FINANCING SMALLHOLDER AGRIBUSINESS IN ZAMBIA:

AN ECONOMIC ANALYSIS OF THE ZATAC MODEL

A Thesis

by

BRIAN NAMUSHI MWANAMAMBO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2008

Major Subject: Agricultural Economics

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Approved by:

Chair of Committee,	Victoria Salin
Committee Members,	Danny Klinefelter
	John C. Groth
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ABSTRACT

Financing Smallholder Agribusiness in Zambia: An Economic Analysis of the ZATAC Model. (August 2008)

Brian Namushi Mwanamambo, B.Eng., University of Zambia

Chair of Advisory Committee: Dr. Victoria Salin

This study investigates the case of a Zambian institution providing credit for smallholder agribusiness commercialization and compares this lender's model with the major microfinance institutions, to identify specific mechanisms employed by the lender and how these have been adapted to suit seasonal agricultural production credit requirements. Econometric models are developed to examine the influence of key economic factors such as nominal and real interest rates, loan fees, and loan term on the supply of credit by the lender. Other important factors considered relevant in the lender's market include availability of contract markets for financed production and the type of borrower (cooperative or investor-owned agribusinesses).

The study uses loan-level and firm-level loan data aggregated from an electronic loan database of individual loan files kept by the lender. Cross sectional data over three years (2005 – 2007) are used in the study.

The study finds that loan fees, loan term and availability of contract markets to borrowers are the key determinants of credit supply. In addition, the study finds that interest rates do not significantly influence the lender's credit supply decisions, a finding

that is consistent with literature on credit rationing in markets with asymmetric information. The study finds no evidence of economies of scale benefit to the lender being passed along to borrowers through lower loan fees.

The study contributes to the literature and development needs of agricultural lenders and smallholder agribusinesses in Zambia through the analysis of different factors that influence the lender's credit supply decisions.

To my wife and my daughter

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NOMENCLATURE

ACMP	Agricultural Credit Management Program
ADB	Asian Development Bank
BOZ	Bank of Zambia
BBA	British Bankers Association
FDIC	Federal Deposit Insurance Corporation, in the U.S.
Fed	The Federal Reserve System of the U.S.
FRA	Food Reserve Agency
FSRP	Food Security Research Project
LIBOR	London Interbank Offer Rate
LuSE	Lusaka Stock Exchange
NFIs	Non Financial Institutions
NGOs	Non Governmental Organizations
OCC	Office of the Comptroller of Currency, in the U.S.
USAID	United States Agency for International Development
USD	United States Dollar
ZATAC Ltd	Zambia Agribusiness Technical Assistance Centre Limited
ZIF	ZATAC Investment Fund
ZMK	Zambian Kwacha

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CHAPTER I

INTRODUCTION

Smallholder agricultural producers in developing countries face many challenges in accessing credit to enhance production and increase the profitability of their activities. For reasons mostly related to smallholder producers' inability to provide adequate collateral for loans, the commercial banking sector tends to shun lending to this category of borrowers. On the other hand, lenders face difficulties in lending to resource-poor smallholder producers due to the high default risk associated with such borrowers.

As a result, smallholder producers cannot expand their businesses, and cannot grow to a level that would enable them to borrow from the banks. The consequence of this is that even when they have viable projects, rural smallholders often find themselves in a poverty trap, with the only option being local money lenders with attendant high interest rates.

To address these constraints, microfinance institutions have emerged, in the last two decades, with mechanisms that have been noted for their ability to minimize risks of lending to smallholders. The popularity of microfinance has mainly been with its use of various innovative approaches to providing financial services to the poor, who would not

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This thesis follows the style of the *American Journal of Agricultural Economics.*

qualify for these services from the conventional formal lending institutions. Microfinance has been broadly defined as the provision of a broad range of financial services such as deposits, loans, payment services, money transfers, and insurance to poor and low-income households and their micro enterprises (Asian Development Bank, 2000).

A number of studies have been conducted to understand the specific features that have enabled microfinance institutions to lend profitably to the poor, usually recording higher loan repayment rates than commercial banks while fostering growth in the real net worth of their borrowers. Morduch (1999) examines some important mechanisms used by microfinance institutions by comparing institutions that were diverse in the type of models they used and their target groups. Morduch's study identifies five key mechanisms employed by these institutions to achieve high repayment rates, namely, peer selection, peer monitoring, progressive lending, regular repayment schedules and the use of collateral substitutes. These mechanisms are described in detail in the literature review section.

Much of the literature has been on microfinance programs that are focused on consumer loans and very short-term loans to merchandizing micro-enterprises, and very little on agricultural loans. This is mainly because the high risks inherent in seasonal agricultural production tend to deter micro lending programs from financing such activities. Another factor is that, in some developing country markets, land owners are relatively well-off and are not targets of development assistance (Yunus 1999). This research investigates the case of a Zambian institution – ZATAC Limited – providing

credit for smallholder agribusiness commercialization and compares this lender's model with the major microfinance models studied by Morduch, to identify specific mechanisms employed by the former and how these have been adapted to suit agricultural production credit requirements. Econometric models are developed to analyze how the key economic variables, interest rates, loan fees, and loan term, and borrower characteristics affect the lender's credit supply and how these in turn affect the lender's sustainability.

Problem Statement and Justification

Many banks in Zambia avoid lending to smallholder agricultural producers as they are perceived to be high risk borrowers. The smallholder farmers turn to microfinance lenders and outgrower schemes to finance their production. An outgrower scheme is a contract farming scheme in which the lender (usually an agribusiness firm) provides inputs such as seed, chemicals or equipment, to small-scale farmers with a contract that requires the borrower to sell all the financed production to the lender, and the lender guarantees a market for the produce at contracted prices. The microfinance lenders which provide credit to the 'risky' borrowers often lack the analytical tools for making sound lending decisions that are employed by commercial banks. Without these tools, the lenders have three alternatives: (i) charge very high interest to mitigate the effects of high risk of default, (ii) charge 'fair' interest rates but only be able to remain in business through donor subsidies, or (iii) if un-subsidized, risk going out of business. This study contributes to the literature and development needs of smallholder lenders in Zambia by documenting mechanisms used by a Zambian microfinance institution, analyzing its

credit supply characteristics, and how supply affects its sustainability. The data are from a leading agricultural lender in Zambia and have not previously been examined in a formal study.

Objectives

The purpose of this research is to analyze the influence of economic and business factors, and borrower characteristics on credit supply by an agricultural microfinance institution, and hence on the sustainability of the lender. The specific objectives are:

(i) To fully describe the microfinance loan contract mechanisms employed by the lender, how they are adapted for the situation in Zambian agriculture as compared to those employed by major microfinance programs in other developing countries, and consider how these contract mechanisms jointly affect the lender's supply of credit.

(ii) To analyze the influence of economic factors and business conditions on supply of credit to borrowers in a quantitative model.

Organization of Thesis

Chapter II describes the relevant literature, beginning with the basic economic logic behind lender-borrower financing decisions using a two-period intertemporal choice framework. This is followed by the more advanced theory of credit rationing, which exists in the presence of information asymmetries, or incomplete information – an important problem in developing country credit markets. The next section then turns to

a discussion of microfinance and a description of common loan contract mechanisms employed by microfinance institutions to ameliorate the incentives for borrowers to default given the information asymmetries. In chapter III, the financial environment and smallholders' access to credit in Zambia are described. Chapter IV discusses the data and methodology used in the study, and tests conducted on the data to ensure that the models used to estimate supply are robust. In chapter V the results of the study are presented followed by a discussion of economic significance of these results to lenders, borrowers and policymakers. Chapter VI summarizes the study findings and synthesizes the key conclusions of the study.

CHAPTER II

LITERATURE REVIEW

This chapter discusses literature relevant to the analysis of credit supply in the context of an agricultural microfinance lender in a developing country. An examination of the theories underlying lender-borrower choices in credit markets is given, followed by the issue of credit rationing in a market with significant information asymmetries as the one in which this lender operates. The mechanisms commonly employed by microfinance institutions to ameliorate these information asymmetries and improve lending efficiency are also outlined. A discussion of the costs and returns of agricultural credit delivery then follows, drawing from studies on developed country markets. The chapter concludes with literature on the assessment of the financial conditions of a lender, based on studies from both developed and developing country credit markets.

Lender – Borrower Choices in Credit Markets

Agricultural lenders operate in the financial markets, which are economic in nature but affected by complexities of risk and timing. This section discusses the basic economic logic behind financing decisions. Financing decisions arise because individuals can choose to maximize their utility over multiple periods of time, in addition to choosing between different goods based on the prices of the goods relative to their contribution to the individual's utility. Consider a simple two-period conceptual framework (Nicholson 2005). The consumer chooses between consumption in the present or consumption in the future, subject to a constraint that reflects current income. The consumer has the

option of investing the portion of income not spent on present consumption and earning a rate of return. Successful investment or savings enable future consumption to be greater than would otherwise have been possible.

The two-period consumption choice can be represented graphically, as depicted in figure 1. Present consumption is represented by C_0, while future consumption is represented by C_1. The individual's budget constraint is represented by

(1) $$I = C_0 + P_1 C_1,$$

where P_1 represents the present cost of future consumption and I represents current income. The "price" of future consumption is re-written in the financial discounting style as:

(2) $$P_1 = \frac{\Delta C_0}{\Delta C_1} = \frac{1}{1+r},$$

where r represents the rate of return between the current and future periods. Combining the two equations yields a budget constraint of:

(3) $$I = C_0 + \frac{C_1}{1+r}\ .$$

Utility for this individual is maximized at C_0^*, C_1^*. By rearranging the terms in the budget constraint and substituting for P_1, future consumption can also be found:

(4) $$C_1^* = \frac{(I - C_0^*)}{P_1}\ ,$$

(5) $$C_1^* = (I - C_0^*)(1+r)\,.$$

Equation (5) means that current savings, ($I - C_0^*$), can be invested at rate of return r to yield C_1^* in the next consumption period. The concept of utility maximization is illustrated in figure 1. For a general utility function, U, an individual will choose to maximize their utility by consuming at point C^*_1 and C^*_0, the point of tangency of the individual's utility function and the budget constraint.

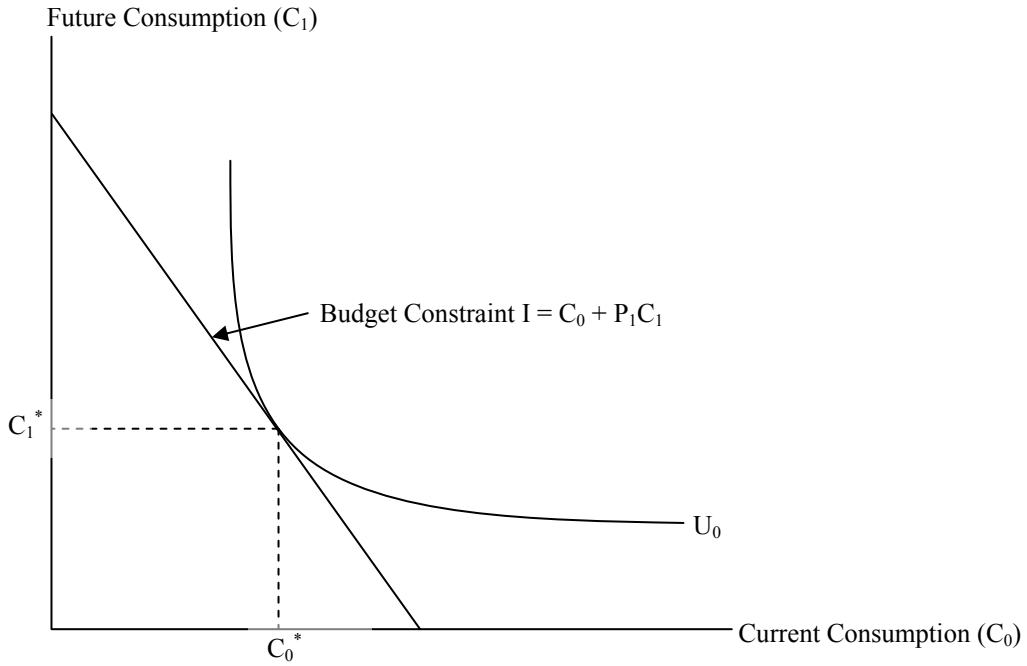

Figure 1. Intertemporal Utility Maximization

The key implications from this simple two-period framework are:

1. The ratio of marginal utilities over consumption in the two periods determines the choice of savings and investment.
2. The rate of return, r, is a key determining factor in the choice of consumption or savings.

It is straight forward to adapt the model above to the situation of a consumer who would prefer to borrow. Very low income individuals face a budget constraint so tight that C_0 is inadequate for sustaining their consumption needs. In this instance, demand for loanable funds exists to allow the budget constraint to be relaxed. For simplicity, consider an individual whose current consumption is equal to income. Saving and investment for this individual is zero, unless he or she borrows. If the individual borrows an amount B, then we can write the new budget constraint as:

$$I + B + \frac{Br_g}{1+r_t} = C_0 + \frac{C_1}{1+r_t} + \frac{B(1+r_b)}{1+r_t} \tag{6}$$

where r_b is the cost of borrowed capital and r_t is the individual's discount factor, which takes into account the individual's risk aversion or intertemporal impatience, and r_g is the rate of return on the borrower's investment. Rearranging equation (6), we can solve for future consumption, C_1,

$$\frac{C_1}{1+r_t} = I + B + \frac{Br_g}{1+r_t} - C_0 - \frac{(B + Br_b)}{1+r_t} \quad , \tag{7}$$

$$C_1 = I(1+r_t) + B(1+r_t) + Br_g - C_0(1+r_t) - (B + Br_b)\,, \tag{8}$$

$$C_1 = (I + B - C_0)(1+r_t) + Br_g - B(1+r_b)\,. \tag{9}$$

Equation (9) shows that for the individual to maximize utility to yield consumption, C_1, in period two, the amount repaid in principal and interest on borrowed funds, r_b, must be

less than the sum of the return on the borrowed amount and gains on investment, r_g, as discounted by the individual's own discount factor.

A common source of the demand for loanable funds is entrepreneurs wanting to take advantage of business opportunities. Consider a situation in which investment opportunities are too costly to be financed out of current income. That is, $I - C_0$ for an individual is small. The borrowed funds, B, are spent on a risky investment project which yields returns at a rate r. The utility maximizer can attain a higher indifference curve (U_1) when borrowing to invest in opportunities that allow higher future consumption. When the investment outcome is successful, lenders receive the borrowed principal (B) plus interest (at the prior agreed rate, r_b). The investor has greater consumption possibilities in the future, as seen by the outward shift of the vertical intercept in the budget line (figure 2).

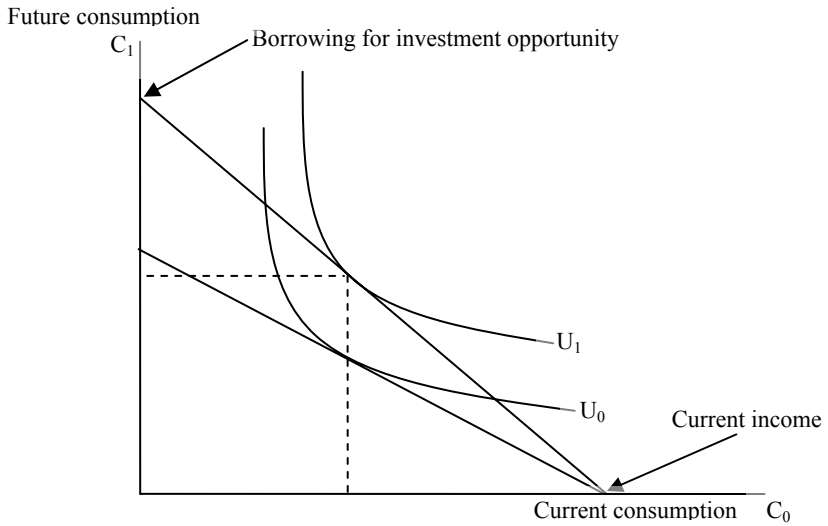

Figure 2. Intertemporal Utility Maximization with Borrowing

From the equation for the budget constraint with borrowing (equation 6), the expected return on investment r_t must equal or exceed the cost of borrowed funds r_b in order for a rational individual to borrow.

The borrower faces the prospect that the risky project will not succeed, in which case the payoff structure takes the form of an option. Borrowed funds B are not repaid, and C_1 is limited to the amount saved. The borrower's payoff is represented by an asymmetric function, which illustrates the incentive to default. Figure 3 illustrates the borrower's option to default. The total value of the investment in period 2 is *R*. Because the project is a risky venture, outcomes for *R* can be anywhere along the horizontal axis, from worthless to a large amount. When *R* is resolved at a large value, the borrower has an incentive to repay the loan plus interest and gains positive payoff of the project value *R* above the debt repayment. When *R* is small, or when 0, the borrower has the incentive to default. The borrower's payoff is a call option, or opportunity to reduce losses to 0 through defaulting on debt *B*.

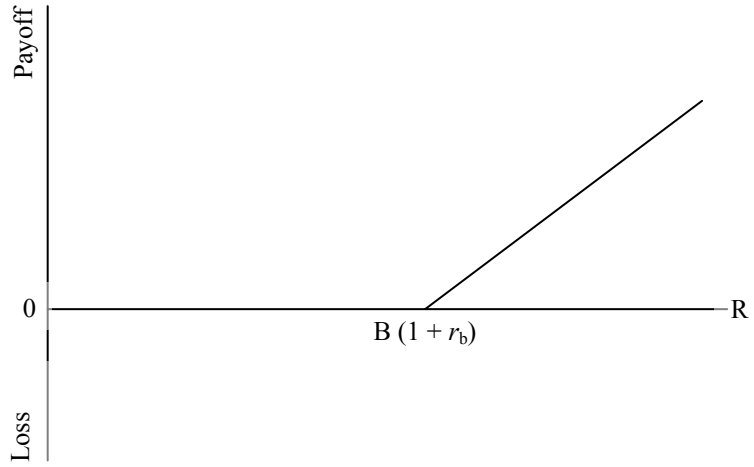

Figure 3. Borrower's Payoff Structure with Default Option

Ignoring all social or institutional pressures for the moment, the payoff to a borrower can be represented in monetary terms as:

$$\pi = \max[0, R - B(1 + r_b)],$$

where R is the total value of the investment in period 2.

The economic incentive to borrow is to increase utility. A key factor in borrowing is the cost of funds or interest on borrowed funds. When borrowed funds are used in risky projects, there is an economic incentive for the borrower to default. These features of demand for credit have implications for the willingness of lenders to supply financing. The lender's position given the default option for the borrower above can also be diagramed as shown in figure 4.

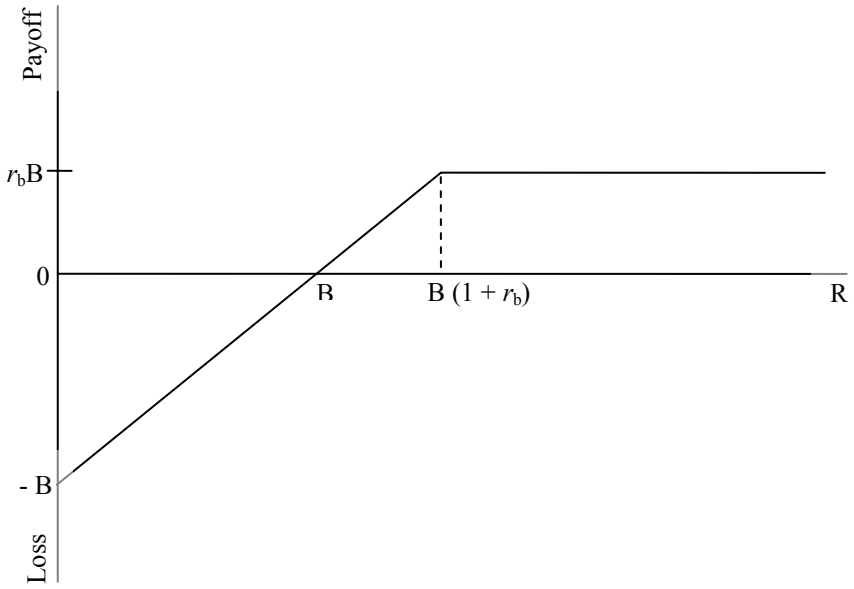

Figure 4. Lender's Payoff Structure with Default Option

The lender's payoff structure can be presented in the form of a sale of a put option to the borrower by the lender. If the borrower's project outcomes are poor, the debt contract gives the borrower the right to sell the project to the lender for the borrowed amount B. The lender, as the seller of the put option, does not have a choice. From the lender's perspective, the payoff R_L can be represented as:

$$-B \leq R_L \leq r_b B .$$

The lender thus has an asymmetric payoff structure as a result of the option to default. The borrower, on the other hand has an incentive to make more risky investments when his or her downside risk is hedged by the put option.

These incentives illustrate the difficulties that lenders face with asymmetric information about potential borrowers. Institutions have developed to ameliorate some risks in credit provision. For example, contract terms exist in credit markets to mitigate this clear incentive for borrowers to default. These contract terms include the microfinance loan contract mechanisms discussed in detail later, such as joint liability (which entails peer monitoring), peer selection, progressive lending, and regular repayments. Before discussing the development of microfinance and the mechanisms used by these institutions, the following section discusses rationing in credit markets and why credit rationing occurs.

Credit Rationing

In-depth analysis of the incentive issues that occur in the market for borrowed funds has shown that credit markets are an instance in which the pricing mechanism – interest rates

– cannot efficiently allocate funds in certain circumstances. Stiglitz and Weiss (1981) show that even in equilibrium, the loanable funds market may be characterized by credit rationing.

Formally, credit rationing is defined as the circumstance when, among loan applicants who appear identical, some receive a loan while others do not; and the rejected applicants do not receive a loan even if they offer to pay higher interest rates. "Criterion *a* rationing" occurs when, among observationally identical borrowers, some get loans and others do not, and the rationed borrowers cannot get credit at any interest rate. A second type of credit rationing (criterion *b* rationing) occurs when entire types cannot get credit at any interest rate, although they would get credit if the supply of funds were sufficiently large. This type of rationing is often termed "redlining" (Stiglitz and Weiss 1987).

The interest rates received on a loan and the riskiness of the loan are both of concern to banks making loans. Stiglitz and Weiss (1981) show that the latter affects the former in two ways: first, through the bank's attempt to sort the potential borrowers to identify borrowers who are more likely to repay, called the adverse selection effect; and second, through the actions of borrowers – the incentive effect. In the first of these effects, the bank uses the interest rate as a screening device: those willing to pay high interest rates may, on average, be riskier borrowers because they perceive their probability of repaying the loan to be low. The incentive effect occurs because higher interest rates decrease the return on projects that succeed and induce firms to undertake projects with higher payoffs when they succeed, but with lower probabilities of success.

As the interest rate increases, the more risk averse borrowers do not borrow as their projects become infeasible, leaving only the risky borrowers in the market. Thus, even if demand increases, lenders do not respond to higher demand by adjusting their prices. The risk-increasing effect of interest expense and the screening effect of high interest rates give rise to credit rationing. Theoretically, there is a concave relationship between the bank's expected returns and the interest rate charged (figure 5). Note that there is no incentive for the bank to lend at interest rates greater than r^*.

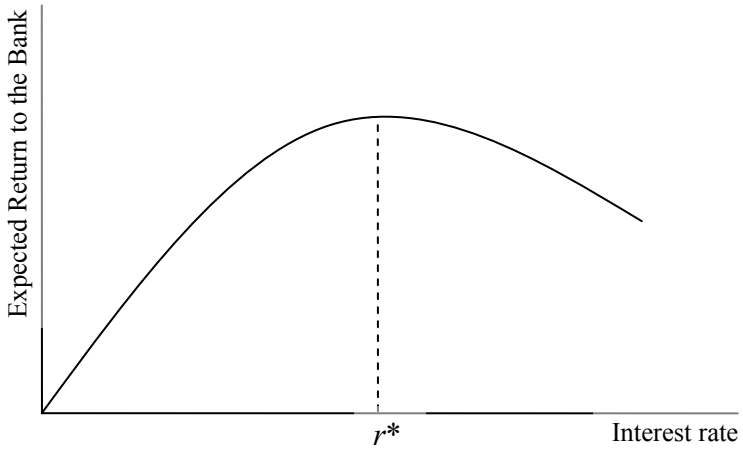

Figure 5. Critical Interest Rate that Maximizes Return to the Bank

Source: Stiglitz and Weiss (1981)

When lenders require collateral, some problems in the credit market may be alleviated because the lender's expected return is increased by the collateral asset. The borrower's payoff structure changes as well, to

(10) $$\pi(R, r_b) = \max\left[R - (1 + r_b)B;\ -(C)\right].$$

The entrepreneur has two possible outcomes from this venture. First, if successful, the project will pay off returns R, hence the borrower receives R less principal and interest repaid at rate r_b on the borrowed amount B. Alternatively, the project is a failure and the borrower defaults, losing the collateral pledged (C).

As illustrated above, collateral can serve to directly minimize the loss to the lender if the borrower's project is unsuccessful, or to indirectly minimize losses by minimizing the incentive for the borrower to default. Banks therefore commonly lend only to borrowers who can provide collateral. However, poor people usually do not have assets of significant value to pledge as collateral in order to obtain bank loans. As a result, this group of potential borrowers can not obtain loans from the banks. Can credit without collateral work? The next section shows that microfinance institutions have developed mechanisms that enable them to successfully lend to the poor.

Developments in Microfinance

Microfinance is a relatively new concept in the finance world that has rapidly evolved in the last two decades. Microfinance institutions use various innovative approaches to provide financial services to the poor, who would not qualify for these services from the conventional formal lending institutions. Microfinance has been broadly defined as the provision of a broad range of financial services such as deposits, loans, payment services, money transfers, and insurance to poor and low-income households and their micro enterprises (Asian Development Bank 2000). Unable to provide sufficient collateral to obtain loans from the traditional banking system, even when they have viable projects, the rural poor often found themselves in a poverty trap, with the only

option being local money lenders who charge very high interest rates. The advent of microfinance has seen a considerable shift in access to financial services by rural people in many developing countries that some have called "local revolutions" (Madajewicz 2003).

The developments in microfinance in the last two decades have sparked interest in multilateral lending agencies, bilateral donor agencies, developing and developed country governments, non-government organizations (NGOs) and a variety of private banking institutions to support its development (Asian Development Bank 2000). The 2006 award of the Nobel Peace Prize to Muhammad Yunus, founder of the Grameen Bank in Bangladesh and a pioneer of microfinance, demonstrates the importance microfinance has been given as a practical solution to poverty alleviation and the economic development of developing nations. In awarding the prize, the Nobel Foundation stated that the prize was being awarded for the recipients' "efforts to create economic and social development from below" (Nobel Foundation 2006).

A wide range of studies have been conducted to understand the specific features that have enabled microfinance institutions to lend profitably to the poor and record usually high loan recovery rates while fostering growth in the real net worth of the borrowers. Morduch (1999) examines some important mechanisms used by microfinance institutions by comparing institutions diverse in the type of models used and the target groups. The study largely features the Grameen Bank of Bangladesh, Bancosol of Bolivia, Bank Rakyat of Indonesia, Kredit Desa of Indonesia and the FINCA village banks throughout Indonesia and Latin America, thus drawing on a

diverse set of microfinance institutions both geographically and operationally. Morduch identifies five key mechanisms used by these institutions to achieve high repayment rates, namely, peer selection, peer monitoring, progressive lending, regular repayment schedules and the use of collateral substitutes.

Peer selection and peer monitoring result from the use of group lending contracts which entail joint liability for loans by the borrowers, thus giving an incentive for self-sorting among the borrowers as they try to avoid partnering with risky borrowers. This, in a sense, shifts some of the monitoring burden to the borrowers themselves and can actually help the lender minimize the adverse selection effect resulting from asymmetric information. It is also one way of ensuring that borrowers exercise prudence in the use of funds so that the likelihood of repayment is enhanced (Stiglitz and Weiss 1981). On the other hand, other studies (Madajewicz 2003) have found that this assortative matching effect of group lending contracts only works with the poorer borrowers and does not hold for the wealthier among the poor. Nevertheless, group lending has been used even in developed nations such as the United States, though at a smaller scale (Prescott 1997).

The third mechanism, progressive lending, refers to a lending and information generation mechanism in which the lender starts with very small loans and gradually increases the loan size as customers demonstrate reliability (Armendáriz and Morduch 2005). Morduch (1999) finds that through the repeated nature of the interactions with borrowers and the threat to cut off lending when loans are not repaid, progressive lending can be exploited by microfinance institutions as a mechanism for securing high

repayment rates. The incentives are enhanced further if borrowers can anticipate the stream of increasingly larger loans.

The fourth contractual mechanism identified in Morduch's research is the use of frequent regular loan repayment schedules, such as weekly repayments, a mechanism used by many microfinance institutions to give an early warning of problem borrowers so that lenders can remedy the situation before it worsens.

Finally the use of various forms of collateral substitutes, including group tax and "forced savings" which borrowers cannot withdraw until after a specified period, provide alternative forms of demonstrating financial commitment, replacing the conventional collateral required by banks.

In summary, the literature on the economics of borrowing and the development of microfinance indicates the potential benefits of credit markets for consumers, as well as the limitations on markets. When borrowers are poor and could gain significant utility from the consumption opportunities, their lack of collateral may lead to interest rates that make borrowing unaffordable, and more risky from the lenders' point of view. The next section examines the literature from developed country credit markets, with a focus on lending to the agriculture sector. The goal is to understand the supply side of credit markets.

Costs and Returns of Credit Delivery

A clear understanding of the factors that influence the costs and returns of agricultural credit should result in efficient credit delivery, thereby reducing the cost of credit for agricultural producers. This information can be used by agricultural lenders to set

interest rates, establish loan fees, price financial services, and develop new methods to efficiently supply credit to all types of borrowers (Gloy, Gunderson and LaDue 2005). Gloy et al (2005), using borrower-level data from 963 agricultural lending relationships at commercial banks and farm credit associations in the northeastern United States, examined how lender-borrower relationships, credit risk, and loan contract factors influence the costs and returns of extending agricultural credit. They found that loan volume, credit risk, contract characteristics, and relationship characteristics all significantly influence how lenders price credit. They found, for example, that interest rate margin decreases as loan volume reaches approximately $3.6 million. To account for this curvature in the interest rate margin function, their model used a quadratic specification of interest rate margin. Their results also show that other things being equal, the largest borrowers have access to credit at more favorable rates than their small peers until a threshold volume at which lenders are unwilling to discount rates is reached. This result indicates that economies of size in credit delivery are exhausted or reversed at the threshold volume.

Gloy et al also found a positive relationship between the length of the lender-borrower relationship and interest rate margin. That is, the longer the lender maintained a lending relationship with a borrower, the greater the interest rate margin paid. For example, an increase of ten years resulted in a thirteen basis points (thirteen hundredths of a percentage point) increase in interest rate margin. They attributed this result to a possibility that borrowers with longer relationships did not make rate comparisons that encourage lenders to lower interest rate margin as the financial situation of the borrower

improves. It could also mean that the borrower is staying with the lender of last resort. They further found that lenders tended to price loan volume much more aggressively than decline in servicing costs would support. Although lenders experienced average cost savings by extending larger loans, the estimated cost decline were less than the estimated decline in interest rate margin. Overall, they found that loan volume had little impact on the lender's profitability per dollar of average loan balance.

The value of these studies in credit delivery is in understanding the price and non-price factors important in credit in U.S. agriculture. This line of research is possible when detailed data from lenders is available and involves advanced econometric modeling.

Assessment of the Financial Condition of a Lender

Literature on assessing the financial condition of a lender is extensive. Much of it has been developed for regulatory questions. However, the approaches used can be applied by ZATAC managers and potential donors to understand the sustainability of ZATAC as a whole. As ZATAC uses a two-tier model in which the prime lender (ZATAC) lends to smallholder cooperatives who in turn lend to their members, the assessment of the financial condition of the co-operatives is of importance to ZATAC. Hirtle and Lopez (1999) examined the time decay characteristics of the quality of bank examination information available to bank supervisors. Defining the quality of information as how accurately the information from prior examinations reflects the current conditions of a bank, Hirtle and Lopez's study focused on banks' CAMEL ratings, as a proxy for the information resulting from bank examinations. CAMEL ratings are numerical ratings of

the quality of a bank's financial condition, risk profile, and overall performance, assigned by bank examiners – such as the Office of the Comptroller of Currency (OCC), the Federal Deposit Insurance Corporation (FDIC), the Federal Reserve, and state banking supervisors in the U.S. – at the conclusion of an examination. The acronym CAMEL refers to the five components of a bank's condition assessed by the regulators: Capital adequacy, Asset quality, Management, Earnings, and Liquidity. Each component is assigned a rating on a 1 to 5 scale, which are then used to assign a composite rating, also on a 1 to 5 scale, for the overall condition and performance of the bank. CAMEL ratings of 1 or 2 indicate good performance, while 3, 4, or 5 ratings respectively indicate conditions of increasing concern to bank supervisors.

The rate of decay of on-site bank examination information determines the frequency with which bank supervisors have to examine banks to prevent high loan losses and bank failures. Hirtle and Lopez's study is motivated by the trade-offs that must be made between the benefits and costs of more frequent examinations. Using ordered logit regression procedures, with the CAMEL rating as a limited dependent variable, and income factors, balance sheet factors, binaries for time, district, and the examining agency, as explanatory variables, they set up two models to predict banks' CAMEL ratings. The two models – one, an on-site model using private supervisory information available only to bank supervisors, and the other, an off-site model using publicly available information about the bank – are then used to determine the rate of decay of on-site examination information. The logarithmic scoring rule (LSR) technique

is used to examine this rate of informational time decay. The mathematical representation of the LSR is

$$LSR = -\frac{1}{N}\sum_{n=1}^{N}\log\left(\sum_{i=1}^{5} P_{in} * R_{in}\right), \tag{11}$$

where N is the number of banks for which forecasts are made, and P_n is a (5x1) vector representing an out-of-sample probability forecast in which the i^{th} element represents the forecasted probability of the CAMEL rating being in state i. R_{in} is an indicator vector such that if the CAMEL rating is i (where i = 1,…,5), then the i^{th} element equals one and zero otherwise. For example, the out-of-state forecast for bank n might be P_n = [0; 0.1; 0.7; 0.2; 0], implying that bank n has 0.1, 0.7, and 0.2 probabilities of receiving CAMEL ratings of 2, 3, and 4 respectively, and zero probabilities of receiving 1 or 5 ratings. If the bank receives a CAMEL rating of 3, then R_n = [0; 0; 1; 0; 0]. A higher LSR value indicates a better model for predicting the actual bank ratings. The LSR ranking permits comparisons of the on-site examination and off-site models, to determine how long on-site model information helps to predict the actual condition of a bank better than off-site information, and therefore the frequency of bank examinations. The null hypothesis for the LSR, can generally be represented as proposed by Diebold and Mariano (1995; cited in Hirtle and Lopez, 1999) as

$$E\left[d_n\right] = E\left[g(P_{An}, R_n) - g(P_{Bn}, R_n)\right] = 0, \tag{12}$$

or equivalently for a single observation as

$$d_n = -\log\left(\sum_{i=1}^{5} P_{Ani} * R_{ni}\right) + \log\left(\sum_{i=1}^{5} P_{Bni} * R_{ni}\right). \tag{13}$$

If the observed difference, d_n, in LRS values between models *A* and *B* is statistically different from zero, then the observed performance ranking is statistically significant.

The mathematical representation for the off-site model and on-site or examination model are given by equations 14 and 15 respectively.

(14) $$y_i = f\left(\gamma x_i + \sum_{j=2}^{15} \beta_j I(lag)_{ij} + \varepsilon\right),$$

(15) $$y_i = f\left(\gamma x_i + \sum_{j=2}^{15} \beta_j I(lag)_{ij} + \sum_{j=1}^{15} \theta_j * I(lag)_{ij} * lagCAMEL_i + \varepsilon_i\right),$$

where y_i is the current CAMEL rating for bank *i*; γ is the vector of independent variables x_i listed in table 1 (except for the indicator variables for the time since the last examination); the $I(lag)_{ij}$'s are the indicator variables corresponding to the time since the last examination for bank *I*; $lag\text{CAMEL}_i$ is the lagged CAMEL rating for bank *I* from the previous examination; the β_j's and θ_j's are the corresponding coefficients for the off-site and examination models, respectively; and ε_i is the error term.

The methods used by Hirtle and Lopez can be used to generate a predictive model of the cooperative/lenders' status whose goal is to control the cost of monitoring. For ZATAC, since there is not much publicly available information on the condition of the cooperative/lenders, there is reliance on on-site examinations. This cost may be high, and a credit risk rating system, coupled with models to predict the informational time decay characteristics of the ratings and the probabilities of rating changes, would enable ZATAC to reduce monitoring costs. Reduced monitoring costs can translate into

increased profitability and the ability of the lender to offer lower interest rates to borrowers.

Table 1. Explanatory Variables Used in the Empirical Models for Predicting Banks' CAMEL Ratings

Component	Explanatory Variables
Capital Adequacy	• equity-to-capital ratio • four-quarter change in equity-to-capital ratio
Asset Quality	• log of total assets • four-quarter change in log of total assets • loan-to-asset ratio • commercial and industrial loans as share of total loans • one-to-four family mortgages as share of total loans • real estate loans as share of total loans • consumer loans as share of total loans • loans past due thirty to eighty-nine days as share of total assets • loans past due ninety days or more as share of total assets • non-performing loans as share of loan loss reserves • loan loss reserves as share of total loans • net charge-offs in year before examination as share of total assets • year-over-year change in net charge-offs as share of total assets • provisions in year before examination as share of total assets • year-over-year provisions as share of total assets
Management	• interest rate risk exposure (assets minus liabilities that mature or reprice in more than five years) • insider loans as share of total assets
Earnings	• ratio of net income to total assets in year before examination • net-income-to-assets ratio lagged one year
Liquidity	• cash as share of total assets
Other Variables	• dummy variables for quarter in which examination took place (Q1, Q2, Q3, Q4) • dummy variables for bank's Federal Reserve District • dummy variables for agency conducting examination (Fed, FDIC, OCC, or state regulator) • dummy variable for number of quarters since last examination

Source: Hirtle and Lopez (1999)

The next chapter discusses the financial environment in the lender's credit market and access to credit by smallholders in this market. A description of the lender's microfinance model is also given in this chapter, describing the data used in the study in the subsequent chapter.

CHAPTER III

THE FINANCIAL ENVIRONMENT AND ACCESS TO CREDIT IN ZAMBIA

Zambia is a landlocked Southern African country with a land area of 752,600 square kilometers (290,580 square miles) and a population of 12 million. About 51% of the population lives in urban areas. A large proportion of the population (64%) lives on less than $1 a day. Access to credit for the smallholder agriculture is limited. When it is available, it is mostly from microfinance institutions, non-governmental organizations (NGOs) and commercial outgrower schemes operated by large agribusiness companies. In many cases the credit is in form of production inputs rather than cash, at least for the latter two sources. The government has a Fertilizer Support Program – a 50% subsidy program in which fertilizer and seed are provided to small scale farmers for a 1 hectare maize production. This program is managed through the Food Reserve Agency (FRA) and benefits members of registered agricultural cooperatives. The subsidy program has benefited an annual average of 127,500 farmers since 2002 when it was introduced (Food Security Research Project 2006). It is evident, considering the more than one million small-scale farmers in the country, that there are still a large number of farmers who do not access these subsidies.

The banking industry in Zambia is composed of the Bank of Zambia and thirteen commercial banks. The Bank of Zambia is the central bank responsible for overall regulation of the banking industry and for setting national monetary policy, and thirteen commercial banks. The commercial sector includes eight foreign owned (including one

that was recently privatized by the Zambian government); four owned by local private investors, and one jointly owned by the Zambian Government and the Indian Government (Bank of Zambia 2007). Non-bank Financial Institutions (NFIs) include one development bank, one savings and credit bank, three building societies (mortgage companies), three micro-finance institutions and nine leasing companies. NFIs are regulated and supervised by the Bank of Zambia under the Banking and Financial Services Act of 2000. There is one exchange – the Lusaka Stock Exchange (LuSE) – established as a modern securities exchange in 1993 as part of the government's economic reform program aimed at developing the financial and capital market in order to enhance private sector investment (Bank of Zambia 2007).

As earlier described, despite the existence of these financial institutions, agricultural businesses have limited access to credit. More than 90% of rural farmers in Zambia hold no title deeds to their farming land. Consequently the average Zambian farmer has little or no access to loanable funds for commercial farming, as the major lending institutions are generally unwilling to extend loans for investment on land without title. Furthermore, without title deeds, the farmers are unable to use their land as collateral for agricultural credit. Given this scenario, microfinance institutions serve an important role of enhancing smallholder producers' access to investment and working capital financing.

There are outgrower schemes which provide small agricultural loans especially for cotton, paprika, fresh vegetable and tobacco production. An outgrower scheme is a contract farming scheme involving the lender providing inputs such as seed, chemicals

or equipment, to small-scale farmers with a contract that requires the borrower to sell all the produce to the lender. Since the lender's core business is processing and marketing of the financed crop, the lender gains in two ways from the transaction. First, they are able to assure supply availability for the financed crop or its by-products to their own buyers. Second, they can generate real gains from the interest and service fees generated from the outgrower lending operation. The outgrower scheme owners also have the ease of recovering the loans from the farmers' crop sales and pay only the balance above the principal and interest, to the extent that side-selling can be prevented. The farmers on the other hand can reap the benefits of having a contracted market for the crops produced under the outgrower scheme. One major problem with these schemes is that they are unregulated in Zambia. As a result, small scale farmers are vulnerable to exploitation on interest and fee charges by the outgrower scheme operators. Small-scale farmers that are desperately in need of financing for their crop production may also accept contract crop prices much less than the forecasted prices of the commodity.

Since the early 1960s, government-initiated credit programs were undertaken, all of which failed, some after recording short-lived successes. Other programs stayed longer possibly only due to government subsidies. As these subsidized programs weighed down heavily on the government, they could not be sustained for long. There is not much research available aimed at understanding the particular characteristics that led to the failure of all the government credit programs. Copestake (1998) describes the Agricultural Credit Management Program (ACMP) that was launched by the government in 1994 with the goal of promoting a private sector network for delivery of

credit in line with the government policy to de-subsidize credit. Copestake concludes that despite being consistent with the credit de-subsidization commitment, the ACMP was not effective in promoting business development, largely because the lending institutions still viewed agricultural lending as unprofitable and risky and therefore did not support it.

In another study that relates more to the commercial banking system, Maimbo (2002) finds that the Zambian central bank's model to detect deterioration of credit was adequate, however, many managerial and financial, i.e. credit, risks remained in the banking system. While the conclusions of Maimbo relate to commercial banking, the importance of capital management ability and lender-borrower interactions are generalizable to all lenders.

Demand for loanable funds by small-scale farmers is high in Zambia, and currently unmet by the existing lending institutions providing credit to this category of borrowers. Some microfinance institutions concentrate on consumer credit and are therefore inaccessible for agricultural production purposes. Most outgrower schemes are also operated as short term projects by donor funded non-governmental organizations (NGOs). Although a good source of small credit, the short-term nature of these schemes has been a limiting factor. Moreover, the loans, averaging less than $600, are often too small to enhance meaningful investments in agricultural production, agro-processing and related projects.

The ZATAC project – a smallholder agriculture commercialization project – was established in Zambia, with USAID funding, by Development Alternatives, Inc. in 1999.

Following the successful commercialization of the smallholder dairy sub sector in the southern province through the establishment of milk collection centers and support systems by the project, a private non-profit company was incorporated in 2002 to ensure sustainability, improvement and replication of the smallholder commercialization model. The company became known as ZATAC Limited. The company offers agribusiness project management services, market development and market linkages, organizational training for new and existing smallholder cooperatives, business development services, and credit through the ZATAC Investment Fund (ZIF) – the company's lending facility.

The ZATAC Smallholder Model

The ZATAC Investment Fund (ZIF) was established with the strategic aim of helping to commercialize smallholder production through increased access to credit. In August 2004, the ZIF had a small loan portfolio of about $320,000. Since then, the ZIF has attracted a number of funding agencies that have channeled loan funds for specific development financing needs through it. As of March 2007, ZIF had a total loan balance of about $2.9 million. Of this portfolio, 59% was in loans to large agribusinesses (mainly agro-processors and exporters that provide a primary market to the smallholder producer groups). The other 41% (that is, $1.20 million was in direct loans to small-scale producers organized in cooperatives and other small to medium agribusinesses. The microfinance portfolio to smallholder cooperatives alone as of that date was about 27% ($970,000). About 64% of the loans to the cooperatives were short- and medium-term loans that were further loaned by the cooperatives to their individual members, usually

25 – 30 members per cooperative. The remaining 36% was long term infrastructure development loans, such as buildings and equipment loans.

The ZATAC technical approach for commercializing smallholder production involves five phases. The first phase involves evaluating the commercial potential for smallholder production to help smallholders transition from subsistence production to cash-earning production and value-addition to maximize returns to labor and investment. The second phase involves identifying and mobilizing producer communities resulting in the development/strengthening of formal business groups and cooperatives. Phase three involves the training of producer groups/cooperative members, usually provided in three tracks: (a) technical skills focusing on animal husbandry, crop production, quality control, (b) business and management skills, including farm budgeting, book-keeping, financial management, markets and marketing, and (c) organizational development/cooperative governance to help raise collective consciousness by pooling resources and building solidarity. In phase four, credit is provided to the smallholder producers through their cooperatives. The loans are in three forms: (a) short term (3 – 6 month) working capital, trade finance and seasonal loans; (b) medium term (1 – 3 year) loans usually for capital investments, such as purchase of dairy cows; and (c) long term (3 – 10 year) loans mainly for plant and equipment. Phase four is accomplished through the ZATAC Investment Fund. The final phase, which runs concurrently with phases one through four, involves building long term relationships between ZATAC and the smallholder producer institutions.

ZATAC lends to rural small-scale producers in organized groups, usually cooperatives and to registered agribusiness companies, especially those that provide markets for rural small-scale farmers. ZATAC does not provide consumer loans. No loans are provided to individuals without a specific viable business plan. Table 2 below provides a summary of the ZATAC lending criteria and loan terms.

Table 2. ZATAC Typical Loan Terms

Criteria	Applicable Terms
Interest Rates	LIBOR[1] rate plus 4% margin on dollar-denominated loans. Prevailing inflation rate[2] (adjusted bi-annually) plus 2 - 3% margin for Kwacha-denominated loans.
Service/Facility Fees[3]	3.5% on dollar-denominated loans. 5% on Kwacha-denominated loans.
Loan Term	3 – 6 months: working capital, trade finance, seasonal loans. 1 – 3 years: medium term capital loans (e.g. dairy restocking). 3 – 10 years: long-term investment loans (plant and equipment).
Repayment schedule	Variable (ranging from monthly to lump-sum payable at maturity).
Collateral	Variable (usually does not require collateral from rural groups).
Group lending	Joint liability through cooperatives (rural and peri-urban), which in turn lend to individual members.

[1]As of March 2007, 6-month dollar LIBOR rate was about 5.32%.
[2]As of March 2007, inflation rate was 15.9%.
[3]Facility fees are paid up front before loans are disbursed. Cooperatives pay service fees calculated in the same way as interest and these are not paid in advance.

Comparison of ZATAC Smallholder Model with Other Microfinance Institutions

Table 3 shows comparisons of the ZATAC smallholder program with other microfinance institutions around the world. The comparisons are based on Morduch's synthesis of key contract mechanisms employed by the major microfinance institutions he surveyed (Morduch 1999). The ZATAC smallholder data was collected from the ZATAC office.

Peer selection and peer monitoring were combined into one mechanism, group lending, since the initial two mechanisms may not be easily observable in the wake of information asymmetries.

Table 3. Comparison of the ZATAC Smallholder Program with Other Microfinance Programs

	ZATAC, Zambia	Grameen Bank, Bangladesh	Banco-Sol, Bolivia	Bank Rakyat Indonesia, *Unit Desa*	Badan Credit Desa, Indonesia	FINCA Village banks
Membership	655 in 22 coops[1].	2.4 million	8,503	2 million borrowers, 16 million depositors	765, 586	89,986
Average loan balance	$1,624 for coop members	$134	$909	$1007	$71	$191
Typical loan term	3 months – 10 years	1 year	4-12 months	3-24 months	3 months	4 months
Percent female members	26%	95%	61%	–	23%	95%
Mostly rural? Urban?	Mostly rural	Rural	Urban	Mostly rural	Rural	Mostly rural
Group lending contracts?	Both group & individual	Yes	Yes	No	No	No
Collateral required?	Yes, except for coops	No	No	Yes	No	No
Voluntary savings emphasized?	Yes, in their own bank accounts	No	Yes	Yes	No	Yes
Progressive lending?	Yes	Yes	Yes	Yes	Yes	Yes
Regular repayments?	Flexible	Weekly	Flexible	Flexible	Flexible	Weekly
Target clients for lending?	Largely poor	Poor	Largely non-poor	Non-poor	Poor	Poor
Currently financially sustainable?	No	Yes	Yes	Yes	No	No
Nominal interest rates	8 – 20%	20%	47.5 – 50.5%	32 – 43%	55%	36 – 48%
Annual consumer price inflation	13.5%	2.7%	12.4%	8.0%	8.0%	–
Real interest rate	5.4%	17.3%	35.1 – 38.1%	24 – 31%	47%	–

[1] ZATAC is not membership based; the figure shows the number of cooperative members borrowing through their respective cooperatives.

Source: Morduch, 1999; except ZATAC figures which are based on data from ZIF office.

The comparisons reveal that there are common features employed by these institutions. The common features include:

1. *Group lending*: ZATAC uses group lending by offering credit to rural small-scale agricultural producers through cooperatives. The members of a cooperative are held to a joint liability contract signed with ZATAC through the cooperative, thus conferring the benefits of peer monitoring to the lender. An adaptation of group lending here is that ZATAC requires that each cooperative signs additional sub-loan contracts with their respective members, which give the cooperative monitoring power and authority to impose stiff sanctions or completely cut off defaulting borrowers. A further adaptation made by ZATAC to the peer selection process of group lending is that ZATAC's loan officers assess the credibility of each cooperative's selection process by visiting all selected members, focusing on their potential to profitably produce the commodity chosen and any characteristics that could affect their ability to do so. The results of these assessments are shared with all members of the cooperative, who may then take into account these findings in selecting loan recipients.
2. *Use of collateral substitutes for cooperatives*: Like many microfinance institutions, ZATAC does not usually require explicit collateral from cooperatives for the funds destined to be lent to individual cooperative members. However, ZATAC holds liens on any plant and equipment and dairy animals purchased through its loan funds. In addition, ZATAC requires that all equipment and dairy animals purchased through its loan funds be insured. Due

to the cost of insurance, however, ZATAC does not usually emphasize insurance of buildings. Emphasis on pre-contracted markets for the agricultural produce before disbursement of loans to cooperatives also provides some form of insurance allowing for the easing of collateral requirements. ZATAC itself gets actively involved in assisting the cooperatives to strike good commodity market deals.

3. *Progressive lending*: The business development section of ZATAC works with the ZATAC Investment Fund (ZIF) to develop long term relationships with borrower cooperatives. Better performing cooperatives with good repayment rates have the promise of receiving further loans. Subsequent loans are not necessarily larger than the first loan due to the high cost of initial investments required for agricultural production and processing projects. Nevertheless the continued loans are often necessary in the early years of these projects for sustainability of operations and in later years for business expansion. Evidence of this is the number of multi-loan borrowers in the ZATAC loan portfolio. More than half of all borrowers had more than one loan.

Differences also exist between the ZATAC model and other microfinance institutions. These include:

1. *Lower real interest rates*: A significant difference between ZATAC and the other microfinance institutions analyzed is that the former offers much lower annual real interest rates, ranging between 5% and 9% compared to a 17.3 – 47% range

for the other institutions. This may imply that ZATAC manages the risk with other mechanisms than interest rates.

2. *Larger loans provided by ZATAC*: The size of the loans provided by ZATAC is significantly larger than those provided by comparable microfinance institutions. This can be explained by the high investment costs required for agricultural investments to be profitable.
3. *ZATAC is very small*: Compared to the other institutions analyzed in the published literature, ZATAC is much smaller. Partly, the current size is a reflection of the short period ZATAC has been in operation given the initial startup capital that it had. The smaller number of borrowers also enables ZATAC to easily monitor the borrowers and reduce the risk of default.
4. *No deposits*: Unlike all other microfinance institutions analyzed, ZATAC does not take deposits. ZATAC therefore does not use 'forced' deposits mechanisms sometimes employed by other microfinance institutions to improve repayment rates. Borrower cooperatives are, however, required to maintain loan repayment accounts with a commercial bank with which ZATAC has a fund management agreement for purposes of monitoring loan repayment activity.
5. *Automatic repayments tied to production*: This is a mechanism extensively exploited by ZATAC to improve repayments that is not used by other microfinance institutions. Cooperative members are required to sell all contracted produce through the cooperative marketing centers. The cooperatives then deduct loan repayments from the sales of each member, based on

production, and directly pay to ZATAC. By publicly displaying charts of both production and loan repayment trends of each member, the cooperative creates a system of peer monitoring which improves production and loan repayments through social pressure. The cooperative leadership can also quickly detect defaulting members and take corrective action as members in good standing try to avoid bearing defaulting members' loan liability. Because payments of sales are made to the members monthly by the cooperative, members have a 'banking' system within their cooperatives and the lump-sum payments enable them to invest in other businesses or expand their current businesses.

6. *Loans disbursed*: Often ZATAC disburses loans in the form of building, equipment and inputs to small-scale farmer cooperatives, based on the cooperatives' project proposals. This ensures borrowed funds are invested in the intended projects. Loans for a dairy project by a cooperative, for instance, will take the form of direct payments to building contractors, equipment suppliers and dairy cow suppliers and/or insurance companies.
7. *Cooperative sanctions on members*: Cooperatives repossess dairy animals and equipment from members who side-sell their milk. Cooperative sanctions are also administered by cooperatives involved in other production projects such as coffee, fresh vegetables, fish farming and honey.
8. *Organizational and business development services*: ZATAC has a developmental focus, often helping build the organizational and leadership capacity of new borrower cooperatives even before the loans are disbursed. Training is given to

all cooperative members to build collective consciousness among members towards resource pooling and collective marketing in order take advantage of economies of scale and lower transaction costs. Identification of new business opportunities for investment by the cooperatives is an integral part of the ZATAC model for smallholder commercialization and dynamic incentives formulation. Business and technical skills training are also given to members of borrower cooperatives. Technical skills include production, quality control and quality assurance systems while business skills range from basic bookkeeping, farm budgeting, markets/marketing to financial management.

9. *Loans to large agribusiness companies*: ZATAC provides a substantial portion of loan funds to larger and more established agribusinesses, especially agro-processors and exporters, who provide markets and sometimes other additional services to smallholder cooperatives. Common uses of such loan funds by the agribusinesses include commodity purchases for processing, export transaction costs and other trade finance requirements. This way, new and growing cooperatives can tap into the capacity of the larger agribusinesses to process and add-value and get market guarantees for their produce.

CHAPTER IV

DATA AND METHODOLOGY

From its origin as an outgrowth of a development project in 1999, ZATAC Limited has progressed rapidly in serving the credit needs of the agricultural borrowers in the Zambian market. As a non-profit company, one of its main objectives is sustainability while meeting development needs.

The description of ZATAC's activities in the previous chapter demonstrates more differences than similarities to the microfinance institutions studied in the development literature. The distinctions are not unexpected given the mission and clientele ZATAC serves in commercializing agribusiness. The similarities discussed in this study demonstrate that the approach of joint liability and community pressures have extended from consumer lending into the agricultural credit sector in Zambia. It is too early to determine whether these features of ZATAC's programs have contributed positively to its performance in terms of repayment. The ZATAC Investment Fund is just completing its start-up phase, increasing loans by over six times between 2004 and early 2007. The economic and business factors associated with ZATAC's supply of credit will be described in a quantitative model in the subsequent chapters. This chapter contains a description of the ZATAC loan portfolio and analysis by firms, followed by a chapter on results from the regression analysis.

The loan data used in the study were collected from ZATAC Limited, a Zambian company with a specialized smallholder agribusiness lending program. ZATAC is one

of several nongovernmental organizations operating in the Zambian agricultural market. However, ZATAC is the only entity with a separate investment fund that serves as an ongoing source of funds to smallholder agribusinesses in Zambia. The company is a significant player in the commercialization of smallholder production in Zambia. ZATAC lends to both smallholder agricultural cooperatives and investor owned agribusinesses that provide a market to smallholder producers for their commodities.

The ZATAC loan portfolio totaled $2.908 million as at March 2007, lent over a three-year period. The ZATAC investment fund had other funds set aside for further lending to smallholder producers. The data collected consists of the full portfolio of loans already disbursed, which included sixty one (61) individual loans disbursed to thirty (30) borrowers. Some borrowers had multiple loans. Table 4 shows the distribution of borrowers with multiple loans. ZATAC's use of progressive lending, as commonly done in microfinance, is evident in the multiple loans borrowed by its clients. More than half of the thirty firms accessed credit from ZATAC more than once.

Table 4. ZATAC Borrowers with Multiple Loans*

Borrower ID	Name	Number of Loans
CHE	Cheetah Zambia Limited	4
CHI	Chinjara Dairy Cooperative	4
MBA	Mbala Agricultural Cooperative	4
MPK	Mpika Livestock Cooperative	4
KAZ	Kazungula Agricultural Cooperative	3
LKM	LKM Investments Limited	3
MBB	Mbabala Multi-purpose Cooperative Society	3
MPI	Mpima Cooperative Society	3
MUN	Munchi Cooperative Society	3
ZIM	Zimba Dairy Cooperative	3
ANT	Antomwe Dairy Cooperative	2
BAT	Batoka Goat Marketing Centre	2
FRE	Freshpikt Limited	2
KAB	Kabwe Tannery Limited	2
LAC	LACCU Agricultural Cooperative	2
NYA	Nyamphande Agricultural Cooperative	2
ZEO	ZEOCO Spices and Oils Limited	2

*Note: thirteen of the thirty firms have one loan. Source: ZATAC Limited, March 2007.

Smallholder cooperative borrowers make up the microfinance component of the lender's total loan portfolio. Cooperatives do not have collateral to secure the loans, so ZATAC employs microfinance mechanisms such as joint liability lending and automatic repayments tied to production when lending to this category of borrowers. Joint liability contracts entail that when a group member defaults on their payment, the group will pay the loan for the member. Automatic repayments tied to production requires that all members of a cooperative market their produce jointly through the cooperative, which then deducts loan repayments from each members sales to pay the lender. The cooperatives extend the loans to their members on the same terms of interest rates, fees, repayment amounts, and loan length as the primary loan contract. On the other hand, agribusinesses can provide sufficient collateral to secure their own loans and the

microfinance loan contract mechanisms do not apply to these borrowers. The data set used in the study does not include individual cooperative member loan records. A loan to several cooperative members through their cooperative is therefore treated as a single loan.

Although not all loans in the portfolio were on schedule in repayment, none were in default, and the portfolio had no debt write-offs over the lending period January 2005 to March 2007. The data collected included loan repayment data. However, the lending period was too short with no significant variation in repayments on the loans to permit a robust analysis of loan performance characteristics. This restricted our analysis to factors affecting supply of credit from the lender.

ZATAC loans cover a number of agricultural sub-sectors. Table 5 gives the industry representation of loans. Dairy and spices accounted for nearly 60% of all loans disbursed. Although these categories accounted for 43% and 16% of the total number of loans, respectively, spices accounted for more than half of the total loan value. Loan records showed that most of the spice/paprika loans were large, short-term trade finance loans to established agribusiness firms. The agribusinesses buy the spices/paprika from the smallholder producers under outgrower schemes and thus provide a market to the smallholder farmers. Contracted production provides an important benefit to smallholder producers by reducing price and income risk in their production. As agricultural commodity prices often vary significantly within an agricultural season, the risk reduction effect of contracted production is of importance to both producers and lenders. Lenders are hypothesized to be more likely to supply credit to producers with

market contracts than those without. This study analyzes this question using a binary variable for contracted market. That is, we define a market variable, *MKT*, such that its value is 1 when the borrower has a contract market for the financed production at the time of borrowing, and 0 when the borrower does not. This enables us to analyze the average effect compared with credit to firms without contracts.

Table 5. Industry Representation of ZATAC Loans

Industry	Number of Loans	% of Total No. of Loans	Loan Value ($)		% of Total Portfolio
			Total for Industry	Average	
Spices/Paprika	10	16%	$ 1,610,156	$ 161,016	55%
Dairy	26	43%	$ 603,536	$ 23,213	21%
Beans	1	2%	$ 200,000	$ 200,000	7%
Fish	3	5%	$ 76,739	$ 25,280	3%
Soybean	1	2%	$ 71,000	$ 71,000	2%
Hogs/Pigs	3	5%	$ 58,443	$ 19,481	2%
Goats	4	7%	$ 44,020	$ 11,005	1%
Leather/Hides	2	3%	$ 41,720	$ 20,860	1%
Poultry	3	5%	$ 25,852	$ 11,845	1%
Cotton/Textile	2	3%	$ 20,238	$ 10,119	1%
Rice	1	2%	$ 20,000	$ 20,000	1%
Other*	5	8%	$ 126,135	$ 22,001	4%
Total	61	100%	$ 2,907,522	$ 47,664	100%

*Includes cucumbers, mushrooms, molasses, and honey. Source: ZATAC Limited, March 2007

ZATAC loans were disbursed in either the local currency or in US dollars. Most borrowers whose products were sold in the export markets preferred to borrow in dollars, the currency in which payment for their products are made. Table 6 and figure 6 show the lender's loan portfolio distribution by currency, with local currency loans converted to dollar terms for comparison purposes. The Kwacha loans were converted to their dollar equivalents using a conversion factor of $1: ZMK 4,056.05. The

exchange rate used represents the average Dollar-Kwacha exchange rate in the lending period, January 2005 to March 2007 (Bank of Zambia). The average loan balance on the US dollar loans was $121,284 with a standard deviation of $91,342. The corresponding mean and standard deviation for the local currency loans were $21,506 and $19,229 respectively.

Table 6. Distribution of ZATAC Loans by Currency of Disbursement

Currency	No. of Loans	Total Amount ($)	Average Loan Balance ($)	Std Deviation ($)
US Dollar Loans	16	$ 1,939,746	$ 121,284	$ 91,342
ZM Kwacha Loans	45	$ 967,777	$ 21,506	$ 19,229
Total	61	$ 2,907,522	$ 47,664	$ 65,677

Source: ZATAC Limited, March 2007

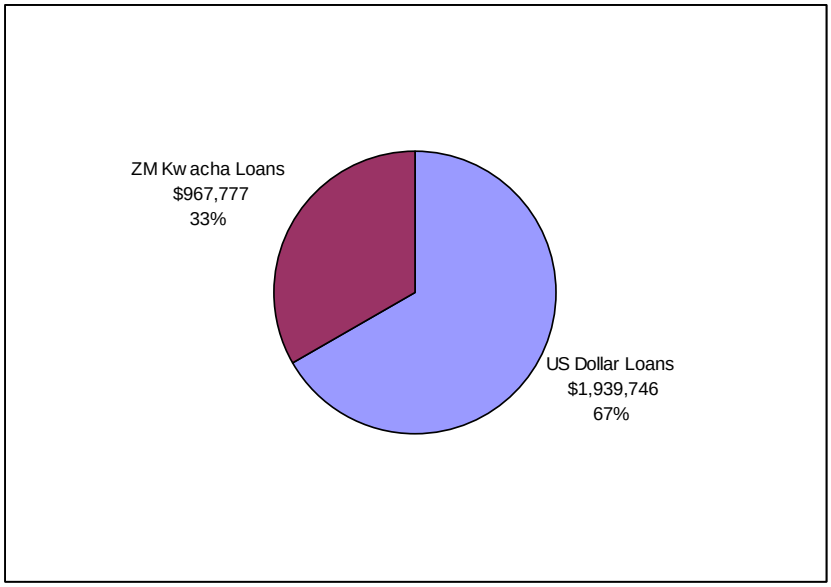

Figure 6. ZATAC Loan Distribution by Currency of Loan Disbursement

Pricing of the credit that ZATAC supplies includes interest rates that differ according to currency, and fees that vary by borrower type. Interest rates on local currency loans were based on the national inflation rate plus a credit risk margin. US dollar-denominated loans had interest rates based on the prevailing LIBOR rates plus a credit risk margin. ZATAC uses inflation rates published by the Ministry of Finance and National Planning (MoFNP) of Zambia, in the *National Economic Report* in June and December of every year, as the reference for determining interest rates on Kwacha loans. Loans are fixed once they are priced. That is, interest rates remain the same on loans already issued, except for long-term loans, on which the loan contracts provide for revisions in rates up or down based on new published inflation statistics. To account for actual inflation in the economic analysis of credit supply, interest rates on the Kwacha loans are adjusted in this study using monthly inflation figures to reflect the real interest rates. The use of real interest rates in the analysis of credit supply is appropriate for the lender because this determines the return to the lender of supplying credit to borrowers. Monthly inflation data are published by the Central Statistical Office (CSO) of Zambia, which is the source of the inflation data used in the analysis (Central Statistical Office, March 2007).

It is important to note that the inflation rates used by the lender are historic inflation rates. The correct way to price loans would be to use forecasted future inflation rates for the lending period and use these in determining the lending rates. However, because the lender uses historic inflation rates, we also make use of historic monthly rates published by the Central Statistical Office. Monthly inflation statistics are used

rather than the bi-annual inflation figures actually used by ZATAC to get a better estimation of real rates due to the high fluctuations in inflation rates. Table 7 shows the inflation and LIBOR rates statistics for the period relevant to this study. For the 2005 inflation data, it was necessary in this study to adjust the two sources (MoFNP and CSO) so that negative interest rates were ruled out.

Table 7. Annual Inflation and LIBOR Rates Data for the Lending Period (January 2005 to March 2007)

Month	Annual Inflation Rate (%)	LIBOR Rate (%)
January 2005	18.2	3.22
February 2005	18.7	3.38
March 2005	17.4	3.68
April 2005	18.6	3.73
May 2005	19.1	3.75
June 2005	19.2	3.81
July 2005	18.7	4.05
August 2005	19.3	4.27
September 2005	19.5	4.21
October 2005	18.3	4.57
November 2005	17.2	4.78
December 2005	15.9	4.84
January 2006	12.2	4.84
February 2006	10.3	5.08
March 2006	10.7	5.14
April 2006	9.4	5.33
May 2006	8.6	5.40
June 2006	8.5	5.60
July 2006	8.7	5.66
August 2006	8.0	5.50
September 2006	8.2	5.38
October 2006	7.9	5.36
November 2006	8.1	5.30
December 2006	8.2	5.22
January 2007	9.8	5.37
February 2007	12.6	5.38
March 2007	12.7	5.20
Min.	7.9	3.22
Max.	19.5	5.66
Mean	13.5	4.74
Std. Deviation	4.7	0.75

Sources: Central Statistical Office, March 2007; British Banker Association, March 2007.

The real interest rates used on the loans are calculated by subtracting inflation in the month in which the loans were disbursed, from the nominal interest rates, as follows:

$$r_{n,t} = i_n - \gamma_t$$

where $r_{n,t}$ is the real annual interest rate on Kwacha loan n disbursed in month t, i_n is the nominal interest rate for loan n, and γ_t is the year-over-year inflation rate in month t.

The lender had a loan fee structure that differed slightly for loans to cooperative and non-cooperative borrowers. For investor-owned agribusinesses, borrowers paid loan fees prior to disbursement. In some cases, especially for small to medium agribusinesses, loan fees were deducted from the loan amount at disbursement. Cooperatives, on the other hand, paid loan fees usually after the loan has been disbursed once the borrower starts repaying the loan. Cooperatives pay fees on the same schedule as interest payments. The lender therefore bears no risk on loan fees from investor owned agribusinesses, but carries some risk on fees from cooperatives. Table 8 gives summary statistics for nominal and real interest rates, and ZATAC loan fees for individual loans during the lending period.

Table 8. Summary of ZATAC Interest Rates and Loan Fees for Individual Loans over the Period January 2005 to March 2007

	Nominal Interest Rate (%)	Real Interest Rate (%)	Loan Fees (USD)
Min.	8.0	0.7	$ 1
Max.	22.0	13.1	$ 7,500
Mean	15.9	5.4	$ 1,585
Std. Deviation	4.0	3.8	$ 1,999

Source: ZATAC Limited, March 2007

The table shows some important differences in loan terms when compared to microfinance lenders such as those studied by Morduch (table 3). Real interest rates are significantly lower for ZATAC than for the other microfinance programs, which ranged from 17.3 – 47%.

Table 9 shows descriptive statistics of ZATAC loan fees expressed in relation to the loan terms, i.e., in US$ per year equivalent. Cooperatives pay loan fees on the same schedule as interest rates while agribusinesses pay loan fees up-front. The data have therefore been separated into cooperative and agribusiness loan fees per year.

Table 9. Descriptive Statistics of ZATAC Loan Fees in Relation to Loan Term over the Period January 2005 to March 2007

	Loan Term (Years)		Equivalent Loan Fees Per Year (USD)	
	Cooperatives	Agribusinesses	Cooperatives	Agribusinesses
Min.	0.25	0.10	$ 1.00	$ 8.16
Max.	9.86	3.00	$ 5,233	$ 7,058
Mean	4.01	0.71	$ 960	$ 1,977
Std. Deviation	4.05	0.92	$ 1,248	$ 2,010

Source: ZATAC Limited, March 2007

The table shows that when loan fees are expressed in dollars per year equivalent, agribusinesses pay on average about twice as much fees as cooperatives. On the other hand, cooperatives accessed loans with loan terms more than five times longer on average than agribusinesses.

To analyze the supply of credit from ZATAC to borrowers, aggregated loan data at the borrower-level are used. The purpose of the aggregation is to enable analysis of how credit supply is affected by the various firm-specific and economic factors that are relevant in the lender's credit market. Firm-specific factors that can influence the lender's willingness to supply can not be easily analyzed at the individual loan level. Firms that had more than one loan were aggregated into one observation (table 10). Aggregation was achieved by summing the dollar amounts borrowed by each firm to obtain supply of credit to the firm. Similarly, the dollar amounts of fees paid by each firm were summed to obtain the aggregate loan fee.

Real interest rate and loan term for the multi-loan observations were created with weights for the loan amount. Thus the real interest rate and term used in the firm-level model are given by equations 16 and 17 respectively.

(16) $$RATE_j = \frac{i_{j1} * \varphi_{j1} + i_{j2} * \varphi_{j2} + ... + i_{jn} * \varphi_{jn}}{\varphi_{j1} + \varphi_{j2} + ... + \varphi_{jn}} = \frac{\sum_{n=1}^{N} i_{jn} * \varphi_{jn}}{\sum_{n=1}^{N} \varphi_{jn}} \quad ,$$

and

(17) $$TERM_j = \frac{\tau_{j1} * \varphi_{j1} + \tau_{j2} * \varphi_{j2} + ... + \tau_{jn} * \varphi_{jn}}{\varphi_{j1} + \varphi_{j2} + ... + \varphi_{jn}} = \frac{\sum_{n=1}^{N} \tau_{jn} * \varphi_{jn}}{\sum_{n=1}^{N} \varphi_{jn}} ,$$

where i_{jn} is the interest rate on loan n for firm j, φ_{jn} is the loan amount for firm j's n^{th} loan, and τ_{jn} is the loan term on firm j's n^{th} loan. Table 10 shows the loan data aggregated by firm.

Table 10. Summary of Firm-Level (Aggregated) Loan Amounts, Interest Rates and Loan Fees over the Period January 2005 to March 2007

	Loan Amounts (USD)	Nominal Interest Rate (%)	Real Interest Rate (%)	Loan Fees (USD)
Min.	$ 1,200	8.5	2.0	$ 1
Max.	$ 525,000	22.0	13.1	$ 13,843
Mean	$ 96,917	15.4	6.8	$ 3,224
Std. Deviation	$ 136,433	4.3	3.6	$ 3,733

Source: ZATAC Limited, March 2007

The loans were issued under three term classifications: short-term (loans with a term of up to one year), medium-term (longer than one year, up to three years), and long-term (longer than three years, up to ten years). Table 11 and figure 7 show the loan portfolio characteristics by loan term. 59% of the total portfolio was in short-term loans, while medium- and long-term loans accounted for 23% and 18% respectively. Short term loans made up 69% of the total portfolio value, with an average of $56,193 per loan. Medium and long term loans had averages of $40,580 and $28,768 per loan respectively. The large number of short-term loans compared to medium- and long-term loans indicates both export financing and the financing needs of seasonal agricultural production. Both of these activities require financing for relatively short terms. Export financing loans were also comparatively larger in size.

Table 11. Distribution of ZATAC Loans by Loan Term

Loan Term	No. of Loans	% of Total No. of Loans	Loan Value ($)		% of Total Portfolio
			Total	Average	
Short-Term	36	59%	$2,022,946	$56,193	69%
Medium-Term	14	23%	$568,124	$40,580	20%
Long-Term	11	18%	$316,453	$28,768	11%
Total	61	100%	$2,907,522	$47,664	100%

Source: ZATAC Limited, March 2007

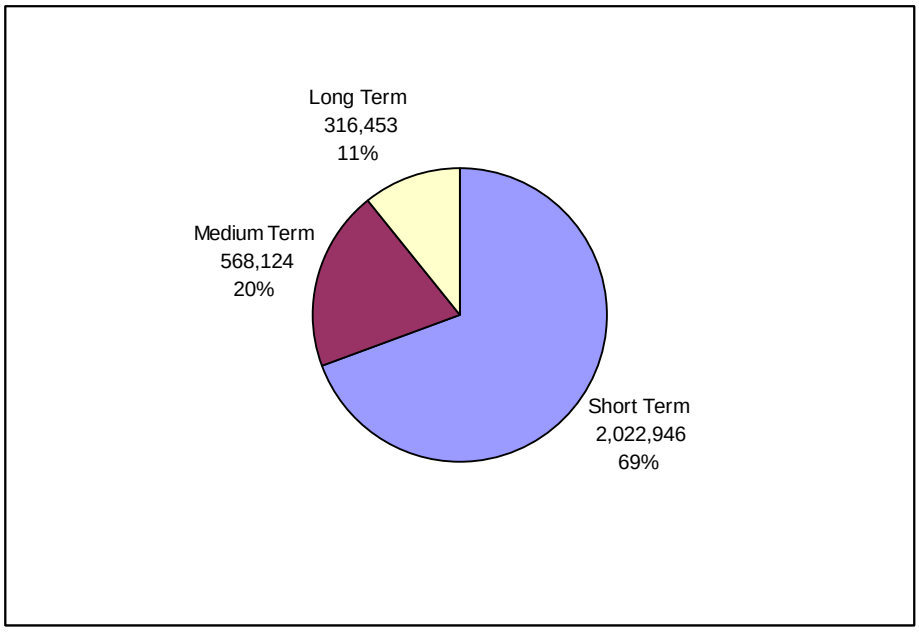

Figure 7. Distribution of ZATAC Loans by Loan Term

Most (70%) of the loan value was used for value-added projects rather than primary production ($2.039 million). The remaining 30% ($0.868 million) were for primary production activities, including infrastructure investments for primary production and minimal processing (table 12).

Table 12. Distribution of ZATAC Loans by Type of Project

Loan Term	Primary Production	Processing Activities
Amount ($)	$ 868,153	$ 2,039,369
Percent of Total (%)	30%	70%

Source: ZATAC Limited, March 2007

There is a wide range of size in the borrowers serviced by the lender. Small agribusinesses and smallholder cooperatives (with assets less than $50,000) made up the largest number of individual loans and accounted for one-third of the total loan portfolio amount, but also had the lowest average loan balance of $25,000. Large agribusinesses (with assets greater than $250,000) had the largest average loan balance of $150,000 and largest share of the total portfolio, accounting for more than half by value. Medium-sized agribusinesses (with assets between $50,000 and $250,000) accounted for one-fifth of the number of loans and 15% share of the total portfolio value.

A number of the loans in the portfolio went to women-led firms. Table 13 shows female representation by number and value of the loans. Although the number of loans was small in the medium to large agribusiness category, the loan amounts were quite substantial. 29% of the total loan portfolio was accessed by women or women-led agro firms. In the large agribusiness firm group, women-led firms held 35% of the loan portfolio. In the small agribusiness and cooperatives group, which are membership-based, women represented an average of 30% of membership, and therefore of the total number of loans and loan value in this category.

Table 13. Loans to Women and Women-Led Firms

Size Category	Number of Loans to Women-led Businesses	Loan Amount ($ '000)		Percent of Portfolio Value
		Total, all Agribusinesses	Women-Led Agribusinesses Only	
Large Agribusiness	2[1]	$ 1,500	$ 552	35%
Medium Agribusiness	2	$ 423	$ 24	6%
Small Agribusiness and Cooperatives[2]	13	$ 980	$ 294	30%
Total	17	$ 2,908	$ 846	29%

[1] These two loans were made to the same firm.
[2] All cooperatives are membership-based and have an average women representation of 30%.
Source: ZATAC Limited, March 2007.

Two-thirds of the ZATAC portfolio was to borrowers who had contracted markets before applying for credit. Table 14 shows the distribution of ZATAC loans for which the financed production or processing had contracted markets versus those with open market arrangements. The average value of the loans for projects not having a contract was comparatively much lower than the contracted projects. The average loan amount for contracted and open market production loans was approximately three to one.

Table 14. Distribution of ZATAC Loans by Product Market Contracts

	Number of Loans	Loan Amount ($ '000)		Percent of Total Portfolio Value
		Total	Average	
Contracted production	26	$ 1,991	$ 77	68%
Open market arrangement	35	$ 916	$ 26	32%
Total	61	$ 2,908		29%

Source: ZATAC Limited, March 2007.

The ZATAC loan portfolio data gives evidence of a broad dispersal of loans in several agro sectors and significant lending to smallholders. The limited lending period involved, however, makes analysis of many important economic questions infeasible. Key economic questions that could be analyzed with more data include loan repayment performance and how firm- and loan-specific factors affect credit risk. The probability of default by different categories of borrowers, or the probability of borrowers migrating into lower credit score ratings over time could also be analyzed with sufficient observations. Studies by Hirtle (1999) and Maimbo (2002) make similar analyses using data from U.S. and Zambian bank regulators respectively.

Sufficient observations for the ZATAC data would further allow analysis of the effects of lender-borrower relationship factors, such as length of lending relationship and borrowers' use of other financial and development-oriented services by the lender, on supply of credit. Gloy, Gunderson and LaDue (2005) carried out similar analysis using U.S. data.

Data limitations preclude analyses of the important economic questions discussed above and limit this study to the analysis to credit supply. Nonetheless, a clear understanding of how credit supply to agricultural producers is affected by various firm and industry factors is in itself as important to lenders and policymakers as it is to the borrowers. This knowledge is critical to the development and growth of more efficient smallholder agricultural cooperatives, a goal that the Zambian government has focused on recently. Policymakers can use the information to develop a variety of programs that improve credit access for smallholder cooperatives, or encourage microfinance

institutions and commercial lenders to increase credit supply to cooperatives. These programs, in turn, may generate lending efficiency gains that lenders can pass to smallholder cooperatives in the form of lower interest rates to enable their growth. Cooperatives can also use this information to strengthen appropriate structures that enhance their access to credit supply, thereby enhancing relationships with their lenders.

Methodology

A quantitative model to analyze the supply of credit from ZATAC to smallholder cooperatives and investor owned agribusiness firms is developed. The model is used to analyze how credit supply is affected by the various firm-specific factors and other economic factors relevant in the lender's credit market. The key economic factors are real interest rate and loan fees. Other important factors in the market include loan term, availability of contracted markets, and the type of borrowing firm (cooperative or non-cooperative).

Real interest rate and loan fees are critical elements of pricing for many lenders. These factors determine the return to the lender, of supplying credit to borrowers and reflect the risk built into the projects being financed as well as market risk. The lender's objective is to at least cover the cost of providing the credit, servicing and monitoring the borrowers. The extent to which the lender relies on either interest rate or loan fees to cover these costs will differ for different credit markets. The extent which these two key variables will clear the markets will vary depending on prevailing market factors, such as access to information by both lenders and borrowers. In markets with high

information asymmetries, studies (Stiglitz and Weiss 1981; Stiglitz and Weiss 1987) have shown that interest rates do not clear the market.

Availability of funds for agricultural lending is limited in the lender's market. Specialized agricultural lenders such as ZATAC therefore face a high demand for credit from smallholder agricultural producers and processors due to smallholders' inability to access credit from the commercial banking industry. This situation creates an allocation problem for agricultural lenders when they seek to support growth in the smallholder agriculture sector, without charging high interest rates, which could stifle smallholder growth and add to the risk of the financed projects defaulting. It is conceivable that lenders would try to shorten loan terms in such a situation to avoid tying up funds for long periods, and make credit available to more borrowers. It is therefore important to understand what role loan term plays in the credit supply function.

Similarly, smallholders are more likely to access credit when they borrow as a group rather than when they borrow as individuals. Peer-selected groups can potentially offer several benefits to the borrower, including ease and cost of monitoring, greater ability for the group to jointly raise collateral for loans, and peer pressure to repay loans borrowed on joint-liability terms. We are therefore interested in analyzing to what extent such groups, mainly cooperatives in the market we study, influence the lender's willingness to supply credit over other borrowers, everything else being equal.

Furthermore, we are interested in understanding the role in credit supply of the availability of contracted markets to borrowers prior to borrowing. It is expected that the lender would prefer borrowers with market contracts prior to borrowing than those

without. Borrowers with contracted markets are those that have supply contracts with buyers for their produce before they borrow to finance the production. Markets for agricultural produce in Zambia are not always guaranteed, and this places a risk on both borrowers and lenders, especially when it involves the production of highly perishable crops. Market contracts guarantee the producers (who are the borrowers) of the quantities and prices at which they will be able to sell. They are therefore able to forecast their incomes more accurately, and minimize the risk of loss due to lack of markets or lower prices, than those with open market arrangements. This also benefits lenders as it reduces the risk of default by borrowers. We therefore examine what role access to contracted markets by borrowers has in the lender's supply of credit.

The supply model developed includes all the key variables discussed above. That is, the dependent variable is supply of credit, or the dollar value of the loan for each borrower, and the independent variables are real interest rates, loan fees, loan term, and binary variables for contracted market availability and type of borrower (cooperative or investor owned agribusiness). The model is shown in equation 18.

$$SUP = \beta_0 + \beta_1 RATE + \beta_2 FEE + \beta_3 TERM + \beta_4 COOP + \beta_5 MKT \,, \tag{18}$$

where *SUP* is the supply of credit, *RATE* is the real interest rate, *FEE* is the loan fee, *TERM* is the loan term, *COOP* is the binary variable for borrower type, and *MKT* is the binary variable for availability of contracted market to the borrower. Table 15 gives a detailed description of the key economic variables expected to affect credit supply and the expected signs of the relationship.

Table 15. Description of Loan-Level Variables

Symbol	Variable	Description	Mean (Std Dev)	Expected Sign
SUP	Credit Supply	Dependent variable; supply of credit by the lender or loan amount, in US $	$ 47,664 ($ 65,677)	
RATE	Interest Rate	Real interest rate charged on the loan, in decimal form.	0.54 (0.38)	+
FEE	Loan Fees	Loan fees charged on the loan, in US $	$ 1,585 ($ 1,999)	+
TERM	Loan Term	Loan term, in years	2.56 years (3.46 years)	–
MKT	Commodity Market	Binary variable for borrower's commodity market; 1 if contracted, 0 otherwise	= 1 if contracted market	+
COOP	Cooperative	Binary variable for type of borrower; 1 if a cooperative, 0 otherwise	= 1 if cooperative	–

Source: ZATAC Limited, March 2007.

A relationship between loan term and contract market availability was established by ordering all loans with access to contract markets, that is, for which the variable *MKT* took the value of 1, and those without contract markets. Only loans with loan terms ranging from 0.10 years (6 weeks) to 2.96 years had contract markets. All loans longer than 2.96 years had no market contracts. In terms of the number of loans, loans longer than 2.96 years were more than those that were shorter. Long terms loans, which are almost all for infrastructure development and equipment are collateralized by a placement of a lien on the loaned infrastructure and equipment. Thus these loans are less risky than the shorter uncollateralized loans. The loan contracts for long term loans are subject to termination if the conditions of the contract are not met by the borrowers.

Since the model is used to analyze credit supply at both the individual level and the firm loan level, the data are aggregated for analysis at the firm level, where aggregation of interest rates and loan term for multi-loan observations is achieved as

described earlier (page 48). Table 16 shows the aggregated data for all borrowers in the portfolio and some summary statistics.

Table 16. Firm-Level Loan Data

	SUP (US$)	REAL RATE (DECIMAL)	FEE (US$)	TERM (YEARS)	MKT (BINARY)	COOP (BINARY)
	1,199.04	0.029	0.83	0.10	1	0
	5,850.00	0.106	117.00	0.25	1	0
	8,677.14	0.085	216.93	0.25	1	0
	13,100.02	0.020	345.37	9.86	0	1
	13,980.82	0.023	349.52	0.33	1	0
	14,388.49	0.071	143.88	0.25	1	1
	14,551.56	0.131	436.55	0.25	1	1
	18,681.06	0.039	931.20	2.75	0	1
	20,000.00	0.129	3,000.00	0.33	1	0
	20,983.21	0.020	382.28	0.75	0	0
	30,920.14	0.020	2,566.80	8.25	0	1
	38,889.27	0.023	3,657.92	3.83	0	1
	40,000.00	0.096	3,500.00	0.50	0	0
	41,719.94	0.103	1,044.61	0.24	1	0
	50,969.76	0.023	1,292.57	3.42	0	1
	55,155.88	0.040	551.56	0.25	1	1
	58,443.34	0.047	4,324.29	1.07	0	1
	62,278.18	0.063	1,868.35	3.00	1	0
	71,000.00	0.096	836.48	0.49	1	0
	76,738.61	0.089	1,939.16	0.32	1	0
	83,016.28	0.026	5,866.42	4.88	1	1
	86,275.03	0.096	2,597.39	5.08	0	1
	88,053.13	0.096	2,636.35	6.86	0	1
	105,027.39	0.059	2,849.34	6.04	0	1
	120,000.00	0.097	5,500.00	1.00	1	0
	132,624.06	0.035	6,351.35	6.38	1	1
	210,000.00	0.104	5,250.00	3.00	1	0
	450,000.00	0.091	13,843.38	0.45	1	0
	450,000.00	0.097	11,186.12	0.49	1	0
	525,000.00	0.096	13,125.00	0.41	1	0
Min.	1,199.04	0.020	0.83	0.10		
Max.	525,000.00	0.131	13,843.38	9.86		
Mean	96,917.41	0.068	3,223.69	2.37		
Std. Dev.	136,432.75	0.036	3,732.96	2.80		
Total	2,907,522.34		96,710.65		19	14

Note: For descriptions of column headings, please see Table 15.
Source: ZATAC Limited, March 2007.

Parameters for the supply model are estimated using Ordinary Least Squares Regression (OLS). OLS is a basic econometric method which explains a dependent variable (Y) in terms of one or more independent variables (X) (Wooldridge 2003). The relationship can be expressed as:

$$Y = \beta_0 + \beta_1 X + u$$

where Y is the dependent variable, β_0 is the intercept parameter, β_1 is the slope parameter(s), X is the explanatory variable(s), and u is the error term. The slope parameter, β_1, is the more significant indicator in an OLS model as it shows the relationship between X and Y when all other factors in the model are held constant (Wooldridge 2003). The term u is introduced to capture the effects of all other influences on the dependent variable, some of which may not be known to us, and any approximation error made when we assumed the model was linear.

OLS is known as the best linear unbiased estimator (BLUE). However, the following Gauss-Markov conditions must be satisfied for OLS to give an unbiased estimate of the linear model (Wooldridge 2003):

1. model must be linear in parameters,
2. zero conditional mean; that is, for each observation, the expected error term is zero,
3. no perfect collinearity; independent variables must not be constant or a perfect linear combination of other variables in the model,
4. homoskedasticity; the variance of the error term on all independent variables must be equal across observations,

5. no serial correlation; conditional on the independent variables, the errors must not be correlated across observations.

The data used in the model are tested for collinearity. A simple way to test collinearity is by using sample correlation coefficients between pairs of explanatory variables that can indicate linear relationships between them (Griffiths, Hill and Judge 1993). A commonly used rule of thumb is that a correlation coefficient between two explanatory variables greater than 0.8 or 0.9 indicates a strong linear association and a potentially harmful collinear relationship (Griffiths, Hill and Judge 1993).

The model results are also tested for heteroskedasticity of errors. Heteroskedasticity describes a situation where the error term is changing rather than constant across observations. There may be reason to believe that error terms associated with very large firms will have greater variance than those associated with small firms (Pindyck and Rubinfeld 1991). The assumption that errors corresponding to different observations are independent and therefore uncorrelated is important in both time-series and cross section studies (Pindyck and Rubinfeld 1991). The Gauss-Markov assumption of homoskedasticity (assumption 4) is needed to justify the t tests, F tests, and confidence levels for ordinary least squares (OLS) estimation of the linear regression model, even with cross-sectional data, as is the case with our data after aggregation. It is therefore necessary to test for the presence of heteroskedastic error variance in the model to assure model robustness and ensure that results are not biased. If $\mathrm{Var}(u|\mathbf{x})$ is not constant, OLS is no longer the best linear unbiased estimator (BLUE) as given by the Gauss-Markov theorem. Although heteroskedasticity does not bias the estimator, it

leads to loss of efficiency, which is also an important problem in econometric estimation. That is, the observed data points will tend to deviate more and more from the estimated mean function. The data in this study are tested for heteroskedastic error variance.

For the linear model shown in equation 19, we take the null hypothesis that the assumption of homoskedasticity – represented by equation 20 – is true and then prove its violation (Wooldridge 2003).

(19) $$y = \beta_0 + \beta_1 x_1 + \beta_2 + ... + \beta_k x_k + u$$

(20) $$H_0 : Var(u|x_1, x_2, ..., x_k) = E(u^2) = \sigma^2$$

Because we are assuming u has a zero conditional expectation, Var(u|**x**) = E(u^2|**x**), and the null hypothesis of homoskedasticity is equivalent to

(21) $$H_0 : E(u^2|x_1, x_2, ..., x_k) = E(u^2) = \sigma^2$$

In other words, we find a test of the null hypothesis of homoskedasticity, $\sigma_1^2 = \sigma_2^2 = \sigma_{31}^2 = ... = \sigma_N^2$, where N is the number of observations (Pindyck and Rubinfeld 1991). A simple test proposed by Goldfeld and Quandt tests if the ratio of two variance estimators follows an F distribution with [($T_1 - K_1$), ($T_2 - K_2$)] degrees of freedom, where T_k and K_k refer to the number of observations and number of coefficients in each of the subsets of observations, respectively (Griffiths, Hill and Judge

2003). The Goldfeld-Quandt statistic when the null hypothesis ($H_0 : \sigma_1^{\,2} = \sigma_2^{\,2}$) is true is given by equation 22.

(22) $$GQ = \frac{\hat{\sigma}_1^{\,2}}{\hat{\sigma}_2^{\,2}} \sim F_{[(T_1-K_1),(T_2-K_2)]},$$

where σ_1^2 is the error variance for the subset of the data thought to be associated with higher error variance, and σ_2^2 is the error variance for the subset of the data thought to be associated with lower error variance. If the residual variances associated with each regression are approximately equal, the homoskedasticity assumption can not be rejected, which supports the conditions for OLS to be the best linear model. But, if the residual variance increases substantially across the observations, we reject the null hypothesis. We can reject the null hypothesis at a chosen level of significance if the calculated significance is greater than the critical value of the *F* distribution.

For our cross section data, we assume that the variable that may give rise to heteroskedastic error variance is the loan fee, due to the wide variation in the observations for this variable. To do the Goldfeld-Quandt test, we order the data by loan fees and run regressions on two subsets determined by inspecting the residuals (the estimates of the error) from an initial regression.

Serial correlation is assumed non-existent in the data set as it is a pure cross-section after aggregation into a firm-level model. As multi-loan observations which occur in different time periods are aggregated into single observations, serial correlation which is associated with time-series data is controlled for. Further, the short lending

period involved (under three years) strengthens this assumption. No tests for serial correlation are therefore necessary to support this model.

To allow more detailed analysis and allow for non-linear relationships in the credit supply model, a model is estimated as a second degree (quadratic) function in variable *FEE,* the loan fees. It is conceivable that the marginal effects of loan fees on supply would diminish at sufficiently high loan fee levels. This is expected as very high loan fees would decrease the number of clients or borrowers seeking credit from the lender. As a result, the lender would have to reduce loan fees until the market clears again. The quadratic term allows for curvature in the supply function, but is still a linear model in the parameters, so we can use OLS. This situation is presented graphically in figure 8.

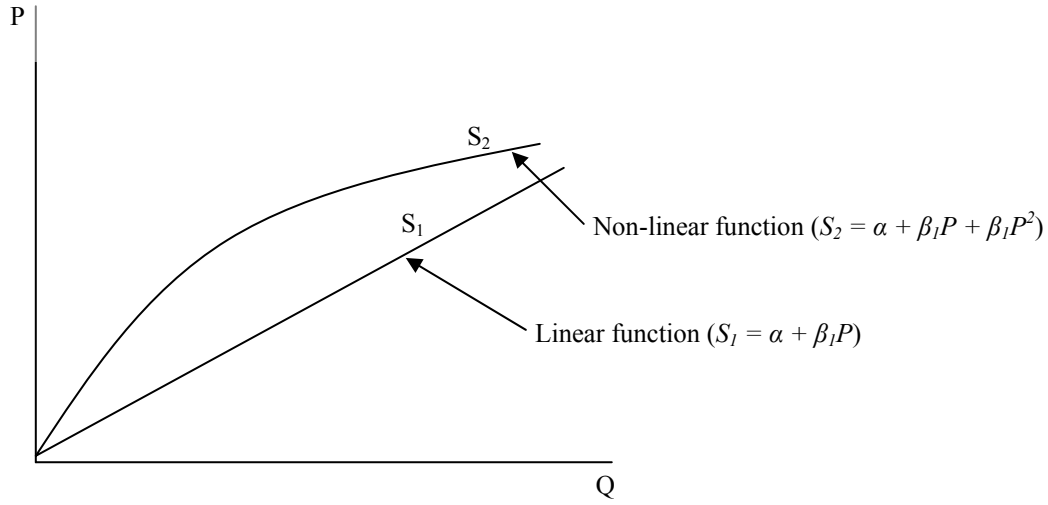

Figure 8. Non-Linear Credit Supply Function

The supply function above can be presented mathematically by the equation

(23) $$S_2 = \alpha + \beta_1 P + \beta_2 P^2$$

where *S* is the dependent variable, supply, and *P* is the independent variable which may have diminishing or increasing marginal effect on supply. Gloy, Gunderson and LaDue (2005) use similar specification in which they develop a model for interest rate margin and loan servicing costs that are both quadratic in loan volume, using borrower-level data from agricultural lending relationships in the U.S. The general non-linear credit supply model can be represented by equation 24:

$$(24) \qquad SUP = \beta_0 + \beta_1 RATE + \beta_2 FEE + \beta_3 FEE^2 + \beta_4 TERM + \beta_5 COOP + \beta_6 MKT + e$$

in which *FEE* is the quadratic variable whose marginal effect on supply is expected to diminish as fees increase. The expected sign for the quadratic term, or the coefficient β_3, is therefore negative if it is indeed diminishing. The *t*-statistic and *p*-value corresponding to the quadratic term in the non-linear model are used to determine whether this variable is significant in the model or not. If economies of scale exist in the credit supply with regard to loan fees, then the marginal effect of fees on supply would decline as fees increase, if savings are passed on.

This chapter provided the data and econometric approaches that are used to analyze the supply of credit that ZATAC provided to the Zambian agribusiness sector during its initial phase of rapid growth. The $2.9 million portfolio includes loans to cooperatives, women-led firms, and large businesses involved in international trade. The pricing mechanisms include interest rates that are low in real terms, and a major component of fees to the non-profit lender. These factors are analyzed econometrically in a supply function whose parameters will provide estimates about key determinants of

ZATAC's lending in its initial years of operation. The next chapter gives the model results and regression diagnostics, and discusses the economic implications of those results.

CHAPTER V

RESULTS AND ANALYSIS

Results and Analysis Based on Full Loan Portfolio

A model of the key economic variables hypothesized to influence credit supply was estimated using firm-level data. Credit supply was estimated using equation 18. Real interest rates were used in the regression. The results of the regression are shown in table 17, while descriptions of the model variables are given in table 15. The full ZATAC smallholder loan portfolio was used in this analysis.

In the second analysis presented later in the chapter, the three largest agribusiness firms were dropped as they were found to have significant differences from the rest of the firms. One of the differences between these three firms and the rest was that they were able to access much larger loan amounts from the lender because they were well established businesses with much larger total assets than the rest of the portfolio's borrowers. Plots of credit supply against interest rates, loan fees and loan terms all showed that the three large agribusinesses were outliers in the population (figures 9, 10 and 11). Our primary interest is credit supply to the firms excluding the three outliers as they represent the true smallholder borrowers in the portfolio. The analysis of the smaller firms forms the basis for the important conclusions in the study. The later analysis also separates the loan data into two sub-groups based on the currency of loan disbursement to give a better understanding of supply patterns to borrowers in the two categories. This analysis is important because of the differences in the loan pricing

structures for local currency (Kwacha) loans and dollar-denominated loans, as explained earlier in the data chapter.

The results and analysis of the full ZATAC smallholder loan portfolio are, nevertheless, presented in order to understand the lender's supply decisions to all borrowers in the portfolio.

Table 17. Regression Estimates and Summary Statistics of ZATAC Credit Supply Model

	Intercept	REAL INTEREST RATE	FEE	TERM	COOP	MKT
Coefficient	-70,667.57	79,245.96	33.99	5,926.08	-1,776.19	73,814.10
t-test	-2.296	0.314	15.446	1.349	-0.083	3.155
Prob(t)	0.031	0.756	0.000	0.190	0.935	0.004
R^2	0.921					
F-statistic	55.792					
GQ-statistic	11.11					

Notes: 1. Number of Observations = 30
2. Units of dependent variable, Credit Supply, are in US dollars.
Source: ZATAC Limited, March 2007.

The results show that only loan fees and availability of contracted market have significant explanatory power in the model. Real interest rates, loan term and the cooperative binary variable all have low *t*-statistics (that is, less than the critical value of $t_c = 1.96$) and high *p*-values. For instance, real interest rate has a *t*-statistic of 0.314 and a *p*-value of 0.756, and loan term has corresponding figures of 1.349 and 0.190 respectively. A *p*-value of 0.190 indicates that the hypothesized variable has a 0.190 probability of not explaining the dependent variable. Interest rate therefore is highly

insignificant with a *p*-value of 0.756. Similarly the borrower type binary variable, *COOP*, is insignificant.

Loan fees and availability of contracted markets, on the other hand, have a significant influence on supply. The first is consistent with basic economic theory and the findings by Gloy, Gunderson and LaDue. Loan fee income is risk-free as the lender receives the fees before loan disbursement. This risk-free income feature is a key determinant of the lender's decision to supply funds. The relationship between loan fees and credit supply is positive as expected. For every $1.00 increase in loan fees, supply of credit will increase by $33.99, all other factors remaining constant. A plot of firm-level credit supply versus loan fees is shown in figure 9.

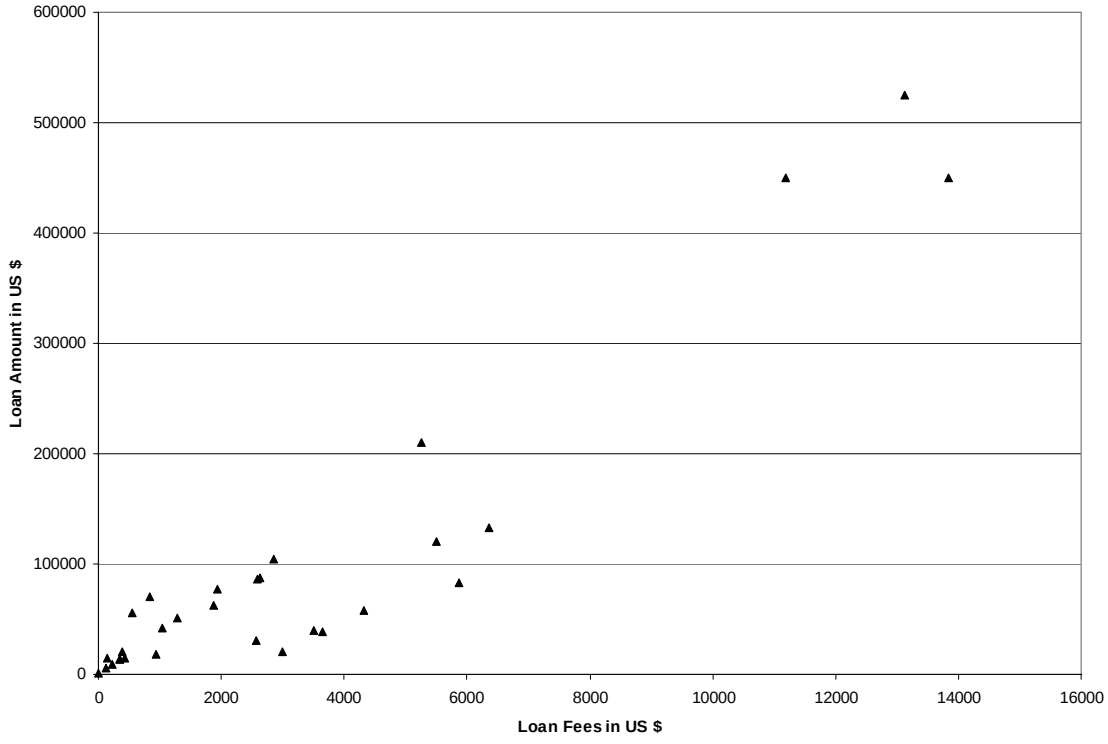

Figure 9. Firm-Level Credit Supply versus Loan Fees

The results show the positive relationship between credit supply and real interest rate that one would expect based on economic theory. For every one percentage point increase in real interest rates, supply is predicted to increase by $ 79,246 (table 17). However, the statistical results further suggest that interest rates do not significantly influence the lender's decision to supply credit to borrowers, other factors held constant. This result is consistent with Stiglitz and Weiss' finding that interest rates do not clear the market in credit markets with significant information asymmetries as in the case of this lender's credit market. Figure 10 shows a scatter plot of supply function versus real interest rates.

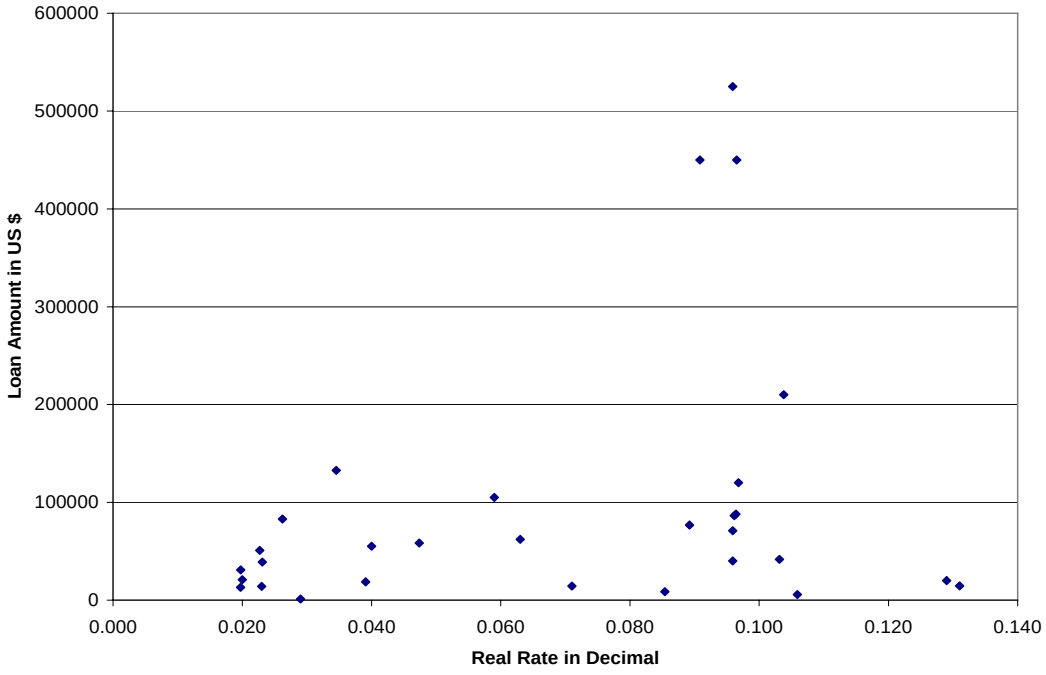

Figure 10. Firm-Level Credit Supply Function versus Real Interest Rates

The regression results further show an unexpected relationship between supply and loan term. Theoretically, one would expect that in a market characterized by low credit availability to meet a high demand for loanable funds, lenders would tend to prefer shorter terms than longer ones. The results, however, show that the lender lent $5,926 more funds for every one year increase in loan term. This unexpected relationship may suggest a stronger willingness by the lender to provide longer term loans to enable smallholder growth than the motivation for pure economic gain that could potentially accrue from higher loan turnover. Figure 11 is a plot of supply versus loan term.

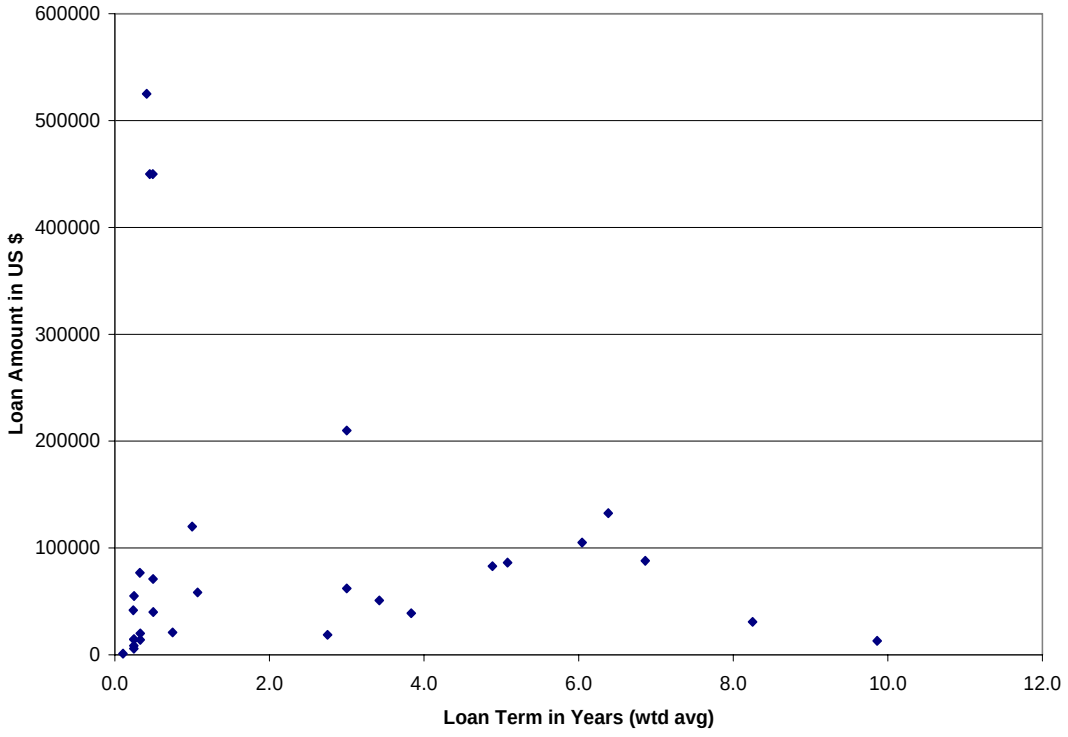

Figure 11. Firm-Level Credit Supply versus Loan Term

On average other things held constant, cooperatives are likely to receive $1,776 less credit than investor owned agribusinesses. This result is consistent with the mechanism of progressive lending employed by microfinance institutions to minimize the downside risk of default (Morduch 1999). Under progressive lending, the lender typically begins by lending small amounts and then increasing the loan amount over time upon satisfactory repayment. The repeated nature of the interactions can be used by the lender to overcome information problems and improve supply efficiency.

Borrowers with contracted markets, that is, whose financed product has a contracted market at the time of borrowing, have a credit supply advantage averaging $73,814 above that accessed by other borrowers with no market contracts. Seasonal price fluctuations experienced in agricultural markets pose considerable income risks on producers (borrowers) and consequently agricultural lenders. Contract production hedges downside income risk when prices are lower, but also limits potential upside revenue when prices are higher than the contracted prices. Lenders are primarily concerned about the downside risk and therefore price the risk-reducing benefits of contracts highly in this type of market. The agro products market is further complicated by the perishable nature of many primary commodities, such as milk, which need to be sold soon after production/harvest. Access to pre-contracted markets is therefore a crucial factor in minimizing the risk of revenue loss due to damage and is found to be a key incentive for ZATAC to supply credit.

A quadratic supply model was estimated using equation 24. The regression diagnostics are shown in table 18, while model variable nomenclature is given in table 15.

Table 18. Regression Estimates and Summary Statistics of Quadratic Credit Supply Model

	Intercept	REAL INTEREST RATE	FEE	FEE^2	TERM	COOP	MKT
Coefficient	-35,471.87	231,804.51	15.17	0.001	5,925.36	-5,635.99	39,583.17
t-test	-1.112	0.966	1.845	2.363	1.472	-0.285	1.530
Prob(t)	0.277	0.344	0.078	0.027	0.154	0.778	0.140
R^2	0.936						
F-statistic	56.308						
GQ-statistic	14.71						

Notes: 1. Number of Observations = 30
2. Units of dependent variable, Credit Supply, are in US dollars.
Source: ZATAC Limited, March 2007.

Compared with the linear model, the quadratic model shows a much higher influence of real rates on supply, but also that the benefits to market contract and loan fees are lower by half. The beta coefficient for the quadratic term is positive and very small (0.001), showing very little curvature in the supply function. These two results indicate that there were no economies of scale effects on loan fees, or at least if there were any, the lender had not started passing them on to borrowers. This result is not surprising given the short period the lender has been in operation, in which the cost of servicing and monitoring borrowers may still be too high to exhibit economies of scale in the provision of credit.

The supply model was tested for heteroskedasticity of errors by dividing the data set into two categories ordered, smallest to largest, by loan amount. The basis for the determining the cutoff for the two sub-groups was an examination of the errors in the first supply regression. The first fourteen observations form the group associated with a lower error variance, while the last sixteen form the group associated with a larger error variance. Figure 12 shows an error variance plot for the full population.

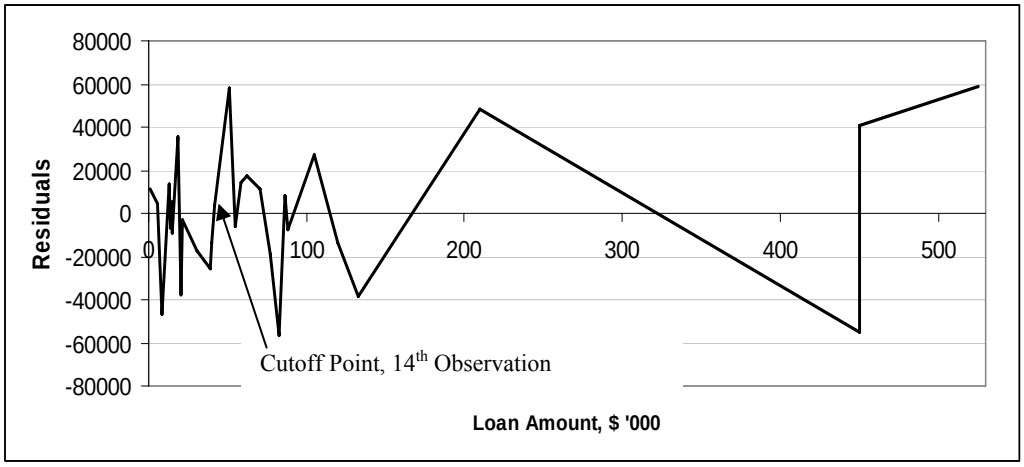

Figure 12. Error Variance Plot for Credit Supply Model

The Goldfeld-Quandt statistic for the model test was 11.11. The corresponding critical value for the *F* distribution, with degrees of freedom ($v_1=9$, $v_2=11$) at the 5% confidence level is 2.90. Thus $G\text{-}Q > F_c$, leading to a rejection of the null hypothesis of homoskedasticity. This can also been seen from a plot of the residuals for the quadratic model. Figure 13 shows the residuals of both linear and quadratic models. A similar pattern of increasing error variance is observed. That is, the data exhibits heteroskedastic

error variance. This causes loss of efficiency in the supply model, and requires to be corrected for.

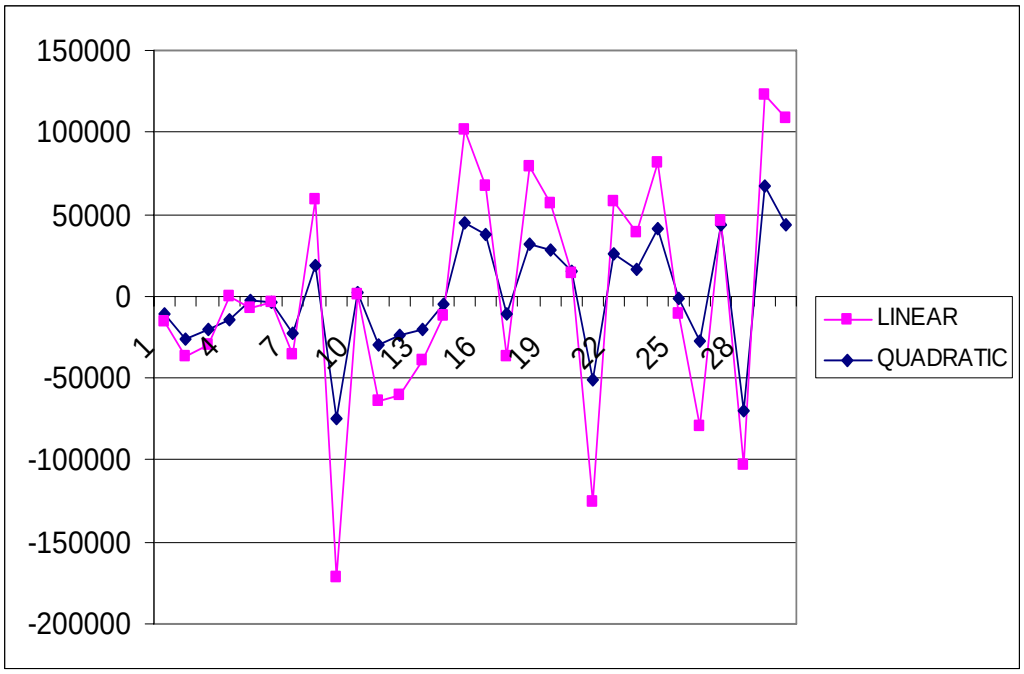

Figure 13. Residuals from Linear and Quadratic Models

To correct for the heteroskedastic errors in the model data, we use weighted least squares (WLS) estimation, which is more efficient than OLS estimation when the data exhibits heteroskedastic error variance (Wooldridge 2006). WLS leads to new *t* and *F* statistics that have *t* and *F* distributions. The WLS procedure calculates estimators (β_j^*s) that minimize the weighted sum of squared residuals, where the squared residual is

weighted by $1/h$, and h is a function of the explanatory variables that determines the heteroskedasticity (Wooldridge 2006).

The data was analyzed for collinearity between independent variables. This was achieved by examining the correlation matrix for all the variables used in the model. The correlation matrix is shown below:

$$\begin{bmatrix} & RATE & FEE & TERM & COOP & MKT \\ RATE & 1 & 0.22 & -0.43 & -0.43 & 0.41 \\ FEE & & 1 & -0.04 & -0.19 & 0.02 \\ TERM & & & 1 & 0.63 & -0.72 \\ COOP & & & & 1 & -0.60 \\ MKT & & & & & 1 \end{bmatrix}$$

Using the commonly used rule of thumb that a correlation coefficient between two explanatory variables greater than 0.8 or 0.9 indicates a strong linear association and a potentially harmful collinear relationship (Griffiths, Hill and Judge 1993), we fail to reject the null hypothesis that the variables are uncorrelated. We can therefore use the data without requiring correction for collinearity. That is, the supply model satisfies the Gauss-Markov assumption that no perfect collinearity between independent variables must exist for the ordinary least squares to yield the best linear unbiased estimates of the model parameters.

Analysis of Credit Supply to Currency-Based Portfolio Sub-Groups

The data was separated on the basis of currency of loan disbursement to enable separate analysis of credit supply to export-oriented firms that borrow in US dollars and

firms that have domestic markets and thus borrow in the Zambian local currency, Kwacha. In this analysis, the three large agribusinesses identified earlier as outliers were dropped from the data set. The three firms had a total of eight (8) loans amongst them. Dropping the three firms from the data analysis allows us to analyze the lender's supply decisions to firms that are more comparable to one another, and represent the smallholder borrowers, whose access to credit is of interest in this study. Important conclusions on the lender's supply of credit to smallholders are therefore based on this analysis.

Table 19 shows the descriptive statistics for the local currency sub-group, at the loan level. Descriptions of the model variables are given in table 15. There were 45 individual loans to 20 firms in this sub-group. Thirty seven (37) of the loans went to cooperatives. Twelve (12) loans financed production that had contract markets. The total loan amount under this subgroup was ZMK 4,035,629,075. This amount is equivalent to US$ 994,965.32 when converted at the exchange rate of US$1.00 to ZMK 4,056.05, the average exchange rate for the lending period under consideration (Central Statistical Office, 2007). Analysis of supply for the local currency loans sub-group was, however, done with supply expressed in the currency of disbursement to avoid introducing exchange rate errors in the model.

Table 19. Descriptive Statistics for Local Currency Loans Sub-Group

	SUPPLY (ZMK)	NOMINAL INTEREST RATE (DECIMAL)	REAL INTEREST RATE (DECIMAL)	FEE (ZMK)	TERM (YEARS)	COOP (BINARY)	MKT (BINARY)
Min	100,000	0.159	0.007	2,218	0.10		
Max	259,700,000	0.220	0.131	21,227,312	9.86		
Mean	89,680,646	0.185	0.049	3,628,389	3.41		
SD	80,185,472	0.012	0.037	4,722,054	3.90		
Sum	4,035,629,075			163,277,487		37	12

Source: ZATAC Limited, March 2007.

Descriptive statistics for the firm-level local currency loans sub-group are given in table 20. The model variable nomenclature is given in table 15. Interest rates and loan term are weighted by loan amount as before. There are 20 observations in the subgroup, representing 20 firms. Average loan amount for firms borrowing local currency loans was ZMK 201.8 million (equivalent to US$ 49,750). After aggregating at the firm-level, average nominal and real interest rates are slightly higher (0.186 and 0.052 respectively) than the corresponding figures for individual loans in the sub-group. The average loan term for local currency loan borrowers is 3.19 years.

Table 20. Descriptive Statistics for Local Currency Loans Sub-Group at the Firm-Level

	SUPPLY (ZMK)	NOMINAL RATE (DECIMAL)	REAL RATE (DECIMAL)	FEE (ZMK)	TERM (YEARS)	COOP (BINARY)	MKT (BINARY)
Min	5,000,000	0.159	0.020	3,444	0.10		
Max	553,042,335	0.220	0.131	26,485,137	9.86		
Mean	201,781,454	0.186	0.052	8,163,874	3.19		
SD	156,475,452	0.014	0.033	7,962,624	3.09		
Sum	4,035,629,075			163,277,487		14	8

Note: Number of Observations = 20
Source: ZATAC Limited, March 2007.

Table 21 shows the descriptive statistics for the dollar-denominated sub-group. The descriptions for the variables in the table are given in table 15. The average loan term for the group, 0.76 years (9 months) was much lower than local currency denominated loans. Nominal rates were lower for dollar loans than for Kwacha loans, although higher in terms of real interest rates. The average loan amount for firms borrowing dollar loans was higher (US$ 64,343) than firms borrowing local currency loans.

Table 21. Descriptive Statistics for US$-Denominated Loans Sub-Group

	SUPPLY (USD)	NOMINAL RATE (DECIMAL)	FEE (USD)	TERM (YEARS)	MKT
Min	5,850	0.085	117.00	0.25	
Max	210,000	0.129	5,500.00	3.00	
Mean	64,343	0.102	2,087.61	0.76	
SD	69,763	0.013	2,299.36	0.94	
Sum	514,746		16,700.87		6

Note: Number of Observations = 8
Source: ZATAC Limited, March 2007.

All firms that borrowed dollar-denominated loans had single loans, except the three large agribusinesses that were dropped from the analysis. The remaining data set on loan-level, dollar-denominated loans, is therefore also the firm-level data set for this sub-group.

Regression Results from the Currency-Based Portfolio Sub-Groups

Ordinary Least Squares (OLS) regression is used to estimate parameters for the supply of credit to each sub-group of the loan portfolio. The model expresses supply as a linear function of nominal and real interest rates, loan fees, loan term, and binary variables for contract market and borrower type (cooperative or agribusiness company). Separate regressions were estimated for the two sub-groups with both nominal and real interest rates. Table 22 shows the regression parameters, estimated using equation 18, for the local currency loans sub-group, using nominal interest rates. Descriptions of the model variables are given in table 15. The model estimates were corrected for heteroskedasticity of error variance in loan fees. The Breusch-Pagan test statistic for the uncorrected model was 4.60 with a *p*-value 0.0319 of being greater than the critical value for the χ^2-distribution with one degree of freedom, leading to the rejection of the null hypothesis of homoskedasticity and the conclusion that heteroskedasticity exists. Heteroskedasticity leads to loss of efficiency in the model, thus requires correction. The reported statistics in table 22 are from the corrected model.

Table 22. Regression Estimates for Kwacha Loans Sub-Group Using Nominal Rates

	Intercept	NOMINAL INTEREST RATE	FEE	TERM	COOP	MKT
Coefficient	69,549,940	-251,112,000	12.80	5,456,739	-7,665,356	41,388,143
t-test	0.31	-0.22	3.90	1.22	-0.24	1.15
Prob(t)	0.7542	0.8289	<0.001	0.2223	0.8113	0.2490
R^2	0.5160					
F-statistic	8.47					

Notes: 1. Number of Observations = 45
2. Units of dependent variable, Credit Supply, are in Zambian Kwacha.
Source: ZATAC Limited, March 2007.

The regression estimates in table 22 show that at the 25% confidence level, loan fees, loan term and market are significant explanatory variables for the supply of Kwacha-denominated credit. Considering the small size of the data set after splitting the data into two groups, a 25% confidence level is a reasonable cutoff level for the significance of supply model parameters. The *F*-statistic (8.47) for the supply model using nominal interest rates is large, showing that jointly, the variables included in the model have significant explanatory power.

The regression estimates show that a ZMK 1.00 increase in loan fees is associated with an increase of ZMK 12.80 in Kwacha-denominated loans. A positive relationship exists between loan term and supply of Kwacha loans. A one year increase in loan term corresponds to a ZMK 5.46 million (US$ 1,345) increase in credit supply. This rather unexpected relationship between loan term and credit supply, which was also observed before splitting the data into two sub-groups, seems to suggest a stronger willingness by the lender to provide longer term loans to enable smallholder growth than

the motivation for pure economic gain that could potentially accrue from higher loan turnover.

The regression estimates also show that the lender will supply ZMK 41.4 million (US$10,200) more credit to borrowers with market contracts at the time of borrowing that to borrowers with open market arrangements. Borrowers with contracted markets are those that have entered into supply contracts with buyers for their produce and borrow to finance the contracted production. As markets for agricultural produce in Zambia are not always guaranteed, open market arrangements often place a risk on both borrowers and lenders, especially when the production of highly perishable crops is involved. Market contracts guarantee the producers (who are the borrowers) of the quantities and prices at which they will be able to sell their produce. Borrowers with market contracts are therefore able to forecast their incomes more accurately, and minimize the risk of loss due to lack of markets or lower prices, than those with open market arrangements. This also benefits lenders as it, in turn, reduces the risk of default by the borrowers. The lender's willingness to supply larger loans to borrowers with market contracts indicates that the lender makes use of the risk-reducing effect of market contracts in its lending decisions.

The model shows that nominal interest rates do not significantly affect the lender's credit supply decisions. This is consistent with the theory of credit rationing in markets with information asymmetries, in which interest rates do not always lead to market clearing (Stiglitz and Weiss 1981).

The corresponding regression estimates, using equation 18, for the Kwacha loans sub-group using real interest rates are given in table 23. The supply model variables are described in table 15. At the 5% confidence level, only loan fees have significant explanatory power in the model, using either nominal or real interest rates. At the 25% level, real interest rates and loan term also have a significant influence on credit supply. The *F*-statistic for the joint significance of all variables in the model is also large enough, leading to a rejection of the null hypothesis that the variables do not explain credit supply.

Table 23. Regression Estimates for Kwacha Loans Sub-Group Using Real Rates

	Intercept	REAL INTEREST RATE	FEE	TERM	COOP	MKT
Coefficient	19,979,007	423,703,750	12.27	5,556,490	-20,298,820	18,425,882
t-test	0.45	1.19	4.03	1.31	-0.69	0.52
Prob(t)	0.6522	0.2350	<0.001	0.1902	0.4873	0.6001
R^2	0.5468					
F-statistic	9.52					

Notes: 1. Number of Observations = 45
2. Units of dependent variable, Credit Supply, are in Zambian Kwacha.
Source: ZATAC Limited, March 2007.

ZATAC Limited uses historic inflation rates to determine nominal interest rates. If credit markets function well, supply of credit is related to the price or interest rate. Lenders who are profit-maximizing will add a component to the interest rate charged to cover the expected loss due to inflation. Expected inflation is therefore, in theory, the basis for the differential between real and nominal rates. A lender can use a naïve

forecast that assumes future inflation will be the same as today's inflation. An improvement to ZATAC's method of determining nominal interest rates, given the high fluctuations in inflation rates in its market, would therefore be to forecast future inflation rates and use these, together with the real interest rate, to price the Kwacha loans.

Equation 18 was used to estimate the credit supply model parameters for the dollar loans sub-group, and the results are given in table 24. Model variable nomenclature is earlier described in table 15. The Breusch-Pagan test statistic for heteroskedasticity of error variance in the model conditioned on loan fees is 0.81 with a *p*-value of 0.3695. We therefore fail to reject the null hypothesis of homoskedasticity and conclude that the error variance is constant. No correction for the problem of heteroskedasticity was necessary for the dollar loans sub-group. As was the case with the Kwacha loans sub-group, the dependent variable, supply, is also given in the currency of loan disbursement (US dollars in this case). Note that the binary variable, *COOP*, which defines whether the borrower was a cooperative or not is omitted from this sub-group because no cooperatives borrowed dollar-denominated loans.

The estimated parameters show that loan fees and market are significant at the 25% significance level. The 25% significance level is again chosen because of the limited size of the sample under consideration. After dropping the three large agribusinesses, the dollar loans sub-group only had eight observations corresponding to eight loans given to eight firms. For every US$ 1.00 increase in loan fees, credit supply to dollar loan borrowers increased by US$ 39.32, which is more than three times the corresponding increase Kwacha loan borrowers would receive for an equal increase in

loan fees. Other things being equal, borrowers with market contracts for the financed project received US$ 106,369 more than their counterparts without market contracts. Compared to Kwacha loan borrowers, this represents an increase that is 10 times the increase in credit supply to Kwacha loan borrowers with market contracts.

Table 24. Regression Estimates for Dollar Loans Sub-Group Using Nominal Rates

	Intercept	NOMINAL INTEREST RATE	FEE	TERM	MKT
Coefficient	-86,665	-98,615	39.32	-1,046.73	106,369
t-test	-1.02	-0.17	2.19	-0.03	1.77
Prob(t)	0.3809	0.8773	0.1167	0.9770	0.1747
R^2	0.9686				
F-statistic	9.52				
Breusch-Pagan	0.81				
$Pr > \chi^2$	0.3695				

Notes: 1. Number of Observations = 8
2. Units of dependent variable, Credit Supply, are in US dollars.
Source: ZATAC Limited, March 2007.

The supply differentials between the Kwacha and dollar loans seem to reflect the risk posed by higher fluctuations in the inflation rates on which the nominal interest rates for Kwacha loans are based, compared to the LIBOR rates which are the lender's basis for setting nominal rates on dollar loans. LIBOR rates, on the other hand, were much more stable at an average rate of 4.74%, with a standard deviation of 0.75%, during the lending period under consideration (British Bankers Association 2007). However, for each sub-group when considered separately, the lender's supply decisions are not

significantly influenced by nominal interest rates. Furthermore, the lender's development objective and the fact that a large portion of the funds received in dollars by the lender are disbursed in the same currency (dollars) could also explain the lack of a significant relationship between supply and interest rates.

Although loan term has the expected negative coefficient, it is also not a significant determinant of the lender's decisions to supply credit to firms borrowing in US dollars. A negative coefficient on loan term implies that the lender will lend fewer funds for longer term loans than it will for shorter term ones. In this case, every one year increase in loan term is associated with a decrease of US$ 1,047 in credit supply. This result suggests that the lender does in fact prefer shorter term loans to longer term loans for established agribusinesses which generally borrow in dollars, although it is willing to supply longer term loans to smallholders, as was found in the analysis of supply to the Kwacha loans sub-group.

The R^2 and F statistics for the dollar loans sub-group are high, at 0.9686 and 9.52 respectively. However, a limitation of the estimated parameters for this sub-group is that the results do not have a high level of stastical significance because of the small sample size.

In summary, the results of the analysis based on the separated loan data showed that loan fees and access to contracted markets are the key pricing factors for the lender's supply of credit to smallholder agricultural producers and processors. In an agricultural credit market such as this lender's, it is not difficult to see the economic rationale for the lender's use of the availability of contracted markets to borrowers as a

key incentive to supply credit. Contract production hedges downside income risk when prices are lower, and minimizes the lender's default loss. The perishable nature of many primary commodities in the agro-industry also makes pre-contracted production more favorable to borrowers and lenders.

The study finds evidence of a strong correlation between loan term and credit supply to smallholders borrowing in the local currency. More than 75% of these borrowers were cooperatives. A positive relationship between loan term and credit supply was found for this sub-group, suggesting that the lender may be more willing to support smallholder business growth with longer term loans rather than the pure profit motive, a finding that is consistent with the mission of the lender as a facilitator of smallholder agribusiness development.

The quantitative analysis of credit supply allowed us to identify which of the key economic variables hypothesized to influence supply were really relevant in ZATAC's lending between 2005 and 2007. It further enabled quantification of the extent to which such factors tend to be associated with supply. The study finds that the lender's supply decision is not strongly affected by nominal interest rates, a result that is supported by theory on credit rationing in markets with asymmetric information. On the other hand, real interest rates had a significant positive relationship with credit supply, suggesting that the lender is willing to supply larger loans at higher real interest rates.

CHAPTER VI

DISCUSSION AND CONCLUSIONS

Credit supply in Zambia plays an important role in the commercialization of smallholder agribusiness. Access to credit by smallholders through the commercial banking sector is limited by their inability to offer collateral for loans and lenders' perception that they are generally risky borrowers. Microfinance institutions therefore provide a key channel through which smallholder agricultural producers have access to credit. Previous studies have highlighted mechanisms that microfinance institutions in developing countries have employed to ameliorate problems of asymmetric information in the supply of credit. The studies have focused on microfinance institutions that provide consumer loans and short term working capital for non-agricultural projects. This study offers insights into smallholder credit supply in the agriculture industry, using data from a specialized agricultural lender in a developing country. The qualitative as well as quantitative analyses lead to several important conclusions about the economic and business factors that affect ZATAC's supply of credit.

Qualitatively, the study finds that ZATAC has both differences and similarities to the microfinance institutions studied in the development literature. The similarities identified in this study demonstrate that the approach of joint liability and community pressures are extended from consumer lending into the agricultural credit sector in Zambia. The cooperative structure is the source of joint liability and community pressure to repay. This works in two ways. Firstly because the cooperative members

self-select themselves, the selection process gives an incentive to members to screen out risky borrowers based on community-available information, when all the members are bound by a joint liability contract. Secondly, because the primary loan contract is between the lender and the cooperative, which in turn has sub-loan contracts with individual members, there is pressure on members to repay their loans or risk having them repossessed by the cooperative. Joint liability compels cooperative members to monitor each other's investments and loan repayment.

Access to multiple loans by more than half of the ZATAC borrowers suggested that the lender employs the mechanism of progressive lending commonly used by microfinance institutions. The repetitive nature of the lending relationship can help lenders overcome some information problems in supplying credit to their borrowers, and increase credit supply efficiency. The short lending period that the lender had been in operation could not, however, allow for an examination of whether these benefits do in fact accrue to the lender.

The distinctions are mainly attributed to the mission and clientele ZATAC serves in commercializing agribusiness. Key distinctions included lower real interest rates (averaging 4.9% for Kwacha loans, 10.2% for dollar loans, and 5.4% for the overall portfolio) offered by ZATAC compared to other microfinance institutions in other parts of the world, which ranged from 17 – 47%. The sizes of loans that ZATAC provided to smallholders were generally larger than comparable microfinance institutions.

Quantitatively, the study finds that loan fees and availability of contracted markets were the key determinants of credit supply by the lender. For local currency

loans, supply of credit increased by ZMK 12.80 for every ZMK 1.00 increase in loan fees, all other factors remaining constant. The lender supplied ZMK 41.4 million (US$10,200) more credit to borrowers with market contracts at the time of borrowing than to borrowers with open market arrangements.

The study further finds that a positive relationship existed between loan term and supply of Kwacha loans. A one year increase in loan term is associated with a ZMK 5.46 million (US$ 1,345) increase in credit supply. This finding seemed to be consistent with the lender's mission to facilitate smallholder agribusiness development by providing longer term loans to support smallholder growth. Collateral on long term loans also serve as an incentive for the lender to supply long term credit. This study finds that only loans with loan terms ranging from 0.10 years (6 weeks) to 2.96 years had contract markets while loans longer than 2.96 years had no market contracts. Long terms loans, which were almost all for infrastructure development and equipment, were collateralized by a placement of a lien on the loaned infrastructure and equipment. Thus these loans are less risky than the shorter uncollateralized loans. The loan contracts for long term loans were also subject to termination if the conditions of the contract are not met by the borrowers. The long term loans (3 – 10 years) provided by ZATAC were specifically for infrastructure development and equipment such as construction or purchase of dairy marketing centers, milk cooling equipment and processing facilities, which served as collateral for the loans.

For the dollar-denominated loans, loan fees and market contracts were the key determinants of the supply of credit. For every US$ 1.00 increase in loan fees, credit

supply increased by US$ 39.32, other things being equal. Furthermore, borrowers with market contracts for the financed project received US$ 106,369 more than their counterparts without market contracts in the dollar loans sub-group.

The lender's credit supply decisions to both local currency and dollar loan borrowers were not significantly influenced by nominal interest rates, a finding that was not entirely unexpected given the information asymmetries that exist in this lender's credit market. This finding is consistent with literature on credit rationing in markets with imperfect information, in which interest rates do not always clear the markets (Stiglitz and Weiss 1981). The lender in this case relies on other factors such as loan fees and contracted markets to price credit supply to its borrowers. Despite the absence of a significant relationship between credit supply and nominal interest rates, an estimation of the supply-real interest rate relationship found that a significant positive correlation did in fact exist between credit supply and real interest rates.

Regressions on the full loan portfolio data which included large agribusinesses that were markedly different in size and credit requirement characteristics gave insights into how the lender's supply decisions to all borrowers of all sizes are affected by the key economic factors and business conditions in lender's credit market. In general, the study finds that the same factors – real interest rates, loan term and loan fees – affect the supply of credit to the full spectrum of borrowers. However, large agribusinesses were able to access much larger credit supply from the lender at the same interest rates as their smaller counterparts. Considering the low interest rates offered by the lender, it seemed likely that a major incentive for the large agribusinesses, which otherwise had the

capacity to borrow from the commercial banking sector, was the ability to borrow from ZATAC at relatively lower nominal and real interest rates.

A further analysis based on the full portfolio modeled supply as a quadratic function in loan fees and concluded that there was no evidence of economies of scale benefit to the lender being passed along to borrowers through lower fees.

A major limitation of the study was the short lending period the lender had been in operation and hence the relatively small number of loans disbursed. Sufficient observations for the ZATAC data would allow further analysis of the effects of lender-borrower relationship factors, such as length of lending relationship and borrowers' use of other financial and development-oriented services by the lender, on supply of credit. Gloy, Gunderson and LaDue (2005) carried out similar analysis using U.S. data. Further research questions that are possible and can build on this study with availability of more loan data relate to the borrowers' loan repayment performance over time, for example how length of the lending relationship affects repayment; the profitability and financial sustainability of the lender's lending operations (including costs and returns profiles); and the effect on smallholder business growth as a result of increased access to credit supply. These questions are of importance to various stakeholders including lenders, policymakers and smallholder agribusinesses.

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