# QUANTIFICATION OF THE RISK ASSOCIATED WITH THE SEASONAL FINANCING OF AGRICULTURAL PRODUCTION

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## ABSTRACT

Since the abolition of government support policies for both agricultural and financial industries during the early 1980s, participants have had to take direct responsibility for the management of the risks involved in their business activity. As a prerequisite to the development of practical risk management strategies and techniques, quantification of risk is considered by this thesis.

A quantification risk index that incorporates both the third and fourth moments of a distribution, thus adding to variance and monotonic transformations, the traditional surrogate risk measures, was developed and applied to sheep and beef farming.

The risk index is developed using logit analysis, where risk is directly estimated. Logit analysis was used because it suited the thesis definition of risk. In this thesis, risk is defined as the probability of incurring loss or harm, where loss or harm is defined, in the context of sheep and beef farming, as zero or less than zero 'net cash returns'. Net cash returns are defined as all cash revenues generated by farm production less all farm and farmer expenditures. The index, or probability, is directly estimated given forecast average market prices, effective farm area, total farmer forecast expenditures and island location (North or South).

The risk index has been developed for banker application to farm budgets submitted for the purposes of seasonal finance approval. The banker is warned by the index that the proposed farm plan has a high probability of ending in farm insolvency and an inability of the farmer to service all lending in the forthcoming year, solely from farm production.

As a consequence of applying the measure to sheep and beef farming, the thesis found that in terms of risk to net cash returns, effective farm area in conjunction with total farmer expenditure is significantly ranked higher than fluctuating market product prices, and that risk trade-offs exist between farm area and expenditures. In a situation of small farm size with relatively high expenditures, optimistic product prices are insufficient to offset the high probability of incurring negative net cash returns.

## ACKNOWLEDGEMENTS

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# INTRODUCTION

## 1.1 THE AGRICULTURAL SECTOR AND RISK

### 1.1.1 BACKGROUND

New Zealand agriculture has undergone considerable change in direction over the past thirty years. After the relative stability but slow general economic growth of the 1960s, the 1970s saw the evolution of a combination of government policies designed to initially stimulate economic growth and later, after an OPEC driven redistribution of the world's income in its favour, protect export agricultural production from the sudden consequential market contraction of industrialised and oil importing countries, and the associated long term price decline in the international commodity market (Hawke 1987).

Reaction to depressed international prices for agricultural commodities included the supplementation of dwindling producer incomes, a policy that was in addition to a growing list of regulatory and interventionist measures designed to compensate agriculture for the costs of import protection and of maintaining an over-valued exchange rate (Hawke 1987).

By 1984 the interventions in place consisted of direct input subsidies (fertiliser, irrigation, interest), production subsidies (supplementary minimum prices), development schemes (livestock incentive scheme, land development encouragement loan), the provision of research and farm services, producer board subsidies, taxation exemptions, industry controls and producer board legislation, as well as state ownership of the rural banking and finance corporation. The 1984 total fiscal cost of these interventions were estimated to be 3.2 percent of gross domestic product (GDP), or $1,087 million. (Raynor 1987).

Under this 'protectionist' environment, producers and agri-service industries protected from the business risks associated with international trade had little incentive to adapt to a changing international commodity market, let alone implement systems of business risk management at the micro level. The early 1980s saw the recognition that the international downturn was not short term, resource utilisation inefficiencies had developed within the economy, overseas borrowing was not sustainable and those in agri-business at all levels had to directly confront the realities of the international marketplace if they were to quickly adjust to the international environment (Hawke 1987).

As a consequence, protectionist policies were removed by the new Labour government elected in 1984. The result has been the removal of those many anomalies that encouraged inefficient use of resources (Pryde,Bain 1985). Since that period the majority

of businesses involved in agricultural activity have had to directly face the undisguised risks associated with their involvement. Given that risk is a predominant feature of all agricultural activity, and agri-business must now take direct responsibility for risk, there is now demand for practical systems of risk evaluation and management.

### 1.1.2 AGRICULTURAL RISK

Within portfolio theory, risk is seen as being comprised of both systematic and nonsystematic elements, i.e., nondiversifiable and diversifiable. This concept tries to divide risk into those risk components that are inherent in all agricultural activity (systematic), and those risk elements that are able to be eliminated through diversification into other investment options. Turvey and Driver (1986) in a study designed to determine the extent of systematic and nonsystematic risk within United States agriculture, concluded that there is in fact a great deal of systematic risk in agriculture and the proportion of local and specific risk that can be diversified away is small, relative to the total risk of the farm sector portfolio.

Opportunities for diversification from one generic type of agriculture into a better alternative are limited by the constraints imposed by all manner of resource factors. For instance, a change from Merino sheep farming to intensive

horticulture may not be feasible due to the absence of those basic physical resources, required by horticulture, such as soil type or appropriate climate.

Given the range of physical resources that are available to any specific farmer, the product option range within generic types of agriculture is also limited by their comparative suitability to those resources. For example Romney sheep would be less suited to South Island high country conditions than Merino sheep.

Once a farmer is committed to a production decision, his options diminish as he draws nearer to harvest. For instance, an arable crop farmer may harvest peas in either their green state, as fresh peas, or in their dry seed state. Once the time has passed for green pea harvest, the farmer is committed to the dry pea market.

Agricultural risk and uncertainty can be further divided into business or financial risk, where business risk can be further categorised according to three sources (Just 1975). First, risk can be associated with environmental factors such as climate, disease, pest infestation and technological obsolescence. Second, risk can arise from market factors such as supply and demand disequilibrium within both input and output markets, and competitive elements associated with market structure. Third, risk can occur from government policy and programs, such as support levels and regulations, as well as

government priorities with regard to economic objectives.

During the season of production, from investment to harvest, a farmer must not only endure the risks and uncertainties associated with any probable change in, or occurrence of, any of the above risk sources, but also the risks associated with their resulting impact or outcome.

The risk incurred as a consequence of a change in any of the above risk elements within the three source categories can vary across the national agricultural economy. Each risk source has a regional qualification. For example, the probability, or risk, of drought on the East Coast is greater than on the West; the risk associated with local price fluctuations for market garden produce are less in the Auckland region than in the Invercargil region.

Risk can also vary according to the 'additive' or cumulative combination of separate risk sources within regions. For example, the perceived risk to, or impact on, cashflows as a consequence of the 1984 SMP removal phase of government policy would have been greater in the Canterbury region than in the West Coast region because Canterbury is much more prone to prolonged drought, meaning that cashflows were already at risk prior to SMP removal. The implication is that the level of risk associated with the occurrence of any specific stimuli on any generic agricultural activity in any particular region differs from other regions according to the combined

probability of risk stimuli occurring concurrently at any point in time.

The level of risk might be determined by the impact of any stimuli rather than the probable occurrence of stimuli. More specifically, the concept of risk might be more appropriately associated with the probable impact of say a large price decrease rather than the occurrence of such a decrease. Total risk within a farm unit describes the combined probable impact upon the security of the farm unit, of the occurrence of any combination of stimuli.

Amongst those industries that service agricultural production, banking is the industry that is an important prerequisite agri-service input common to all agricultural and aquacultural production and associated activities. This fact makes agricultural production dependent on the security and risk exposure perceptions that a bank may have with regard to agricultural finance involvement. A bank is in a position to determine the productive longevity of any individual producer, using its ability to either invest or disinvest in its farmer client.

As a consequence, a feature of agricultural risk, from a producer's point of view, is the financier's reaction to the impact upon the producer of any adverse change in any risky factor. This form of risk can be categorised as financial risk, and is best described by the following scenario.

Assume that during October a sheep farmer has entered an unexpected drought period. Further, his June negotiated seasonal overdraft facility requires that he receives better than average prices for his produce and his expenditure be at a controlled minimum level. The farmer's overdraft includes a drought allowance that facilitates the purchase of a small quantity of stock feed should it be required. Overall this farmer's debt equity ratio is dangerously large but his current account deficit not unusually large for this time of the year. He is classified by the bank as being a 'security borderline' client.

As the drought progresses into January, it becomes apparent that the stock feed allowance will need to be spent, and an 'insufficient' quantity of feed barley is purchased due to the unit price paid being beyond budget expectation as a consequence of the high regional demand for feed barley, generated by the drought. Further, he sells a large proportion of his prime lambs earlier than expected, to ease the immediate stock demand for pasture, at prices less than budget expectations.

The farmer believes he has reacted sensibly to his situation, in that he is implementing decisions designed to protect his future production from the impact of the drought, thus minimising his long-term loss. His concern centres around controlling the weight loss of his ewes prior to mating and

shearing, as well as maintaining a small weight gain in his replacement ewe lambs. He is also concerned with reducing his short term loss by selling lambs before the market further worsens.

As a consequence of his early sale of lambs and delayed purchase of stock feed, his overdraft facility is now certain of being exceeded. At this point he visits his bank manager with an application to extend his current account overdraft facility. He believes that he was justified in selling his lambs early, as they would not have reached budget target liveweights and grades under the circumstances, and prices offered by the meat companies were worsening as a consequence of the unusually high regional supply of lambs from farmers concurrently wishing to sell lambs early.

Although it is certain that the farmer will sustain an accounting loss and show a consequential deterioration in his equity position, if the bank is prepared to accommodate the overdraft extension then, from the farmer's point of view, the impact of the drought will not be so bad. The farmer has no idea how the bank will react to his application, and considers a possible adverse bank reaction to his plight as an additional risk component within the total risk of drought and its final impact. Should the bank not accept his reasoning and 'harden' their position, then the final impact of the drought on this farmer would be particularly harmful.

The above scenario serves to illustrate two points. First it conveys the concept that risk in agriculture is not only related to the impact on cash outcomes of various uncontrollable stimuli, whatever they may be, but also that the severity, or level of risk again differs according to the impact that the resulting cash outcome may have on the attitudes and business decisions of those financing agriculture, and their consequential influence on the ability of the farmer to continue farming. Second, financiers of agricultural production, once committed to a level of financial involvement, either run the risk of inadvertently underwriting those components of agricultural business risk they feel uncomfortable with, or be requested to do so, thus placing them in the unenviable position of having to decide whether or not to exert great pressure on their client.

Agricultural risk is multi-dimensional in terms of its wide range of source stimuli, and the variability across farmers and regions of the impact that those stimuli may have on the farm unit. Although sources of risk can be categorised and the probability of those source stimuli occurring are known, the quantifiable level of risk itself, or the impact of those stimuli, is not known. Risk can only be described according to the consequential harmful impact of the occurrence of any uncontrollable agricultural characteristic.

## 1.2 THE FINANCIAL SECTOR AND RISK

### 1.2.1 BACKGROUND

At the time the Labour party came to government office during 1984, New Zealand's financial sector was the most regulated in the Western world. Since 1984, the financial sector has been completely overhauled. The removal of blanket regulations controlling lending and deposit rates and the abolition of the penal marginal ratios to financial institutions preceded the revocation of both the 30 day rule, which had prevented the trading and savings banks from entering the short end of the money market, and the 3 percent interest rate restriction on the ordinary accounts of savings banks. The removal of credit growth guidelines, foreign exchange controls and the liberalisation of bank registration were also introduced to increase competition and efficiency in the financial system. With the ability to borrow or lend offshore, and substantial changes to the system of tendering for Treasury bills, banks are now in a position to openly compete for custom (Russell 1985).

Deregulation has seen an increase in the number of banks from the major four in 1984 to over 20 in 1990. A growing trend is the number of mergers into large supermarket type banks offering a wide range of financial services. Smaller banks are emerging as niche banks, filling the gaps left by major

### 1.2.2 THE ROLE OF THE TRADING BANK

Whilst it is difficult to be precise in defining a 'bank' or banking business, a financial institution is part of the banking system if its main functions include the acceptance of demand deposits, the operation of money transfer, and the creation of demand deposits through the making of loans and provision of overdraft credit (Deane 1982).

It is the ability of trading and commercial banks to create money in the form of demand deposits by making loans and extending credit, that distinguishes them from other financial institutions. The creation of deposits can continue so long as banks hold sufficient currency and reserves to meet regulatory requirements and to redeem whatever amounts the holders of deposits want to convert to currency (Crosse 1979). The money a bank can lend or invest, at any point in time, is its excess of cash and bank balances over required reserves and minimum cash requirements, according to its daily balance sheet. The bank must stand ready to pay out the deposits it creates when it makes new loans or extends overdraft facilities.

The creation of demand deposits through overdraft extension is particularly suited to the characteristics of agricultural production. By supplying liquidity to producers, through their ability to lend and invest, they are able to provide money, at a cost, in consideration of assets or effort that have a future money value.

Given that the creation of deposits through lending is directly related to their depository function, i.e., the demand deposits that constitute the major portion of the money supply, then their ability to create deposits is constrained by not only the willingness of customers to deposit funds, but also by the total pool of funds available for deposit.

Where the pool of funds available for deposit is itself constrained and a major proportion of those deposits is transacted for consumption, i.e., they are short duration deposits, then the bank has the essential role of apportioning or rationing the available long term deposits, as credit, to what it perceives as being the most efficient users of that credit.

### 1.2.3 RISK IN BANKING

Risk within the banking industry can be categorised according to four basic sources. First, market risk broadly consists of elements such as the general state of the economy and competition within the banking industry. Second, political risk includes that risk inherent in changes of government policy as well as the internal management politics often found within large corporations and their boards of directors. Both of these categories can be included within the broad category of business risk.

The third category, deposit risk, identifies the risks associated with the liability side of a bank's balance sheet. Demand deposits present risk according to both the term and size of the deposit. On call deposits present the greatest risk within this category. Deposit risk is included within financial risk, along with the fourth category, credit or default risk, which describes those risks associated with the asset side of a bank's balance sheet. The non-payment of either a loan principal at maturity or interest at any stage during the term of a loan are the main sources of this type of risk.

Default risk is the main emphasis of this thesis and, as the title suggests, concentrates on the short term seasonal provision of working capital to agricultural producers.

Risk is a banker's preoccupation. If loans are not repaid then the banker in turn will not be able to meet his commitments. In this way both deposit and default risk are linked. Risk is inherent in the choice of borrower; risk is implicit in the industry being financed; risk by the business to which the banker may grant too much or too little credit; risk which involves the whole economy; a gambler's risk with weather, geography, technology and politics (Camu 1977).

In making innumerable loans to thousands of undertakings of all sizes, large banks are able to protect themselves against at

least the consequences of risk, if not against risk itself. The banker covers himself against risk by guarantees and securities with solid legal backing (Camu 1977).

A bank manager faced with a request for loan or overdraft facility is generally concerned with the answers to four basic questions:

(i) How much does the customer want to borrow?
(ii) What does he want it for?
(iii) How long does he want it for?
(iv) How is it to be repaid?

The four questions are all related to the security aspects of minimising default risk. Although security is not often directly questioned, it underlies the reason for asking these questions in the first place (Cox 1979).

The 'how much' question establishes not only the ability of the bank to feasibly provide such amount according to its current balance of excess demand deposits, but also to ascertain the ratio between what the customer himself is providing against what the bank is being asked to provide. Bank policy generally determines a maximum provision ratio according to the realisable value of the asset being financed, and ensures some equity to the borrower thus guaranteeing a collateral for the loan (Cox 1979).

For short term finance, as well as long term finance, the 'how much' question relates to the 'what for' question. This question is related to the credit use issue where the manager is attempting to establish the security parameters of his involvement. Is the activity high risk, i.e., is it speculative? Will the activity generate a sustainable interest yield? Will the amount requested hinder the ability of the operation to preform to expectation in terms of loan servicing? Are the characteristics of the operation such that it is vulnerable to a whole range of uncontrollable influences? Is the customer sufficiently knowledgable of the operation?

This question also begins to address the security question directly. What assets will be used as collateral for the loan? Do these assets have a realisable value, and how easy are these assets 'cashed in'? For seasonal finance, future production is sufficient collateral if the value of future production exceeds the value of the seasonal finance (Cox 1979).

Because the bank's current liability constitutes short term notice of demand deposit payment, it makes good sense to have loans out on a short term basis. The 'how long' question relates the term and type of loan to the nature of its intended use.

The 'how is it to be repaid' question is related to how the loan will provide for future operation earnings. Will the nature of the operation provide sufficient future profit from

which the loan can be repaid? Will repayments be such that they ensure regular cash flow to the bank, i.e., will payments be monthly etc.? Will the loan realise a regular yield, or will the return from the loan occur at some future date? (Cox 1979).

Apart from answers to the above questions, other factors play a vital part in linking together the answers to the four basic questions when evaluating the loan application. One highly variable factor is the customer. A bank manager must get to know his customer's health, age, activity and the value of connected family and business accounts held at the branch. This is vital information to the manager (Cox 1979). It serves to not only indicate to the bank manager any possible sources of default risk, but also the extent of possible guarantees and securities that are at his disposal. His objective is to increase bank assets by lending to earn interest revenue and in so doing, help the customer by providing a loan with such security that the risks are minimised for both parties (Cox 1979).

## 1.3 THE THESIS DEFINITION OF RISK

### 1.3.1 RISK DEFINED

Risk is not an observable entity - it is a concept verbally defined by Websters dictionary as 'the chance of injury, damage or loss'. Although the verbal definition is intuitively appealing, it would not appear to lend itself well to measurement and analysis. It is therefore desirable to develop a surrogate for the dictionary definition of risk that is amenable to quantification. For it to be intuitively pleasing it must measure, either directly or indirectly 'the chance of injury, damage or loss, so that it may be used synonymously with the word risk (Francis 1986).

More generally in analysis, risk is defined as being described by a known probability distribution of a particular event occurring, in contrast to uncertainty where the probabilities are unknown, with the surrogate measure of risk involving the variability, or some monotonic transformation, of that distribution. The greater the variation of that distribution then the greater is the risk of that particular event not occurring (Van Horne 1981).

Although risk and uncertainty are frequently used interchangeably, no distinction is made between the two in this research. They are conceptually seen as describing the same

probability of loss or harm. The elements of doubtfulness, fickleness or changeability that characterise uncertainty can be described just as much by a subjective probability distribution as can risk by an objective probability distribution (Francis 1986). As such, uncertainty is not recognised as being distinctly different from risk in the context of this thesis.

There needs to be a clear distinction between the risk of a source stimuli as an event occurring, and the risk of an adverse or harmful result occurring as a consequence of that source event. For instance, we can refer to 'the chance, probability or risk' of an event such as a drought or price crash occurring, or we can refer to 'the chance, probability or risk' that the occurrence of a drought or price crash will be harmful, where harm itself is considered the event.

Two aspects of the verbal definition for risk require clarification and definition. First 'chance' and second 'damage, loss or harm'. Chance is easily interchangeable with probability. In the context of the risk definition, chance, possibility, probability and odds are synonymous. Therefore the definition can be altered to 'the probability of damage, loss or harm', where probability is indeed either objectively or subjectively quantifiable.

In order to define 'harm' as an event, in the context of the thesis definition for risk, one must pull together those

aspects of both agricultural and banking risk, discussed earlier, that are identifiably common to both.

It has been indicated earlier that the level of agricultural risk inherent in the occurrence of a source stimuli varied according to the impact that resulted. Regardless of the source of that risk, the final impact of any source component of agricultural business risk is ultimately reflected in either a change in farm revenues or a change in farm expenditures, or both. An adverse impact would obviously consist of either a decrease in farm revenue or an increase in farm expenditures. More precisely, an adverse impact would be reflected in a decrease in farm profit, the magnitude of which essentially determines the magnitude of the financial risk inherent in that specific agricultural activity, through the effect that the decrease in profits has on farmer equity. Therefore the ultimate impact of any combination of business risk stimuli is itself a source of financial risk.

However a small decrease in farm profits, or equity, is not harmful if 'sufficient' profit and equity remain after the impact, but is harmful if little equity existed beforehand, and a financial loss resulted rather than a profit, thus causing negative equity. In this situation the financial loss would not only increase the default risk the bank first undertook in financing the operation, in terms of interest default on both long and short term loans and repayment of seasonal loans, but would also threaten the security underlying the total financing

of the farm. If the situation were such that default did in fact occur then the situation would also constitute harm to the bank.

The commonality between agricultural and banking risk is therefore identified within one financial risk component of both entities, i.e., the profit component of farmer equity within the financial risk inherent in the farm operation and the default risk component of the financial risks inherent in banking. Joint, or common 'harm' can therefore be defined as 'zero or negative farm profit'.

The thesis definition of risk, which is also tantamount to a definition for default risk, within the context of short term seasonal financing of agricultural production, then becomes 'the probability of zero or negative farm profit', where zero or negative farm profit is assumed to be a jointly harmful event.

One more component of the thesis definition argument needs to be examined before a true link between farm financial risk and bank default risk can be established. It is contained within the definition of 'farm profit', and the implications associated with the accounting definition of farm profit.

### 1.3.2 FARM PROFIT AND THE CURRENT ACCOUNT

By far the largest proportion of trading bank gross operating revenue consists of interest income. The Bank of New Zealand group reported in its 1990 consolidated profit and loss statement that it received eighty percent of its gross revenue through interest earnings, and fifty percent of its total operating income from net interest income, net of interest payments (Bank of New Zealand 1990). Bank profit is therefore determined by the relative interest magnitudes of both assets, in the form of advances, investments and securities, and liability deposits.

Two characteristics of interest revenue are important in the context of risk. First, interest is essentially a cash revenue sourced as cash payments made by the lender from revenues derived by the activities the bank is financing. Second, the duration of that interest revenue is related to both the solvency of the lender, or his ability to continue servicing the loan, and the security underlying the loan in relation to its term.

From a bank revenue point of view, solvency would seem to be a more important component of minimising total default risk than would security. If the activity being financed is strong enough to provide, or guarantee, the ongoing servicing requirements of the loan, but has poor financial security in terms of that loan, then so long as that security improves over

time as a consequence of the activity's strength, it would seem rational for the bank to continue its involvement.

Assuming that lender solvency is a dominant characteristic of continued bank involvement, and security is a dominant characteristic, or pre-condition, for initial loan provision, and both solvency and security are related via the financial strength of the activity, then it follows that from both the bank and farmer point of view, cash flow, or cash solvency, is the dominant criteria upon which default risk should be evaluated.

In terms of monitoring and measuring the default risk of bank involvement, then monitoring the current account is the only effective way of gaining information regarding the cash strength or solvency of the borrower. Current account is defined as the sum of all accounts, bank or otherwise, through which all cash transactions are made. For this reason, and because solvency is related to cash, the normal reporting format of farm accounting needs to be adapted to accommodate the thesis definition of risk.

The recommended format for farm accounting, as outlined by the New Zealand Society of Accountants 1985, is diagrammatically abbreviated in Figure 1.1.

With the emphasis on cash flow, the need for re-defining 'farm profit' becomes apparent when one notices the combination of

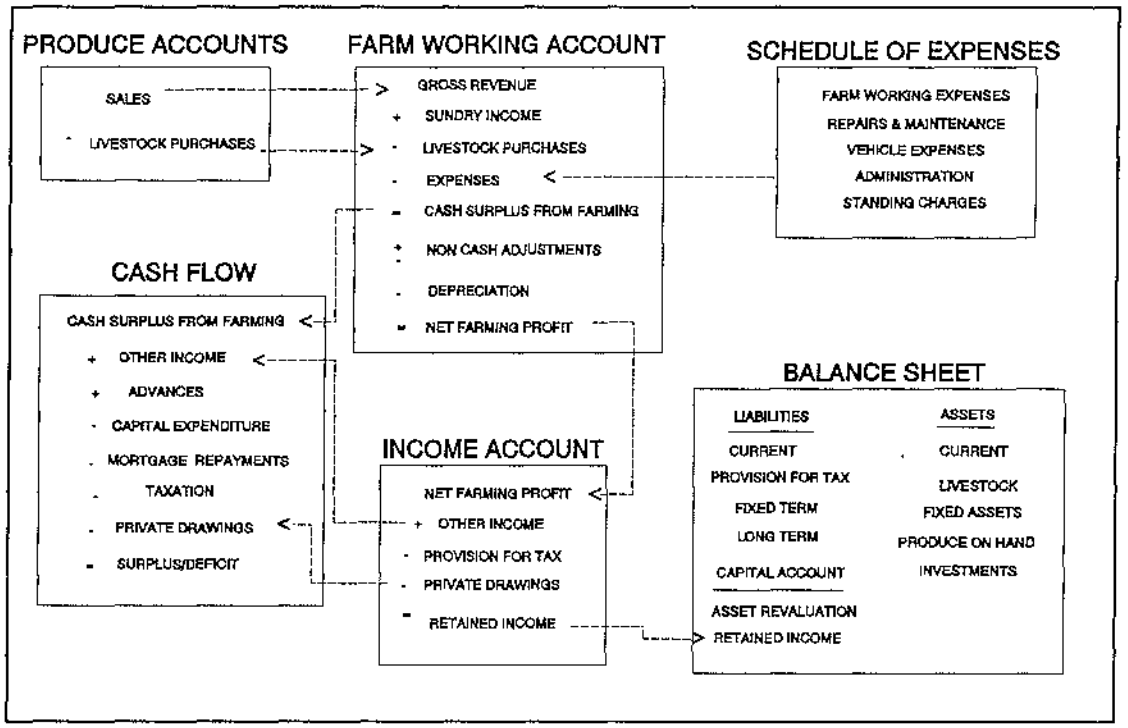


Figure 1.1 Farm Accounts

tangible objective cash items with comparatively intangible subjective values throughout these accounts. Cash surplus from farming is a true cash definition which is adjusted according to changes in livestock values and depreciation to derive net farming profit.

The cash flow statement, although a true cash definition, incorporates injections of loan capital or advances, which confuses the issue of cash solvency in terms of interest payments derived from the 'strength of the enterprise'. Cash injections of borrowed capital, if used to repay seasonal debt, also confuses the issue of seasonal finance secured by future farm production. The use of cash injections, whilst constituting a cash flow transaction through a current account, also increases both the liabilities and assets of the balance

sheet (depending on whether or not capital is purchased with the injection) therefore directly influencing the equity security issue within default risk.

By separating out all intangible subjective components of the farm accounts, as well as removing external cash injections other than earned revenue, we are left with a net cash position that is related more to the capacity of the individual and his farm to earn sufficient revenue such that he can be defined as being 'productively solvent and secure'. As such we are attempting to separate out those cash components of the farm operation that directly relate to 'farm solvency' and distinguish between lending to achieve solvency and earning to achieve solvency.

The relationship between solvency and security is identified diagrammatically in Figure 1.2. Assuming that security is defined as percentage equity, where equity represents the proportion of the capital account to total assets, then one can clearly see from the diagram how important a positive cash flow is in relation to equity and security.

The diagram is not meant to show the relative magnitudes of the effect of changes in any of the accounting components, nor does it show the off-sets with regard to changes in 'below the dashed line' intangible components caused by changes in the 'above the dashed line' tangible components. It merely tries to establish the relationship between tangible cash components

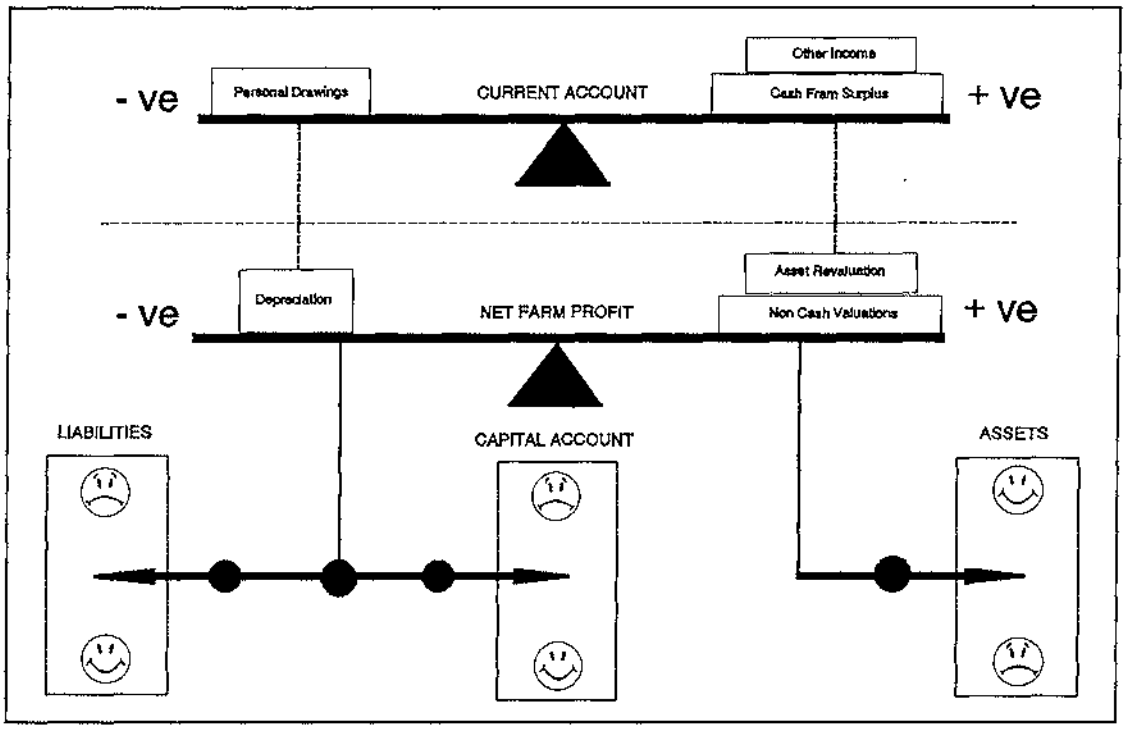


Figure 1.2 Cash balance

and equity. The diagram also indicates the sensitive balance between asset values, and adjustments, farm cash flow and cash profit, and the balance sheet components.

In the context of the thesis definition for risk, we define risk inherent in the provision of seasonal finance to agriculture as being ' the probability of incurring zero or negative net cash returns' where net cash returns are defined as being 'the sum of all revenues earned by the farmer on the farm less all cash expenses and payments made by the farmer'. The risk so described refers to the risk of insolvency and the inability of a farmer to service the sum total of all borrowing. This definition links together the two common financial risk components of agriculture and banking.

## 1.4 SEASONAL CREDIT AND THE NEED FOR RISK QUANTIFICATION

### 1.4.1 THE EQUITY PROBLEM

Amongst the many repercussions on the rural sector of the removal of agricultural support policies during the early 1980s, was a general 'across the board' loss of farmer equity. With government support and protection having been capitalised into land values prior to 1984, their removal almost immediately decreased land values and, as a consequence, farmer equity levels (Pryde 1987). Compounded by decreased product prices, many farmers found themselves sustaining and servicing debt levels with little or no underlying security.

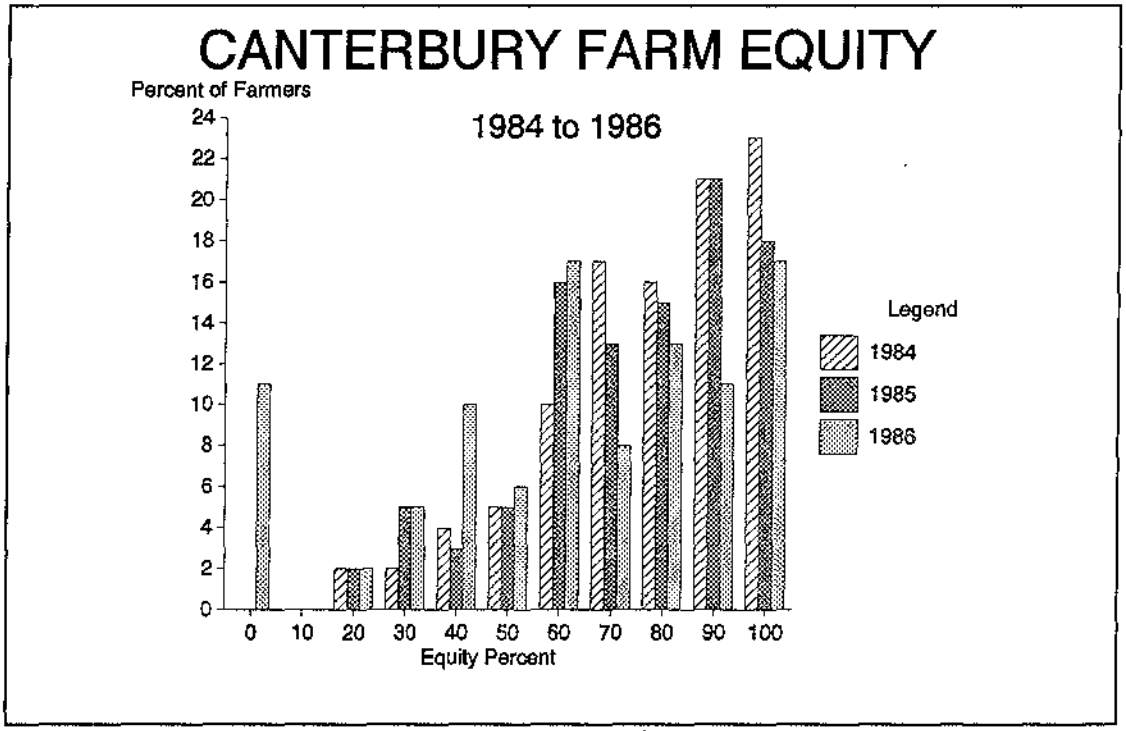


Figure 1.3 Canterbury farmer equity Source: Pryde 1987.

Evidence supporting a general loss of equity can be found in Pryde's 1987 analysis of the equity levels for a sample of Canterbury farmers. Figure 1.3 shows that during the period 1984 to 1986 inclusive, the sample distributions of farm equity changed from left skewed exponential to bimodal. The interesting feature of his analysis is that although all farm equity levels had dropped, by 1986 the distribution showed that no farmer in the survey had an equity of between 10% and 20%, and 11% of farmers had equity levels of less than 0%. Pryde's analysis also shows that in the period 1983/84 to 1985/86 the percentage of Canterbury farmers with 50% or less equity had grown from 13% to 35%.

Pryde's analysis is also supported by the 1984/85 to 1988/89 equity distributions, displayed in Figure 1.4, of a national sample of sheep and beef farmers taken annually by the New Zealand Meat and Wool Board's Economic service.

This distribution illustration also indicates a sudden 1986 increase in the percentage of sheep and beef farmers with zero or negative equity levels. For the 1984/85 season only 0.2% of sheep and beef farmers were in this category. By the end of the 1985/86 season, the percentage of farmers in the negative equity category had increased to 3.7% of the sample, inferring that some 800 sheep and beef farmers, among approximately 22,000 sheep and beef farmers at that time, had absolutely no financial equity security, and the percentage of sheep and beef farmers with 50% or less equity had grown from 7.9% to 20.8%.

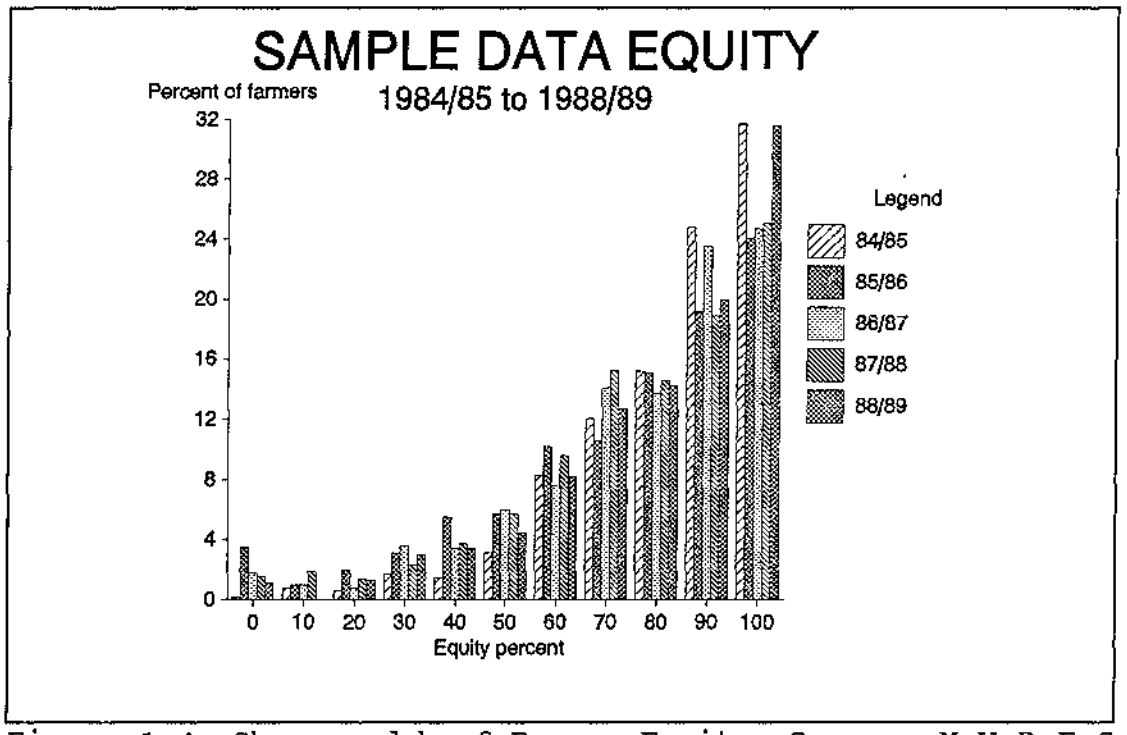


Figure 1.4 Sheep and beef Farmer Equity Source: M.W.B.E.S

By the end of the 1988/89 season the percentage of negative equity farmers had improved to 2%.

In discussions with numerous financial advisors, Pryde found that in assessing the financial situation of farmers, they now paid no attention to averages, and less attention to equity. Farmers are categorised into 'boxes' that depict distinct situations (Pryde 1987). In a typical cross-section of Canterbury farmers, 6% were in deep financial trouble, and had been for at least ten years, 21% were in trouble but probably could recover under favourable conditions, 49% were described as struggling, having been caught by their level of borrowing, and 24% were described as 'very sound'.

If we consider just the first 'box', 6% in serious trouble, in

just Canterbury alone, there were between 300 - 400 farmers in this predicament (Pryde 1987). Over the country this may conservatively be estimated at between 4000 - 5000 farmers. Further, the total agricultural debt at 1987 was estimated to be about $8 billion. With an average indebtedness of approximately $150,000, this equates to a total of between $600 million and $750 million of at risk farm debt, and this is for only 6% of the total farmer population. It is unlikely that by 1991 the situation is much improved, despite the improvement noted in Figure 1.4. Note that the distributions also infer that banks must indeed be currently financing at least 1.5% of farmers with no equity security.

Although Pryde's research describes only the Canterbury experience, it seems probable, according to figure 1.4, that similar equity situations occurred throughout New Zealand. Pryde's 1987 survey of financial advisors and institutions revealed a profile of the type of farmer affected by financial difficulties. His list of characteristics, abbreviated below, would appear to be generally applicable.

Characteristics of farmers in financial difficulty:

1. The standard of resource management is generally poor.
2. Working expenses exceed a certain proportion of income.
3. A lack of economies of size and scale.
4. Excessive levels of personal drawings.

## 1.5 CHAPTER SUMMARY

The current environment within which both farmers and bankers conduct their business demands a more direct responsibility for the management of risk. Given the unique business risks inherent in agricultural activity, plus a need for bankers to avoid involvement in farm plans that increase the risk of loan servicing and repayment default and the adverse consequences of default occurring, specific agricultural risk needs to be measured before risk management strategies can be developed and implemented.

The specific agricultural risk to be measured is defined as 'the probability of a farmer client incurring zero or negative net cash returns'. A client that conducts a farm activity which results in a negative cash position after one season of operation, is deemed to be unable to totally service existing debt. A pre-condition of servicing is that funds available for servicing must be sourced from earned activity and not borrowed.

Net cash returns are defined as consisting of all earned gross cash revenues less all farm and personal cash expenditures. The proposed cash transactions, or farm budget, conducted through the farmer's current account, excluding injections of borrowed capital, will be utilised in the quantification of default risk.

Measuring the probable inability for an activity to service debt constitutes a warning mechanism with regard to lending secured by farmer equity. Avoidance of the repercussions, on both banker and farmer, of loan interest and repayment default underlie the objectives of such a measurement.

## 1.6 THESIS OBJECTIVES

The first objective of this thesis is to quantify the default risk of seasonally financing agricultural production according to the definition 'the probability of zero or negative net cash returns'. It is intended that the probability be directly estimated utilising the probability modelling technique of logit analysis, and applied to the dominant components of sheep and beef farming.

The second objective is to concurrently develop a method for combining multiple farming activities such that the resulting risk measure refers to an individual farmer client involved in any combination of those activities.

## 1.7 THESIS ORGANISATION

Chapter One has described the background and associated need for the measurement of a specific type of risk common to both farmers and bankers, and has identified and defined that risk.

Chapter Two evaluates traditional risk measurement techniques for their general suitability as a risk measure. Chapter Three presents and describes probability modelling techniques.

Chapter Four describes and defines the variables used in the modelling process, as well as describes the data used in the construction of the variables. Chapters Five through Seven specify the logit model and report the results of model building and testing.

The thesis concludes with Chapter Eight, which discusses the results, strengths and weaknesses of the model, as well as a framework within which the model could be utilised. Limitations and problems encountered in this analysis will indicate areas for further research.