may be expected. Hence, interest rates and other contract terms are not only household specific but also crop specific.

It follows, then, that the rate of interest on *shail* loans is determined by the contract price and the actual harvest price. Although the factors determining these prices are different in the two segments of the credit market, the *shail* rate can be calculated

according to the formula for the *elsalam* rate of interest as in Equation 1.

Empirical research on informal borrowing has focused on its prevalence and exploitative nature in terms of exorbitant interest rates. For example, a study of 96 tenants in the Gezira scheme finds that 80% of tenants having 5 – 20 feddans borrowed for sorghum, 45% for wheat and about 35% for groundnuts (Adam and Apaya, 1973). This study demonstrated that the contract price per sack was in most cases less than half the harvest price especially for small farmers. They argued that the absence of formal credit made it possible for village merchants and other money lenders to charge such high implicit rates of interest. However, they provide no information on the duration of loans. Ahmed (1983) found that only 11.8% of 391 peasants in southern Kordofan were involved in informal borrowing for agriculture. One of the few studies that use quantitative information to calculate interest rate was conducted by Saleem (1987), who found that 44% of a sample of 249 tenants from Gezira and Rahad schemes were engaged in *shail* dealing and that the rates of interest were too high to be attributed to the lender's risk. The compounded monthly interest rate ranged between 172% and 201%. Saleem explains these rate levels in terms of power relations, monopoly and corresponding undervaluation of borrowers' crops. Similar arguments were advanced earlier by Bottomley (1975) and Bhaduri (1983) for some developing countries.

The wisdom that informal lending in Sudan is widespread and exploitative was challenged by a study by Tecnoserve (1987), who found that farmers in El-Obeid district have very little credit and that 89% of these credits were interest-free. This finding was supported by Kevane's (1993) study of the Butana area of Central Region and the Sheikan area of Kordofan over a four-year period. Kevane maintains that borrowing may vary from one period to another depending on previous period's harvest, and that informal *shail* credit is neither as prevalent nor as exploitative as the literature suggests. He provides evidence of a high percentage of interest-free loans and relatively low volume of lending especially in Kordofan. Moreover, the evidence for Sudan suggests that there is no or little link⁶ between the formal and informal credit markets.

IV. Survey results

The main empirical questions to be addressed in this section are: How extensive is participation in the formal and informal segments of the agrarian loan market? How high are the rates of interest charged on institutional and non-institutional credit? How do these rates compare with non-agricultural rates of interest?

Survey structure

Cross-section data were obtained through a farm household survey covering the three subsectors. The Gezira Scheme was chosen to represent irrigated agriculture, farmers from Gedarif area to represent mechanized farming and traditional peasant farmers in the same region to represent traditional agriculture. A multi-stage⁷ sampling strategy was adopted to select respondents in each subsector. A total of 935 households was covered, with 342 respondents from the mechanized subsector, 267 from traditional agriculture and 326 from irrigated agriculture. Out of the overall rain-fed farms, 12 cases were found to contain substantive errors of transcription, and hence discarded. The remaining sample of 923 used in this study contained 326 respondents from the irrigated segment, 337 mechanized farm households and 260 traditional farm households.

The data were collected after the 1994/95 harvest season, which was very successful. In the Gezira Scheme, the major crops grown were cotton, wheat, sorghum, peanuts and vegetables. All respondents in the rain-fed subsector cultivate almost exclusively two crops: sorghum (*dura*) and sesame. Sorghum is a food crop produced largely for the domestic market, while sesame is a major export cash crop. Production in mechanized farms is profit-oriented while traditional farmers produce mainly for subsistence with limited scope for surplus and profit generation.

In the mechanized subsector, crop production is associated with sizeable non-agricultural business, mostly trade and services. Both land endowment and non-land wealth are quite high. Mechanized farm owners are organized and better educated. Hence on economic and non-economic counts they seem to have better access to modern banking services. Traditional farming is normally combined with livestock raising, but crop income dominates all other sources of income (see Appendix Table A1 for details).

During the 1994/95 season, the commercial banks consortium and the Agricultural Bank of Sudan provided substantial credit facilities that were supposed to be available to farmers across different subsectors. These credits were in the form of *elsalam*. As negotiated by the scheme's administration and the farmers' union, *elsalam* advances

were available to all Gezira tenants, although restricted to wheat and cotton, which is marketed by the scheme's administration. However, farmers in the mechanized subsector have evidently benefited considerably from CBC advances, which were either negotiated through their union or on bilateral basis.

Aside from *elsalam* credit, some formal cash loans were also contracted. Where formal loans were not enough or accessible, or perhaps less preferred, informal borrowing assumed significance. For analytical convenience, we distinguish among five types of credit arrangements in both formal and informal credit markets. Formal credit included *elsalam*, which involved mainly sorghum, and to a limited extent sesame, beside cash credit in which both advances as well as loan repayments are made in cash. Informal credit consisted of sorghum (*shail*) credit, sesame (*shail*) credit, and cash credit where the lender and the borrower informally agree on a certain interest payment over and above the amount loaned.

As the analysis to follow indicates, a high proportion of cash credit, especially in the informal market, was interest free. In the entire sample, there were only two cases of lending in which both loan disbursement and repayment were made in kind, with the quantity repaid being the same as the quantity loaned. The rate of interest on *elsalam* and *shail* advances is calculated according to Equation 1, using the harvest and contract prices of the crop in question. Interest rates on cash loans are simply the percentage difference between the amount loaned and the amount repaid. In the event that a household uses more than one of these credit categories, the interest rate it faces is obtained as the percentage difference between the value of all amounts paid and amounts received. We examine below the extent of borrowing in agriculture, along with the structure of interest rates, and then proceed to estimate an implicit household credit demand function in the next section.

The extent and cost of borrowing

It is traditionally the case that all tenants in the Gezira scheme obtain some formal advances against crops such as cotton and wheat. Hence as mentioned previously, all respondents in this subsector had borrowed formally, but only six of them admitted informal borrowing, perhaps because they are legally bound not to do so. Out of the 597 households from rain-fed agriculture, 62.8% borrowed in some form or another, and 37.2% had no stake in the credit market. Of those who borrowed, 98.6% were net borrowers, and 8.5% have taken more than one loan; 16 out of 122 informal borrowers took more than one loan. This relatively high borrowing ratio following a successful harvest is comparable to the borrowing ratio of 80% found by Kevane (1993) in Butana area, but his survey followed a season of crop failure. Probably the percentage of borrowers in rain-fed subsectors in a normal season would be between 63% and 80%.

Table 1 shows the breadth of various types of advances in agriculture with a breakdown of loans by subsector. The table also displays the number of interest-free loans. It is clear from the table that borrowing in mechanized agriculture is greater than that in traditional agriculture in terms of both number and average loan size, and in both formal and informal

credit markets. Some 83% of households in mechanized agriculture borrowed formally and 26% borrowed informally. For traditional peasant farmers these percentages are 9.6% and 13.5% respectively.

Table 1: Extent and type of borrowing in agriculture (S£1000)

Loan type	Irrigated agriculture		Mechanized agriculture		Traditional agriculture		Total		IFL*
	Cases	Amount	Cases	Amount	Cases	Amount	Cases	Amount	
Formal:									
1. <i>Elsalam</i>	328	62.0	263	2528	22	248	613	690.7	0
2. Cash	-	-	19	1969	3	198	22	1728	3
Informal:									
1. Sorghum <i>shail</i>	-	-	50	1323	16	151	66	1039	2
2. Sesame <i>shail</i>	-	-	11	656	11	63	22	459	0
3. Cash	06	18.0	35	1663	15	434	56	1294	28
Households taking informal credit									
	06	18.0	87	1564	35	302	128	1146.5	9

Source: Survey data.

Notes: Irrig. agric.: irrigated agriculture; mech. agric.: mechanized agriculture; and trad. agric.: traditional agriculture. * IFS: interest-free loans.

The remarkably high average loan size and borrowing ratio in mechanized farming may be viewed as a consequence of the subsector's commercial nature, which requires relatively large working capital during the crop season. Almost all labour and material inputs in this subsector are purchased from the market, and 98% of loans were used to finance such expenses. In contrast, traditional peasant farmers depend mainly on family labour and most other inputs are natural. The finance of crop production aside, large farmers in mechanized agriculture may actually borrow to pay in kind by way of securing a market for their future crop, which was expected to be plenty in that season. In other words, taking *elsalam* loan may be considered as a means of hedging against marketing uncertainties. Moreover, as farms are operated as part of a multipurpose business, surpluses from last season's crop sales are likely to be committed to non-agricultural activities by the start of the new crop season. In our sample of mechanized farms, 115 households (i.e., 34%) undertook substantial investment of various types in the season considered.

Furthermore, compared with traditional farmers, mechanized farm owners are relatively well informed and have better access to formal sources of credit. They have secured 92% of all formal loans in the rain-fed subsectors, but they also hold 93% of the

271 bank accounts for the entire sample. Of these accounts 94% are current and the rest are saving and deposit accounts. Informal interest-free cash credits appear to be prevalent, reflecting the society's attitudes towards interest rates; notably, however, interest-free formal credit (or *qurd hassan*) is limited.

Table 2 displays the periodic interest rates for various types of credit. The average loan period was found to be four months. As the table may testify, the formal *elsalam* rate of interest is higher for traditional agriculture than for mechanized agriculture. This merely reflects differences in harvest prices, which are usually lower in remote areas than in areas that are closer to major crop markets, but relative abundance of crops in mechanized farming may lower harvest prices relative to prices in remote and small crop markets. In contrast, the average informal lending rate was lower for mechanized agriculture compared with traditional farming, and this is theoretically consistent given the risk and transaction cost characteristics of the latter. The weighted periodic rate of interest was thus almost the same for the two segments of rain-fed agriculture averaging 51.21%, and this was remarkably lower than the counterpart rate of 63.68% for irrigated agriculture.

Interestingly, sorghum's *shail* rates of interest are lower than *elsalam* rates, countering the wisdom that informal rates of interest are higher than formal rates. This observation was also true for the overall periodic average informal rate of interest. The average periodic *shail* rates of interest, which varied between 46.6% and 71.9% for all crops, were low compared with those found by Saleem (1987). In his estimates, the average periodic *shail* rate for all crops in the Gezira scheme was 177%. The average compounding monthly rates of interest (*rm*) and the average compounding annual rates (*ra*) are shown in Table 3. These rates are calculated according to equations 2 and 3, respectively, and may be compared with the formal non-agricultural rate of interest (*rb*) in the season considered as well as the rates found by previous researchers. Saleem's (1987) estimated periodic rates of interest give rise to a monthly compounding interest rate of 34% in Gezira and 44% in Rahad. The corresponding annual compounding rates are 3,189% and 4,273%, respectively. Our estimates in Table 3 show comparatively low monthly and annual compounding rates in agriculture in the season considered; the annual compounding rates varied between 215% and 408%.

Perhaps more meaningful is the comparison between the formal *elsalam* rate of interest in agriculture and the formal non-agricultural rate. For a maximum period of six months the maximum short-term (*murabahah*) non-agricultural bank rate was 48%. When compounded annually this yields 119% compared with 281% for the *elsalam* rate. Given the rate of inflation of 120% in 1994/95, the real annual *elsalam* rate was 160%, while the non-agricultural rate⁸ was -1% in real terms. This high real agricultural rate of interest may provide the most plausible explanation for increased involvement of formal banks in agricultural lending. Beside the incentive issue, in the 1993 – 1995 seasons, the risk of lending to agriculture was probably negligible; in the last season the percentage of outstanding *elsalam* loans was 1%. (Obviously, the situation might be different if the harvest season was not successful, a possibility that has not been dealt with here.) Moreover, the role of scheme administrations and farmers' unions in *elsalam* arrangements, as described in the previous section, should also imply lower administrative

and risk elements of credit cost. The benefits from such relatively high rates of interest in agriculture have to be weighed against their potentially negative impact on agricultural growth since they tend to make investment in other sectors relatively more profitable.

Table 2: Structure of average periodic agricultural rates of interest' (%)

Loan type	Irrigated agriculture	Mechanized agriculture	Traditional agriculture	Entire agriculture
Formal:				
1. <i>Elsalam</i>	63.68	55.8	58.2	56.22
2. Cash	-	11.8	0	11.8
Informal:				
1. Sorghum <i>shail</i>	-	46.3	47.8	46.6
2. Sesame <i>shail</i>	-	76.5	67.4	71.9
3. Cash	-	24.9	25.7	25.1
Average informal rate	-	42.2	45	42.9
Overall rate**	63.68	51.15	52.0	51.51

Source: Survey data.

* Interest-free loans are not considered when calculating these rates.

** Weighted average periodic rate of interest on all types of loan.

Table 3: Structure of average compounding monthly (rm) and annual (ra) interest rates in agriculture (%)

Loan type	Irrigated agriculture		Mechanized agriculture		Traditional agriculture		Entire agriculture	
Formal:								
1. <i>Elsalam</i>	13.11	338.5	11.7	278.2	12.2	296	11.8	281.3
2. Cash	-	-	2.82	39.7	0	0	2.82	39.7
Informal:								
1. Sorghum <i>shail</i>	-	-	9.9	213.1	10.3	222.9	10	215.1
2. Sesame <i>shail</i>	-	-	15.3	449.8	13.7	369.1	14.5	408
3. Cash	-	-	5.7	94.8	5.9	98.6	5.8	95.8
-Average 1-3	-	-	9.2	186.3	9.7	204.9	9.3	191.8
-Overall rate*	13.11	338.5	10.88	245.3	11.10	251.18	10.95	247.8

* Overall weighted average rate of interest.

V. A model of household participation in the rural credit market

Constrained credit supply gives rise to either loan size rationing, when the size of loan demanded exceeds the amount supplied, or loan quantity rationing, when some potential borrowers are unable to get credit, or both. It is often noted that if credit contracts are non-exclusive, unsatisfied loan demand under a single lender may be satisfied through borrowing from more than one source. "Assuming that borrowers maximize their expected utility and derive loan demand from the terms and conditions of an accessible marginal contract, the loan demand would be identified (satisfied) at the margin. A marginal lender is the one who satisfies the loan demand of a borrower, while an infra-marginal borrower will credit ration the borrower" (Nagarajan et al., 1995:2).

Model specification and definition of variables

In their analysis Nagarajan et al. supposed that the loan supply (L^s) by the infra-marginal lender is less than the total loan demanded by the borrower. The determinants of loans' supply vary with the type of lender's expected profit maximization function. Given the marginal loan (L^*_2), total loan size (L^*_D) and loan demand (L^*_D) are:

$$L^*_D = L^*_D = L^*_{s1} + L^*_2 \text{ if } L^*_D > L^*_{s1} \text{ and } 0 < L^*_D < L^*_{s2} \quad (4)$$

or

$$L^*_D = L^*_D = L^*_2 \text{ if } L^*_D > L^*_{s1} \text{ and } 0 < L^*_D < L^*_{s2}$$

It is therefore possible to interpret loan demand from the individual loans that are often supply constrained. This implies that observed borrowing is obtained by matching the demand for and supply of loans and is associated with the determinants of both loan supply and loan demand. Total borrowing can be measured by aggregating over all loans obtained by a household during the period considered, and households with only one loan may be assumed to choose the marginal lender to satisfy their entire loan demand. The structural model for loan demand and loan supply may thus be written as:

$$L^*_D = \alpha_0 + \alpha_1 Z + \alpha_2 r + U_1 \quad (5.1)$$

$$L^*_S = \beta_0 + \beta_1 M + \beta_2 r + U_2 \quad (5.2)$$

$$L^*_D = L^*_S \quad (5.3)$$

where Z and M are vectors of observed exogenous variables affecting loan demand and loan supply, respectively, and U_1 and U_2 are white noise error terms. As Equation 5.3 implies, the rate of interest is endogenously determined and is correlated with the random terms. This is so because interest rates in rural markets are often lender and borrower specific and are related to the loan size.

Given the nature of the dependent variable due to the existence of non-borrowers, a Tobit model can be used to obtain efficient and consistent estimates. The loan demand equation (L^*_D) can therefore be estimated on the basis of the observed total loan size (L^*_D). Since the interest rates are observed only for positive loan sizes, the basic single-equation Tobit model can be extended to accommodate simultaneous estimation. This can be done following, in Amemiya's typology, the type three Tobit model (see Amemiya, 1989), which can be specified as:

$$\begin{aligned} Y^* &= X_1\beta_1 + U_{1i} \\ r^* &= X_2\beta_2 + U_{2i} \\ L^*_D &= L^*_D = X_3\beta_3 + \beta_4 r^* + U_{3i} \text{ if } L^*_D > 0 \\ &= 0 \text{ otherwise} \\ Y^* &= 1 \text{ if } L^*_D > 0 \text{ and } L^*_S \leq 0 \\ &= 0 \text{ if } L^*_D \leq 0 \text{ and } L^*_S \leq 0 \\ r^* &= r^* \text{ if } L^*_D > 0 \text{ and } L^*_S > 0 \text{ or } Y^* = 1 \\ &= 0 \text{ if } L^*_D \leq 0 \text{ and } L^*_S \leq 0 \text{ or } Y^* = 0 \end{aligned} \quad (6)$$

where Y^* = set of the potential factors that affect the decision to take a loan; Y^* = set of observed factors determining the matching of the decision to borrow and the lender's decision to offer loans; L^*_D = loan demand; L^*_S = loan size; r^* = the rate of interest related to the loan demand; and r^* = the observed interest rate.

In this framework, Heckman's (1979) two-stage procedure can be applied on the Y^* and r^* equations to obtain the predicted value of the rate of interest. This is given by a probit model in Greene (1992), which can then use the predicted value of the rate of interest to estimate the loan demand function by a Tobit procedure (see Greene, 1992). For estimation purposes the model can be modified to include the following: (1) set Z affecting loan demand is composed of borrower characteristics and other exogenous factors; and (2) set M influencing loan supply is composed of lender characteristics, other exogenous factors and the information base available to lenders.

The dependent variable, total borrowing (L_b), is measured as the sum of all loans

reported by a borrower household in the period considered. There are three sets of regressors. The first set includes borrower characteristics: (1) borrower's farming ability as proxied by age of the household head (AGE); education of the household head (EDUC) measured as number of years of schooling; and risk-aversion parameter (AGESQ) measured as the square of the age of the household head. And (2) borrower's farming, and loan repayment, capacity as proxied by the number of feddans or area of land (AREA) operated by the household; land quality (LQ) measured as net returns per unit of land per annum; value of physical assets (ASSETS) inherited by the household; family labour endowment (LF) represented by the number of adults in the household; and net income earned through non-farm enterprises (NFINC).

The second set of variables consisting of lender's characteristics encompasses:

lender type given by the dummy variables representing trader lender (TRD) and non-trader lenders (NONTRD), beside loan characteristics including the rate of interest (r). The third set, information variables such as reputation of borrower as measured by years of stay in village, is often included in empirical analysis of rural credit demand functions (e.g. Udry, 1994). In our data, there is no suitable proxy for information, but the effects of information elements may well be embodied in the lender's type variables. Finally, there are other exogenous variables depicting, for example, availability of irrigation and level of infrastructural development in the village. The former variable is represented by an irrigation dummy (IRRV), and the latter by a bank dummy (BD), plus a distance (DIST) variable indicating the distance of the village from major marketing centres. In addition, a village specific dummy (VSD) is added in order to test for variations in loan demand and the interest rate across villages. Similarly, a loan source (LS) dummy is used in estimating pooled loan demand to test if interest rates vary by loan source, formal and informal. On the basis of the above, the general forms of loan demand and supply are specified as:

$$L_B = a_0 + a_1 r + a_2 LF + a_3 AGE + a_4 AGESQ + a_5 ASSETS + a_6 NFINC + a_7 AREA + a_8 LQ + a_9 EDUC + a_{10} VSD + a_{11} BD + a_{12} DIST \quad (7.1)$$

$$L_S = b_0 + b_1 r + b_2 LF + b_3 AGE + b_4 AGESQ + b_5 ASSETS + b_6 EDUC + b_7 AREA + b_8 LQ + b_9 TRD + b_{10} NONTRD + b_{11} LS + b_{12} VSD + b_{13} BD + b_{14} DIST + b_{15} IRRV \quad (7.2)$$

It is hypothesized that loan demand is negatively related to interest rates, but the direction of causality between loan demand on the one hand and farming ability and capacity on the other is theoretically ambiguous. In general, the response of credit demand to changes in any exogenous variable depends basically on expectations⁹ concerning end of period or future income. If the end of period income is expected to be high, the household would tend to consume more in the first period by increasing borrowing and vice versa. Saving and borrowing are the means through which such income transfers are achieved, and it follows that income effects and inter-temporal adjustments rely on the demographic and market characteristics of the household.

In empirical literature, farming capacity is defined to include all income-generating assets owned by the household such as the quantity and quality of the land, and any non-land physical assets including the value of such items as livestock, trading stock, tools and articles owned by the family. Farming ability is influenced by farm-specific factors that determine differences among farmers in terms of natural abilities and farm-level investment such as adoption of modern inputs. As in our specification, these factors include education (EDUC) or investment in human capital, and age of the household head. Moreover, following Iqbal (1983), investment opportunities or the level of infrastructural development at the village level may influence income expectations and hence credit demand. These effects are proxied here by the BD and DIST variables.

In the absence of monopoly the rate of interest is determined by all the factors relating to the opportunity cost of the lender, the cost of administering the loan and the risk premium. The opportunity cost of lending would vary with such factors as the source of the loan (LS), distance between the village and major market/urban centres, and the presence and accessibility of official lending institutions. Therefore, the loan source (lender type) and the bank dummy variable (BD), which takes the value of 1 if a bank branch exists within the locality and zero otherwise, are included in the loan supply function and are assumed to have negative signs. The administrative cost of a loan is often related to its size. The larger the loan the lower the unit cost of its administration, but since the lender's risk increases with loan size, the size variable is theoretically ambiguous in sign. Finally, lender's characteristics and all the factors that influence the repayment abilities or incomes of borrowers are expected to affect the risk component of the rate of interest.

Econometric estimation and discussion of results

The type-three Tobit – full information maximum likelihood – model is applied following the procedure in Equation 6. Given the limited number of multiple contracts, and the difficulties in selecting marginal contracts, no attempt has been made to identify the marginal contract. As mentioned previously, households taking a single loan are assumed to choose the marginal contract to satisfy their entire loan demand. However, formal and informal credit demand functions have been fitted separately on the grounds that the terms and conditions of loan contracts might be significantly different between the two segments of the credit market, especially in determining contract prices and interest rates. For example, the formal loan rate of interest, as opposed to the informal rate, may be fixed per locale and hence not household-specific. If this is true, a pooled sample estimation would yield biased results.

The estimates for formal loan demand are reported in Table 4, while Table 5 shows the estimates for demand for informal credit. To further test the validity of these separate regressions, pooled sample regression results for loan demand are given in Table 6. In all cases several regressions were run, but only the most statistically sound one is presented and discussed here, and some regressors were dropped for statistical problems.

The log-likelihood function was significant in all three regressions, indicating that

the models are good. However, with the exception of the pooled sample estimate, the rate of interest was found to have an insignificant, though negative, impact on credit demand. In general, farm household participation in the credit market is influenced by the ability and capacity to specialize in farming as well as some other exogenous factors. But the factors influencing household participation in the formal credit market are notably different from those determining the decision to take informal loans.

Table 4: Formal loan demand estimated with type three Tobit method

Variable	Probit (Y*)	Selection (r)	Tobit loan demand (L^*_D)
CONSTANT	1.013 (7.46)*	8.60 (4.98)*	-810.70 (0.59)
rhat#	-	-	-46.16 (0.69)
AGE	-0.0034 (0.66)	-0.028 (0.77)	3.81 (0.44)
AGESQ	0.000049 (0.92)	0.00032 (0.81)	-
AREA	0.00010 (3.67)*	0.00033 (6.47)*	1.014 (11.70)*
LF	-0.015 (2.44)*	-0.034 (1.20)	-46.43 (1.37)
EDUC	-0.010 (-1.87)***	-0.0116 (0.96)	6.75 (0.38)
ASSETS	-0.000016 (0.25)	-0.000021 (1.36)	-0.012 (2.33)*
LQ	0.0013 (2.00)**	0.486 (0.94)	2.62 (0.36)
VSD	-0.031 (10.30)*	-0.439 (5.92)*	30.0 (0.42)
DIST	0.106 (3.86)*	0.620 (14.4)*	-0.75 (0.003)
BD	0.792 (2.51)*	0.366 (2.88)*	54.79 (2.77)
NFINC	-	-	0.033 (5.94)*
Log-likelihood	-410.36	-316.90	-4963.0
Chi-square		532.92	
R ²	0.37		0.47
Rho		0.136!	
Sigma	0.39		1693.3!

Predicted value of the rate of interest.

! Jointly estimated with the coefficients of both equations.

(.) t-ratios in parentheses.

*, **, and *** represent significance at 1%, 5% and 10%, respectively.

Table 5: Informal loan demand estimated with type-three Tobit method

Variable	Probit (Y*)	Selection (r')	Tobit loan demand (L_0^*)
CONSTANT	-0.290 (2.66)*	-16.83 (4.65)*	-228.51 (6.99)*
rhat#	-	-	-17.711 (0.88)
AGE	0.0047 (1.10)	0.0053 (0.114)	-2.748 (0.32)
AGESQ	-0.000039 (0.91)	-0.00001 (0.001)	-
AREA	-0.00018 (1.65)***	-0.00036 (1.88)***	-0.212 (1.68)***
LF	0.0050 (1.01)	0.0333 (0.84)	61.51 (1.58)
EDUC	0.0016 (0.74)	-0.0204 (1.08)	-33.77 (1.79)***
ASSETS	-0.000001 (0.95)	-0.00003 (2.46)*	-0.023 (1.94)**
LQ	-0.0010 (1.26)	-0.0010 (0.06)	4.61 (0.44)
VSD	0.0117 (4.83)*	0.734 (4.44)*	101.32 (6.38)*
DIST	0.026 (4.20)*	0.278 (4.32)*	318.0 (4.32)*
BD	-0.021 (0.83)	-0.299 (1.68)***	46.70 (2.61)*
TRD	0.357 (9.55)*	0.305 (1.37)	-
NONTRD	0.172 (3.67)*	0.271 (1.00)	-
NFINC	-	-	-0.015 (1.10)
Log-likelihood	-216.85	-241.86	-1244.1
Chi-square		214.06	
R ²	0.19		0.32
Rho		0.999!	
Sigma	0.313		1367.5!

See notes to Table 4.

In the formal loan demand estimate, the coefficient of multiple determination of 48% is relatively high. Credit demand is positively and significantly responsive to the household's farm size (AREA), non-farm income (NFINC) and the availability of banks within the locale as indicated by the bank dummy (BD). This suggests that if households have the capacity to farm, then the existence of a bank will raise their loan demand. Loan

demand is also significantly, but negatively, related to the family labour (LF) variable, and family assets. The village-specific dummy and the other variables representing the general level of infrastructural development in the locale, such as DIST, are insignificant. This suggests that household-specific variables are more important determinants of the decision to borrow.

Table 6: Pooled loan demand estimated with type-three Tobit method

Variable	Probit (Y*)	Selection (r*)	Tobit loan demand (L _p)
CONSTANT	0.974 (11.93)*	4.33 (4.14)*	717.90 (0.41)*
rhat#	-	-	-15.01 (1.67)***
AGE	0.0019 (2.17)**	0.0079 (0.95)	2.00 (0.2332)
AGESQ	-	-	-
AREA	-0.000037 (2.98)*	-0.00016 (1.47)	1.14 (13.94)*
LF	-0.013 (2.52)*	-0.109 (2.72)	4.669 (0.199)
EDUC	-0.0042 (1.90)***	-0.021 (0.94)	-0.331 (0.02)
ASSETS	-0.000012 (1.15)	-0.00010 (0.41)	-0.0145 (2.88)*
LQ	-0.0008 (1.44)	-0.0044 (0.47)	2.39 (0.26)
VSD	-0.019 (7.76)*	-0.172 (4.44)*	70.51 (1.179)
DIST	0.135 (21.23)*	1.398 (18.58)*	-
BD	0.1046 (4.02)*	0.448 (1.75)***	69.9 (3.40)*
NFINC	-	-	0.021 (2.42)*
LS	-0.271 (8.19)*	-2.179 (6.30)*	-
Log-likelihood	-243.3	-124.1	-5815.9
Chi-square		772.2	
R ²	0.48		0.38
Rho		-0.45!	
Sigma	0.322		2031.9!

See notes to Table 4.

However, in the predicted formal interest rate equation the existence of modern banking institutions and the distance variable have positive and significant coefficients, while the village-specific dummy has a negative sign indicating that interest rates are significantly different across villages. Among household-specific variables only the one for farm size has a significant (positive) impact on the predicted rate of interest.

The estimates for the informal borrowing function produced rather interesting results. The coefficient of the farm size (AREA) variable is significant but negative in sign, suggesting that it is smaller farmers who participate more in the informal loan market, and this is theoretically consistent. Of similar indications is the finding that the greater is the value of the physical assets owned by the household the less is its demand for informal credit. The results also show that higher education levels (EDUC) and availability of formal financial institutions (BD) imply reduced demand for informal loans, perhaps because of enhanced access to formal credit. Equally interesting is the finding that the VSD and DIST variables have negative and significant effects on informal loan demand. Notwithstanding the importance of household-specific variables, this finding supports the hypothesis that demand for informal loans is higher the poorer the level of infrastructural and institutional development in the area considered.

In the predicted informal interest rate function, household economic variables such as farm size and assets have adverse and significant impacts, while the existence of a bank branch has a positive effect. This finding is consistent with our descriptive analysis, which indicated that there were more informal interest-free loans and that informal interest rates were generally lower, probably because of unobserved economic or social factors affecting the determination of these rates. The results show that while village specific differences exist, there is no significant difference between interest rates charged by various informal money lenders.

As expected the pooled credit demand function's estimate indicates that the results are dominated by the factors affecting participation in the formal loan market, i.e., biased. This is not surprising given the overwhelming number of formal loan contracts compared with informal credit agreements. Therefore, there is a clear justification for the separate estimates of loan demand functions. The R^2 of 38% in the pooled sample estimation is between the R^2 for the two separate regressions. The only significant difference in the pooled sample regression is that the rate of interest is both negative and statistically significant though only at the 10% level. Moreover, the loan source (LS) dummy, which takes the value of 1 for formal loans and zero otherwise, produced rather inconsistent results.

The coefficient of this dummy is statistically important, indicating that there are significant differences between formal and informal interest rates, but its negative sign contradicts the fact that formal interest rates are generally higher than their informal counterparts and that the existence of banks contributes to higher and not lower interest rates.

The findings above may be compared with those of similar studies. In several studies, loan demand was found to be responsive to the interest rate as well as to economic and demographic factors such as land size and family size (see Desai and Mellor, 1993, for a review of such evidence). For example, Nagarajan et al. (1995) provide evidence that farm loan demand in the Philippines is negatively influenced by the rate of interest, but the coefficient of this variable is only marginally significant. In their regression, both farm size and household assets have positive and significant coefficients, while net non-farm income has an adverse and also significant effect.

VI. Conclusions

This study used survey data to examine the rural credit market in Sudan in the light of recent macroeconomic and financial policy shifts. The study analysed the extent and cost of both formal and informal credit as well as the determinants of agrarian household participation in the loan market. The findings indicate increased rural household participation in the organized loan market, in which interest rates were higher relative to the unorganized money market, which reported sizeable interest-free loans.

The Islamic financing mechanism of *elsalam*, which is akin to the traditional informal *shail* mechanism, although relatively costly, seems to be widely acceptable. Increased availability of formal loans might be one of the reasons for the observed relatively low levels of informal lending rates. There was a link between the formal and informal segments of the agrarian credit market in the sense that *elsalam* and *shail* credit were competing with one another, and many farmers have combined both formal and informal loans. This resulted in considerably low informal rates of interest compared with those reported by earlier studies. There is no evidence in our findings that the terms of informal credit are less favourable, but the average loan size is quite small.

The study specified and estimated an implicit loan demand function for a sample of 923 agrarian households containing non-borrowers as well as borrowers. The latter type of respondents also included formal and informal borrowers, and have reported some multiple loan transactions. Accordingly, a type-three Tobit, maximum likelihood estimation, model was used to fit separate loan demand functions for household participation in the formal and informal credit markets. The two estimates were compared, and the validity of the separate estimates further tested by running a pooled sample regression for all credit types. This regression shows that pooling formal and informal credit yields biased results.

An important policy implication of this study concerns the promotion of credit institutions specializing in saving mobilization and credit supply to agrarian household specifically. There is concern that the present enhanced role of formal financial intermediaries in rural credit markets is no more than a temporary measure of achieving the immediate macroeconomic objective of food security. For this reason, and given the evidence that agriculture as a whole could be a net lender, there appears to be a necessity as well as a scope for the promotion of appropriate financial intermediaries. These could include voluntary savings and credit cooperatives, which could pool funds from surplus units for lending to deficit households so as to smooth seasonal discrepancies between farm household income and expenditure.

Notes

1. Sudan has an arable land area of about 88.6 million acres, of which only 20% is currently used despite the availability of run-off, ground and surface water. It has also been estimated that only a small fraction of available grazing land is used to maintain an animal population of about 57.1 million head (*Economic Survey*, 1991).
2. Islam categorically prohibits receipt or payment of predetermined rates of interest. For a detailed discussion of the Islamic principles of finance see Khan (1986).
3. For example, two alternative formulations produce similar outcomes: (1) pure screening in which there is no moral hazard as the loan is tied to a specific project and the lender knows how much equity the borrower possesses and collateral fully covers principal and interest payments, but adverse selection exists because borrowers are not homogeneous and there is no complete information (Stiglitz and Weiss, 1981); and (2) complete lender's certainty, in which the interest rate is determined by the opportunity and administrative costs (Basu, 1984). See also Bell (1988: 772-778).
4. Following Heckman (1979), various econometric models have been developed to allow efficient estimation of credit demand by the use of sample selection methods.
5. 1 Feddan = 0.41 hectares.
6. P_h has consistently been far greater than P_c for all crops. For example, the difference between agreed and harvested wheat prices ranged from 56% to 131% during 1990-1993. Accordingly, the cost of loans by the CBC represented 20% of the total production costs of major crops in 1991/92.
7. In addition to economic endowments, social links and borrower's reputation may be considered as good collateral.
8. As Aryeetey (1992) suggests, links between these markets may take one of three forms. First, where formal credit competes with informal credit in farm finance. Second, where the two are applied in a complementary manner by farmers. Finally, informal credit suppliers may act as conduits between formal financial institutions and borrowers.

9. For example, each location is divided into blocks, from each of which a few villages were randomly considered in the final, also random, selection of respondents.
10. This calculation, however, does not take account of the fact that *Mudarabah* loans are normally repaid in three or four equal instalments, with the first instalment to be paid at the beginning of the operation, i.e., before receiving the credit.
11. This idea is best explained in the context of a two-period model that takes into account the impact of both income and price expectations on borrowing (see, e.g., Iqbal, 1983).

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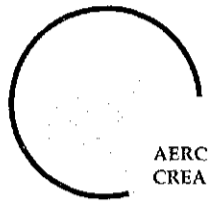
Appendix

Table A1: Mean and standard deviation (SD) of relevant variables (S£ 1000)

Variable type	Irrigated Mean	Agric SD	Mech Mean	Agric SD	Trad Mean	Agricc SD
Economic:						
Land (feddan)	26.9	87.0	1302	171.7	16	13.8
Wealth	708.7	117.8	20361	436	2598	539
Farm income	878.0	302.0	13561	206	559	90
Total income	1216.9	504	16218	299	1377.6	212
Farm prod. exp.	199.6	106	5610	187	268	147
Farm investment	56.3	77.8	801	253	49	17.7
Consumption*	73.4	24	184.5	139	96.4	29.9
Formal credit	62.0	69.0	1558	138	258	35.4
Informal credit	**	-	301.6	1222	41.5	72.4
Deposits	#	-	1194.4	476	26.0	96
Formal interest rate@	63.68	50	55.8	-	58.2	-
Informal interest rate@	-	-	42.2	-	45	-
Demographic:						
Education	3.4	4.3	6.4	5.5	3.2	5.5
Age	50.48	17.9	45.3	11.7	44.5	11.9
Household size	8.3	4.0	7.3	4.8	6.6	2.9
Observations	326		337		260	

* Monthly consumption expenditure, including home-produced goods. ** There were 6 loans averaging S£18000.
 # Few deposits were reported with no details. @ Average periodic rates.
 Inflation rate in 1994/95 = 120%; the average exchange rate was S£ 600 = US\$1.

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