Assessing, Perceiving and Insuring Credit Risk

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Abstract

This thesis is concerned with the assessment, perception and insurance of credit risk. The thesis aims to make contributions both within these areas, and at specific points of interface between them. No attempt is made to develop a single unifying thesis. Rather, a series of partial models are developed, both theoretical and empirical, that develop and connect particular facets of financial economics.

The first model demonstrates how movements in market risk produce movements in lender risk-assessment effort. It is demonstrated that deleterious movements in market-wide risk can actually produce a fall in assessment effort. The capricious nature of risk assessment causes changes in the lender's perception of the weights placed on determinants. This has important implications for borrowers' attempts to minimize risk premiums. Time-variability of signal-weights is tested using structural break tests on ordinary least squares and fixed effects panel models. Results suggest a fluid relationship between risk and determinants.

Central to empirical investigation is the measurement of perceived risk. A critique of potential measures rejects the use of interest rate spreads – the most commonly used measure – on the basis that they do not take into account the possibility of credit rationing. A model is then constructed to reproduce the standard explanation of credit rationing – Adverse Selection induced Credit Rationing Equilibrium (ASCRE). This model is then extended to include classificatory risk assessment. Assessment is found to reduce the scope for ASCRE, and to cause favourable selection. Credit insurance is then included, and it is found that insurance cover makes risk assessment less of an imperative to lenders, and reduces the utility losses from raising interest rates. The parallel implication is that credit insurance weakens ASCRE, to the extent that full insurance with flat-rate premiums removes the possibility of ASCRE altogether. If the terms of insurance are made contingent on the terms of the loan, a new form of credit rationing emerges: Contingent Insurance induced Credit Rationing Equilibrium (CICRE). CICRE is separate, but not mutually exclusive, to ASCRE.

A theoretical model of the demand for loan insurance is developed, and empirically estimated, in the context of the UK mortgage market. *Inter alia*, the model examines the role of auto-perception of risk determining credit insurance demand. Results reveal the take-up of credit insurance to be relatively insensitive to the borrower's perception of his/her own risk.

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1 Introduction

1.1 Assessing, Perceiving and Insuring Credit Risk

Mark Twain once described a banker as someone who 'lends you his umbrella when the sun is shining and wants it back the minute it rains'.[i] Of course, it is usually the lender's hope that the borrower will be able to return the loan at the required time, whatever the weather. Unlike the use of an umbrella to protect against the rain, however, the ability of the debtor to return the borrowed sum is often directly contingent upon the success or failure of the very purpose to which the loan was put. For an entrepreneur, repayment will be contingent upon the outcome of the particular project for which the money was borrowed. For a debtor country, it will depend on the success or failure of a whole range of investment projects, plus a plethora of other micro and macro influences.

It is inevitable, therefore, that lenders will base their decision regarding whether or not to lend, and the terms of lending, on some ***perception*** of the borrower's risk. The degree to which this perception corresponds with reality will depend, at least in part, upon the efforts and lengths the lender has gone to in establishing the likely success of the borrower's intended project. Thus, an essential determinant of the interest rate charged, and indeed of the decision regarding whether to grant credit at all, will be the ***assessment*** of risk.

Even in the most favourable of circumstances, however, such procedures are often too costly or too cumbersome to fully allay the lender's fears and so the lender will usually attempt to secure an arrangement which guarantees some cost to the borrower and some remuneration to himself in the event of default. However, even the existence of collateral may be insufficient to appease the lender, particularly if he is averse to risk. An additional strategy for ensuring a profitable outcome would be to *insure* against the risk of default.

Insurers, of course, will have concerns of their own, particularly with regard to whether the insurance cover will adversely affect the bank's lending decisions (for example, by making risk assessment less of a necessity; or by encouraging the lender to set interest rates at a level that will boost repayment revenues, but discourage good risks). Thus, the insurer may attempt to ensure that the terms of the insurance contract are designed in such a way as to positively influence the lender's decisions in setting the interest rate and selecting borrowers.

The requirement to provide collateral, or the desire not to be blacklisted in future credit applications, may mean that it is the borrower who initiates the purchase of loan insurance, not the lender. Again, the *perception* and *assessment* of risk – this time by the borrower with regard to his own risk – will be paramount in determining whether or not credit insurance is purchased.

It is these issues—a nd their implications for existing theoretical and empirical models—which form the substance of the thesis.

1.1.1 Defining terms

The terms that specifically need defining are *risk, perception of risk, assessment of risk,* and *credit insurance*. In modern portfolio analysis, *risk* is defined simply as the variance of returns to an investment (see, for example, Ball *et al.*, 1998). So a project is said to have low risk if the variance of returns is small and vice versa. The thesis will not look at the returns of specific projects—project returns are only of relevance to the thesis in that the distribution of returns will affect the probability of default on the loans used to fund these projects. That is, the investor may only be able to repay the loan if the returns are above a certain threshold. Therefore, holding other things equal, the greater the variance of returns on a project, the greater the chance of default. 'Risk', for the intents and purposes of the thesis, is thus taken to be synonymous with 'probability of default' and with related phrases such as, 'risk of default'. Creditworthiness is simply the probability of not defaulting (taken to be one minus the probability of default).

Note that I do not follow Knight's (1921, pp. 20, 226) distinction between risk and uncertainty. According to Knight, *risk* applies only to situations where objective measurements of probabilities can be computed, such as the probability of a number occurring on a fair die. *Uncertainty*, on the other hand, refers to situations where no objective classification is possible, such as the probability that Scotland will win the next world cup. This distinction, however, has 'proved to be a sterile one' (Hirshleifer and Riley, 1992, p.10) because,

> 'It does not matter ... whether an "objective" classification is or is not possible... even in cases like the toss of a die where assigning 'objective' probabilities appears possible, such an appearance is really illusory. That the chance of any single face turning up is one-sixth is a valid inference *only if the die is a fair one* – a condition about which no one can ever be "objectively" certain. Decision-makers are therefore never in Knight's world of risk but instead always in his world of uncertainty.' (*ibid.*).

All economic decisions are therefore based on the *perception of risk*: individuals make decisions on the basis of the probability of an event occurring as they perceive it. All probabilities are subjective as far as the user of those probabilities is concerned. That is not to say that individuals do not have different levels of confidence in the probabilities they ascribe to events. To return to Hirshleifer and Riley's (op cit.) analogy of rolling a die, one would be more confident of one's beliefs about the probability of a certain number occurring if one had information on the frequency of the number occurring in all previous rolls of the die. One could thus ascribe probabilities (also perceived), or 'levels of confidence,' to one's own estimates of the probabilities of events occurring (similarly, there are implicit 'levels of confidence' about one's estimates of 'levels of confidence' etc. but I shall not explore the potentially infinite layers of uncertainty). Where there is some financial loss or gain attached to the actual outcome of an event, (such as a money-gamble on the die coming up with a six), there is a clear incentive to acquire information about the event in order to increase one's confidence in one's perceived probabilities. In the context of credit markets, this attempt to gather information is called '*risk assessment*' – a process central to most lending decisions. One of the key areas of exploration in this thesis is the actual process of risk assessment: how the level of risk assessment is determined (particularly when there are costs involved) and how it affects credit rationing and insurance behaviour.

There arises, therefore, two subtly different avenues of research into risk assessment: (1) research done by lenders which attempts to estimate the credit risk of individual borrowers for the purpose of lending decisions; and (2) research done by academics into how lenders arrive at these estimates. Rather confusingly, the literature has labeled these two avenues: (1) 'analyses of *objective* risk', and (2) 'analyses of *subjective (*or *perceived*) risk' respectively. The labeling is confusing because, as I have noted above, there is strictly speaking no such thing as objective risk – or at least, it is not knowable with total certainty, and so for the purpose of economic decision-makers, it is a redundant concept. The labeling does have a rationale, however, in that the first category of researchers are making the measurement of objective risk their goal (albeit an unattainable one), whereas the second category of researchers are really not interested in objective risk, but in the behaviour of the first category of researchers and how they came to arrive at those estimates. Thus they see the results of the first category for what they are: i.e. subjective probabilities which may vary across lenders and over time, even though actual risk remains constant. I shall discuss this terminology again when I come to review the literature (chapter 2), but it is worth summarising how the above nomenclature will be used in the bulk of the thesis:

- in the development of theoretical models, all probabilities of events occurring will be assumed to be *perceived*: that is, all decisions by economic agents are based on their estimates of those probabilities;
- *objective risk* will be used to refer to the goal of risk assessment and to those academic studies which have this goal as the main motivation for their analysis.

One would assume that the most obvious analytical framework for examining decisions made on the basis of subjective probabilities is a Bayesian one, since this is the approach most commonly associated with perceived risk. In chapter 2, I explain why this is not the case for the topics analyzed in this volume, and why I have chosen not to use this framework. For the purposes of clarifying the use of terminology, it is worth summarising the argument here before we come to it: Bayesian analysis only adds to the understanding of a problem when it is possible to measure the revision of beliefs based on new data. Where it is only possible to measure lenders' *a posteriori* probabilities (i.e. those after new data has been received) and not *a priori* probabilities (i.e. those before), or where it is one-off probability estimates that we are analyzing (i.e. there is no scope for revised belief), then the Bayesian approach reduces to (or adds nothing of substance to) a classical probability approach.

Having explained what will be meant by the perception and assessment of risk, the only core term that remains to be defined is that of insurance. This is simply: *indemnification taken out by the lender or borrower to protect against the consequences of default.*

1.1.2 Partial Models

It was assumed from the outset of the research process that a single unifying theory of all aspects and variants of credit markets was not a realistic or desirable goal and so a strategy of developing a series of separate 'partial' models seemed inevitable (hence the presentation of the thesis as a series of papers rather than as a unified thesis). Note that even multiple models could not hope to capture all the variants and aspects of credit markets; the handful of models developed here consider only a selection of queries and issues, each of which relate in some way (if not directly) to the interpretation of each of the other models.

Although complete integration of the various models is not attempted, a degree of synthesis can be achieved by considering the implications of, and connections between, the separate models. This is discussed in the concluding chapter as a means of drawing together the various strands of the thesis.

1.2 Plan and Aims

The thesis is comprised of nine chapters; an introductory chapter (1), a literature review (2), four theoretical chapters (3, 5, 6 and 7), one purely empirical chapter (4), one chapter with both theoretical and empirical analysis (8), and a concluding chapter (9). The aims of each chapter are as follows:

Chapter Two: Literature Review

This chapter will aim to show how the models developed in the thesis relate and contribute to their respective literatures. This will entail a review of previous studies and explain the conceptual connections between the various elements of the thesis. These connections include the effect of changes in market risk on assessment effort, which in turn affects perceived risk (chapters 2 and 3). Credit insurance is also shown to affect perceived risk via its implications for credit rationing (chapter 4). Changes in market risk affect credit insurance take-up and so this has credit rationing implications (chapter 5).

Chapter Three: Heteroskedastic Risk Assessment Errors

The first model presented in the thesis examines the way in which fluctuations in risk assessment effort may result in changes in the weighting of risk signals, even though actual risk is constant. Chapter 3 provides a rationale for why risk assessment effort might vary due to changes in market risk. It attempts to demonstrate how movements in market risk produce movements in lender risk assessment effort, and in particular, how deleterious movements in market-wide risk can actually produce a fall in assessment effort. The capricious nature of risk assessment causes changes in the lender's perception of the weights placed on determinants. This has important implications for borrowers' attempts to minimize risk premiums.

Chapter Four: Empirical Testing of Fluctuations in Weights

This chapter tests for movements in weights over time using a measure of perceived risk of sovereign debt as the dependent variable. An important theme of this chapter is the measurement of perceived risk and the problems with using interest-spreads as an indicator of perceived risk, particularly with regard to the effects of credit rationing which is an important indicator/consequence of lender perceptions of risk. Time-variability of signal-weights is tested using structural break tests on ordinary least squares and fixed effects panel models.

Chapter Five: Classificatory Risk Assessment* and *Favourable Selection

This chapter examines the implications of classificatory risk assessment, where the risk assessment procedure yields bands of risk rather than a continuum. It begins by reproducing the S&W (Stiglitz and Weiss, 1981) result that raising the rate of interest causes adverse selection when there is no risk assessment, providing a rationale for equilibrium credit rationing. The chapter then introduces risk assessment and shows that differentiated interest rates, will always increase the return on loans to a borrower of particular risk type. The chapter also shows that risk-differentiated pricing can produce favourable selection, and how there will exist an absolute limit for the optimal level of risk assessment. At this limit, it is shown that there is no scope for ASCRE – Adverse Selection induced Credit Rationing Equilibrium – the S&W source of credit rationing. (The two subsequent chapters examine how the introduction of credit insurance produces moral hazards for lenders and the possibility of a new type of credit rationing – Contingent Insurance induced Credit Rationing Equilibrium [CICRE]).

Chapter Six: Credit Insurance, Perverse Incentives and Rationing

Although a vast body of literature exists on the operation of credit and insurance markets, apart from the considerable efforts in the literature devoted to analyzing deposit insurance, relatively little has been done to examine interaction of the two markets, particularly with respect to loan insurance. Nevertheless, loan insurance is a large and pervasive industry, employed in a range of markets, from mortgage insurance to Government initiated small firm loan guarantee schemes, and the indemnification of balance sheet receivables. This chapter attempts to develop a suitable theoretical model to examine the agency and credit rationing issues associated with loan insurance. Loan insurance is introduced into the model developed in chapter 5 and shown to reduce the utility gain from lending to lower risks, with the corollary that insurance cover makes risk assessment less attractive, which is bad news for the insurer, given that risk assessment and risk pricing result in favourable selection. In addition, a further moral hazard is shown to exist, termed 'acute moral hazard'. This refers to the tendency for insurance to reduce the utility losses from raising interest rates and so results in a higher optimal interest rate, thus screening out good risks.

Loan insurance is also shown to weaken ASCRE (the S&W credit rationing result), because flat rate loan insurance reduces the utility loss of lending to bad risks, diluting the adverse selection effects associated with raising interest rates to clear the market. Thus, when coverage is 100%, there is no utility loss from lending to bad risks, and so no disincentive to raising interest rates in the event of excess demand. In this situation, equilibrium credit rationing is not feasible, irrespective of the level of information asymmetry between banks and borrowers. I also show how insurance rationing is a feasible equilibrium outcome when borrowers pay since raising premiums to clear the market increases the costs of borrowing, having a similar adverse selection effect as raising interest rates.

Chapter Seven: Implications of Alternative Insurance Regimes

This chapter considers the effect of alternative insurance regimes on the credit rationing results of chapter 6. A number of possibilities are discussed including: loan insurance with flat rate premiums, where lenders pay the premiums; loan insurance with flat rate premiums, where borrowers pay the premiums; interest contingent insurance terms, where lenders pay contingent premiums and where borrowers pay; loan insurance with contingent coverage; assessment of risk by insurers; observable actions and knowledge of payoffs. One of the findings of this chapter is the result that contingent insurance terms can cause a previously overlooked form of credit rationing – contingent insurance induced credit rationing equilibrium (CICRE) – which is different from ASCRE, but not mutually exclusive.

Chapter Eight: Take-up of Flat Rate Credit Insurance: Borrower Perceptions

This chapter considers how perceptions of risk are not just important in determining the behaviour of lenders and insurers but also of borrowers since they too face uncertainty. A theoretical model of the take-up of credit insurance is developed where it is the borrower who pays the insurance premium, and this model is estimated using data on mortgagors in Glasgow and Bristol. Estimates are derived of take-up elasticities with respect to premiums, state provided welfare, perceived unemployment/ill health risks and private cover. These elasticities are important because they identify the factors to which the insurance decision of mortgage borrowers is most sensitive. In particular, whether the state safety net for mortgage borrowers affects the insurance decision in any significant way (that is, whether it 'crowds-out' private mortgage protection insurance). Also of interest is the sensitivity of take-up to 'auto-perception' of risk (the borrower's perception of her own risk of ill-health and unemployment) the results of which will be of interest because they will demonstrate the likely effects of movements in market risk upon the prevalence of credit insurance. The chapter will also aim to consider the extent to which rational economic incentives drive the decision to take out insurance, compared with other factors (such as the timing of the purchase decision, and ignorance of statutory changes).

1.3 Categorisation According to Underlying Assumptions

One way of distinguishing/categorising the models presented in subsequent chapters is by their underlying assumptions. The following table summarises the models developed in the thesis by their title, purpose and assumptions. It can be seen that the models revolve around the trinity of themes listed in the thesis title: assessing, perceiving and insuring credit risk. The model developed in chapter one assumes asymmetric information between borrowers and lenders (i.e. borrowers know their true credit risk but lenders do not); borrowers to be risk neutral and lenders to be risk averse; risk assessment produces estimates along a continuum of possible default probabilities (i.e. borrowers are not classified into broad risk categories) and these estimates become more reliable the greater the risk assessment expenditure; there is no credit insurance; collateral is assumed to be exogenous (i.e. borrowers and lenders do not vary collateral – to offset risk, for example) and credit rationing only occurs if the expected profit from offering credit is less than zero. The model developed in chapter five is also based on exogenous collateral and information asymmetry, but this time risk assessment is discrete – the greater the expenditure on risk assessment, the finer the classification of risks. Chapter six extends this model to include credit insurance, and chapter seven extends the model further by relaxing a variety of assumptions (e.g. by allowing insurers to assess risk or to have knowledge of the lender's payoff function). Chapter 8 assumes symmetric information between borrowers/lenders/insurers, and assumes that borrowers are risk averse. Credit insurance is paid for by the borrower and demand is determined by the borrower's perception his/her own risk. Collateral is implicit in the model, and both interest rates and access to credit are assumed independent of whether or not the borrower has credit insurance (Mortgage Payment Protection Insurance—MPPI).

Table 1-1 Underlying Assumptions of Economic Models in the Thesis

Model and Chapter	Title and Purpose	Assumptions
Model 1: (Ch. 3 and 4)	Heteroscedastic Risk Assessment Errors Purpose: to provide a rationale for the time variance of signal weights	▪ Asymmetric information ▪ Borrowers are risk neutral ▪ Lenders are risk averse ▪ Continuous risk assessment ▪ No Credit Insurance ▪ Exogenous collateral/punishment strategy ▪ No strategic credit rationing
Model 2: (Ch. 5)	Classificatory Risk Assessment Purpose: to examine the implications of non-continuous classification of risks following assessment	▪ Asymmetric information ▪ Borrowers are risk neutral ▪ Lenders are risk averse ▪ Classificatory risk assessment ▪ No Credit Insurancc ▪ Exogenous collateral
Model 3: (Ch. 6)	Credit Insurance Purpose: to examine the moral hazard and credit rationing implications of credit insurance	▪ Asymmetric information ▪ Borrowers are risk neutral ▪ Lenders are risk averse ▪ Credit insurance ▪ Lenders assess risk ▪ Exogenous collateral
Model 4: (Ch. 7)	Alternative forms of Credit Insurance Purpose: to examine the implications of alternative insurance arrangements	▪ Asymmetric Information ▪ Borrowers are risk neutral ▪ Lenders are risk averse ▪ Various assumptions considered: Insurer assesses risk..... ▪ Exogenous collateral
Model 5: (Ch. 8)	Take-Up of Credit Insurance Purpose: to examine the borrower decision to take out credit insurance	▪ Symmetric Information ▪ Borrowers are risk averse (lender behaviour is not explicitly modelled) ▪ Demand for insurance contingent upon borrower's perception of own risk. ▪ Implicit collateral ▪ Interest rate independent of whether or not have MPPI ▪ access to credit independent of whether or not have MPPI

1.4 Summary

This chapter has provided an introduction to the thesis by defining the key terms, categorizing the analytical models according to underlying assumptions, and summarising the aims and structure of the thesis. I shall now go on to delineate and overview the relevant literature before developing the main theoretical and empirical models of the thesis.

Notes:

[i] Quoted in CHRUS News (1996), Issue 3, February 1996, Newsletter of the Centre for Housing Research and Urban Studies, p.1.

2 Literature Review

2.1 Introduction

This chapter aims to provide an overview of four strands of literature, including: (i) analyses of actual risk assessment (particularly applied empirical work in the field of international sovereign risk – i.e. models of country behaviour); ii) analyses of perceived risk (i.e. models of bank behaviour); (iii) analyses of, and explanations for, credit rationing; and (iv) investigations into the nature and consequences of credit insurance. Before moving to review these strands of writing, it is worth saying something about the relevance of these strands to the themes of the thesis, and how the particular avenues of reading were chosen.

2.1.1 The Choice of Reading

2.1.1.1 Actual and Perceived Risk

The first branch of literature is relevant to the thesis in that it sets the context for perceived risk analyses. As discussed in Chapter 1, in analyses of *objective* (or *actual*) risk, the focus is on borrower behaviour; in the analysis of *perceived* (or *subjective*) risk, the focus is on lender behaviour and their attempts to model actual risk. Although distinguishable, the two strands of literature are inextricably intertwined and so it is not possible to consider one branch of literature without reference to the other. Because the focus of the thesis is very much on the second strand, the choice of literature considered relevant to perceived risk will be used to determine the boundaries for choosing the selection of readings from the first strand. Choice of perceived risk analyses will in turn be driven by the choice of credit market for empirical examination. Risk assessment is applied in some form or other in just about every credit market. However, for the most part, these procedures are something of a black box and it is not possible to observe lender behaviour with regard to how they assess risk and how the assessment results affect loan decisions. This is particularly true in credit markets where loans are made to individuals or firms where data protection and confidentiality requirements preclude academic investigation. Thus, in order for meaningful empirical investigation and verification/falsification of theories of risk assessment to proceed, a real life credit market situation has to be found which matches a fairly demanding set of criteria.

First, it has to be a market where the same set of borrowers can easily be traced over time; if this is not possible, then it will be difficult to identify whether it is lender behaviour that is changing, or simply the pool of borrowers (i.e. it will not be possible to disentangle heterogeneity of borrowers from other causes, as a cause of variation in risk assessment procedures). Second, the perceived risk results on each borrower, which arise from the assessment procedure, must be publicly available, otherwise we shall have no measurable dependent variable in our analysis. Third, data on the characteristics of borrowers must be widely available, to the extent that the observer of lender behaviour can be reasonably confident that he has at his disposal the same set of relevant information on borrowers as do lenders. Fourth, there have to be enough borrowers to constitute a viable sample, and it must be possible to acquire a sample that is sufficiently large and representative to reflect the characteristics of the population. Fifth, it has to be a credit market in which there have been sufficient variations in market risk to facilitate the examination of the impact of movements in mean risk on lender behaviour (it will become apparent in chapter 3 why this is necessary when I present a rationale for the time-variance of signal weights based on movements in risk assessment investment driven by movements in mean market risk).

Given these fairly stringent requirements, the choice of credit markets suitable for empirical investigation is rather limited. It also implies that the boundaries of relevance of the literature will be clearly defined. It is my conclusion, that one of the few credit markets to meet these criteria (if not the only one) is that of sovereign debt. It is evident that this is a market where: (i) the same set of borrowers (namely sovereign states) can be traced over time; (ii) lender estimates of perceived risk are publicly available in the form of interest rate spreads, secondary market prices, and country credit ratings (see discussion of the dependent variable in chapter 4); (iii) data on the economic, debt, and political characteristics of countries are readily available, at least in hindsight (the main advantage that the lender has over the academic observer is that it can use its substantial resources to obtain up to date estimates of these characteristics whereas the researcher has to wait for official publication, which is not a handicap if the researcher can be satisfied with historical analysis); (iv) there is data available on a sufficient number and types of countries to ensure a representative sample, and the feasibility of tracing these borrowers over time means that data can be pooled to avert degrees of freedom problems; (v) LDC debt crises and cycles in world economic activity ensure variation in market wide risk.

It is not surprising, given the research-friendly nature of sovereign debt markets, that much of the work on the analysis of risk assessment has been written in this context. Thus, in practice, the stringent criteria listed above leave no shortage of literature to be reviewed.

2.1.1.2 Credit Rationing

The third strand of literature (credit rationing) is chosen because of its relevance to chapters 5, 6 and 7 of the thesis, which examine the links between risk assessment, credit insurance and credit rationing. I will thus only give an overview of the credit rationing literature (truly vast in its entirety) that is relevant to the thesis, which is effectively confined to the theoretical explanations put forward for equilibrium credit rationing (one of the innovations of the thesis is to provide an additional theoretical rationale for the existence of credit rationing, namely credit insurance with endogenous terms).

2.1.1.3 Credit Insurance

The final strand of literature to be considered is that relating to credit insurance, which is relevant to chapters 6, 7 and 8 of the thesis. Because it is one of the aims of the thesis to examine empirically the demand for credit insurance, as in the choice of perceived risk literature, the credit insurance literature is selected on the basis of finding a real life credit market with relevant characteristics. This implies constraints in terms of finding a market where data is readily available on borrowers, the price of credit insurance, and on the loan characteristics. Because most loan insurance procedures are even more of a black box than lender risk assessment procedures, the shorter list of requirements is no less restrictive in the choice of markets that are suitable. The process of elimination left two practicable possibilities. First, the UK mortgage payment protection insurance (MPPI) market; and second the UK Loan Guarantee Scheme (LGS). In the end, the selection was narrowed further to the choice from a set of one because the LGS has already been extensively researched by Cowling (1995) and access to appropriate data was not possible within the time frame of the research. Thus, analysis of the demand for MPPI was selected as the optimal research path. Due to the complete absence of empirical work on the take-up of MPPI in the existing literature, this resulted in ground breaking work in this area (presented in chapter 8) by providing the first estimates of MPPI take-up elasticities.

2.1.2 Gaps in the Literature

In the final section of this chapter, I will aim to highlight the main gaps in the literature. It is the view of the author that the most striking gaps are not to be found within the subject areas themselves, but between them. Although each of these streams of research have become established subjects in their own right, each has developed independently, and their paths rarely cross. Consequently, although research in some of the areas has matured to the point of near saturation, the interface between them remains undeveloped, and it is at this interface that the present thesis aims to make progress (hence the eclectic nature of the thesis and the strategy of presenting it as a series of papers, rather than a single unified thesis). The final section of this chapter, then, will point to the most obvious areas of neglect of *inter*, rather than *intra*, disciplinary credit-market research, and identify the particular gaps that this thesis aims to fill.

We shall now move on to consider the first relevant strand of literature: analyses of actual risk.

2.2 Analyses of Actual Risk

The empirical literature on risk analysis can be divided into two broad groups: i) direct (or *actual* or *objective*) assessments of risk determination, which are essentially models of *country* behaviour; and ii) assessments of perceived (or *subjective*) risk determination, which essentially model *bank* behaviour. Figure 2.1 gives a diagrammatic representation of the two distinct concepts. Starting from debt, economic and political characteristics (depicted in the middle of the diagram) these variables are assumed to determine the decision to default/reschedule. From these observable outcomes, analyses of actual risk attempt to estimate the relationship between default decisions and the characteristics of the country. Analyses of *perceived* risk, on the other hand, do not examine the default decision directly, instead they are interested in how the characteristics of country relate to the lender's estimate of risk. They are thus concerned with the risk assessment procedure of banks rather than the default decision of borrowers. The second class of literature (analyses of the determination of perceived risk) has emerged because there is no one commonly accepted equation that defines objective risk, nor is there one common equation used to explain perceived risk, and so questions about bank behaviour and optimal risk assessment have emerged.

As we shall see later in thesis, the lender's assessment and perception of risk feedback to the debt characteristics of the country because they determine the risk premium and quantity of credit offered to the borrower (hence the connecting arrow in the diagram between 'Subjective/Perceived Risk' and 'Debt Characteristics of the Country').

2.2.1 Accuracy of Risk Assessment

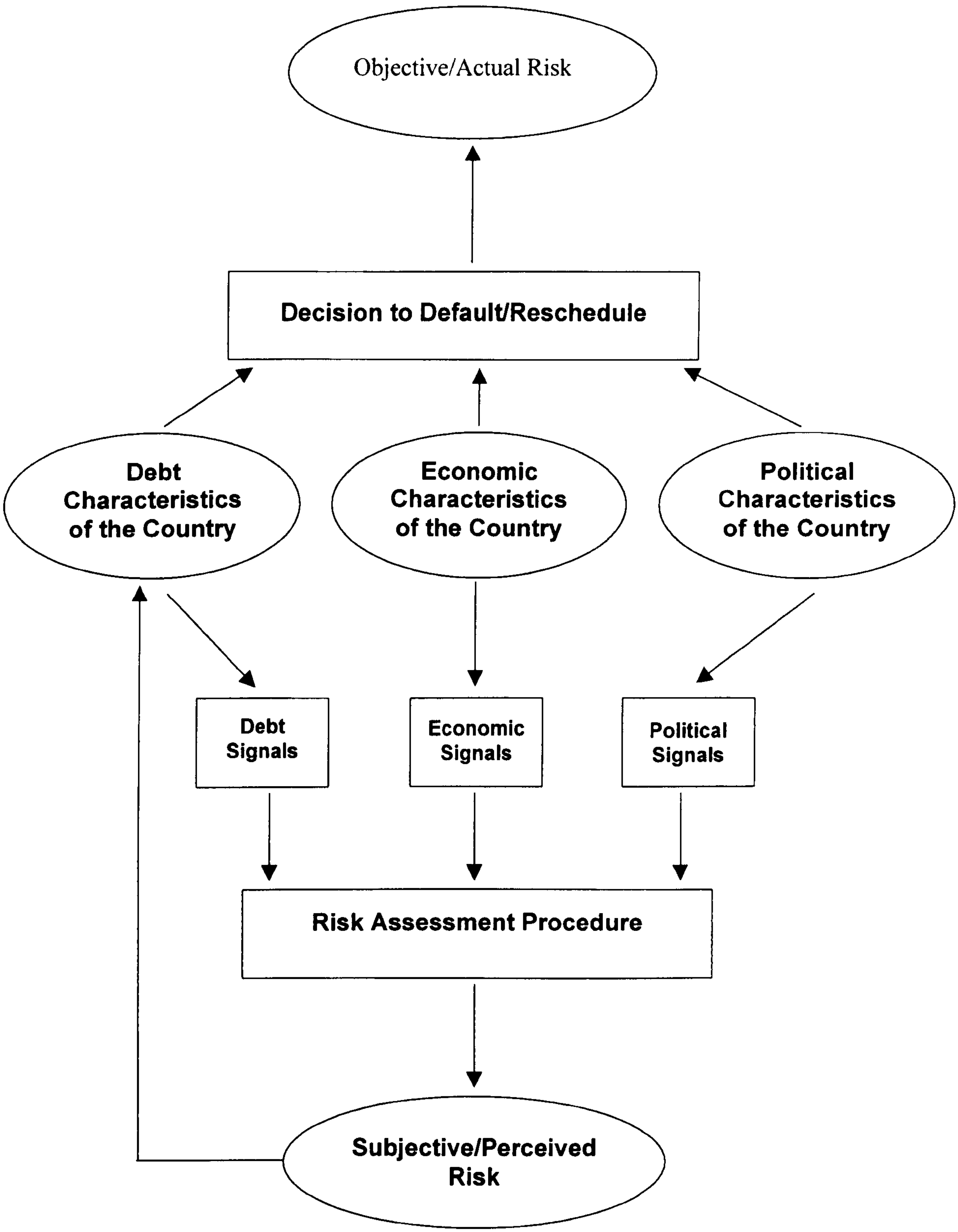
That the measurement of risk by the banking community is not exact, is supported by the failure of the banking community to anticipate successive debt crises (such as the sovereign debt crisis of the early 1980s and the UK house repossessions crisis in the early 1990s; the subjects of chapters 4 and 8 respectively). The extent to which bank assessment improves subsequent to such crises is questionable and certainly does nothing to invalidate this assumption as no lender would claim error free risk assessment. The credit market is thus generally perceived to be one of asymmetric information: banks not able to observe the true risk of default. Indeed, some have questioned whether the majority of banks use any method of systematic assessment at all, relying instead upon qualitative assessment (Goodman, 1978), though most would agree that risk assessment has become more sophisticated and quantitative over time, indicative of the growth and wide dissemination of computer technology (Hefferman *et al.* 1985a,b). There is also evidence (Goodman *op cit.*; Kutty 1990) to suggest considerable variation between institutions at any point in time with regard to risk assessment. Kutty (1990), for example, notes that, 'Some banks rely on a single yardstick, such as the debt service ratio, some others use check lists to evaluate sovereign risks' (Kutty, 1990, p.1649).

Given this dichotomy between actual and perceived risk, it becomes immediately obvious that even the sophisticated academic studies of sovereign risk are themselves less than perfect and so arrive at measures which are still essentially *subjective*. The distinction remains useful, however, in that it allows us to distinguish between those studies which directly examine what determines the decision to default/reschedule, and those which analyse the risk assessment procedures of lenders. Some studies straddle the two categories of literature by comparing their own estimates of objective probabilities with those of published ratings, such as Balkan (1992), for example.

Although Hefferman (1986) provides a comprehensive review of the objective risk literature up to that time, and most analyses of country risk since then have included at least a brief review of the most salient literature, these reviews are either now out of date, or have largely neglected the *subjective* risk assessment literature. So it is worthwhile providing a brief survey.

Figure 2-1

Relationships Between Country Characteristics, Actual Risk and Perceived Risk



2.2.2 Theoretical Foundations of Actual Risk Analysis

On the whole, greatest emphasis has been placed on the influence of economic and debt variables. This is partly due to the popular assumption that the decision to reschedule is mechanically related to the economic and debt status of debtors; and partly due to the difficulties involved in measuring political influences. However, it is important that default is not seen (whether explicitly or implicitly) as a mechanical outcome of a series of events, as Edwards (1984) and the other early studies of objective risk, conceived it. Rather, it is 'the result of a set of decisions', both on the part of borrowers and of lenders. Thus in considering the determinants of 'default', lenders must consider factors which influence the *willingness* to repay, not just variables which affect the *ability* to repay. The same can be said of rescheduling:

> 'A nation's decision to reschedule its external debt reflects not only its economic circumstances, i.e. its ability to meet its obligations, but also its willingness to service these obligations. The latter reflects the political environment of the debtor nation in that the decision to reschedule is a political decision.' (Balkan, 1992, p.999).

Few studies have ventured so far as to include political variables in their analysis, and of those which have, only a handful offer any comprehensive conceptual framework to accommodate such influences, even though they have found them to be of considerable importance in the determination of objective risk. This is largely because, with the exception of Alesina and Tabellini (1988), the impact of political variables on risk was all but overlooked in the theoretical literature.

Most of the early theoretical literature was concerned with identifying and explaining links between the factors which drive the long run growth of the economy and factors which drive the size of debt and the decision to reschedule. In the context of domestic debt, Domar (1944) identifies the debt burden as the necessary tax rate to finance interest payments, when a government borrows a given fraction of output each period. Examination of the after-tax income of non-bondholders reveals that the link between the rate of interest on debt and the growth rate of output is the key relationship in assessing the debt burden. In extending this approach to external financial flows, Domar (1950) and Solomon (1977), among others, traced out time paths of macroeconomic variables, and compared the time paths of debt with income, or with debt service to income ratios. From these comparisons they evaluated the sustainability of the predicted foreign borrowing programmes. Provided the marginal return on investment exceeds the real interest rate, no debt difficulties are foreseen. Bardhan (1967) draws similar conclusions from more flexible neo-classical growth models, where foreign borrowing is treated explicitly as a means of maximising utility subject to an intertemporal budget constraint.

As Kharas (1984) notes, however, one of the main problems with the growth theory approach is that it can not be subjected to straightforward empirical analysis. The approach was unsuitable for analysing shocks to the system because there was 'no clear identification of the process by which overborrowing can occur', (Kharas

1984, p.416). For example, little indication was given of the viability of the growth path if major price changes occurred which have the potential to reduce the mean existing capital stock return, but raise the marginal return on new investment. Also, rates of interest were generally assumed to be constant.

Contract Theory Approach

A more recent theme in the theoretical literature has been attempts to construct equilibrium models which would give rise to a debt crisis (e.g. Eaton and Gersovitz, 1980, 1981). Such models usually construct an environment which has maximum credit levels or limited enforceability, and attempt to model a game between the debtor and creditor where it is usually advantageous for debtors to default at some point. If periods of world recession posit an optimum time for default as far as debtors are concerned, such models may go some way to explaining why defaults tend to cluster. However, as noted by Citron and Nickelsburg (1987), it seems unlikely that the wave of reschedulings that came in the sovereign debt crisis of the 1980s can be entirely explained as the outcome of an optimal borrowing strategy conceived of from the moment the loans were agreed.

2.2.3 The Empirical Approach

Parallel to these various strands in the theoretical literature, an empirical thread has emerged that has tended to stress 'the levels of macroeconomic variables at any point in time rather than emphasising the parameters of the system as in the theoretical approach' (Kharas 1984, p.416). These studies take account of the fact that the impact of such shocks will tend to be contingent upon the levels of the capital stock and outstanding debt (some also consider nature of the political regime in which rescheduling decisions are made, but usually estimation is done in absence of theory).

The rationale behind estimating objective default probabilities is clear: a reliable measure of sovereign risk would be of great value to the lending community as it would provide a guide to the appropriate risk premium that should be attached to a particular sovereign loan and provide an early warning indicator of default. Thus, the academic literature has attempted to develop the most appropriate procedure for estimating risk.

A number of fundamental problems have been encountered in these studies, particularly with regard to measurement of the dependent variable. The great majority of papers use methods that allow for a dichotomous limited dependent variable, such as logit or probit so as to take advantage of the extensive data on rescheduling. The aim is to,

> '[gauge] a country's prospects of repaying the funds loaned to it' using 'a variety of economic indicators, usually in the form of aggregate ratios' ... These ratios are introduced into formal models which estimate an "objective probability of default" for each country-case and classify countries into two categories (rescheduling and non-rescheduling) in order to arrive at an early warning model of debt-servicing difficulties'(Savvides, 1991, p.309).

The problem here, however, is the precise definition of default. Eaton *et al.* (1986) argue that most of the studies up to that point did not define what they meant by the term. In a two period model default can be simply conceived as, 'whenever the borrower gives to the lender less than the fixed amount that he is committed to pay' (Eaton *et al.*, 1986, p.483). But in a multi-period situation, the concept is more elusive: 'A default occurs whenever the lender *formally declares* that the borrower has violated a certain condition of the loan' (*ibid.*, emphasis mine).

The concept is further complicated by the fact that the lender does not *have* to declare the loan in default every time the borrower fails to meet scheduled repayments. The contract merely provides him with the right to do so. Indeed, in a multi-period situation, it is in the interests of the lender to attempt some type of rescheduling agreement with the borrower, rather than accept outright default. In fact, a loan may never be considered completely 'in default' since there always remains some unknown probability that repayments may resume some time in the future.

2.2.4 Measurement of Default

Ambiguity surrounding the definition of default has inevitably lead to problems regarding measurement. During the period 1960 to 1990, only two countries have actually been guilty of outright default: Cuba in 1961, and North Korea in 1974 (Balkan, 1992, p.1000) and even for these countries, there will always remain some probability that they will continue with repayments. As such, no dependent variable exists for the required period which explicitly represents repudiation and so authors have resorted to using the occurrence of rescheduling as a proxy. However, rescheduling, defined as an agreement initiated either by the debtor or creditor to redefine the terms or repayment (interest rate, grace period and maturity), may not be a very good proxy for default and there is a case for keeping the two concepts quite distinct.

First, it is not at all clear that rescheduling of loans is necessarily a negative event for the lender. Often banks can achieve an increase in the face value of the debt through rescheduling by offering additional loans to ease current interest repayment difficulties, but rarely offer any forgiveness of debt. Outright default, on the other hand, has no obvious benefits for the creditor, hence the tendency of banks to prefer endless debt-rescheduling over declaring the loan in default. (Either the creditor or the lender can suggest rescheduling, but the ultimate decision to reschedule remains with the debtor since the lender has little incentive to refuse new finance if the alternative is default).

Second, there is the issue of debtor bargaining power, which although of little relevance to the subject of default, may be of considerable importance in the decision to reschedule. This dichotomy arises because there is an additional variable involved in the decision to reschedule which is not involved in the decision to default; namely the *terms of rescheduling*. These include the interest rate, grace period and maturity agreed upon in the rescheduling contract. It has become evident that there are substantial differences in the terms offered on rescheduled loans to different countries, differences which have widened considerably since 1982. Larger middle income countries have managed to negotiate 'substantial increases in maturities and reduced spreads' (World Bank, 1993, p.87). Argentina, Brazil, Mexico, the Philippines and Venezuela, for example, have achieved reschedulings with 15 to 20 year maturities and with spreads of 13/16 per cent (*ibid.;* 13/16 per cent is 0.8125 =13 divided by sixteen over LIBOR, which is greater than the London inter-bank offer rate on US six month deposits). This compares with the much harsher terms of sub-Saharan African countries (Nigeria excepted). Mozambique was offered 15 years maturity with eight years grace in 1987, but with a margin of 1-1/8 per cent (i.e. 1.125 greater than LIBOR). Gabon (in 1987) was given 10 years maturity, with five years grace, and a spread of 1-3/8 per cent. Smaller countries such as Gambia (1987) and Malawi (1988) did even worse, receiving eight year maturities with 1 per cent margins (*ibid.*).

Using a multinomial logit model Lee (1991b) has shown that country size (measured in terms of GNP) and the absolute value of debt are important factors in determining the terms of rescheduling. These differences, it is argued, inevitably affect the rescheduling decision. If country A has a larger external debt and greater economic clout than B, A's expectations of obtaining favourable terms are likely to be greater than B's, and so it is reasonable to conclude that A will have more incentive to reschedule during times of difficulty than country B, *cet. par.*

2.2.5 Confusion of Rescheduling and Default

Thus, rescheduling is quite different to default, and is not even a good proxy. The latter cannot be viewed as simply an acute manifestation of the former. Nevertheless, there is much confusion in the literature between the two, and a number of authors speak of them synonymously (for example, Moghadam *et al.*, 1991, p.512; Citron and Nickelsburg, 1992, p.386). One of the few empirical studies to offer explicit definitions of default and rescheduling is Kutty (1990). Even so, his definition essentially equates default with rescheduling, and is not consistent with the traditional theoretical definition (Eaton *et al.*, 1986). Kutty's justification is that symptoms of repayment difficulties reflect the underlying likelihood of default. This assumption, as we have explained, may not always be valid.

A further possible aspect of the importance of distinguishing between default and rescheduling is that they are likely to require different policy responses. One of the questions investigated in the theoretical literature is whether a country having repayment problems is best helped by finance (i.e. new loans) or forgiveness (i.e. reduction of the contractual value of debt). Krugman's (1988) view is that liquidity is intrinsically linked to solvency since a country only encounters liquidity problems if there are doubts about its solvency. If reschedulings are tied to illiquidity, and illiquidity is linked to solvency, does this mean that reschedulings are linked to solvency? If so, there may be a case for supporting the use of rescheduling as a proxy for default.

The weakness of Krugman's argument is that it pivots on the assumption that decisions to default or reschedule are solely dependent on the solvency and liquidity of the country. In contrast, Eaton *et al.* (1986) argue that rescheduling and default are the outcome of a deliberate *decision*, not the mechanical realisation of economic forces. For this reason Eaton *et al.* (1986) emphasise their 'dissatisfaction with models that simply take critical parameters of the economy as exogenous and by so doing create a problem' (p.484). What these studies overlook is that a country can reschedule or default *without* having liquidity problems or being insolvent. The choice is based on an assessment of the costs and benefits involved. Costs will be perceived as the net present value of the punishment threatened by lenders, usually assumed to be the exclusion from the capital market after the time of default. The exact exclusion cost will dependent on the circumstances involved, such as the volume of international trade (Eaton and Gersovitz, 1980), the fluctuations of unsmoothed consumption (Eaton and Gersovitz, 1981), and the restriction to capital accumulation (Allen, 1983). Benefits of default, on the other hand, will be evaluated as the net present value of outstanding debt obligations and interest payments which would otherwise have to be transferred to the creditor if repayments continue.

Furthermore, such choices are not made in a political vacuum. Each decision is likely to be influenced by cultural and political factors as well as economic variables. A distinction should also be made between the country and the decision making body of that country, since governments may make decisions in their own interests, but which are at odds with the interests of the country at large. For instance, a government may choose to default in order to maintain its own political stability (Citron and Nickelsburg, *op cit.*), or for the benefit of the social class it represents (Alesina and Tabellini, 1988), but there is nothing to guarantee that either of these decisions are in the long term interests of the population as a whole. This fundamentally undermines the mechanical application of economic theory to rescheduling decisions because the emphasis on the role of economic and debt variables assumes that the incumbent aims to maximise the welfare of its citizens, and so its behaviour is congruent with the optimisation principles of standard neo-classical economic theory. When this assumption breaks down, the relationships between rescheduling, default, illiquidity and insolvency become inevitably ambiguous.

Thus, in general the government will decide to reschedule (default) if and only if

$$U_R \geq U_N$$

where U_R is the expected government utility from rescheduling (default) in each period, and U_N is the expected government utility from not rescheduling (defaulting) in each period. The extent to which these utilities coincide with the social welfare function of the nation is given by

$$T = (W_R - W_N) - (U_R - U_N)$$

where,

T = transparency of the political system,

Wj = social welfare function in the reschedule (R) or no-reschedule (N) states of the world.

The value of T is contingent upon the incentive structure of the political process and the quality of democratic representation. The extent to which they reflect exclusively the standard measures of international liquidity and solvency depends heavily upon the level of influence which political factors have in the decision making process. Thus illiquidity and insolvency cannot be used to justify a systematic relationship between rescheduling and default since the decision to do either is only ambiguously related to the concepts of liquidity and solvency.

Interpreting the reschedulings

How then should reschedulings be interpreted? Eaton *et al.* (1986) offer a number of definitions. One interpretation is that rescheduling is a another means of issuing a long-term loan. This has a number of advantages for banks over explicit long-term loans in that it gives the creditor 'more control over the borrower's indebtedness' (*op cit.* p.510). Thus 'short-term loans may be employed even when it is correctly anticipated that there will be high probability of a rescheduling' (*ibid,* p.510).

The conclusion is that, in the context of empirical testing, it is more accurate (but less ambitious) to interpret estimates of 'risk' in discrete dependent variable models as attempts to estimate 'risk of rescheduling' rather than the 'risk of default'. Clearly, the consequences to lenders of rescheduling are by no means so catastrophic as in the case of absolute default. As such, the rationale behind estimating the risk of rescheduling is less forceful than that behind the estimation of the risk of default; although authors have argued that reschedulings are costly and de-stabilising, and as such banks wish to avoid them. Nevertheless, it is safer to limit the conclusions that can be drawn from these models to those which refer to rescheduling rather than to default. Moreover, if it is recognised that it is actually the risk of rescheduling that is being estimated, it becomes a serious deficiency if such a model does not at least attempt to include the influence of the expected terms of rescheduling upon the decision to reschedule, since it is clear that these terms influence the decision to reschedule. Few of the studies considered in this review actually did this (the principal exception is Lee 1991a) and so we view this to be a major weakness of the literature so far.

2.2.5.1 Estimation Method

As already mentioned, the methods of estimation applied have tended to be heavily influenced by the nature of the dependent variable, particularly with respect to its dichotomous nature. From Table 2-1 it can be seen that the most common method of estimation is logit, followed by probit and discriminant analysis. Although similiar, each statistical method will produce slightly different results (Maddala 1992).

Table 2-1 Estimation Methods in Analyses of Actual/Objective Risk

Method	Studies
Logit	Kutty, 1990 (logit); Lee, 1991a (logit); Feder *et al.*, 1981 (logit) Oral *et al.*, 1992 (logit, G-logit) Citron and Nicklesburg, 1987 (logit);
Probit	Balkan, 1992 (probit) Moghadam and Samavati, 1991 (probit); Moghadam *et al.*, 1991 (probit); Kharas, 1984 (theory + probit); Savvides, 1991 (simultaneous probit);
Discriminant Analysis	Frank and Cline, 1977 (Discriminant); Taffler and Abassi, 1984 (Discriminant).
Multinomial Logit	Lee, 1991b (multinomial logit)
Generalised Logit	Oral *et al.*, 1992 (logit, G-logit)

Few authors have strayed from using one of the three principal approaches, the main exception being Oral *et al.* (1992) who compare the performance of logit with Generalised Logit (G-logit), based on algorithms developed by the authors themselves, and found that under the given circumstances, the G-logit model was an improvement on the standard logit model. Linear probability models have generally been avoided because it is 'generally unsuitable when the dependent variable takes 0 or 1 since there is no guarantee that predicted probability will lie within the probability limit of 0 and 1' (Kutty, 1990, p.1651).

The seminal paper which set the precedent for the application of dichotomous dependent variable models to risk assessment was the article by Frank and Cline

(1977) which used quadratic discriminant analysis to estimate creditworthiness. More recently the paper has come under criticism because of 'the group overlap between rescheduling and non-rescheduling cases causing a weak discriminatory power of the model' (Kutty 1990). What makes the study unusual, however, is that it was done before the debt crisis and so predated the subsequent flurry of interest in sovereign risk.

Although discriminant analysis is less widely used in the economics literature as a whole, Taffler and Abassi (1984) defend the use of discriminant analysis on the basis that logit and probit techniques are not superior to the discriminant analysis, particularly when continuous explanatory variables are used and 'where the groups are well separated' (Taffler and Abassi, 1984, p.548).

Another important deviation from the standard risk estimation procedure is Lee (1991b). This study hypothesises that borrowers become increasingly likely to seek a debt rescheduling—rather than risk the consequences of default—as the probability of default increases. Lee goes on to make the assumption that increases in the risk of debt rescheduling are necessarily indicative of increases in the probability of default, although, as already stated, this assumption is questionable. Lee separates commercial rescheduling cases into subgroups and constructs a trichotomous multinomial logit model accordingly. Dependent variable groups are defined as follows, $Y = 0$ if no rescheduling; $= 1$ if 'pure' rescheduling; and $= 2$ if 'partial' rescheduling. 'Pure' rescheduling is defined as those rescheduling cases in which a borrower managed to postpone its obligations, but failed to negotiate a lowering of the terms of repayment; and 'partial' rescheduling is defined as those rescheduling cases in which a borrower *does* manage to negotiate lower debt service obligations.

Lee's method of distinguishing between 'pure' and 'partial' instances of rescheduling is to subtract the average spread on all new loans (NLS—new loans spread) was calculated as the difference between the average interest rate charged on all new loans to a particular country and the LIBOR on US six month deposits during the rescheduling period. Data were obtained from World Bank (1993) in the rescheduling year from the spread in the rescheduling agreement. This gives the CS (comparison of spread):

RS	-	NLS	=	CS
(Rescheduling Spread)		(New Loans Spread)		(Comparison of Spreads)

If the CS is positive, the rescheduling case is *pure*; if negative then the rescheduling case is *partial* (That is: *If* RS $\geq$ NLS *then* Pure Rescheduling; *if* RS < NLS *then* Partial Rescheduling).

This method requires the calculation of the difference between the NPV (Net Present Value) obtained using rescheduling terms (i.e. interest rate, grace period, and maturity) and NPV obtained using the average terms on all new loans contracted by the borrower during the agreement year. If this calculation produces a negative figure, then that rescheduling case is 'partial'. In all but three cases (Sudan in 1981 and 1982, Mexico in 1984), however, the NPV method produced equivalent results to the CS method.

These studies, although of interest in themselves, are relevant only indirectly to the remainder of the thesis in that they provide the necessary context (rather than core substance) to the perceived risk studies of sovereign debt, which are our main concern. Because neither academic researchers, nor lenders, have agreed upon a unified single approach to estimating default risk (Burton and Inoue, 1983), studies have emerged which investigate the actual nature and process of lender risk perception. It is to these studies that we now turn.

2.3 Analyses of Perceived Risk

It was noted in Chapter 1 that economic decisions are always in the context of uncertainty and are inevitably made on the basis of subjective probabilities (rendering the distinction between risk and uncertainty redundant). Thus, it is contended that the papers described above as studies of 'actual' or 'objective' risk are inevitably and intrinsically subjective because the estimates of risk calculated by these authors, no matter how sophisticated and rigorous, are still *estimates*. As in the tossing of 'fair die', one can never be objectively certain that the risk assessment procedures involved are unbiased, exhaustive and appropriate. Nevertheless, the aforementioned papers are distinct from what has become known as the 'perceived risk' literature since the latter do not attempt to make estimates of risk *per se*, but to analyse the determinants of lender perceptions of risk. Since it is on the basis of 'perceived' or 'subjective' risk that lending decisions are made (actual risk, as Hirshleifer and Riley, 1992, correctly stipulate, is in the strictest sense merely a theoretical abstraction and never the basis of economic decisions) it is of considerable importance how these perceptions are determined. In the words of Feder and Just, 'Lenders' behaviour ... depends crucially on their subjective evaluation of the probability of default' (1980, p.125). However,

> '... to explain lender behaviour, knowledge of lenders' subjective information is generally unobservable; and empirical analysis of lending behaviour is, therefore, difficult. Furthermore, there is often reason to believe that subjective information may vary considerably from lender to lender or from transaction to transaction because of previous experience, personal relationships, etc; and, hence, the role of subjective perceptions cannot be ignored'. (Feder and Just, 1980, p.125).

2.3.1 The Absence of Bayes

The above comment from Feder and Just goes some way to explaining why the most obvious framework for analysing perceived risk—Bayesian statistics—has not been applied in the sovereign debt context: namely, because of the unobservability of key aspects of lender behaviour. Bayesian methodology only adds to the understanding and modelling of decisions made under uncertainty when the revision of beliefs in the light of new evidence can be explicitly incorporated into the analysis. It is therefore clearly not relevant in the context of the credit rationing models of chapters 5, 6 and 7 where the loan offer is a one off decision in each case. The methodology would seem most appropriate in the context of lending decisions where borrowers take out long term loans with variable interest rates or where the same borrowers return for additional credit. That this applies to the sovereign debt market suggests at first sight that Bayesian statistics would be an appropriate method of risk estimation for international lenders. There are four reasons, however, why Bayesian analysis has not been applied in this thesis (and in the perceived risk literature in general):

1. Chapters 3 and 4 are concerned not with deriving a robust estimate of the default risk of each country (for which Bayesian statistics may be useful), but with how lenders assess risk and the weights they place on determinants. We are not interested in prior and posterior probabilities.
2. To apply Bayesian analysis we would have to attribute to lenders their perceived prior probabilities. In the event, we only have data on lenders posterior probabilities—measured by Country Risk Ratings. That is, we can only observe the published perceived probabilities of default after risk assessment has been completed in each period.
3. It is not possible to observe the relationship between new information and revised posterior probabilities in subsequent periods because we do not know what new information has caused the revision. We can only observe changed posterior probabilities and infer changes in the weights that lenders place on determinants, but we cannot say which new information in particular has caused the change in weights. We can only draw the more general conclusion that the change in weights has come about due to some change in the risk assessment procedure.
4. The literature (for example, Hefferman 1986) suggests that lenders in fact adopt a more classical approach to statistical risk assessment, rather than a Bayesian approach, even if Bayesians (such as Phillips, 1973, p.69) have long argued that the application of Bayesian methods is the only certain way of rationally interpreting data.

2.3.2 Nature of the Literature

It should be noted that the perceived risk analysis is distinct from the costly monitoring literature (for example, Williamson, 1987) which assumes that lenders 'know as much as borrowers about the riskiness of the projects being funded, but only the borrower is able to observe his project returns costlessly.' (Hillier and Ibrahimo, 1993, p.276). The risk assessment literature, in contrast, assumes that lenders are also asymmetrically informed about the risk, not just the return, on loaned funds. Lenders are assumed to know less than borrowers about the riskiness of the projects being funded, and lenders consequently undertake some form of risk assessment to discover something of the borrower's true risk before lending.

Fortunately, many of the problems that surround objective risk estimation are not encountered in the analysis of subjective/perceived risk. This is largely due to the fact that, whilst subjective risk analysis is not without its problems with regard to dependent variable measurement and definition, the difficulties encountered are by no means so severe as those encountered in the conceptual minefield of using rescheduling as a proxy for default. In contrast to objective risk analysis, models of bank behaviour have a number of measures to choose from which could act as dependent variables (see discussion in chapter 4).

Interest in the assessment procedures of lenders and in the determination of perceived risk has arisen out of the apparent failure in a number of credit markets of the banking community to anticipate repayment crises. Recent examples include the 1992 repossessions debacle in the UK mortgage market (see chapter 8), the ongoing Asian crisis, and the Third World Debt problem. Because of its amenability to empirical research (see the introduction to this chapter) much of what has been written about perceived risk analysis has been in the context of the latter of these credit market problems.

The determination of perceived risk is not just of academic interest, if for no other reason, than that it has direct and profound financial consequences for borrowers. If the risk premiums attached to loans are driven by lender perceptions, it is in the borrower's interests to comply with the lender's signals of risk. If, however, lender perceptions are not consistent over time, it will be difficult for borrowers to identify how to maximise its perceived creditworthiness.

It has been argued (see Feder and Ross, 1982; Edwards, 1986) that banks themselves had a significant role in the development of the sovereign debt crisis, particularly with respect to their failure to anticipate the crisis, and the extent to which, as a result, lending institutions over-exposed themselves to problem countries. It could be even argued that if banks had successfully anticipated the repayment problems of participating countries, much of the crisis could have been avoided. Accordingly, a strand of empirical literature (Feder and Ross, 1982; Edwards, 1986) has focused on what Savvides terms the 'subjective probability of default' (Savvides, 1991, p.310). This probability is reflected in measures such as the LIBOR spread, and published risk ratings such as *Institutional Investor* and *Euromoney*. These studies have attempted to identify the factors which drive the process of sovereign risk assessment and focus not on the behaviour of borrowers, but on the conduct of the international banking community.

There are two main questions of interest and relevance to this thesis: first, *How do banks assess risk?* That is, what variables do they take into account before calculating the creditworthiness of a country. This is discussed further in chapter 4 where *a priori* possible influences are categorised into three areas: economic, debt, and political factors. Second, *has their method of assessing risk changed since the debt crisis? If so, how?* In particular, how have they changed the relative weights they put on these various factors? This is important because it has implications for borrowers in terms of how they restructure their economies to maximise their perceived creditworthiness. This is also the subject of chapter 4 and forms the motivation for the empirical search for structural breaks in the relationship between perceived risk and determinants.

Related to both these questions is the extent to which lender's assessment of risk is distorted by bias and prejudice. Just as the state failure literature (Alesina, 1989; Alesina, 1987; Brown and Jackson, 1990; Heald, 1983; Hibbs, 1977; Nordhaus, 1975) has critiqued the notion of the objective, disinterested policy maker, so too assumption of risk assessment on the basis of purely objective and rational criteria may be unrealistic. The judgement of risk assessors may be distorted by their own political bias, prejudices and knee-jerk reactions. To what extent (and in what direction) are banks influenced by whether governments are socialist or capitalist, totalitarian or democratic, stable or unstable? What role, if any, does income inequality and civil rights have upon risk assessment? Clearly answers to these questions have implications for policy makers in developing countries and for the ethics of country risk assessment. These non-cognitive aspects of the decision making process may thus dominate, or at least introduce bias to the empirical assessment of risk. Consequently, any model of risk assessment must allow for this.

2.3.3 Perceived Risk Literature

A more comprehensive discussion of the literature on perceived risk and econometric modelling is given in the next chapter, and so what follows is a brief summary. In contrast to the objective/actual risk studies, the perceived/subjective risk literature is relatively undeveloped and some of these questions have yet to be considered in any depth (for example, the issue of the determination of perceived risk changing over time). This is indicative of the theoretically-lightweight nature of the literature as a whole. There are exceptions, such as Feder and Just (1980), who offer a theoretical basis for analysing lenders' perceived risk, but even here, there are major theoretical shortcomings in the assumption that interest rate spreads reflect perceived risk and do not affect the probability of default (these issues are discussed in more detail in chapter 4).

Most studies are purely empirical and attempt to establish the relationship between indicators of subjective risk and likely determinants. The dependent variable is some measure of perceived risk, such as interest rate spread (Feder and Just, 1977, 1980; Haegel, 1980; Edwards, 1984; Gottlieb, 1989; Calvo and Kaminsky, 1991; Rockerbie, 1993), or some risk rating composed from a survey of lender opinions (Feder and Ross, 1982; Feder and Uy, 1985; Brewer and Rivoli, 1990; Cosset and Roy, 1991; Seck, 1992; and Lee, 1993). One study (Balkan, 1992, p.999ff) compares performance of these various measures (*Institutional Investor*, *Euromoney*, and *International Country Risk Guide*) with that of a probit model constructed along the same lines as the objective risk studies.

Explanatory variables in these models include all measurable influences on the lender's perception of borrower risk. However, if creditors do vary their level of risk assessment according to the level of market risk (as suggested in chapter 3), there may be implications for the validity of conventional econometric estimation procedures (tested in chapter 4). Detailed discussion of these papers is given in chapter 4, and so there is little to be gained from providing more detail here on the variables and techniques used. It is worth noting, however, the main gap in the literature which this thesis tries to plug in chapters 3 and 4. Studies of perceived risk have invariably assumed a constant relationship between risk and determinants. This is an important assumption in a number of ways. First, if true, it implies that lenders set interest rates in a consistent way. Second, it means that borrowers have a clear and fixed goal to aim for in terms of manipulating economic policy to maximise creditworthiness and minimise the risk premium they face in international markets. This assumption has not been seriously challenged or tested before except in a very limited way by Thapa and Mehta (1991) who tested for a structural break between the sample periods 1979-1981 and 1982-1983. They found that the Chow test statistic was not significant, and so the null hypothesis that the two regressions were the same could not be rejected. However, they did not test for structural breaks across other time periods and only included a limited selection of explanatory variables (with no measure of political stability). They also did not consider any theoretical rationale for structural breaks. The aim of Chapter 3, therefore, is to provide a theoretical rationale for why the assumption of constant parameters may not hold. Chapter 4 then attempts to test empirically whether perceived risk parameters have indeed remained stable over time by testing for structural breaks between a range of time periods.

2.4 Credit Rationing

Central to any empirical analysis of perceived risk is *measurement*. What constitutes a reliable indicator of lenders' opinion of borrower credit risk? As discussed above and in Chapter 4 below, the measure most commonly used has been interest rate spreads. This has the obvious drawback of not picking up the effect of credit rationing as an aspect of lenders' response to risk. Rather than raising the interest rate on loans to a group of borrowers who are perceived as becoming more risky, lenders may simply ration credit to this group. Hence interest rate differentials may not have a consistent relationship with differences in perceived risk. It is thus necessary to consider the literature on credit rationing, particularly since an additional rationale for the existence of credit rationing is offered in Chapters 5, 6 and 7.

Not all of the vast and sprawling literature on credit rationing is of equal relevance to the core themes of the thesis. The main reason for the growth of interest in credit rationing is the implications it has for a number of other fields, not least the impact on the macro-economy, which has been discussed at length in the literature (Greenwald and Stiglitz, 1993; Baachetta and Caminal, 1996). The main concerns of the macro effects of credit rationing are that during 'episodes such as the Great

Depression, developments in credit markets seem to have amplified output fluctuations' (Baachetta and Caminal, *op cit.*, p.1; see also Bernanke, 1983), though systematic evidence on the link between financial factors and business cycles is still tentative (Baachetta and Caminal, 1996). Given the potential importance of credit rationing in determining macro variables, it is not surprising that a large literature exists specifically devoted to this field. Greenwald and Stiglitz (1993), Baachetta and Caminal (*op cit.*) provide dynamic general equilibrium models where capital market information asymmetries exacerbate output fluctuations. Because a number of surveys of the literature on the ramifications of credit rationing already exist (Gertler, 1988; Lowe and Rohling, 1993), and since these ramifications are not *per se* the subject of this thesis, there seems little to gain from providing an exhaustive review here. It is true that the macro effects of credit rationing may be a source of feedback to the actual risk of default, but this link is tenuous since the type of credit rationing considered in this literature is primarily that faced by individuals and firms borrowing from domestic lenders, not sovereign nations borrowing from external banks. Credit rationing may still have adverse implications for the macro economies of these countries, but not through the kind of transmission mechanisms developed in such papers.

There has also been research which considers the impact of credit rationing on specific markets (Leece, 1995, for example, examines the UK mortgage market), but little has been done to explore the implications for perceived risk, and nothing at all on the impact of credit insurance on credit rationing.

Whilst the 'macro effects' literature is not directly relevant, studies which provide a theoretical rationale for credit rationing are of interest, since one of the main aims of the thesis is to proffer a new explanation for the *cause* of credit rationing. Thus, it is worth spending some time summarising the 'explanatory' literature. Again, a number of more than adequate reviews already exist (Clemenz, 1986; Hillier and Ibrahimo, 1993) and so there is little to be gained from providing an in-depth review, or from attempting to compare the various models within a common framework (this has already been done by Clemenz, 1986). So what follows is a review with enough detail to trace the development of the theoretical credit rationing literature and to identify where the developments presented in chapters 5, 6 and 7 fit into the overall landscape of existing work.

It is worth noting, as an introduction, that although the ramifications of credit rationing have been amply explored and tested for in a variety of directions, there is only a small number of adequate *theoretical justifications* for the existence of equilibrium credit rationing. Indeed, finding a sound conceptual foundation for credit rationing equilibria has escaped economic theorists until relatively recently, becoming something of a Holy Grail in the 1960s and 1970s.

The intractability arose from the surprising theoretical robustness, under the assumption of full-information, of the traditional automatic adjustment mechanism of the market. In most markets, a situation where supply does not equal demand constitutes a position of disequilibrium. Hence, 'Conventional economic theory has traditionally viewed market clearing and market equilibrium as being one and the same' (Clemenz, 1986, p.15). However, the equivalence of market clearing and equilibrium is not inevitable; it is merely the consequence of certain informational assumptions. If these assumptions are relaxed, particularly in the case of credit markets, a non-market clearing position (particularly excess demand for credit) is possible. Thus, equilibrium credit rationing is defined as occurring where there are no net forces in the system to bring about change to quantity or price, even though demand exceeds supply. For this type of credit rationing to be a theoretical possibility, therefore, there has to be some explanation of why it is not in the lenders best interests to raise the price of credit to clear the market.

This has proved to be a more difficult goal to achieve than casual theorising might suggest. The early attempts at solving this puzzle tried to find a solution within a full-information framework and tended to examine what Clemenz (*op cit.*, based on Keeton's 1979 distinction) described as Type I rationing; that is, where 'some or all loan applicants get a smaller loan than they desire at the quoted loan rate of interest'. More recent models have tended to consider what Clemenz classifies as Type II rationing: 'some loan applicants are denied a loan even though for the bank they are indistinguishable from accepted applicants' (p.18). It is the possibility of credit rationing in the presence of perceived homogeneity of applicants that has proved to be of most interest, hence the shift of emphasis towards it.

Another characteristic of the early attempts to explain credit rationing was their assumption that borrowers had different wealth endowments, and hence different capacities to offer collateral. Studies which employed this core assumption include Hodgman (1960), Freimer and Gordon (1965), Jaffee (1971), Jaffee and Modigliani (1969, 1976), Smith (1972), and Azzi and Cox (1976). These studies attempted to show, for example, that the probability of default was greater for larger loans and that this may lead the bank to restrict the size of loans to certain borrowers. Clemenz, *op cit.*, notes that a general weakness of these studies, however, was a failure to explicitly model the demand side. When consideration of demand was fully taken into account, it became impossible to demonstrate the optimality (and hence potential for equilibrium) of rationing. Adjusting price or offering separate prices to the different classes of borrowers, always proved more profitable to the lender than restricting quantity. Clemenz concludes that 'the older literature on credit rationing, though it offered some valuable insights, did not provide a satisfactory explanation' (*op cit.* p.31).

Two more successful attempts at a theory of equilibrium credit rationing were proffered by Cukierman (1978) and by Fried and Howitt (1980). Cukierman's explanation pivoted on the assumption that lenders offer a range of services besides credit, such as 'demand and time deposits, foreign exchange transactions and in some countries like Israel even brokerage functions' (Cukeirman, 1978, p.165, quoted in Clemenz *op cit.* p.31). By assuming that the demand for banking services is an increasing function of the loan size, Cukierman showed that customers with a lower propensity to buy banking services may be rationed if the lender has to charge one loan rate to all borrowers. Fried and Howitt attempted to apply implicit contract theory as a means of explaining credit rationing. By assuming a volatile deposit interest rate (causing fluctuations in the loan rate) they assume that the lender insures risk averse borrowers by offering them a fixed interest rate, and it is this implicit contract which (in certain circumstances) results in credit rationing.

Both the Cukierman and the Fried and Howitt explanations had major weaknesses of their own, however. In the Cukierman model, the weakness lay with the uniform rate restriction: 'if the bank were free to charge different loan rates to different clients rationing would not occur' (Clemenz *op cit.*, p.33). The main weakness of the Fried and Howitt model is that, following the onset of the loan agreement, there is always an implicit incentive either for borrowers to attempt renegotiation of the loan terms or for lenders to offer a lower interest rate, depending on whether the fixed loan rate is above or below the deposit rate plus administration costs.

A convincing rationale for equilibrium credit rationing did not really appear until the development of the theory of asymmetric information. The seminal work of Arrow (1968) and Akerlof (1970) showed how markets could radically deviate from their conventionally ascribed patterns of behaviour when the traditional assumption of complete information was relaxed. Arrow developed the principal-agent framework, and refined the notion of 'moral hazard': the possibility that where the preferences of principal and agent differ and where the principal's knowledge of the agent's behaviour is less than complete, the agent may be tempted to take actions which are sub-optimal for the principal. Akerlof's contribution was to highlight the importance of adverse selection, which focused on, 'the difficulty of distinguishing good quality from bad' which Akerlof argued was 'inherent in the business world' and may 'explain many economic institutions' (1970, p.500). In his example of the second hand car market, Akerlof showed how the buyer's lack of information on quality may lead to sellers of high quality goods withdrawing from the market resulting in the fall in average quality of goods on sale (i.e. 'adverse selection').

The first applications of these concepts to credit rationing were by Jaffee and Russell (1976), and S&W. In Jaffee and Russell's model, borrowers vary with respect to their costs of default, and from this they demonstrate that an increase in the rate of interest may result in an increase in the share of defaulters. In S&W borrowers vary by the riskiness of their projects, with risky projects being more profitable. This means that good risks have a lower threshold interest rate and so are screened out by a rise in the rate of interest. These applications showed how, unlike conventional markets, a rise in price has a deleterious effect on the quality of the lender's loan portfolio, and thus provided a possible incentive for lenders not to raise the rate of interest to clear the market when there is excess demand. This led S&W to conclude that,

> 'The Law of Supply and Demand is not in fact a law, nor should it be viewed as an assumption needed for competitive analysis. It is rather a result generated by the underlying assumptions that prices have neither sorting nor incentive effects. The usual result of economic theorising: that prices clear markets, is model specific and is not a general property of markets – unemployment and credit rationing are not phantasms' (S&W, p.409).

Since the S&W model will be reproduced and extended in Chapters 5, 6 and 7, nothing more will be said about it here. It is sufficient to say that a number of developments have been made since their paper, most notably the development of multi-period models, and the inclusion of endogenous collateral. The one-period nature of the S&W model has been cited as an important weakness (Clemenz, *op cit.*) and so attempts have been made to anticipate the effect of extending the model to a multi-period framework. Clemenz (1986) makes some steps towards a dynamic extension of the S&W model; a multiperiod version is attempted by Stiglitz and Weiss (1983), and other developments have been made by Diamond (1989), and Bester (1994).

One of the limitations of the theory so far, however, is that it has not taken into account the effect of risk assessment or of credit insurance. The literature has tended to assume that lenders' information set is fixed or exogenous, but most lenders in reality have a choice of how much knowledge they choose to accumulate on borrowers. Increased expenditure on risk assessment reduces the pooling of risks and the asymmetry of information and hence reduces the moral hazards and adverse selection that generates the S&W result. In that sense, the common assumption in the literature is a heroic one. In addition to the option to assess risk, both lenders and borrowers usually have the opportunity to insure against the risk of default. Again, the implications of credit insurance for the credit rationing results have been overlooked. It is therefore the aim of chapters 5, 6 and 7 of the thesis to rectify to some extent this omission and explore the impact of introducing risk assessment and credit insurance into the S&W model. Having already discussed the risk assessment literature I shall now review the insurance literature which has emerged relatively independently.

2.5 Credit Insurance

Most of the literature examining the relationship between insurance and credit markets has been in the context of deposit insurance (McCulloch, 1985, Thomson 1987; Urrutia, 1990; Duan *et al.* 1992; Allen and Saunders, 1993; Kerfriden and Rochet, 1993; Brewer and Mondshean, 1994, for example), and has tended to apply Black and Scholes (1973) option pricing techniques to analyse the incentives of flat rate premiums.[i] More recently, these techniques have also been applied to the mortgage insurance market by Kau, Keenan, and Muller (1993); and Kau and Keenan (1996). Deposit insurance and loan guarantees are viewed as 'put option[s] on the value of a bank's assets at a strike price equivalent to the promised maturity value of its debt' (Keeley 1990, p.1183). A number of variations on the basic option pricing model have been developed, such as the inclusion of catastrophic events (Kau and Keenan 1996) and of coinsurance and adjustable clauses (Urrutia 1990). Other models have been developed based on a risk-rated structure of insurance premiums that would vary with a bank's portfolio risk (Scott and Mayer, 1971; Goodman and Santomero, 1986); Bayesian graduation of mortgage insurance contracts (Herzog, 1983); and optimal mortgage payment pattern models with uncertain future house values (Brueckner, 1984, 1985).

Although the option pricing approach has the appealing quality of being empirically testable, leading to estimates of appropriate premiums for insurance, the assumption of perfect capital markets (which is essential to the analysis), inhibits examination of the intricate incentive implications of information asymmetries. Brueckner's (1985) study is one of the few papers written prior to the application of option pricing which aimed to develop a theoretical analysis of loan insurance. He constructs a two period model to examine the mortgage choice problem faced by borrowers in a world of uncertain house values: either opt for a mortgage with a low LTV (loan to value ratio) and avoid insurance costs, or choose a riskier mortgage, and pay the associated insurance premiums. Brueckner shows that,

> 'borrowers who discount the future heavily choose risky mortgages carrying high insurance premiums, while those who place a higher value on future consumption opt for less risky contracts carrying low (or zero) premiums' (Brueckner, p.129).

Brueckner's analysis has its limitations, however. Although loan to value ratios still dominate most lender's risk assessment calculations, it is clear that it is by no means the only determinant of default, and indeed the increasing use of sophisticated credit scoring techniques reflects this. Even if borrowers are treated primarily as consumers, as in Brueckner *op cit.*, a great deal of the risk associated with repayment arises from factors independent of LTVs such as future employment status, future income flows, probabilities of divorce, death or ill health. Moreover, many property purchase decisions are made at least in part with some kind of investment motive. This may be a speculative motive (purchased in the anticipation of making capital gains), landlord motive (purchased to earn a rental income), or as some component of a broader entrepreneurial decision (such as business/living premises for self employment). Where there exist investment motives for borrowing, a general financial rule usually applies; namely, the greater the return from the project if successful, the smaller the associated probability of success. (S&W, for example, assume mean preserving spreads, which is a special case of this rule. If higher return projects did not have associated higher risks, then there would effectively be an arbitrage opportunity. Thus in the housing market, any housing investments which do not follow this financial rule must reflect a temporary state, and not one where the market has adjusted and returned to equilibrium. Interest rate rises may also have a moral hazard effect in the mortgage market by making borrowers more inclined to purchase in areas with rapidly rising but more volatile house prices in the hope of recapturing the increased costs of borrowing. Or it may induce borrowers to locate in high risk employment areas, or purchase a dwelling more likely to have structural faults, or buy in a difficult to sell locale, or locate somewhere further from work making it more difficult to successfully maintain employment. The greater the interest rate hike, the greater the gamble that borrowers may be willing to take. Equally, it may screen out borrowers too risk averse to take these risks, or induce good risks to take out smaller mortgages relative to high risks).

If the textbook relationship between risk and return exists in conjunction with information asymmetries, then there will be a much broader range of implications for, and from, loan insurance than simply those implied by variations in LTVs and time discount rates. To highlight some of these implications, the model developed in chapters 5, 6 and 7 assumes constant LTVs, and zero time-discount rates.

Thus, it is argued that studies which assume only uncertainty regarding future events, and overlook possible information asymmetries, lack much of the richness derived from more game theoretic approaches[ii] that have been applied separately to the markets for credit and for insurance (such as Rothschild and Stiglitz, 1976; S&W; Eaton *et al.*, 1986; Bester, 1985, 1987, 1994 *inter alia*). However, this literature has tended to focus either on the problem of explaining equilibrium credit rationing and other credit market paradoxes with the assumption of an insurance free loans market (S&W; Bester, 1985, 1987; 1994); or upon insurance as a market in itself (Rothschild and Stiglitz, *op cit.*).

A handful of papers have examined agency problems in the mortgage insurance industry, but have done so by focusing upon the relationship between lender and insurer, without modelling the borrower explicitly. (Mulherin and Muller 1988, for example, describe an incentive conflict from loan insurance removing any motivation to maintain and repair foreclosed properties; and Mulherin and Muller 1987 show how on a fully insured mortgage in danger of default, an incentive may exist for lenders to actually encourage default rather than restructure the loan). Thus, as far as the author is aware, no asymmetric information study to date has examined the simultaneous interaction of both insurer incentives, lender incentives and borrower incentives, and considered the implications of loan insurance for lender decisions to offer credit, set interest rates, and assess risk. Thus, it is these issues which the theoretical model presented in chapters 6 and 7 attempts to analyse. Chapter 8 continues the theme of credit insurance, but focuses on a specific real-life example, namely Mortgage Payment Protection Insurance (MPPI) in the UK, and we shall postpone the discussion of the literature relevant to this market until then.

2.6 Identifying Gaps in the Literature

It has already been indicated that the most obvious gaps in these literatures are not within, but between. Thus, in this section, I attempt to summarise the areas of neglect in the inter-disciplinary research alluded to above (each discipline falling within the universal of 'credit market research'). However, to point out the unresearched links between the different fields presupposes knowledge of what these connections might be. Hence, an epistemological paradox emerges: the delineation of areas of ignorance is constrained by ignorance of where the boundary between potential knowledge and the unknowable actually lies. Because we cannot know what we don not know, the construction of an exhaustive list of under-researched connections between our four fields of interest is precluded. So what follows is, by logical necessity, an incomplete list arising out of connections made by the author whilst investigating each subject field. A small subset of these identified areas of ignorance are the connections explored in this thesis.

I certainly do not make any claims, therefore, to have plugged all the gaps. For one thing, ignorance of the gaps, as I have said already, precludes this. Also, some gaps, even when they have been correctly identified, may be intrinsically 'unpluggable' because of the lack of data or because of the intractable nature of the problem. Even the handful of gaps selected as the subject for the present investigation are by no means plugged in any final or complete sense, they are merely explored and initiated. What follows now is an overview of these gaps and where the thesis attempts (if at all) to bridge the abyss.

First, the thesis considers the interface between actual and perceived risk assessment. Apart from Balkan (1992) comparison of the various risk ratings, very little has been done to test why and how lender perceptions of risk may differ from reality. Moreover, no study has considered the effect of movements in actual risk on risk assessment effort and expenditure. One of the aims of the thesis, therefore, is to demonstrate theoretically that movements in market risk can cause changes in optimal level of risk assessment and that the relationship is not necessarily monotonic (see chapter 3). The thesis also aims to empirically test the implications of this hypothesis (namely, the time variance of perceived parameters) using data on the sovereign debt market between 1979 and 1990 (see chapter 4). In chapter 5 the thesis also considers how categorical risk assessment can affect the selection of risks.

Second, the thesis considers the interface between analysing perceived risk and credit rationing. The author is aware of only one study (Seck, 1992) which briefly examines the implications of credit rationing for the analysis of perceived risk. Credit rationing has profound implications for the observation and measurement of perceived risk, because if credit rationing exists, it will result in perceived creditworthiness being reflected in quantity as well as price. Chapter 4 will discuss the measurement of perceived risk, and consider the implications of credit rationing for the validity of popular measures of perceived risk such as spread over LIBOR and published country risk ratings based on a surveys of lenders.

Third, the thesis considers the interface between credit rationing and insurance. As far as the author is aware, no study to date has considered the possible connections between equilibrium credit rationing and the terms of loan insurance. As such, we attempt a new theory of credit rationing, based on the spillover effects of asymmetric information in the insurance market on the market for loans (see chapters 6 and 7).

Fourth, the interface between credit insurance and perceived risk will also be considered in the context of the demand for loan insurance. Again, as far as the author is aware, there is no published work which examines the link between the take-up of credit insurance and the insuree's perception of risk. Thus, in chapter 8 a model of Mortgage Payment Protection Insurance demand is developed in which the borrower's decision to take out mortgage insurance is affected by his/her perception of his/her own risk of ill health and/or unemployment.

Another aspect of the interface between credit insurance and perceived risk to have remained untouched in the literature is the effect of the terms of the credit insurance contract on lender incentives to assess risk. This aspect is considered in the theoretical models developed in chapters 6 and 7.

Fifth, the interface between actual risk and credit insurance. Although a massive literature exists on the moral hazards and adverse selection implications of *deposit* insurance, no published work could be located on the perverse incentive effects of *credit* insurance. This also will be considered in the models developed in chapters 6 and 7.

2.7 Summary

This chapter has delineated and reviewed the literature relevant to the thesis. Four main strands of literature were considered: assessment of actual risk; assessment of perceived risk; credit rationing; and credit insurance. It was concluded that the main gaps of research lie not within these fields but between them. As such, it is at the interface of these four areas of financial economics that the thesis aims to contribute. Although it should be emphasised that each of these contributions are discrete—no attempt is made to develop a unifying theory that plugs all the gaps in the literature. Instead, the thesis will offer a selection of models which connect two or more concepts at particular points which have hitherto remained separate in the literature (such as credit insurance and credit rationing). The next chapter will develop a theoretical rationale for the time-variance of signal weights in a model of perceived risk.

Notes:

[i] For a flavour of the more general discussion surrounding deposit insurance see Kane (1993); Barth and Bradley (1989); Barth et al (1991); Brickley and James (1986); Cebula,(1993); Diamond and Dybvig (1983); Dowd (1993a,b); Flood (1992); Grossman (1992); O'Driscoll (1988).

[ii] The disadvantage of the game theoretic approach, of course, is that it is less conducive to empirical testing, and so many of the results of these papers are inherently unverifiable.

3 Biased and Heteroscedastic Assessment Errors

And The Time-Variance Of Signal Weights

3.1 Introduction

The bulk of the empirical research into the nature of perceived risk has assumed models with linear, time-invariant parameters. This approach is supported by the fact that there are no immediately obvious *a priori* reasons to support variations in the relationship between actual risk of default and its determinants/signals—any changes can be modelled as one-off regime shifts by introducing intercept dummies. However, there may be reasons to believe that the relationships between *perceived* risk and determinants of default are subject to variation that cannot be represented simply as intercept shifts.

This chapter aims to provide a rationale for the variability of coefficients in a linear parameterisation of perceived risk. The chapter shows how fluctuations in market risk (represented by changes in the proportion of bad risks) result in fluctuations in risk assessment levels, and in the estimated linear parameters, even though the true values of those parameters may be constant.

The chapter also shows how the optimal level of risk assessment will not necessarily rise when market risk is rises. This is because the probability of the bank setting an interest rate less than or equal to the borrower's reservation (threshold) rate does not necessarily rise as assessment-error variance falls (for example, where the bias declines rapidly relative to the decline in the variance when risk assessment expenditure increases). These results are of interest because they highlight the possibility that risk premiums faced by debtors may vary even though their actual risk is unchanged, and may even rise when their actual risk has fallen.

That such results are important are supported by Brewer and Rivoli (1990, *p.*357): 'The determinants of credit worthiness are of central importance because these perceptions affect both the supply and cost of capital flows to developing countries', and it is not only the availability of credit that is affected by perceived risk, all forms of foreign direct investment are in jeopardy since country risk ratings are widely available to international institutional investors.

Moreover, inconsistencies in perceived credit risk may distort the economic policy decisions of the countries concerned. Aizenman (1989) has shown that for countries with high levels of external borrowing, it may be optimal for a country to restrict the private sector from borrowing abroad directly and for all external borrowing to be done via the central bank, auctioning the available credit domestically at a demand-determined price. This result, however, is contingent upon international lending institutions having predictable, unbiased, and sound judgements regarding the creditworthiness of the country. This paper shows how a lenders' perceptions may, in fact, be fluid, driven by a complex relationship with movements in market-wide risk. As such, borrowers may find it difficult to identify the cocktail of economic policies that will minimise risk premiums on external borrowing because there is no stable relationship between perceived credit risk and determinants.

Before moving on to consider the details of the model, it is worth spending some time outlining the background to the 'real life credit-market' which forms the basis of the empirical analysis of the next chapter, namely the sovereign debt market of the late 1970s and 1980s. The remainder of the chapter is structured as follows: following a brief summary of the debt crisis, previous perceived risk studies are reviewed; then a theoretical model of perceived risk is developed which allows for variations in risk assessment effort. The chapter concludes with a summary of the model's findings.

3.2 Background to Sovereign Debt

Before the 1970s, financing to LDCs (Less Developed Countries) was generally made through bonds or foreign direct investment (FDI). Lending to these countries underwent a major institutional change in the 1970s as both international bonds and FDI came to be replaced by bank loans (see Folkerts-Landau, 1985 for more details of the emergence of the sovereign loans market). Many sovereign states were keen to borrow in order to expand their capital base, with a view to building up particular industries and developing new areas of comparative advantage. Availability of credit allowed nations, particularly LDCs, to take advantage of 'off the shelf technology' (Charbaji *et al.*, 1993, p.751). However, as Charabaji *et al.* (*op cit.*) point out, borrowed funds often came to be used to finance current expenditures or public borrowing requirements.

Nevertheless, the responsibility for the LDC debt problem cannot be laid only at the door of the borrowers. Lender behaviour and the credit-rich context of the early 1970s explain much of the problem that was to follow. Growth of the Eurodollar market arising from oil surpluses, resulted in a large increase in lending to developing countries, particularly to Latin American and Caribbean nations. As a consequence, the early 1970's saw an unprecedented growth in commercial bank lending to developing countries to the extent that commercial banks became the principal source of finance for many LDCs (Hefferman 1986). Not only were banks extremely keen to make large-scale loans on the principle that 'countries never go bankrupt' (Citicorp Chairman Walter Wriston, quoted in Sachs 1989 p.8), but LDCs were also eager to take advantage of the negligible, even negative, real interest rates. Moreover, as Sachs (1989) notes, during the 1973-79 period, the export proceeds of some developing countries boomed, enabling the borrower to finance its debt out of export earnings rather than its own resources. Banks had become not so much concerned with debtors long run ability to repay (which they took for granted), but with their ability to meet immediate interest repayments which had become such a lucrative source of bank revenue. Poor screening of bad risks resulted (Charbaji *et al.*, *op cit.*, p.751).

By the mid-eighties, the perceived creditworthiness of many LDCs deteriorated considerably. The total debt of Latin American countries doubled between 1980 and 1987 (from $242.7 billion to $445.4 billion), but the dollar amount of the debt rescheduled increased over 100 times, from $782 million in 1980 to $123.5 billion in 1987 (Moghadam *et al.* 1991, p.510). While slightly more than three-tenths of one percent of the Latin American debt was rescheduled in 1980, almost 28 percent of the debt was rescheduled in 1987.

The main causes of this reversal of fortunes for the sovereign debt market were the effects of two simultaneous global shocks at the end of the 1970s. First, the rapid fall in export earnings of LDCs following the inception of a world recession. Second, there was a rapid rise in interest rates, which came as a result of developed countries tightening their monetary policy with a view to controlling inflation (see Sachs, 1989, p.7). The full implications of these shocks were not realised until 1982 when a major debtor, Mexico, announced that it could no longer meet its international financial obligations (Edwards, 1986). This announcement on Friday 13th August 1982 marked the beginning of the worst international debt crisis since the Great Depression. What was initially thought to be an isolated case of temporary illiquidity, soon spread to most of the developing world, destabilising the whole of the international financial system.

As well as being an event of tremendous social and political significance, the debt crisis has also proved to be a unique opportunity to observe the factors that influence default and the changing behaviour of banks with respect to their assessment of country risk. Hence the emergence of a substantial literature surrounding the analysis of country risk over the past twenty years. A contributing factor to the burgeoning of academic interest was the apparent failure of lenders to anticipate the debt crisis as a whole and their apparent ineptitude at gauging individual borrower creditworthiness. Many creditors based their loan decisions on simple financial ratios (such as the debt service ratio) qualified by essentially subjective judgements regarding the economy and political risk. Lenders tended to consider some of the relevant characteristics of countries, but overlooked others (Edwards 1984).

In the event, few countries actually defaulted outright, which is surprising given the absence of collateral or legal enforcement of loan repayment. Eaton and Gersovitz (1980, 1981) suggest that in the market response to the absence of a legal institutions able to enforce sovereign debt agreements, is to threaten exclusion from future international capital, and it may be this threat which has proved to be the major long term deterrent to default.

Although widespread default did not materialise, the debt crisis has continued, in the sense that, external debts of some of the world's poorest nations continued to accumulate during the 1980s and 1990s. Many LDCs have taken on further loans just to keep up with interest payments. The plight of these countries has recently returned to the public eye following the work of the pressure group 'Jubilee 2000' which has campaigned for widespread debt forgiveness by the end of the millennium – 'Jubilee' relates to the Theonomic system of the Old Testament in which all debts were forgiven and all land returned to original owners every fifty years.[i] It is unlikely that the year 2000 will incur such extensive forgiveness for it to be classified as a true 'Year of Jubilee' but, at the time of writing, there has been initial steps taken towards an agreed strategy of staggered forgiveness towards the most impoverished borrowers, potentially achieving a significant level of debt relief for the countries concerned.[ii]

3.3 Review of Previous Perceived Risk Studies

Saini and Bates (1984) highlight two main criticisms of statistical analyses of country risk. First, they tend to, 'exclude all social and political factors which give rise to debt repayment problems or (refusal)' (Saini and Bates, p.353), and second, they preclude the possibility of 'structural shifts over time in the parameters of predictive equations.' (Saini and Bates, p.353). With regard to the effect of political risk, more recent studies (Citron and Nicklesburg, 1987; Oral *et al.*, 1992; Balkan, 1992) have included political variables, but the assumption of constant coefficients has remained. It is generally assumed that this can be justified on the basis that fundamental economic connections between risk and the determinants/signals of risk remain constant. Saini and Bates (*op cit.*), however, question this assumption, particularly where risk analysis is being applied to debtors undergoing rapid economic and political change:

> 'Given that the economies of developing countries and the international environment in which they trade and borrow are undergoing rapid transformation, the use of equations derived to minimise errors in explaining past debt service problems may be of limited use in forecasting such events' (Saini and Bates, 1984, p.353).

However, it is possible that the effect of regime shifts may simply be captured in intercept shifts, with no fundamental change in slope parameters. Moreover, were political variables to be included in formal risk analysis, such upheavals could be controlled for, leaving the underlying economic connections unchanged.

However, even with these caveats in mind, the constant parameters assumption may have little substance in the context of *perceived* risk analysis (i.e. the lender's perception of the debtor's creditworthiness). A possible driver of movements in parameters may be *risk assessment effort* – fluctuations in the expenditure on risk assessment may cause shifts in parameter estimates.

Before exploring this avenue more thoroughly it would be helpful to review the literature on perceived risk. Analyses of perceived risk have tended to fall into two categories: i) the survey approach and ii) the econometric approach. These shall now be considered in turn.

3.3.1 Survey Approach

A number of attempts to examine how banks assess risks were published during the period of interest (late 1970s to 1990). This typically involved the use of survey analysis: a selection of banks being sent a questionnaire or interviewed regarding the techniques used for risk assessment. Three well known studies which took place in the context of sovereign loans during this period include: Goodman (1978; survey of 37 EXIM banks which accounted for half the sovereign loans made by US banks), Burton and Inoue (1983; survey of 25 banks in 1980 using a combination of questionnaire and interview, 11 of which were US banks), and Hefferman *et al.* (1985a,b; survey of 27 US, European, Middle Eastern, Asian and Australian banks).

Both Hefferman *et al.* (1985a,b) and Burton and Inoue (1983) found that most banks employ a flexible approach to the frequency of risk assessment. In particular, Hefferman *et al.* found that 26 per cent of banks 'regard their policy as flexible in that the frequency of reviews rises with perceived risk and/or exposure' (Hefferman *et al.*, 1985b, p.37). This confirmed the Burton and Inoue finding that risk assessment reviews were taken at a fairly regular frequency unless economic or political events prompted a more frequent update. Changes in the frequency of reviews have important implications for the relationship between the cost of risk assessment and the level of perceived risk. Assuming that risk assessment becomes more expensive the more frequently reviews are undertaken[iii], and assuming that the frequency of review is a function of perceived risk, then a general rise in the level of bank risk assessment, will imply a rise in risk assessment costs, *cet. par.* The reverse should also be true, provided the unit cost of each risk assessment does not change over time.

Another important finding of the surveys is the change in sophistication of risk assessment, particularly during the debt crisis. There is a marked difference between the earlier findings of Goodman *op cit.* (only 11 per cent of the sample used a fully quantitative approach, 62 per cent followed a 'structured qualitative approach', and 14 per cent had no systematic system at all), and those of Hefferman *et al. op cit.* (all respondents indicated that they used 'one or more of the systematic approaches to country risk, that is, they use something other than an *ad hoc* method in assessing the creditworthiness of a country', Hefferman *et al.*, 1985b, p.38). Moreover, 22% of the respondents to Hefferman *et al.*'s survey (carried out in 1984) indicated the use of statistical models, compared with only 3% in Goodman's study. Although such comparisons must be interpreted with care, particularly when the samples vary so much between studies, they do indicate some evidence of a trend towards the adoption of increasingly sophisticated risk assessment techniques over the late seventies/early eighties period (Hefferman, 1986, p.68-69).

3.3.2 Econometric Approach

Most econometric studies of credit risk have been analyses of *objective*, rather than *perceived* risk, usually involving some form of dichotomous dependent variable technique to predict the likelihood of a country, firm or individual defaulting on a given loan (examples include, Frank and Cline, 1977; Feder *et al.*, 1981; Kharas, 1984; Citron and Nicklesburg, 1987; Kutty, 1990; Lee, 1991a,b; Moghadam and Samavati, 1991; Moghadam *et al.*, 1991; Savvides, 1991; Oral *et al.*, 1992; and Balkan, 1992 – the earlier studies are reviewed in Saini and Bates, 1984). A number of studies have, however, attempted to model the factors which drive *subjective* or *perceived* risk assessment, which is the concern of the current chapter. In this case, the dependent variable is a measure of perceived risk, such as the spread over LIBOR (Edwards, 1984; Feder and Just, 1977; Haegel, 1980; Gottlieb, 1989; Calvo and Kaminsky, 1991; Rockerbie, 1993), or some risk rating composed from a survey of lender opinions[iv] (Feder and Ross, 1982; Feder and Uy, 1985; Brewer and Rivoli, 1990; Cosset and Roy, 1991; Seck, 1992; and Lee, 1993). Explanatory variables include what the author believes to be the key measurable influences on the lender's perception of borrower risk. However, if creditors do vary their level of risk assessment according to the level of market risk, as suggested in this chapter, there may be implications for the validity of conventional econometric estimation procedures.

Most empirical studies of perceived risk use panel data to estimate an equation of the form:

$$\hat{d}_{it} = a + \boldsymbol{S}_{it}\hat{\omega} + u_{it};$$

where,

$\hat{d}_{it}$ = perceived risk;

$\hat{\omega}$ = vector of perceived weights (the coefficient parameters which the model would attempt to estimate);

$\mathbf{S}_{it}$ = vector of signals/determinants (i.e. the data matrix).

Examples include Feder and Just (1977—data on 27 countries for eight quarters between 1973 and 1974), Haegel (1980—20 countries over four years), Edwards (1984—19 countries over five years), and Rockerbie (1993—27 less developed countries and 14 developed countries over seven years). In pooling the panel data these authors implicitly assume that the both the coefficients and intercept term remain constant over time, which is equivalent to imposing the restriction that signal weights are time-invariant. The only paper to date that has actually tested whether coefficients are stable over time is the perceived risk study of Thapa and Mehta (1991) which tested for structural break between the sample periods 1979-1981 and 1982-1983. They found that the Chow test statistic was not significant, and so the null hypothesis that the two regressions were the same could not be rejected. However, they do not test for structural breaks across other time periods and only include a limited selection of explanatory variables (with no measure of political stability – see discussion in Chapter 4). Although variation in risk assessment does not *necessarily* imply variation in signal weights, it does suggest that coefficients have the potential, if not the likelihood, of changing between periods.

A similar problem arises with studies which use time series data on a single country or individual, such as Gottlieb (1989, data on Israel for 1971 to 1983), since they also assume constant coefficients. Simple fixed effects models of the form,

$$\hat{d}_{it} = a_t + \mathbf{S}_{it}\,\hat{\omega} + u_{it};$$

which allow the intercept to vary across time, may still be inappropriate since individual slopes, and not just intercepts, may change during times of crisis. I now go on to present a theoretical rationale for why estimated perceived risk parameters may change over time.

3.4 Theoretical Model

There are n types of investor i, where $i = 1, 2, \ldots n$, each with the opportunity to invest in a project requiring a fixed amount of capital, K. Lenders in turn specify a common punishment strategy C, and charge interest rate r_i on each loan. Investor i's project succeeds with probability $1\text{-}d_i$ yielding the positive return R^s_i; and fails with probability d_i yielding zero return, where higher risk projects receive a higher return: $0 < d_1 < d_2 < \ldots d_n < 1$ and $K < R^s_1 < R^s_2 < \ldots. < R^s_n$. Lenders know the structure of the borrower's payoff function, and the relationship between R^s_i and d_i. It is further assumed that the interest charged on deposits is unrelated to the terms of the loan, and that the lender uses a common systematic risk assessment procedure for all borrowers in period t.

In general, default risk for borrower i is assumed to be determined as follows:

$$d_i = d_i(s_{ki}, \omega_k) \text{ where } s_{ki} \in S_i, \text{ and } S_i \in \mathbf{S}.$$

where s_{ki} are signals/determinants of risk and ω_k are weights. There is a potentially large number of commonly observable signals s_{ki} (normalised indices reflecting economic/behavioural characteristics of the borrower and/or project), and weights ω_k that should be attached to each signal, although for sake of exposition, we shall assume only two signals and two weights. Lenders have to make some estimate of ω_k to achieve an estimate of default probability. Their estimate of default risk is, however, subject to error even though lenders have perfect knowledge of s_{ki} due to imperfect information regarding the relationship between d_i and s_{ki}.

3.4.1 Risk Assessment

Indices, s_{1i} and s_{2i}, reflect the economic/behavioural characteristics of the borrower, and are normalised such that $0 < s_{1i}, s_{2i} < 1$. Assume further that there are unique values of s_1 and s_2 for each i, and that actual default risk is determined by a single parameter ω, such that,

$$d_i = \omega s_{1i} + (1-\omega)s_{2i}\,, \qquad [1]$$

where $0<\omega < 1$. Risk assessment procedures produce a unique estimate of default risk $d_i^{\wedge}$ for each i. These estimates are subject to two sources of random error: (1) a general procedural error term arising from the inadequacy of the systematic risk assessment common to all loan applications and resulting in bias and variance in the estimated parameters; (2) that arising from borrower heterogeneity represented by the individual-specific error term δ_i, which arises because of the inability of the assessment procedure to cope with borrower heterogeneity.

Thus, the lender can observe s_1 and s_2, but is faced with the problem of estimating the weights, $\omega^\wedge$. It undertakes risk assessment for each risk type, and for that risk type comes up with a unique estimate of d_i based on a common set of perceived weights, $\omega^\wedge_k$, from its estimation procedure,

$$d_i^\wedge = \omega^\wedge s_{1i} + (1 - \omega^\wedge)s_{2i} + \delta_i, \qquad [2]$$

where,

$$\omega^\wedge = \omega + \gamma \qquad [3]$$

and γ is the general procedural error term which has a cumulative probability distribution denoted by G(γ), with associated probability density function g(γ). This distribution has mean μ, and variance σ^2. If ζ is the expenditure on risk assessment, then it is assumed that,

$$\sigma^2 = \sigma^2(\zeta, \bar{d}), \qquad \sigma^{2\prime}(\zeta) < 0, \qquad [3.1]$$

$$|\mu| = |\mu|(\zeta), \qquad |\mu|'(\zeta) < 0.$$

Thus both the variance and absolute mean of γ are negatively related to risk assessment, as is the variance of δ_i, where $\delta_i \sim X(0, \phi_i^2)$, and $\phi_i^2 = \phi_i^2(\zeta, d_i)$, $\phi_i^{2\prime}(\zeta) < 0$. Substituting [3] in [2] yields,

$$d_i^\wedge = d_i + \gamma(s_1 - s_2) + \delta_i \qquad [4]$$

3.4.2 Borrowers

Assume that there is no price searching on the part of borrowers, so that they accept (or reject) only the first offer (this is equivalent to assuming that lenders have monopoly positions in their respective markets).[v] Borrowers' expected returns are given by,

$$\pi_i^h = (1-d_i)[R^s_i-(1+r_i)K] - d_iC, \qquad [5]$$

where r_i is the interest charged to i on the basis of risk assessment. It is assumed that the entrepreneur of type i only takes out the loan if,

$$\pi_i^h \geq 0 \qquad [6]$$

The corollary of these two expressions is that for each $i \in I$ there exists some threshold level of risk, $d_{i\#}$, below which it will not be worth the investor applying because the costs of borrowing for a given r_i exceed the returns if successful. This follows on from equations [1] and [2] which imply that the *actual* threshold interest rate is given as a function of risk and return,

$$r_{i\#} = \left(R^s_i - \frac{Cd_i}{1-d_i} \right) \frac{1}{K} - 1 \qquad [7]$$

3.4.3 Lenders

Risk neutral lenders are assumed to maximise perceived profits Ψ with respect to risk assessment expenditure ζ,

$$\Psi^* = max_\zeta \left(\Sigma_{iD}\, \psi_i - \zeta \right)$$

where,

$$\psi_i = \hat{N}_{iD}((1 - \hat{d}_i)(1 + r^\wedge_{\# i})K + \hat{d}_iC - (1 + \theta)K) \qquad [8]$$

where $\hat{N}_{iD}$ is the bank's estimate of N_{iD}; $N_{iD} = 0$ if $r_i > r_{\# i}$; and θ the deposit rate. If $r_i \leq r_{\# i}$ then all applicants accept the loan offer and $N_{iD} = N_i$. Clearly the ideal interest rate to charge i would be $r_i = r_{\# i}$. Above this level, revenue from lending to i is zero, and below it, borrowers of type i enjoy a surplus (i.e. borrowing below their reservation price). It seems reasonable to assume, then, that banks will set r_i equal to their perception of i's reservation price, $r^\wedge_{\# i}$; although, equivalent results are achieved with the weaker assumption of a positive relationship between $r_{\#i}$ and $r^{\wedge}_{\#i}$

Similarly, the lender's estimate of $r_{i\#}$ is given as a function of perceived risk and perceived return:

$$r^{\wedge}_{\#i} = (1/K)(R^{s\wedge}_i - (C\hat{d}_i/1-\hat{d}_i)) - 1 \qquad [9]$$

Given that there is a one to one relationship between R^s_i and d_i, and that the lender knows the precise nature of this relationship (assumed for simplicity to be $R_{si} = qd_i$), it follows that the lender can impute i's return if successful, $R^{s\wedge}_i$, based on its estimate of default risk, $\hat{d}_i$:

$$R^{s\wedge}_i = q[d_i + \gamma(s_1 - s_2) + \delta_i], \qquad [10]$$

Because the bank bases the interest rate charged to i on its estimation of i's reservation price, which in turn is driven by its estimation of i's default probability, it can be seen that $\hat{N}_{Di}$ is not exogenous but determined as follows:

$$\hat{N}_{Di} = p_i N_i \qquad [11]$$

where $p_i = \Pr(r^{\#}_i \geq r_i)$ and it is assumed that the bank knows N_i or has some perception of it based on previous risk assessment. Using equations [9] and [11] to substitute out $r^{\wedge}_{\#i}$ and $\hat{N}_{Di}$ in the profit equation [8] gives:

$$\psi_i[\zeta] = p_i[\zeta]N_i(q(\hat{d}_i[\zeta] - \hat{d}_i^2[\zeta]) - (1+\theta)k) \qquad [12]$$

3.5 Capricious risk assessment and weight variation

A key question we wish to answer is whether the optimal level of risk assessment ζ^* remains unchanged, rises or falls as market risk increases (an increase in market risk is denoted by an increase in N_2 relative to N_1, where $d_1 < d_2$). From the first order conditions, ζ^* is given where $\partial\Psi/\partial\zeta = 0$, and so it can be seen that $\partial\zeta/\partial N_i = f[\partial/\partial N_i\ (\partial p_i/\partial\zeta),\ \partial/\partial N_i\ (\partial(d^{\hat{}}_i - d^{\hat{}2}_i)/\partial\zeta)]$, indicating that the optimal level or risk assessment is indeed contingent, *inter alia*, on market risk. It can be seen that this has an ambiguous sign because $\partial p_i/\partial\zeta$ has an ambiguous sign (see the example below).

This suggests that the optimal level of risk assessment will vary with market risk, but not necessarily rise when market risk rises. This is because the probability of the bank setting an interest rate less than or equal to the borrowers reservation (threshold) rate does not necessarily increase as assessment error-variance falls (for example, where the bias declines slowly relative to the variance when risk assessment expenditure increases).

3.6 The Example of Normally Distributed Procedural Errors

To illustrate the ambiguity of sign of $\partial p_i/\partial\zeta$, consider the case where G(γ) is normally distributed and where individual specific errors, δ_i, are zero. To reiterate, $p_i = \Pr(r^{\#}_i \geq r_i)$ is the probability that the lender will not overestimate the borrower's threshold interest rate. Given the above assumptions, it can be written as,

$$p_i = \Pr(r^{\#}_i - r_i \geq 0)$$

$$= \Pr\big((d_i\,(q\text{-}c\text{-}q\ d_i)/k(1\text{-}d_i) - d^{\hat{}}_i\,(q\text{-}c\text{-}q\ d^{\hat{}}_i))/(k(1\text{-}d^{\hat{}}_i)) \geq 0\big)$$

$$= \Pr\left(\frac{d_i(-c+q-d_i q)}{(1-d_i)k} - \frac{(d_i+\gamma s_i)(-c+q-q(d_i+\gamma s_i))}{(1-d_i-\gamma s_i)k}\right).$$

If this is solved for γ then the probability can be written as,

$p_i = \Pr(\gamma \leq \alpha[s_i, d_i, C, q])$,

$= G(\alpha)$.

where α is the value for γ implied by the threshold rate of interest (in other words, if $\gamma \leq \alpha$, the loan offer is accepted). Solving yields $\alpha = -(c - q + 2\, d_i\, q - d_i^2\ q)/(q\ s_i - d_i\, q\, s_i)$ and,

$p_i \quad = G\big(-(c - q + 2\, d_i\, q - d_i^2\ q)/(q\, s_i - d_i\, q\, s_i)\big)$.

Now if $p_i = \Pr(\gamma \leq \alpha) = G(\alpha)$ and $G(\alpha) \sim N(\mu, \sigma^2)$ where $\sigma^2{}'(\zeta) < 0$, and $|\mu|'(\zeta) < 0$, then $\partial p_i/\partial\zeta = \partial G(\alpha)/\partial\zeta = f(\sigma^2{}'(\zeta), |\mu|'(\zeta))$. The effect of increased risk assessment on p_i will thus depend upon the combined effects of the concomitant fall in the error-variance and error-bias, and their impact on effect on $G(\alpha)$. It can be seen from the equation for $\partial G(\alpha)/\partial\zeta$ that the combined effect has ambiguous sign,

$$\frac{\partial G(\alpha)}{\partial\zeta} = \frac{\sqrt{\pi\sigma^2}\left(-2\sigma^2\mu'[\zeta] - \alpha\sigma^2{}'[\zeta] + \mu\sigma^2{}'[\zeta]\right)}{2\sqrt{2}\exp\left[\frac{(\alpha-\mu)^2}{2\sigma^2}\right]\pi\sigma^4},$$

Notice that the sign of this expression depends upon the sign of the main parenthesised term in the numerator, which (because alpha is small) depends upon the sign of the first and last terms within the parentheses: $-2\sigma^2\mu' + \mu\sigma^{2\prime}$. Note from [3.1] that if the mean is negative then $\mu' > 0$, and if it is positive, $\mu' < 0$.

Thus the sign of $\partial G[\alpha]/ \partial\zeta$ is ambiguous. If μ is large relative to σ^2 and/or μ' is small relative to $\sigma^{2\prime}$, then $\partial G[\alpha]/ \partial\zeta$ is negative.

This argument is depicted graphically Figures 3-1 and 3-2 which show how the area under the curve to the left of the vertical line $\gamma = \alpha$ (assuming a normal distribution of errors) does not necessarily rise as variance and bias fall. In Figure 3-1, the bias declines slowly relative to the decline in variance as risk assessment rises, and the area under the curve to the left of α decreases monotonically. However, from Figure 3-2 it can be seen that if the bias declines rapidly relative to the variance as risk assessment rises, then the area under the curve to the left of α may actually rise. The corollary is that the probability of setting an acceptable interest rate (i.e. one no greater than the borrower's reservation rate) is not necessarily improved by bolstering investment in risk assessment.

Note that if we were to assume a constant zero mean for the error term (i.e. no bias in risk assessment), and examine the effect of changes in risk assessment on d_i, then the ambiguity in the impact of risk assessment would not arise because the sign of $\partial X[\alpha]/ \partial\zeta$ would always be positive: assuming normally distributed individual specific errors with zero mean we have,

$$\frac{\partial X(\alpha)}{\partial\zeta} = \frac{-\alpha\sqrt{\pi\phi^2}\left(\phi^{2\prime}[\zeta]\right)}{2\sqrt{2}\,\mathbf{exp}\left[\frac{\alpha^2}{2\phi^2}\right]\pi\sigma^4},$$

which is small but positive since $\phi^{2\prime}[\zeta] < 0$.

3.6.1 Likelihood of Risk Assessment Causing a Fall in the Probability of a Loan Offer Being Accepted

Given the counter-intuitive nature of the result described above, one has to ask what is the likelihood of it occurring. The answer is bound up with the relative sensitivities of the variance and bias to changes in risk assessment. If there is bias in perceptions of borrower risk, to what extent does more risk assessment mitigate that bias? If the source of the bias is due to prejudice (such as the political or racial preconceptions of lenders), then the lenders' views may be robust to increases in risk assessment expenditure and only the variance may decline with any pace. If, on the other hand, the source of bias is purely statistical/procedural, and if the risk assessment is sufficiently transparent and objective to allow new information to influence all previously held beliefs, then there is no reason why the bias (if it exists) will not decline at a similar rate to the variance.

Note also that the bias could well be positive rather than negative. In other words, as risk assessment increases, the distribution in Figure 3-2 could well shift rapidly to the left as risk assessment rises and the variance declines. This would, of course, have the effect of causing rapid decline in the probability of a loan offer being accepted—$\Pr(\gamma \leq \alpha)$. Also, the bias may decline rapidly at first, but stabilise as it approaches some level, whereas the variance may decline more steadily and for longer (and vice versa).

So, there are at least 5 possible scenarios: (1) zero bias; (2) non-zero bias that is unresponsive to risk assessment; (3) positive bias causing rising risk assessment to increase the probability of loans being accepted even if variance declines slowly; (4) the bias declines more rapidly than the variance only for certain ranges of risk assessment expenditure; (5) bias declines more rapidly for all or most of the range of values for risk assessment expenditure. So although it is an interesting theoretical possibility, it is one that may well not dominate real-life decision making. Given its counter intuitive nature, it is also unlikely that lenders conceive of the possibility in their risk assessment strategy: that is, they may assume that as risk assessment expenditure increases, there is always an increase in the probability that they have charged the appropriate interest rate (i.e. one that is just low enough to make it profitable for the borrower to accept the loan offer). Nevertheless, the theoretical feasibility of the reverse being true only highlights the ambiguous nature of the relationship between perceived risk and risk assessment.

3.6.2 Effect on Weights

I have shown that ζ^* will change as market risk changes, although the relationship may not be monotonic. Now, given that $\hat{\omega} = \omega + \gamma$, a change in the distribution of γ will affect the expected value of $\hat{\omega}$. Note that this is the case even when the true value of the parameter ω remains constant. So, if changes in N_i result in changes in ζ^*, and changes in ζ^* affect the distribution of γ (by reducing both the bias and the variance), it follows that changes in market risk will cause movements in the expected value of $\hat{\omega}$, despite the relationship between actual risk and the determinants of risk remaining constant. This result is important because it suggests that the risk premiums faced by debtors may vary, even though their actual risk is unchanged, and may even rise when their actual risk has fallen.

***Figure 3-1:* Movements in the Distribution of the Procedural Error Term, γ, as ζ Rises: The Case where the Mean of γ Declines Slowly Relative to the Decline of the Variance of γ.**

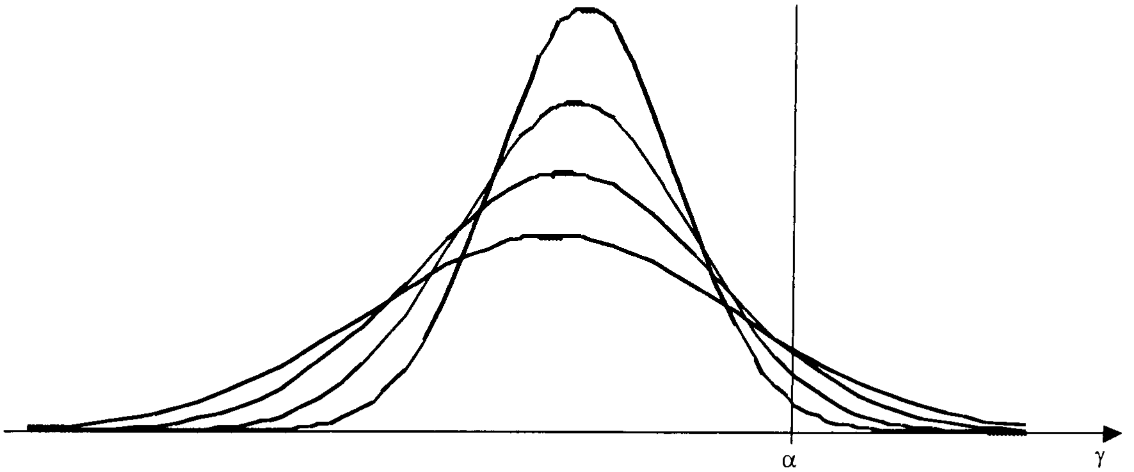
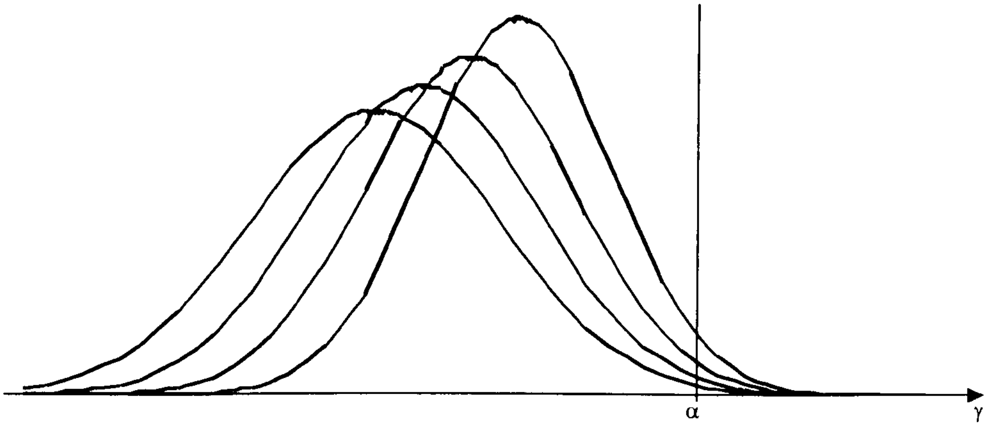


***Figure 3-2:* Movements in the Distribution of the Procedural Error Term, γ, as ζ Rises: The Case where the Mean of γ Declines Rapidly Relative to the Decline of the Variance of γ.**



Notes for Figures 3-1 and 3-2:
If $\gamma \leq \alpha$ then the loan offer is accepted. Thus, the probability, p_i, that the loan is accepted is represented by the area under the curve to the left of the vertical line $\gamma = \alpha$. The figures show that whether this area increases or decreases with ζ depends upon whether the mean of γ declines rapidly or slowly relative to the variance of γ as ζ rises.

3.7 Summary

This chapter has examined how fluctuations in market risk can result in changes in risk assessment and shifts in estimated risk parameters. It has examined what happens when risk assessment errors are not white noise (zero mean and constant variance), but biased (non-zero mean) and heteroscedastic (variance varies). A brief literature review demonstrated the prevalence of the assumption of constant parameters in existing studies. Then a theoretical model was developed which assumed both the bias and variance to be negatively related to the level of risk assessment expenditure, and this model was used to demonstrate how the optimal level of risk assessment will change as market risk changes.

It was shown, however, that the relationship between risk assessment and market risk is not necessarily monotonic. Risk assessment investment may fall when market risk rises, and rise when market risk falls. This is because the probability of the bank setting an interest rate less than or equal to the borrower's reservation (threshold) interest rate does not necessarily rise as assessment-error variance falls (for example, where the bias declines rapidly relative to the decline in the variance as risk assessment expenditure rises).

If these errors relate to the estimates of signal weights themselves (as in the model described) and not just the final estimate of actual default risk, then the movements in the error distribution brought about by changes in risk assessment will result in shifts in the estimated weights, even if the true values of these weights remain constant. The corollary is that it is possible for a borrower's actual determinants/signals of risk to remain constant, and for the true values of signal-weights to remain constant (and hence for true default risk to have remained constant), but for the lender's estimates of those weights to have altered, and hence, for perceived risk to have altered.

In summary, I have shown how movements in market risk over time can feed through to changes in risk assessment expenditure over time, which in turn result in shifts in the perceived risk-parameters over time. These results are of interest because they highlight the possibility that risk premiums faced by debtors may vary, even though their actual risk is unchanged, and may even rise though their actual risk may have fallen. The results also challenge the assumption of the existing literature that parameters of perceived risk remain constant over time so long as the relationship between actual risk and determinants remain constant. Changes in risk assessment can cause these parameters to change irrespective of the actual relationship and so there is no reason to believe that parameters of perceived risk are time invariant.

It should be noted that a possible adaptation of the theoretical model presented in this chapter would be to apply it to the setting of interest rates on existing loans, where if r is set too high, the borrower defaults. The corollary would be that r and perceived risk become two distinct entities, the former being an important cause of the latter. Because of the effect of interest rates on the probability of default, it is possible that in a situation of excess demand for credit, lenders may choose to ration credit, rather than raise the rate of interest to clear the market. Although credit rationing was not explicitly explored in the model presented in this chapter (our focus has been on perceived and actual risk), credit rationing is considered at some length in subsequent chapters, although in a slightly different modelling framework (i.e. one where risk assessment classifies risk into categories rather than the risk continuum produced by the risk assessment in this chapter). In chapter 4, for example, I consider the implications of the existence of credit rationing for the empirical modelling of perceived risk and, in chapter 5, the possible effect of risk assessment on the existence of credit rationing is also examined. It should be noted that the credit rationing model developed in chapter 5 is due *not* to moral hazard, but to ASCRE—Adverse Selection induced Credit Rationing Equilibria—as expounded in S&W. The implications for measuring perceived risk are the same, however, as those of a model in which credit rationing arises because of moral hazards. In chapters 6 and 7, a new form of credit rationing is introduced—CICRE— 'Contingent Insurance induced Credit Rationing Equilibria', which does not depend on adverse selection or *borrower* moral hazard, but rather on the terms of the loan insurance and the behaviour of lenders.

Notes:

[i] For a Christian commentary on the debt problem, see McKee (1991).

[ii] see Eichengreen and Lindert, 1989; Sachs, 1989; and Bird, 1989 for more details on the historical development of the debt problem

[iii] particularly since both the Hefferman *et al.* [1985a,b] and Burton and Inoue [1983] studies found that specialised staff are usually employed for the task.

[iv] Seck (1992) argues that the latter is preferred because interest rates alone do not take account of S&W type credit rationing which may be a key response of lenders to risky borrowers.

[v] this assumption is included in order to simplify the analysis. Although the assumption is not entirely realistic, there is little to be gained from introducing, for example, an endogenous probability that a borrower finds a lower priced loan elsewhere, since the results of capricious risk perception remain intact.

4 Empirical Testing of Fluctuations in Weights

4.1 Introduction

Having, in the previous chapter, provided a theoretical rationale for volatility in perceived risk, this chapter goes on to attempt empirical verification. Direct comparison of perceived and actual risk is not possible (at least within the confines of the available data) because it would be necessary to have complete knowledge of the actual risk of borrowers, which indeed (as we outlined in Chapter Two) has been the holy grail of much empirical work, particularly in sovereign debt markets. The problem would come when we attempt to compare our estimate of actual risk with perceived risk. The primary perceivers of risk (i.e. lenders) will have used the very techniques we would be using in our estimation to arrive at their perception of risk (see Hefferman, 1986, p.29, and discussion of determinants below). So in effect, our comparison would highlight differences arising, not from actual vs. perceived, but from '<u>our</u> economic' model vs. '<u>lenders'</u> economic model'; '<u>our</u> perceptions' vs. '<u>lenders</u>' perceptions'. Consequently, discrepancies would be driven by disparities in risk assessment efforts, and not necessarily by differences between actual and perceived. Therefore verification of the theory would be undermined by the prime mover of the theory itself, namely risk assessment effort. In short, it is impossible to test whether differences between actual and perceived risk have any systematic variation by controlling for movements in actual risk, because actual risk cannot be measured.

Despite these epistemological problems, it is still possible to test whether there is evidence, in a real-life credit market, that the *perceived weights* placed on risk signals fluctuate significantly over time. If we employ the assumption that *actual weights* – reflecting the ***relationship*** between actual risk and the determinants of actual risk – remain stable (an untestable though not unreasonable assumption), then measured fluctuations in *perceived weights* would imply that a borrower's true risk, and his risk as perceived by the lender, do not necessarily move in perfect tandem over time.

Practicalities of research require further assumptions to be made, including: (i) that our model of perceived risk is determined by the same factors assumed to drive lender estimates of risk (i.e. that there are no important omitted variables in our model of perceived risk); (ii) that the relationship between risk (both perceived and actual) and determinants, can be approximated using a linear formulation; (iii) that it is possible to measure perceived risk reliably. The third of these assumptions is of particular interest and will be discussed in more detail below with regard to whether interest rates can be used as a measure of perceived risk, given the theoretical developments in the credit rationing literature that were noted in chapter 2. (In subsequent chapters, it is demonstrated that credit rationing is a complex phenomena, arising not only because of motivations highlighted by S&W but also because of credit insurance, the demand for which is contingent upon the borrower's perception of his own risk (chapter 8)).

The implications of the research presented in this chapter are important because the access to credit, and the interest rate available to a borrower, will be driven by lender estimates of perceived risk, which in turn depend on the perceived weights placed on determinants of risk. The further perceptions of risk diverge from actual risk, the further the equilibrium price and quantity of credit diverge from efficient market allocation. Furthermore, if the relationship between estimated risk and the determinants of risk is volatile, then attempts by the borrower to manipulate these determinants to maximize the market's perception of it as a creditworthy borrower, will be frustrated.

The remainder of the chapter is structured as follows: first the basic econometric model is outlined, considering in particular the appropriate structure of regressions and diagnostic test for parameter change over time. I then go on to discuss the measurement of variables, discussing in some detail the problem of measuring perceived risk. Regression results are then presented, followed by tests for parameter stability. The chapter concludes with a brief summary and discussion of results.

4.2 Econometric Model

The Econometric simulation will attempt to estimate a model similar to equation [2] in the theoretical model (see chapter 3), but will include a larger number of signals. No attempt will be made to suggest *a priori* which signals are bogus and which are true. The model will also include a constant term and allow the weights to vary over time. Hence, the model estimated is given by,

$$1-\hat{d}_{it} = \hat{w}_1 + \hat{\mathbf{w}}_2\mathbf{s}_{2it} + \hat{\mathbf{w}}_3\mathbf{s}_{3it} + \hat{\mathbf{w}}_4\mathbf{s}_{4it} + u_{it} \qquad 0 \leq \hat{d}_{it} \leq 1 \;\; \forall\, i, t.$$

$$1-\hat{d}_{it} = \hat{\mathbf{W}}\mathbf{S}_{it} + u_{it};$$

where,

$\hat{d}_{it}$ = perceived probability of default;

$\mathbf{s}_{2it}$ = a vector of debt signals;

$\mathbf{s}_{3it}$ = a vector of economic signals;

$\mathbf{s}_{4it}$ = a vector of political signals;

$\hat{\mathbf{w}}_v$ = where v = 2, 3, 4 = vectors of perceived weights for debt, economic, and political signals respectively; and v = 1 is the intercept term. These are the coefficient parameters which the model aims to estimate;

$\hat{\mathbf{W}}$ = $[\, \hat{w}_1, \hat{w}_2, \hat{w}_3, \hat{w}_4 \,]$;

$\mathbf{S}_{it}$ = $\begin{pmatrix} s_{1it} \\ \mathbf{s}_{2it} \\ \mathbf{s}_{3it} \\ \mathbf{s}_{4it} \end{pmatrix}$;

s_{1it} = $1 \;\forall\, i, t.$

Note that there are no restrictions on the values of the variables except that the dependent variable is between zero and one. Note also that the circumflex accent over the dependent variable does not represent predicted values from the estimated econometric model, rather, it represents (as in the theoretical model) a measure of bank perception of country risk.

This model translates into a simple OLS regression on a pooled sample of 43 countries over 12 years. This regression is also run on a variety of subsamples to test for structural shifts in the parameters over time to test for time-variance of signal weights. The null hypothesis for such tests is:

$$H_0: \hat{\mathbf{w}}_{vt} = \hat{\mathbf{w}}_{vt+1} \quad \forall\ v>1, t$$

Provided $F^r_{df_u}$ has a significance level less than 0.05, then we can be 95%+ confident that the null is rejected, where,

$$F^r_{df_u} = \frac{(RSS_R - RSS_U)/r}{RSS_u / df_u}$$

where RSS_R = restricted residual sum of squares = $RSS_{n1} + RSS_{n2}$,

RSS_U = unrestricted residual sum of squares = RSS_{n1+n2}

df_u = $n_1 + n_2 - 2k$

n_1, n_2 = sub-samples, such that $n_1 + n_2$ = full sample.

A second category of regressions include *fixed effects models* of the form:

$$1-\hat{d}_{it} = \hat{w}_{1t} + \hat{\mathbf{w}}_2\mathbf{s}_{2it} + \hat{\mathbf{w}}_3\mathbf{s}_{3it} + \hat{\mathbf{w}}_4\mathbf{s}_{4it} + u_{it} \qquad 0 \le \hat{d}_{it} \le 1 \ \forall\ i, t$$

which allow the intercept to vary over time to account for any movement in the perceived risk relationship. Again, these regressions will be run on a variety of samples and ANOVA used to identify time-variance of signal weights.

4.3 Dependent variable

Existing studies have employed three main measures of perceived risk: (i) interest rate spread; (ii) secondary market prices; and (iii) country risk ratings. Not all measures are equally robust, however, and some of the problems associated with the choice of dependent variable have been overlooked in the literature. Each of these variables will now be discussed in the form of a critical review of the associated literature.

4.3.1 Interest Rate Spread

The majority of perceived risk studies have used either spread over LIBOR (London Inter Bank Offer Rate) or some other measure of interest rate spread as the dependent variable – i.e. as a measure of perceived risk. This is partly due to the desire to explain variations in the risk premium component of interest rates.

Feder and Just (1977), for example, construct a theoretical model yielding an 'equilibrium relation between the interest rate and the probability of default such that higher probability implies higher interest'. This forms the basis for an econometric model which the authors claim 'generates estimates of the weights attached to subjective risk indicators'. The model actually estimated, in fact, reduces to a regression of the spread over LIBOR on a series of variables which affect/reflect the probability of default (debt-service ratio, debt-GNP ratio, amortization-debt ratio, GNP per capita, exports fluctuation index, growth rate, import-GNP ratio, import-reserves ratio, projected GDP growth rate) for 27 countries over eight quarters between 1973 and 1974. Feder and Just (1980) run similar regressions based on cross-sectional Eurodollar market data for January 1975 on 27 countries, as does Haegel (1980) based again on the Eurodollar market (20 countries between 1974 and 1978).

Edwards (1984) estimates a comparable relationship but uses a 'random-effect error components equation' based on the Fuller and Batesse (1974) procedure.

They use this model to attempt to consider whether banks had the ability to distinguish between 'good' and 'bad' risks, and in particular whether they had anticipated the international debt crisis of 1982-83. Edwards again uses the spread over LIBOR as an approximation for the perceived probability of default[i] and regresses this on a number of variables, and the estimates achieved used to calculate the banks' perception of the probability of default of 19 LDCs over the period 1976-80. Having calculated the perceived probabilities of default, Edwards compared them with actual default statistics for the years 1980-83. For some countries which later ran into financial difficulties (Brazil for example) the perceived default probabilities increased between 1976 and 1980, showing that banks anticipated well in advance their debt problems. For others, however, this was not so. As Edwards notes,

> 'for Argentina, a country which in 1982 encountered serious financial difficulties, estimates indicate that the perceived probability of default *declined* throughout the period' (1984, p.726).

Edwards (1986) uses OLS and instrumental variable methods to estimate an essentially similar relationship and compares the results with those of regressions with spreads on bonds issued by LDCs as the dependent variable.

Other relevant studies include Gottlieb (1989), Ben-Bassat and Gottlieb (1992), Rockerbie (1993), and Calvo and Kaminsky (1991). Gottlieb (1989) is one of the few time-series studies of perceived risk, and is based on data on Israel from 1971 to 1983. Ben-Bassat and Gottlieb (1992) offer another time-series analysis, based again on Israel (1979-88 quarterly data) and also attempt to estimate the cost of rescheduling to debtor nations in terms of the GNP foregone (based on 13 nations which rescheduled between 1960 and 1982). Rockerbie (1993) computes a weighted average interest rate spread (using loan quantities and maturities as weights) and regresses this on the usual explanatory variables using pooled sub-samples of 41 countries over the period 1978-84. One of the few papers with a strong theoretical element is Calvo and Kaminsky which explores 'some of the implications of assuming that bank syndicates and debtor countries entered into implicit debt contracts during the 1970s' (1991, p.35). From their implicit contracts model, they derive a system of three equations (one of which explains the interest rate spread) and these are estimated simultaneously using non-linear least squares techniques.

There is an important weakness, however, which undermines all these studies, in that they are based on the crucial assumption that the rate of interest does not affect the probability of default. A number of the theoretical papers reviewed in chapter 2 (*inter alia* Jaffee and Russell, 1976; S&W) have provided more than adequate arguments for rejecting this assumption. In particular, S&W have shown how raising the rate of interest will screen out good risks where the interest rate is pooled (it is demonstrated in chapters 5 and 6 how similar adverse selection can occur with differentiated interest rates provided there is more than one risk type in any interest rate category), or produce moral hazards for borrowers who have a choice of projects to invest the loaned funds (assuming the relationship between risk and 'return if successful' is positive). Moreover, since lenders are unlikely to be ignorant of this effect it is probable that their perceptions of risk will be altered by movements in interest rates and the inevitable corollary is that this will feed through to their decisions on interest rates setting, including the possibility of equilibrium credit rationing. The studies also overlook the fact that, 'the ranking ignores the possibility that fees may act as a partial substitute for higher spread' (Hefferman, 1986, p.31).

Feder and Just (1980) justify their use of interest rates as a measure of perceived risk on the basis that 'lending transactions are assumed to be of sufficiently negligible size relative to the borrower's scale of operations ... so that the probability of default is not influenced by the lender's current decision, i.e. the interest rate on the loan does not affect default probability' (p.125). This argument is weakened, however, by the fact that on such large loans as those made in the sovereign debt market, changes in the rate of interest can incur massive changes in the levels of repayment, and may affect the willingness to repay, if not the ability. Consequently, lenders may prefer to dampen upward movements in interest rates and ration further credit to borrowers. Where credit rationing of this kind exists, interest rate spreads are not a sound measure of perceived risk.

It should be noted that the debate over the usefulness of interest rates in the presence of credit rationing has extended well beyond the literature on perceived risk analysis. A commonly held view amongst economists during the early post war period in the US, for example, was that 'central bank control over interest rates was useless as a restraint upon cyclical swings in the American economy' (Rosa, 1951, p.270, quoted in Hillier and Ibrahimo, 1993, p.273). One motivation for this view was that, if credit rationing is prevalent, saving and investment would be insensitive to the rate of interest, rendering impotent monetary policies based on interest rate control.

With regard to the implications of credit rationing for the usefulness of interest rates as a measure of perceived risk, Seck (1992) has argued that the LIBOR spread variable used by Edwards and others is inadequate because the use of spreads alone does not take into account restriction of access to credit markets which is in itself an important reflection of how banks perceive a country's risk. Edwards assumes that 'if the financial community distinguishes between countries with different probabilities of default, these perceptions will be reflected in spreads over LIBOR' (1984, p.726). Support for Edwards' approach is provided by Folkerts-Landau who argues that,

> 'Even a casual inspection of the difference between the borrowing and lending rates of banks active in the international market suggests that the spread between the interest rate charged to borrowers and the banks' own cost of funds – the London Interbank Offer Rate, or LIBOR – has come to reflect the market's assessment of expected loss due to debt rescheduling...' (1985, pp.331-332, quoted in Calvo and Kaminsky *op cit.* p.9)

Even though Edwards (1984) is aware that there may exist a 'credit ceiling' beyond which 'that particular country will be completely excluded from the credit market'(*ibid*), he does not suggest proxies to take this into account. It is possible that lenders perceive borrowers to have different thresholds with respect to the maximum interest they are willing to pay (analogous to the thresholds for loan application suggested in chapter 3), and if lenders' estimates of a particular borrower indicate that the existing interest rate is already near its threshold, then they may decide to stifle increases in the spread in the event of a rise in perceived risk and ration new loans (either quantitatively or qualitatively) to that borrower. This may be less true of other borrowers, where the spread will be allowed to rise without fear of it reaching the borrower's reservation rate for countries where other determinants of default have adversely changed or countries which have less bargaining power.

Strong evidence for the case against Edwards is given in Lussier and Alford (1993, p.713) where it is noted that 'during the first round of rescheduling negotiations in 1983, the spread was maintained at two per cent over LIBOR. However, during the second round, 1984-85, the average spread was reduced to 1.2 per cent and to below one per cent in the third round, 1986-87. The interest rates were not reduced because the solvency situation of the debtor countries had improved, rather to ease the debt-service requirements.'

Thus, it can be seen how distortions may arise in the LIBOR spread which cause it to diverge from perceived risk. Indeed, one of the factors which sparked the flurry of papers based on interest rate spreads was the desire to explain why the 'lending spreads in the market [are] currently very low' and because of 'concern that lenders are not being adequately compensated for the risks they are assuming' (Haegel, 1980, p.41).

4.3.2 Secondary Market Prices

During the 1980s a secondary market for sovereign debt began to develop which allowed banks to buy and sell assets comprised of outstanding country debt. The market began in 1984 and has 'grown from a volume of five billion dollars in

1986 to more than 100 billion dollars in 1991' (Lussier and Alford, 1993, p.725). Initially, transactions in the secondary market were 'dominated by banks attempting to decrease their exposure in one currency while increasing their exposure in another currency (debt-for-debt swaps)' (*ibid*). Such transactions were made with a view to concentrate or to diversify their portfolios of loans to LDCs. More recently, developing countries themselves have traded in the market in attempts to reduce the face value of outstanding loans through 'debt buy-backs' (for a discussion of such policies see Bulow and Rogoff, 1988; Snowden, 1989; Wijnbergen, 1990; Acharaya and Diwan, 1993).

The important aspect of the secondary market for the purposes of this chapter is that the price of a country's debt on the secondary market (expressed as pence in the pound) has been viewed as an approximation of the perceived probability of default of that nation. For example, if the secondary market price (SMP) is 0.8, then this can be interpreted as indicating that the market, at that point in time, expects only 80% of the loan will be repaid (or that there is an 80% chance of the full amount being repaid). It has been argued (by Lussier and Alford, 1993, for example) that secondary market prices offer a better reflection of perceived risk than the spread over LIBOR, and this is demonstrated by the fact that, whilst interest rate spreads were narrowing in order to 'ease the debt service requirements' (*ibid*, p.713), the average discount on the secondary market (that is, one minus the secondary market price) was at times over fifty per cent (*ibid*, p.714).

A number of authors have sought to exploit this feature of secondary market prices and a small literature has emerged which uses SMPs as measures of perceived risk. Laney (1987), for example, uses a sample of 31 countries to run cross-section regressions of secondary market prices in 1986 on economic risk and socio-political risk variables, each derived using principal components from a range of sub-variables. Both variables had the correct sign, although the latter was not statistically significant. Sachs and Huizinga (1987) regresses SMP prices for 28 countries against Debt/GNP, real GNP growth, a dummy variable for rescheduling, and a dummy variable to indicate whether US bank regulators had required a loan-loss allocation for each country. Both these studies are cross-sectional and so do not allow for changes in perceived risk over time. Boehmer and Megginson (1990) try to rectify this by using SMP data on ten countries over a 32 month period, but since most of the determinants were not available on a monthly basis, it was not possible to derive a true panel model. Lussier and Alford (1993) use a much larger sample, consisting of data on 31 countries over the six year period 1985-90. The data are pooled, however, and so no time variation of parameters is tested for, neither are fixed or random effects models used to exploit the panel properties of SMPs.

Khor and Rojas (1991) differ in their approach from the above papers because they consider whether the interest rate spread and SMPs are cointegrated. Given the previously mentioned proposition that secondary market prices are a better reflection of perceived risk than interest rates, this study is important. For if the two are essentially equivalent, then it cannot be claimed that SMPs are superior.

Khor and Rojas argue that, 'it is reasonable to expect divergence in the behaviour of the variables in the short run; however, we would expect the variables to move together in the long run.' (*ibid*, p.865). Their results show that neither the Dickey-Fuller test, nor the Augmented Dickey Fuller test, support the hypothesis of cointegration at the five percent level of significance. However, Khor and Rojas do find that there exists an error-correction mechanism that 'tends to restore the long-run equilibrium relationship ... Therefore, this test supports the hypothesis that [the two variables] are cointegrated' (*ibid* p.867).

However, care should be taken in assuming that the test for cointegration is a test of 'guilt by association' – that a long run relationship between SMPs and interest rate spreads necessary implies a fundamental weakness in SMPs as a measure of perceived risk. The corollary is weak because the existence of a long-run relationship (and relatively complex one at that) between SMPs and interest rates, may say more about the long run behaviour of interest rate spreads than about any distortion in SMPs. It may be, for example, that there is in fact a long run equilibrium relationship between interest rates and *perceived risk*, but that the impact of credit rationing and other distortions cause deviations in the short run (and consequently render LIBOR spreads impotent as indicators of perceived risk). The positive test results for a cointegrating relationship between SMPs and interest rates (where interest rates are known to be an unreliable barometer of perceived risk) do not necessarily invalidate SMPs as a measure of perceived risk because, in the context of perceived risk, short run distortions are highly consequential given the size of the loans involved. The fact that Khor and Rojas found substantial short run deviations (to the extent that only via an error correction mechanism could a long run relationship be identified), demonstrates that, in principle, SMPs cannot be excluded as valid measures of perceived risk.

There are, however, problems with acquiring and applying secondary market prices as a measure of perceived risk in the kind of panel regression to be developed here. First, they are not made publicly available: application has to be made to an international financial institution which trades on the secondary market, such as Solomon Brothers, and this is difficult for researchers outside of the USA (and outside of the private financial community) where the appropriate departments appear to be located. Second, the secondary market is still considered to be an 'emerging market' and so the volume of trade (and the prices themselves) are somewhat erratic. SMPs may, therefore, be unreliable because some of the price movements will reflect insecurity about the secondary market itself, rather than with regard to the borrower. Third, it is mainly LDC debt that is traded on the market, and so secondary market prices would not be available for all countries in the study. Fourth, it is not clear what the effect of country buy-backs are on the purity of SMPs as a reflection of perceived risk. If lenders view debt buy-backs as increasing the probability of repayment, they may be willing to sell debt back to a country intending to redeem its own debt, at a price below that suggested by the lenders' perception of the country's risk. At the same time, a country buying back its own debt effectively pushes up the price for its debt simply because its decision represents an outward shift of demand. Such intentions may provoke speculative behaviour, which may push up the price of the country's debt. However, the country may, of course, never actually buy-back, and so the price fluctuations which result from lenders cutting prices and speculative demand pushing up prices, may have no bearing on movements in the country's actual default risk. Add to this fact that the propensity to buy-back debt has not been uniform or consistent across countries, and the corollary is that the ordering of SMPs may not reflect the ordering of perceived risks (an issue that has not, as yet, been discussed in the perceived risk literature).

4.3.3 Country Risk Ratings

To overcome the inadequacies of LIBOR spreads to capture perceived risk, Seck (1992) employed the country risk rating published annually by the *Euromoney* periodical. This rating was first published in 1979 for countries active in the Eurocurrency markets, and had been used by a number of studies prior to Seck's analysis (although, without Seck's credit rationing justification), including Brewer and Rivoli (1990) and Cosset and Roy (1991). However, an examination of the computation of *Euromoney's* rating reveals that, as a measure of perceived risk, the rating has many of the same weaknesses as interest rate spreads (partly because spread over LIBOR forms part of the calculation).

Hefferman (1986) reveals that the computation of the rating for a particular nation is based on the country's average weighted spread:

$$\text{Average Weighted Spread} = \frac{\sum(\text{Volume} \times \text{Spread} \times \text{Maturity})}{\sum(\text{Volume} \times \text{Maturity})}$$

where volume = all the loans signed for a given country in a given year on the Eurodollar loan markets; spread = the spread over LIBOR; and maturity = the time over which the loan matures. As Hefferman (*op cit.*, p.30) notes, there are a number of weaknesses to this approach. First, 'the sample is self-selecting in that it only ranks countries active on the Euromarket in a given year' (*ibid*). Countries not participating in the market in a particular year will be omitted from the listings, even if they are amongst the most risky borrowers. Second, if the average LIBOR spread alters in a particular year then, 'the ranking will be biased in favour of countries which borrowed before the increase in the spread, even though this has nothing to do with the riskiness of the individual borrower' (*ibid*). Third, the calculation assumes spread and maturity to be independent, whereas in fact they are highly interdependent. Fourth, as we have argued earlier regarding the use of LIBOR spreads, the *Euromoney* rating may not move in tandem with perceived credit risk,

> 'the method suggests that lenders always adjust for higher risk by raising the spread. However, for the risk-averse lender, who is faced with less than perfect information with respect to the borrowers, this may not be the case. If the lender always responded to higher risk by raising the spread, the deterrent effect would be greater for the low risk than the high risk borrower. At some point, the increase in spread will raise the average riskiness of the portfolio and lower expected returns. To prevent this from happening, the lender sets credit limits to deal with the risk/information problem rather than raising spreads.' (Hefferman, *op cit.*, p.31)

Moreover, as with LIBOR spread studies, the *Euromoney* ranking 'ignores the possibility that fees may act as a partial substitute for higher spread' (*ibid*).

Since 1979, the calculation of the *Euromoney* ratings have undergone a number of changes (for example, see *Euromoney*, September 1982, p.74). These modifications have not addressed the weaknesses noted above, however, and have only served to exacerbate the problems of applying it as a panel measure of perceived risk because the changes mean that the measure is no longer consistent over time.

Institutional Investor Country Risk Rating

The only suitable, publicly available alternative to the measures listed above is the *Institutional Investor* annual survey of the major lending institutions to rate the creditworthiness of over a hundred countries on a scale of 0 to 100 (no bank ranks the country in which it has its headquarters). These ratings are then combined into a weighted average for each country, with weights being gauged according to the banks' sovereign lending as proportion of total sovereign lending. This measure has a number of advantages. First, it is not an *ad hoc* survey but a panel data set, and so can be combined with World Bank economic panel data on borrowing countries. Second, it is not the reflection of one particular computation of risk (as in the *Euromoney* rating) but a true reflection of the perception of lenders themselves (assuming the weights ascribed are appropriate). Third, the views of small lenders cannot disproportionately distort the overall rating because of the weighting procedure employed by *Institutional Investor* magazine.

Although a number of weaknesses of this rating as an objective measure of risk have been noted by Hefferman (1986, p.31ff), his criticisms do not generally undermine its usefulness as a measure of perceived credit risk because his comments refer to the inadequacies of 'banker judgement'. Indeed, Hefferman notes that 'the II rating is best interpreted as a reflection of market opinion rather than as an indicator of sovereign risk' (p.32). One aspect of Hefferman's critique that is relevant, is the possibility that 'a banker may be reluctant to reveal his/her true judgement on the survey for fear that this information may become public. This is especially true if a certain bank is known to be highly exposed in sovereign lending to one or more countries' (p.31). However, the extent to which this effect distorts the rating as a true measure of lenders' beliefs is likely to be small given the large number of lenders interviewed and the strict anonymity of those interviewed.

It is, therefore, this measure which was considered most appropriate for the econometric model estimated below. The *Institutional Investor* rating has been used in a number of previous studies, including Feder and Uy (1985), Brewer and Rivoli (1990), Cosset and Roy (1991), Thapa and Mehta (1991) and Lee (1993). Feder and Uy (1985) and Lee (1993) examine data from 1979-1983 and 1979-1983 respectively to ascertain the determinants of credit risk perceptions. Brewer and Rivoli (1990) and Cosset and Roy (1991) essentially adopt the same approach, except that they also run the regressions using the *Euromoney* ratings and find that the results are similar between the two sets of regressions. The Brewer and Rivoli study is distinct from the other studies in that it is the only paper to examine the impact of political variables on the *International Investor* ratings. Thapa and Mehta (1991), as we noted in chapter 3, test for a single structural break in their sample and find that they cannot reject the null hypothesis of stable coefficients. Other studies (Feder and Ross, 1982; Burton and Inoue, 1983) have compared the institutional rating to the spread over LIBOR, and have found a strong empirical relationship.

To summarise, then, there are a number of possible panel data which could be used to represent the dependent variable, including the *Institutional Investor* (II) and *Euromoney* country risk ratings, LIBOR spread and secondary market prices. The advantage of the II rating is that it is not hampered by non-clearing equilibria, whereas the LIBOR spread and *Euromoney* may be distorted by credit rationing as part of the lender's response to risk. Moreover, unlike secondary market prices, II ratings are published for a wide range of countries over a prolonged period. Because the II ratings have been around longer, are more consistent than the *Euromoney* listings, and have a more sound methodological basis as a measure of perceived risk, it was decided that these would be the most appropriate for the model used.

4.4 Determinants

Note that we are interested here in the variables that drive *perceived risk* and that these determinants may, of course, differ from those that determine actual risk, depending on the completeness and accuracy of the lender's risk assessment procedure. The aim, therefore, is to replicate the list of variables lenders use in their estimates of borrower risk. This is not as ominous a task as it might appear since there are a limited number of relevant and measurable variables that are likely to be used by lenders in their subjective estimates of objective risk. A reasonable way of arriving at the key set of signals is to examine the existing literature on actual-risk estimation and from these identify the most significant variables. This approach is supported by Hefferman's (1986, p29) observation that, 'Much of this literature comes from academic publications that do not have a wide readership among practising international bankers. Nonetheless, the models developed in the academic literature are used by a wide range of international banks, either directly or indirectly through economics appraisal services.'

Determinants used in the literature generally fall into three categories: (i) debt variables – those based on some aspect of the loan agreement; (ii) economic variables – those based on macro indicators; (iii) political variables – those based on the political bias, democratic development of a country. Tables 4-1, 4-2, and 4-3 give listings of the core explanatory variables used in the rescheduling-prediction literature.

Table 4-1 Debt Variables Used in the Objective Risk Literature

Variable	*Definition*	*References*
AM_DB	debt amortization / total outstanding debt	Frank and Cline, 1971 (discriminant); Kutty , 1990 (logit); Balkan, 1992 (probit)
DB_GNP	Debt outstanding / GNP	Kutty , 1990 (logit); Balkan, 1992, (probit) Moghadam *et al.*, 1991, (probit); Lee, 1991a (logit); Lee, 1991b (multinomial logit) Similar measures (such as debt/exports) used by: Savvides, 1991, (simultaneous probit); Oral *et al.*, 1992 (logit, Cart, G-logit)
SA_XP	ratio of debt service to export earnings(i.e. the debt service ratio)	Frank and Cline, 1971 (discriminant); Moghadam *et al.*, 1991, (probit); Savvides, 1991, (simultaneous probit); Balkan, 1992 (probit); Kutty , 1990, (logit) Feder *et al.*, 1981 (logit) Similar measures (such as Total debt service / GNP) used by Moghadam *et al.*, 1991 (probit); Kharas, 1984 (theory + probit);

Table 4-2 Economic Variables Used in the Objective Risk Literature

Variable	*Definition*	*References*
IN_GNP	Gross domestic investment / GNP	Moghadam *et al.*, 1991 (probit); Oral *et al.*, 1992 (logit, Cart, G-logit);
GNPPC	GNP / capita	Oral *et al.*, 1992 (logit, Cart, G-logit) Kharas, 1984 (theory + probit); Similar measures (such as growth of GNPPC or GNP growth) used by: Balkan, 1992, (probit); Savvides, (1991) (simultaneous probit); Lee, 1991a (logit); Lee, 1991b (multinomial logit); Kutty, 1990 (logit) Citron and Nicklesburg, 1987 (logit)
RE_MP	International reserves / imorts (reserves include: gold, dollar / sterling holdings, and net position at the IMF)	Frank and Cline, 1977 (discriminant); Balkan, 1992, (probit) Moghadam *et al.*, 1991 (probit); Savvides, 1991, (simultaneous probit); Kutty , 1990 (logit) Oral *et al.*, 1992 (logit, Cart, G-logit) Feder *et al.*, 1981 (logit) Similar measures (such as international reserves or growth rate of imports) used by: Citron and Nicklesburg, 1987 (logit);
XGNPR	Exports / GNP	Feder *et al.*, 1981 (logit) Similar measures (such as Growth rate of exports or imports/GNP) used by: Frank and Cline, 1977 (discriminant); Balkan, 1992 (probit); Savvides, 1991, (simultaneous probit); Kutty , 1990, (logit) Oral *et al.*, 1992 (logit, Cart, G-logit)

Table 4-3 Political Variables Used in the Objective Risk Literature

Variable	*Definition*	*References*
POLINST	Level of political instability	Balkan, 1992, (probit) Other measures of political instability used by: Citron and Nicklesburg, 1987 (logit); Oral *et al.*, 1992 (logit, Cart, G-logit)
POLDEM	Level of Democracy	Balkan, 1992 (probit)
GE_GDP	government expenditure (or debt held domestically) as a proportion of GNP	Lee, 1991a (logit); Lee, 1991b (multinomial logit)

4.4.1 Rationale for Including a Variable in the Regressions

The question to bear in mind when looking down the list of variables listed in the above tables is why might the lender include this variable in its analysis of objective risk? In other words, what is the rationale behind the variable? Table 4-4, Table 4-5, and Table 4-6 summarise the expected signs and typical rationale put forward for these variables. A variety of other variables have been tried in various papers which are not included in these tables, either because they were not significant in the regressions or because the data could not be obtained for the full panel. Also, some variables are not included either because the rationale was weak (and so unlikely that lenders would include them), or because their effect is picked up by other variables (as indicated in Tables 4-1, 4-2 and 4-3), or because the variable proved statistically insignificant in the initial regressions. The first variable listed is AM_DB, debt amortization over total outstanding debt, which has been used by Frank and Cline (1977) amongst others to measure the extent to which long-term debt liabilities dominate the debt portfolio of the country. It is expected to be positively related to creditworthiness. DB_GNP, outstanding debt over GNP, measures the proportion of current output that must be diverted to debt service and has been used by a wide range of studies (see Table 4-1) to measure the level of 'debt burden' a country faces. This is expected to be negatively related to current creditworthiness. The debt service ratio, SA_XP, has ambiguous expected sign because, whilst on the one hand, high levels of debt service may be an indicator of commitment to repayment, on the other, it reflects the dependence on export earnings. As a measure of prospects for future growth, many authors use IN_GNP, the ratio of investment to GNP. This is obviously expected to be positively related to creditworthiness, as is GNP per capita, used as a measure of current income flows and the capacity for taxation income to repay debt. RE_MP represents the stock of a country's reserves relative to imports, and the higher this is, the less likely a country is to face repayment difficulties. Also positively affecting creditworthiness is the level of foreign exchange a country has left over after debt service payments relative to its GNP since this measures another aspect of a country's debt service capacity. Most authors use XGNPR, exports/GNP, to measure this determinant.

Before I go on to discuss the particular problems associated with measuring political determinants of creditworthiness, it is worth noting some of the drawbacks of the above variables. First, it is clear that these are all very crude indicators of the underlying influences they are trying to measure. This is a legitimate criticism of *objective* risk studies, but not necessarily of *subjective* risk analysis (as defined in chapters 1 and 2) because there is abundant evidence to show that measures such as these are actually used by lenders to assess risk (Hefferman, 1986). More qualitative factors will no doubt often be taken into account (see discussion in the previous chapter), and no doubt there will be fluctuations in the level of sophistication of models used to combine these variables, but simple financial ratios have an increasingly dominant role (Hefferman *op cit.*). Another cause for concern is that of measurement. The accuracy of all of these variables is dependent to some degree on the national accounts and data recording practices of the countries concerned. International organisations such as the World Bank (from which most of these variables were collected) make significant attempts to standardise measurement, but questions over reliability remain, particularly for many less developed countries, some of which have reputedly doctored figures to improve the economic image of their country. However, these variables and the sources I used are typically the sources that lenders themselves use and so again, although measurement is a particular concern for *objective* risk studies, it is not necessarily so for *subjective* risk analysis. The most important goal of the data collection aspect of my empirical model is to reflect with reasonable similarity the determinants used by lenders, even if this means including the measurement errors that lenders face. As noted above, the strategy I have adopted is to follow the pattern of determinants used in academic studies as these have strongly influenced the models used by lenders (Hefferman *op cit.*).

Not all variables included in the literature are included in the model below, however, particularly if only one or two studies include them since this is unlikely to reflect general lending practice. One example of a variable not included is *capital flows*. Most studies which have included the variable (Feder and Just, 1977; Feder, Just and Ross, 1981; Kharas, 1984) have assumed flows of capital to be an indicator of a country's creditworthiness and have found it to be an important determinant. Such authors argue that commercial and non-commercial inflows represent a significant source of exchange for many LDCs which can be used to meet the obligations of external debt (Feder *et al.*, 1981). Thus, the greater the capital inflow, the less chance there is of encountering debt service difficulties.

However, Eaton and Gersovitz (1981, p.289) and Kharas (1984, p.429) consider capital flows to be endogenous. Kaharas *op cit.* observes that if at the start of the year a nation decides to reschedule, such a decision may affect the volume of capital inflows in that year, indicating that 'capital inflows cannot be taken as independent of the error term'. In response to these arguments, Savvides (1991) constructed a simultaneous probit model of creditworthiness and capital inflows and found a reversal in sign (i.e. positive rather than negative) in its influence on risk. He suggests that this may be explained in terms of defensive lending where existing creditors extend new loans to problem debtors in order to defend the value of their existing claims (see also Krugman, 1988). Thus, an increase in the flow of foreign capital constitutes 'a signal of reduced creditworthiness' (Savvides, 1991, p.320).

In the absence of a full simultaneous system, however, Cline comments on the role of capital flows in determining creditworthiness are apt:

> 'It would not be surprising to find a negative statistical relationship between them (as Feder and Just do). But high capital inflow should be construed more as a consequence of creditworthiness than a cause of it, and this variable therefore would not appear to belong on the right-hand side of the equation as an explanatory variable' (1983, p.219).

It is this view which is adopted here, hence the exclusion of capital flows as a determinant of risk.

Another series of variables not included in the regressions are those used in the literature to reflect the bargaining power of borrowers. In addition to standard financial ratios and economic variables[ii], Lee (1991b) includes variables to capture the bargaining power of borrowers during negotiations. These are: (i) MB - a dummy variable for major borrowers[iii]; and (ii) DHIC - a dummy variable for highly indebted countries[iv] (Lee, argues that, 'Since the commitment of lenders is already large, it is expected that major borrowers, and to a lesser extent the highly indebted countries, are able to obtain better terms on rescheduling their loans', 1996b, p.469); (iii) GNP - included as a measure of the size of borrowers (Lee hypothesizes that the larger the borrower is, the more bargaining power it will have during the re-negotiation of its loan.); and (iv) EXP - borrower's exports to industrialized countries as a share of total exports, included as a measure of the extent of the borrowers trade links with lenders. It is expected that the greater the ratio is, the *less* the borrowers' bargaining power will be[v].

However, these bargaining variables are likely to be highly correlated with other debt and econonic variables and so much of their explanatory power is captured without their inclusion. Not surprisingly, they were not generally statistically significant when included in preliminary regressions, and so were excluded from the final model.

Table 4-4 Debt Variable Definition and Expected Signs

Variable	*Expected sign* †	*Rationale*
AM_DB	(+)	Low AM_DB (debt amortization over total outstanding debt) indicates long term debt liabilities dominate the debt portfolio of the country. This implies little short run flexibility in reducing debt service commitments by temporary reduction of borrowing. Therefore, the country is more likely to reschedule. 'The absence of short term liabilities also indicates that a country does not have significant access to short-term commercial credit facilities, i.e. the country is not particularly 'credit-worthy'. A lack of a good credit reputation makes it difficult for a country to obtain quick access to additional credits when shortfalls in exchange earnings occur and rescheduling of debt becomes a more attractive alternative to alleviate foreign exchange crises' (Frank and Cline, 1977 p.332.)
DB_GNP	(-)	Debt outstanding over GNP measures the proportion of current output that must be diverted to debt service.
SA_XP	(+ or -)	The ratio of the debt service to export earnings is an indicator of debt service capacity; increase of SA_XP implies an increase in the vulnerability to foreign exchange crises. 'Any shortfall in foreign exchange earnings or capital imports which is not covered by exchange reserves must be met by reducing imports: since debt service is a fixed obligation, the higher the debt service ratio, the greater is the relative burden on import reduction for a given shortfall in foreign exchange' (Frank and Cline, 1977). On the other hand, high levels of debt service may be an indicator of commitment to repayment and so an indicator of the willingness to repay which may explain why certain studies have found a negative relationship with risk (Edwards, 1986, p.579, found it to be negatively related to bond spreads; see also Burton and Inoue, 1985 and Calvo and Kaminsky, 1991, p.31). Calvo and Kaminsky explain the ambiguity of sign is due to such variables being 'simultaneously determined with the probability of default' (p.11).

† Positive if increases creditworthiness.

Table 4-5 Economic Variables: Rationale and Expected Signs

Variable	*Expected sign*[†]	*Rationale*
IN_GNP	(+)	Gross domestic investment over GNP, 'Reflects the country's prospective for future growth' (Moghadam *et al.* 1991 p.6)
GNPPC	(+)	GNP per capita is a measure of current income flows and capacity for taxation income to repay debt
RE_MP	(+)	International reserves over imports: *cet. par.*, the country with the high reserves relative to imports is less likely to reschedule (Frank and Cline, 1977)
XGNPR	(+)	Exports over GNP: 'Of two countries with equally high debt service ratios, the country having the highest exports-GNP ratio would have the most foreign exchange left over after debt service payments relative to its GNP, *cet. par.* This more stable characteristic of the economy may thus influence the attitude toward rescheduling. A high export / GNP ratio would tend to reduce the need for painful domestic adjustments' (Feder *et al.*,1981, p.658)

[†] Positive if increases creditworthiness.

Table 4-6 Political Variables Rationale and Expected Signs

Variable	*Expected sign* †	*Rationale*
FR	(- / +)	This is Gastil's (1988) Freedom Rating which attempts to capture democratic development, both in terms of the extent to which the political system is democratic, and in terms of whether the behaviour of the populous suggests that the electoral system is genuinely working (i.e. absence of revolutions, anti-government demonstrations, guerilla warfare etc.). This has an ambiguous sign since there has been considerable debate in the literature as to whether democracy helps or hinders development.
GE_GNP	(- / +)	Government expenditure over GNP: according to Alesina and Tabellini (*op cit.*), left wing governments are more likely to default and to the extent that political bias is reflected in government expenditure/debt, this variable will be negatively related to perceived creditworthiness. A less political rationale is given by Lee, 'Inappropriate domestic policies may have compounded debt problems faced by borrowers. Hence, the ratio of domestically held government debt to GDP variable is included to serve as a proxy measure of government fiscal policy' (Lee, 1991b, p.475). However, high government levels expenditure may be justified if targeted at infra-structure, for example, and so lenders may not always view this variable pejoratively.

† Positive if increases creditworthiness.

4.5 Political Determinants

Of the three categories of variables listed, economic and debt variables have generally dominated the regression analysis of sovereign risk. Few studies, however, offer a rigorous theoretical framework for the influence of economic variables, and those that do (e.g. Kharas 1984) tend to adopt a highly mechanistic explanation, violating the guidelines laid down by Eaton *et al. op cit.*. Ideally, models should incorporate economic factors in terms of their influence on the willingness to reschedule, the ultimate decision being contingent upon a wide range of factors.

In a similar vein, Balkan, notes that,

> 'A nation's decision to reschedule its external debt reflects not only its economic circumstances, i.e. its ability to meet its obligations, but also its willingness to service these obligations. The latter reflects the political environment of the debtor nation in that the decision to reschedule is a political decision' (1992, p.999).

One of the major shortcomings of many of the early studies (such as Feder *et al.*, 1977, for example) was their failure to take into account the affect of *political factors* on the decision to reschedule. Reasons for this may include the belief that such variables were not measurable; that the measures that did exist were either considered highly subjective or not relevant to risk analysis. Political variables are partly indicative of a country's 'attitude' to debt repayment and so one might hypothesise that when risk assessment levels are low, these variables are not included in lender assessment procedures or not measured with great precision.

Most of the literature that has considered the effects of political elements have tended to focus on the influence of these factors on development as a whole, not on risk assessment *per se*. For example, Pourgerami and Assane (1992) consider the relationship between democracy and the pace of development. He concludes that democracy does *not* have a negative effect. On a similar note, Healey *et al.*, 1992, conclude that, 'democratic regimes are no worse at controlling fiscal deficits than authoritarian regimes' (p.1). Balkan and Green (1990) examine the question of whether authoritarian regimes will necessarily incur more foreign debt. Testing the relationship between debt and political liberty, they find 'little empirical support for the thesis that democracy or autarky influence foreign debt levels'. There is also a good deal of literature on the effects of democracy on inequality (surveyed by Sirowy and Inkeles 1990).

The question more pertinent to the issues at hand, however, is whether democracy has any impact on perceived creditworthiness. It is only in the more recent studies that the influence of political factors on sovereign risk have been examined (for example, Abdullah, 1985; Citron and Nichelsburg, 1987; Brewer and Rivoli, 1990). Abdullah (*op cit.*) develops an indicator of debt-servicing vulnerability by compiling a weighted index combining several financial ratios. These ratios are indicators of: the international liquidity position, internal debt growth, inflation rate, export position, and the political stability of a country. He labels the index the 'Payments Interruption Likelihood Index'.

Citron and Nicklesburg (1987) incorporate a measure of instability in the political structure. There rationale is as follows: relieving pressure on government budgetary obligations using rescheduling or default is costly to the borrower (presumably in terms of loss of international creditworthiness), but these costs may be considered acceptable during times of political instability, particularly if the pressure to meet repayment obligations may require tax increases which would ensure political collapse. When governments are changing frequently, the option of rescheduling becomes all the more attractive. Citron and Nicklesburg thus use a five year moving aggregate of the number of changes in government as a proxy for political instability. This variable proved significant, although only three other variables were included in the regression, and the sample consisted of only five countries (Argentina, Brazil, Mexico, Spain, and Sweden) considered over the 1960-1983 period. If instability is as important as the authors claim, then there is perhaps a case for reconsidering the policy of imposing on LDCs strict requirements for economic policy reform if such impositions serve only to add to the political instability. Indeed, 'both Argentina and the Dominican Republic have emphasised that because such policies increased instability they were unwilling to strictly adhere to them' (Citron and Nicklesburg, 1987, p.392).

Brewer and Rivoli (1990) examine the effect of political factors specifically on perceived risk and attempt to answer two central questions: '(1) Do international bankers and financial markets respond to these political phenomena in their assessments of countries' creditworthiness? (2) What types of political instability affect creditworthiness perceptions?' They consider the effects of government regime change, political legitimacy and armed conflict in addition the current account balance / GNP and total debt / GNP. 'Political legitimacy' was measured using Gastil's (various years) annual reports on human rights which rank countries on the extent to which the political process is democratic versus authoritarian.

Countries with a high rating allow free and open elections, popular participation in government, and genuine political opposition (see Bollen, 1986, for further information on measuring political rights and liberties). Brewer and Rivoli find that, 'political variables are at least as important as economic variables in explaining perceived creditworthiness' (*op cit.* p.357). Interestingly, they found creditworthiness to be negatively related to the democracy scores, suggesting that 'more authoritarian regimes are more creditworthy in the short run. These regimes may be better able to extract resources from the economy, and also better able to institute or maintain austerity programs that lack popular support' (*ibid*, p.365).

This interpretation, however, is controversial, and has to be measured against the ongoing debate in the literature as to whether democracy is positively or negatively related to development (see Pourgerami and Assane, 1992). Indeed, Brewer and Rivoli acknowledge a second possible interpretation of their results, 'that the lenders' risk assessments are short sighted in their failure to consider a longer-term and more comprehensive view of country stability...' (Brewer and Rivoli, 1990, p.365). That human rights violations have a deleterious effect on credit risk is supported by the fact that,

> 'Authoritarian regimes increase the chance of violent and revolutionary change, as many recent examples make clear, and therefore we would expect that the risks of country lending would be higher under such regimes.... For example, we know that the illegitimacy of the authoritarian regime of Ferdinand Marcos, as well as continued armed conflict in the Philippines, had deleterious effects on the ability to service sovereign debt.' (Brewer and Rivoli, 1990, p.365)

Although the measures of political risk used *inter alia* by Abdullah (*op cit.*) and Citron and Nicholsberg (*op cit.*) are sound, variables suitable for the econometric model developed below are restricted by the requirement that they be available as a panel series over the full 12 year period 1979-1990. This limits considerably the options available given that many of the variables used to assess political risk are collected on an *ad hoc* basis for two to three years at most. Gastil's measures (used, for example, by Brewer and Rivoli, *op cit.*), on the other hand, are available on an annual basis for an extended period and so are more suitable.

The econometric model developed in this paper uses two measures covering political bias and political development:

4.5.1 Political Bias

This is essentially the grading of political regime as in terms of right or left wing ideological alliance. Alesina and Tabellini (1988) give a theoretical underpinning for this type of measure by constructing a dynamic model based on a simple class division between workers and capitalists. That is, 'two social groups behaving non-co-operatively' (Alesina and Tabellini, 1988, p.216). In this scenario, a right wing government (one that serves the interests of capital) is less likely to renege on debt repayment since it is capitalists who suffer most from bank punishment strategies (for example, credit restrictions and trade sanctions initiated through the influence of banks on the international community). The corollary is that left wing governments are less creditworthy than right wing governments and so are more likely to default.

This is obviously a controversial conclusion, and one that is not easily empirically verified. Our main concern here, however, is not whether the conjecture is true, but whether international banks perceive it to be so. As far as the author is aware, no studies to date have explored this aspect of political risk using an empirical analysis. If and only if the coefficient on GE_GNP is positive, will it be possible to reject the hypothesis that left wing governments (defined as those with high levels of intervention) have higher perceived credit risk.

4.5.2 Political Development

The second category of political risk is 'political development' which refers to the extent to which a country can be called democratic. Some measure is needed of the extent to which there is political freedom or political repression; protection of human rights or violation of human rights; rule by the masses or rule by an elite. Governments who disregard the civil and political rights of their civilians are less likely to have regard for repayment ethics. Moreover, since such countries are likely to be already out of favour with the international community, bank punishment strategies will carry less weight.

To support their inclusion of a political development measure, Brewer and Rivoli (1990) refer to Shapiro's (1985) argument that a government's ability to meet its debt obligations depends upon the state's ability to extract the necessary resources from its citizens. Brewer and Rivoli argue that, 'stable regimes are more likely to have this ability than unstable ones' (1990, p.359). However, as discussed earlier, whether authoritarian regimes are any less stable cannot be answered without qualification, neither can the question of whether authoritarian regimes are more or less conducive to economic development (particularly since many of the emerging Asian economies that demonstrated rapid growth in the mid-eighties and early nineties were less than democratic).

Democracy is assumed to be comprised of two aspects (both of which are captured in the FR variable): (i) the absence of populous behaviour indicative of a less than democratic system; and (ii) the fairness and transparency of the electoral system. The first aspect measures the amount of social unrest that occurred in a given year (number of: assassinations, anti-government demonstrations, guerilla warfare, riots, general strikes, revolutions, *coups d'etat*, government crises and purges). The higher the political instability, the higher the risk of rescheduling. The second aspect captures two elements: a) extent that the executive and legislative branches of government reflect the popular will; and b) the degree of exclusion of political parties from the system and the ability of the largest party to dominate national elections.

4.6 Econometric Results

Having decided upon a suitable measure of perceived risk (the *Institutional Investor* Risk Rating) and an appropriate list of determinants of perceived risk (drawn largely from existing studies), regressions were run on a variety of samples to facilitate the search for structural breaks. All variables were derived from World Bank data except for FR which, as discussed above, was taken from Gastil's Freedom Rating, and the dependent variable (II) which was collated from the *Institutional Investor* published ratings. The results of the OLS and Fixed Effects regressions are listed in Table 4-7 and Table 4-8 respectively. The results of the one year regressions are not listed but the elasticities based on these regressions are given in Table 4-9 and graphed in Figure 4-1.

Looking at the 12 year OLS regression it can be seen that the overall explanatory power is reasonable (adjusted R^2 = 0.556), all of the regressors have the expected signs and only the political variables are statistically insignificant, and then only in particular years. Diagnostics generally improve the less pooled the sample, and are generally stronger for the second half of the sample period (the OLS regressions pooled on twin years from 1985 onwards all have adjusted R^2 over 0.7). Both of these symptoms suggest the existence of structural breaks over time. A similar story is told in the fixed effects twelve year regression panel model (regression 20) with an adjusted R^2 of 0.557, compared with an adjusted R^2 of 0.746 for 1987-1990 (regression 27). The Bruesch-Pagan results for the OLS models suggest much stronger heteroscedasticity in the latter years of the sample, and this was dealt with using Whites standard errors. All variables were significant in at least **one** regression.

FR was found to be much more significant in the early years (regressions (4), (6), (9), (10), (11), (23), (25), (28), (29)) and to some extent this is also true for AM_DB. However, the opposite appears to be the case for GE_GNP which is most significant (and most negative) towards the latter half of the 1980s (regressions (5), (8), (18), (19), (22), 24), (27)). The variables tending to have the highest significance levels overall are DB_GNP, IN_GNP and XP_GNP.

Table 4-7 Ordinary Least Squares Regressions: Samples Pooled

(a)

Variable	*Sample*				
	(1) 1979-1990	(2) 1979-1986	(3) 1983-1990	(4) 1979-1984	(5) 1985-1990
	12 Years	**8 Years**	**8 Years**	**6 Years**	**6 Years**
Constant	3.099 (2.713)	0.205 (0.125)	-7.1041 (-3.538)	1.148 (0.510)	-4.812 (-2.141)
AM_DB	0.49171 (7.329)	0.558 (6.702)	0.26765 (3.025)	0.585 (5.504)	0.263 (2.593)
DB_GNP	-9.9163 (-12.377)	-11.608 (-10.364)	-8.7240 (-8.710)	-10.942 (-6.503)	-9.700 (-9.035)
SA_XP	0.65289 (4.287)	3.6534 (6.856)	0.38810 (2.867)	3.125 (3.512)	0.452 (3.599)
IN_GNP	0.21984 (3.833)	0.19135 (3.881)	12.181 (6.435)	0.182 (4.300)	9.815 (4.560)
GNPPC	1.1860 (3.949)	2.0013 (4.970)	0.82628 (2.279)	1.835 (3.636)	1.009 (2.455)
RE_MP	2.1154 (6.742)	2.1706 (4.984)	1.6496 (4.413)	2.348 (4.105)	1.337 (3.599)
XP_GNP	5.9453 (8.054)	6.8294 (7.406)	5.3530 (5.677)	5.832 (4.850)	6.097 (6.071)
FR	-0.052 (-1.244)	-0.097 (-1.674)	-0.021 (-0.394)	-0.177 (-2.538)	0.030 (0.523)
GE_GNP	-0.31907 (-1.804)	-0.161 (-0.742)	-0.708 (-3.530)	-0.164 (-0.595)	-0.59758 (-2.915)
N	516	344	344	258	258
F-test for H_o: $\omega_k = 0 \ \forall \ k$	72.590 [0.3E-13]	39.685 [0.000]	81.226 [0.000]	24.170 [0.000]	72.468 [0.000]
Breusch-Pagan Chi-Squared	36.5756 [0.3E-04]	19.2697 [0.023]	56.4381 [0.5E-08]	21.6053 [0.010]	46.8074 [0.4E-06]
Adjusted R^2	0.556	0.504	0.678	0.448	0.715

Figures in rounded brackets are t-values based on White's standard errors.
Figures in square brackets are significance levels

(b)

Variable	*Sample*		
	(6)	(7)	(8)
	1979-1982	1983-1986	1987-1990
	4 Years	**4 Years**	**4 Years**
Constant	0.56201	-12.044	-3.675
	(0.196)	(-4.681)	(-1.218)
AM_DB	0.54134	0.324	0.237
	(4.023)	(2.851)	(1.860)
DB_GNP	-7.8378	-10.207	-10.029
	(-3.986)	(-7.483)	(-8.576)
SA_XP	2.4003	3.647	0.435
	(2.150)	(7.574)	(3.596)
IN_GNP	0.18636	13.955	8.307
	(6.139)	(6.709)	(2.939)
GNPPC	1.7035	1.377	1.043
	(2.924)	(3.162)	(2.057)
RE_MP	2.6447	1.804	1.370
	(4.098)	(2.900)	(3.317)
XP_GNP	4.0085	6.3121	6.625
	(3.035)	(5.507)	(5.741)
FR	-0.27021	-0.059	0.074
	(-3.397)	(-0.678)	(1.129)
GE_GNP	-0.10073	-0.403	-0.64007
	(-0.305)	(-1.368)	(-2.766)
N	172	172	172
F-test for	14.408	41.240	57.287
H_o: $w_k = 0 \ \forall \ k$	[0.6E-15]	[000]	[0.1E-15
Breusch-Pagan	13.5508	19.343	41.2686
Chi-Squared	[0.139]	[0.022]	[0.4E-05]
Adjusted R^2	0.414	0.679	0.748

Figures in rounded brackets are t-values based on White's standard errors.
Figures in square brackets are significance levels

(c)

Variable	*Sample*					
	(9)	(10)	(11)	(12)	(13)	(14)
	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985
	2 Years	**2 Years**	**2 Years**	**2 Years**	**2 Years**	**2 Years**
Constant	0.46612	-7.4903	-9.0020	-13.763	-14.126	-10.810
	(0.137)	(-1.752)	(-1.956)	(-3.457)	(-3.674)	(-2.922)
AM_DB	0.55751	0.26672	0.32763	0.34952	0.32433	0.42233
	(2.917)	(1.578)	(1.688)	(2.166)	(1.879)	(2.098)
DB_GNP	-7.0140	-8.6102	-8.5049	-8.4958	-10.178	-10.053
	(-2.985)	(-3.862)	(-3.097)	(-3.246)	(-3.681)	(-5.341)
SA_XP	2.0666	3.0599	2.8027	2.5262	3.1699	3.6679
	(1.403)	(1.950)	(1.617)	(1.943)	(2.500)	(5.824)
IN_GNP	0.18609	12.663	14.119	18.183	17.279	13.441
	(7.557)	(3.941)	(3.359)	(5.492)	(5.662)	(4.756)
GNPPC	1.7743	0.59262	0.50274	0.61470	0.71974	1.4701
	(2.454)	(0.985)	(0.782)	(1.022)	(1.031)	(2.295)
RE_MP	2.0337	1.7594	2.2738	2.7799	2.5317	1.4607
	(2.691)	(1.725)	(1.932)	(2.747)	(2.404)	(1.823)
XP_GNP	3.8236	3.6679	3.2585	2.9210	6.0252	5.8307
	(2.543)	(1.774)	(1.300)	(1.584)	(2.831)	(3.411)
FR	-0.279	-0.371	-0.289	-0.124	-0.101	-0.059
	(-3.004)	(-3.722)	(-2.512)	(-0.983)	(-0.755)	(-0.490)
GE_GNP	0.2317	-0.499	-0.457	0.10694	-0.496	-0.844
	(0.510)	(-1.640)	(-1.082)	(0.207)	(-1.142)	(-1.861)
N	86	86	86	86	86	86
F-test for	6.462	13.123	12.5709	152759	17.8218	19.730
H_o: $w_k = 0 \ \forall \ k$	[0.9E-06]	[0.2E-11]	[0.6E-11]	[0.7E-13]	[0.2E-14]	[0.4E-15]
Breusch-Pagan	6.010	12.602	23.571	31.123	25.953	15.011
Chi-Squared	[0.739]	[0.182]	[0.005]	[0.2E-03]	[0.002]	[0.091]
Adjusted R^2	0.366	0.562	0.551	0.6018	0.6404	0.665

Figures in rounded brackets are t-values based on White's standard errors.
Figures in square brackets are significance levels

(d)

Variable	*Sample*				
	(15)	(16)	(17)	(18)	(19)
	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990
	2 Years	**2 Years**	**2 Years**	**2 Years**	**2 Years**
Constant	-9.9683 (-3.174)	-6.7684 (-1.888)	-5.320 (-1.260)	-1.8180 (-0.443)	-2.2810 (-0.559)
AM_DB	0.30117 (2.055)	0.066 (0.379)	0.14017 (0.833)	0.33142 (1.947)	0.30385 (1.677)
DB_GNP	-10.849 (-6.526)	-12.128 (-5.987)	-10.898 (-5.931)	-9.8794 (-5.237)	-9.7291 (-6.572)
SA_XP	3.8749 (8.057)	0.63932 (1.559)	0.52984 (2.890)	0.46679 (2.592)	0.38096 (2.254)
IN_GNP	11.061 (4.138)	12.437 (3.887)	10.707 (2.644)	6.3203 (1.856)	6.4755 (1.788)
GNPPC	1.9141 (3.375)	1.1671 (1.939)	1.5033 (2.344)	1.5758 (2.015)	0.42402 (0.546)
RE_MP	1.2834 (1.761)	1.3167 (2.165)	1.2373 (2.372)	1.6529 (2.673)	1.3572 (2.060)
XP_GNP	6.8627 (4.986)	7.4118 (4.603)	6.2140 (4.112)	5.5878 (3.177)	7.6981 (4.238)
FR	0.009 (0.080)	0.040 (0.432)	0.10511 (1.272)	0.067 (0.713)	0.24786E-01 (0.245)
GE_GNP	-0.178 (-0.508)	-0.003 (-0.010)	-0.545 (-1.573)	-0.98272 (-2.509)	-0.67962 (-2.121)
N	86	86	86	86	86
F-test for H_o: $w_k = 0 \ \forall \ k$	25.07144 [0.4E-15]	26.851 [0.000]	28.245 [0.3E-15]	24.490 [0.000]	28.248 [0.1E-15]
Breusch-Pagan Chi-Squared (D.F.= 9)	8.1707 [0.517]	17.7282 [0.039]	0.7425 [0.999]	16.0748 [0.065]	21.6825 [0.010]
Adjusted R^2	0.7182	0.732	0.743	0.713	0.7426

Figures in rounded brackets are t-values based on White's standard errors.
Figures in square brackets are significance levels

Table 4-8 Fixed Effects Regressions

(a)

Variable	*Sample*				
	(20) 1979-1990	(21) 1979-1986	(22) 1983-1990	(23) 1979-1984	(24) 1985-1990
	12 years	**8 years**	**8 years**	**6 years**	**6 years**
AM_DB	0.50406 (5.854)	0.55603 (4.778)	0.272 (2.888)	0.566 (3.935)	0.258 (2.590)
DB_GNP	-9.4115 (-10.713)	-10.331 (-8.742)	-9.188 (-9.799)	-9.718 (-6.414)	-9.870 (-9.496)
SA_XP	0.67524 (4.146)	4.1034 (6.111)	0.378 (2.614)	3.727 (3.815)	0.433 (3.129)
IN_GNP	0.24772 (3.112)	0.22726 (2.740)	11.956 (8.854)	0.216 (2.477)	9.704 (6.449)
GNPPC	1.1563 (3.860)	2.0181 (5.114)	0.849 (2.608)	1.879 (3.939)	0.990 (2.750)
RE_MP	2.0602 (5.185)	2.1767 (4.138)	1.626 (3.953)	2.356 (3.578)	1.350 (3.031)
XP_GNP	5.9778 (7.604)	6.9262 (6.599)	5.484 (6.204)	6.082 (4.503)	6.264 (6.620)
FR	-0.061 (-1.298)	-0.011 (-1.772)	-0.013 (-0.259)	-0.188 (-2.561)	0.029 (0.528)
GE_GNP	-0.302 (-1.618)	-0.092 (-0.380)	-0.703 (-3.542)	-0.082 (-0.275)	-0.594 (-2.762)
N	516	344	344	258	258
F-test for H_o: $\omega_k=0\ \forall\ k$	33.385 [0.1E-77]	23.879 [0.1E-44]	45.874 [0.1E-72]	17.001 [0.8E-28]	46.237 [0.2E-59]
Adjusted R^2	0.557	0.516	0.677	0.466	0.711

Figures in rounded brackets are t values.
Figures in square brackets are significance levels

(b)

Variable	*Sample*		
	(25)	(26)	(27)
	1979-1982	1983-1986	1987-1990
	4 Years	**4 Years**	**4 Years**
AM_DB	0.546 (3.075)	0.3238 (2.108)	0.23326 (2.141)
DB_GNP	-7.515 (-3.938)	-10.207 (-7.633)	-10.207 (-8.361)
SA_XP	2.526 (2.049)	3.6468 (5.363)	0.41720 (3.027)
IN_GNP	0.204 (2.363)	13.955 (7.533)	8.1381 (4.382)
GNPPC	1.773 (3.117)	1.3766 (2.841)	1.0202 (2.415)
RE_MP	2.495 (3.032)	1.8037 (2.993)	1.4082 (2.789)
XP_GNP	3.925 (2.448)	6.3121 (4.885)	6.8183 (6.025)
FR	-0.275 (-3.135)	-0.0591 (-0.812)	0.0736 (1.148)
GE_GNP	-0.071 (-0.198)	-0.40259 (-1.385)	-0.632 (-2.498)
N	172	172	172
F-test for H_o: $w_k = 0 \ \forall \ k$	11.086 [0.7E-15]	41.23955 [0.1E-15]	42.874 [0.1E-42]
Adjusted R^2	0.41445	0.679268	0.746

Figures in rounded brackets are t values.
Figures in square brackets are significance levels

(c)

Variable	*Sample*					
	1979-1980	1981-1982	1983-1984	1985-1986	1987-1988	1989-1990
	2 Years	**2 Years**	**2 Years**	**2 Years**	**2 Years**	**2 Years**
AM_DB	0.564 (2.394)	0.329 (1.250)	0.329 (1.362)	0.302 (1.461)	0.143 (0.921)	0.305 (1.900)
DB_GNP	-7.054 (-2.673)	-8.438 (-3.336)	-10.195 (-4.537)	-10.832 (-5.895)	-10.944 (-5.867)	-9.714 (-5.762)
SA_XP	2.022 (1.251)	2.829 (1.615)	3.227 (2.247)	3.887 (5.032)	0.526 (2.143)	0.386 (2.122)
IN_GNP	0.195 (2.342)	14.049 (5.210)	17.173 (5.768)	11.065 (4.558)	10.666 (3.380)	6.477 (2.653)
GNPPC	1.807 (2.455)	0.512 (0.612)	0.721 (0.941)	1.918 (2.927)	1.503 (2.607)	0.428 (0.644)
RE_MP	1.983 (1.707)	2.286 (2.027)	2.517 (2.590)	1.287 (1.602)	1.227 (1.782)	1.362 (1.676)
XP_GNP	3.853 (1.707)	3.245 (1.251)	6.137 (2.646)	6.854 (4.355)	6.210 (4.013)	7.700 (4.367)
FR	-0.272 (-2.231)	-0.290 (-2.508)	-0.101 (-0.889)	0.009 (0.093)	0.105 (1.245)	0.025 (0.241)
GE_GNP	0.183 (0.362)	-0.447 (-0.913)	-0.498 (-1.060)	-0.177 (-0.465)	-0.540 (-1.455)	-0.688 (-1.841)
N	86	86	86	86	86	86
F-test for H_o: $\omega_k = 0 \ \forall \ k$	5.920 [0.1E-05]	11.177 [0.2E-10]	15.873 [0.7E-14]	22.271 [0.1E-17]	25.166 [0.4E-19]	25.124 [0.4E-19]
Adjusted R^2	0.367	0.5449	0.636	0.71448	0.73979	0.73945

Figures in rounded brackets are t values.
Figures in square brackets are significance levels

4.7 Elasticities

The parameter estimates from regressions run on each year were used to calculate elasticities (see Table 4-9), which were plotted over time (Figure 4-1). The elasticities were based on the estimated weights and computed as the mean across i of $(\partial(1-d_i)/\partial\omega_{ik})(\omega_{ik}/d_i)$. It can be seen from these figures that there is considerable movement over time in the responsiveness of perceived risk to many of the determinants. Elasticities also vary in magnitude between determinants, with the majority of regressors proving fairly inelastic (AMDB, SAXP, GNPPC, REMP, FR, GEGNP); only DBGNP, INGNP and XPGNP were found to have elasticities with absolute value greater than one. The most volatile elasticities appear to be with respect to XPGNP, and INGNP, with AMDB and FR having the least variation in their elasticities. Interestingly, although the FR elasticities vary little in magnitude, there is a distinct change in sign over the period from negative to positive. This would suggest that before 1985, the level of democracy in a country was seen by lenders to have a negative effect on credit worthiness, but from the mid-eighties onwards this view changed and democratic development came to be seen as a favourable influence on risk.

Interestingly, the debt service ratio was not found to be a particularly important determinant of lender's perceived risk with an average elasticity of around 0.6, despite the fact that,

> 'The debt service ratio has achieved the status of a rule of thumb by which to judge a country's creditworthiness. Most authors (Feder *et al.* 1977; Cline, 1983) have expected (and found) a significant, positive correlation between the debt-service ratio and the likelihood of debt rescheduling' (Moghadam *et al.*, 1991, p.511).

In the first half of the 1980s this elasticity was noticeably higher than in the period from 1987-1990. Thus, it would appear that lender's assessment of risk became less sensitive to SA_XP.

Elasticities for DB_GNP and SA_XP generally rose in absolute terms over the period 1979-1987, except for a small dip in 1982. Both elasticities fell noticably in 1987, particularly E_SAXP and remained at a lower level until 1990. E_AMD proved highly inelastic throughout the period, with little fluctuation.

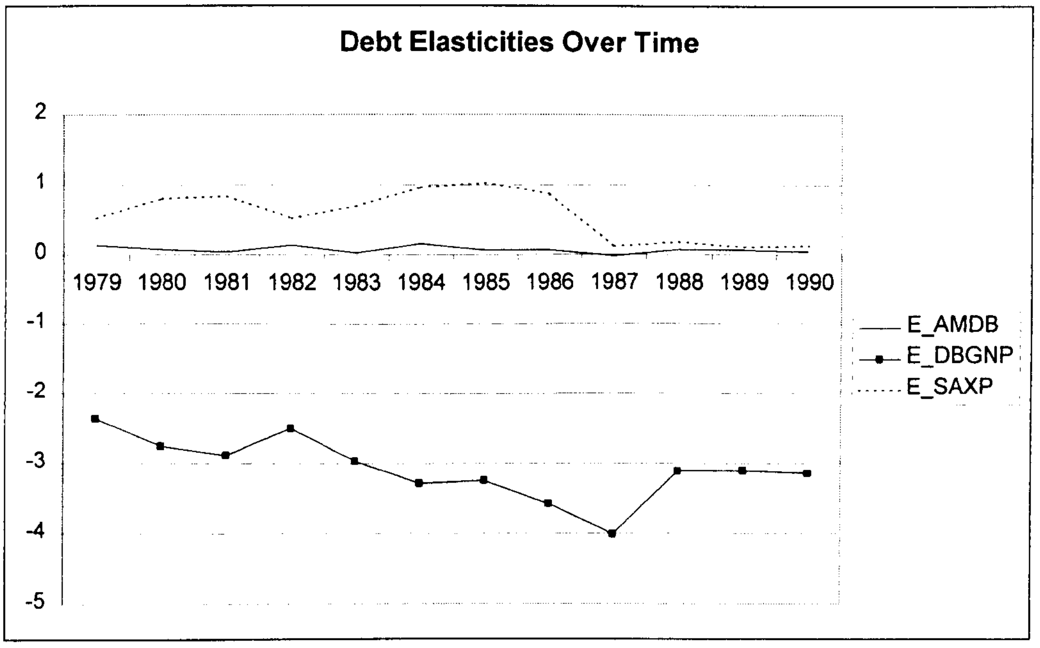
All economic variables had the expected positive elasticities throughout the sample period. E_INGNP proved to be the largest (and most volatile) of the elasticities. Apart from 1979, all values were greater than one. XP_GNP was the only other variable to have an elasticity greater than one and proved to be elastic in more years than not.

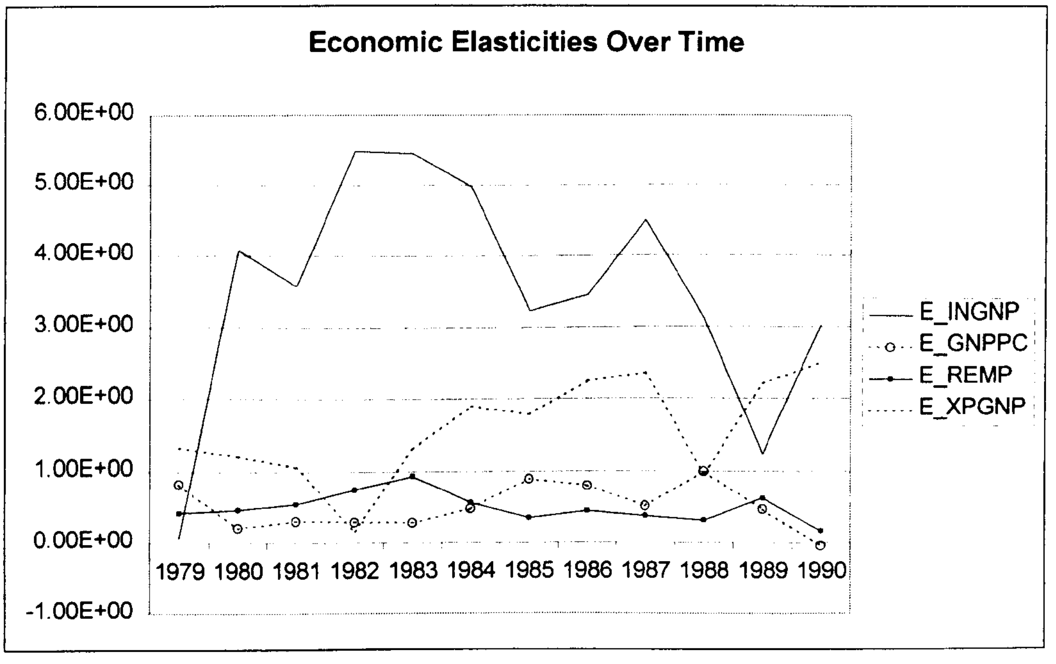
Table 4-9 Elasticities of Perceived Risk

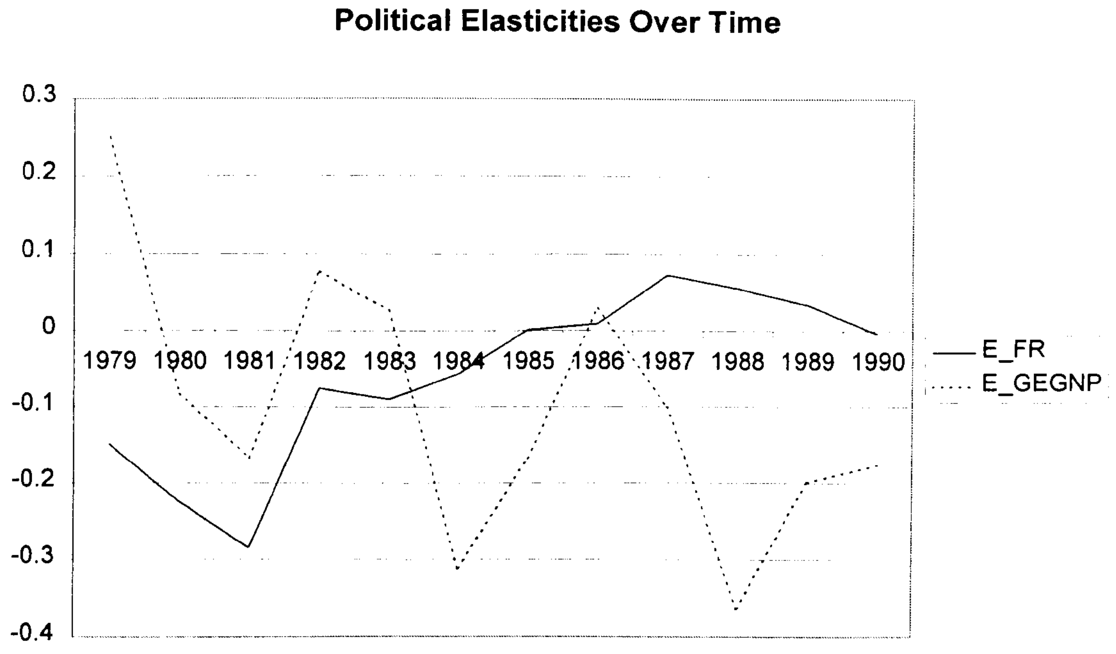
Year	*AMDB*	*DBGNP*	*SAXP*	*INGNP*	*GNPPC*	*REMP*	*XPGNP*	*FR*	*GEGNP*
1979	0.139	-2.359	0.527	0.056	0.824	0.424	1.335	-0.149	0.249
1980	0.079	-2.747	0.801	4.080	0.209	0.464	1.217	-0.224	-0.082
1981	0.040	-2.881	0.834	3.557	0.309	0.550	1.059	-0.284	-0.167
1982	0.142	-2.495	0.530	5.488	0.291	0.745	0.168	-0.075	0.077
1983	0.030	-2.965	0.694	5.451	0.283	0.940	1.318	-0.090	0.026
1984	0.160	-3.288	0.964	4.981	0.482	0.568	1.897	-0.056	-0.312
1985	0.070	-3.244	1.031	3.228	0.898	0.351	1.780	0.001	-0.168
1986	0.068	-3.581	0.865	3.439	0.798	0.449	2.248	0.009	0.028
1987	-0.015	-4.011	0.117	4.500	0.515	0.380	2.353	0.072	-0.100
1988	0.082	-3.109	0.180	3.114	1.000	0.319	0.965	0.055	-0.364
1989	0.069	-3.103	0.107	1.238	0.472	0.624	2.202	0.034	-0.199
1990	0.043	-3.141	0.123	3.021	-0.045	0.168	2.505	-0.004	-0.176
Mean:	0.076	-3.077	0.564	3.513	0.503	0.499	1.587	-0.059	-0.099
StDev	0.051	0.449	0.353	1.616	0.318	0.206	0.696	0.112	0.172

Source: Based on coefficients from econometric estimates

Figure 4-1 Elasticities Over Time







Although Brewer and Rivoli (1990) used Gastil's measures in their study of perceived creditworthiness, they did so only as part of a cross-sectional analysis and so the econometric model developed here is the first to exploit the panel properties of Gastil's measures. The movement of the freedom rating parameter suggests support for Brewer and Rivoli's second possible interpretation of their results, 'that the lenders' risk assessments are short sighted in their failure to consider a longer-term and more comprehensive view of country stability….' (*op cit.*, p.365). The results presented here show a marginally positive relationship for the year of the Brewer and Rivoli study (i.e. 1986), whereas Brewer and Rivoli found this to be negative, though not statistically significant. Looking at the bigger picture of how this parameter has changed over time, it can be seen that their study was done at a time when lenders were changing their view as to the role of political democracy on development, and the consequential uncertainty at that time explains the lull in the statistical significance of the variable in the mid-eighties. Although the t-values pick up marginally toward the end of the decade, they never fully recover, suggesting that banks are not fully convinced of the positive relationship between democracy and creditworthiness.

It was stated above that if and only if the coefficient on GE_GNP is positive, will it be possible to reject the hypothesis that lenders perceive left wing governments (defined as those with high levels of intervention) to have higher credit risk. As the tables and graph show, the sign on the coefficient proved to be somewhat erratic, reflecting a degree of uncertainty in the lending community. However, in more years than not, the consensus was that left wing governments entail a higher risk of default, and so it would seem that the Alesina and Tabellini conjecture is one that holds favour with the international lending community. Alternatively, the perceived positive relationship between risk and GE_GNP may be based on the belief that high levels of intervention produce inefficiencies in the domestic economy through crowding out effects and high income taxation.

4.8 Structural Break Results

As a means of gauging the location and magnitude of parameter movement seen in the graphs of Figure 4-1, F-tests were used to measure the extent of structural breaks over time. The process involved running OLS regressions pooled across a number of years (for example, 1979-1982), and then comparing coefficients with those of regressions run on two subsets of this time period (for example, 1979-1980 and 1981-1982). The null hypothesis is constant coefficients across time, and so the time-variation of signal weights is indicated by a large F-value (i.e. one with a significance level less than or equal to 0.05).

Because it is possible that these structural breaks over time may be controlled for by parameter shifts in the explanatory variable, F-tests for coefficient stability over time were also carried out on fixed effects models of the form:

$$d\hat{}_{it} = \alpha_t + \omega' \boldsymbol{s}_{it} + \varepsilon_{it}$$

The results of the pooled OLS and fixed effects regressions are reported in Table 4-10 and Table 4-11 below.

The only previous study to date to have tested whether coefficients are stable over time is that of Thapa and Mehta (1991) which tested for a structural break between the sample periods 1979-1981 and 1982-1983. They found that the Chow test statistic was not significant, and so the null hypothesis that the two regressions were the same could not be rejected. However, they did not test for structural breaks across other time periods and only include a limited selection of explanatory variables (with no measure of political stability. In constrast, it can be that 8 out of 15 of the tests on pooled regressions in Table 4-10 rejected the null hypothesis of constant coefficients. The two largest structural breaks came in the early eighties (1980-81 and 1982-83). This is consistent with the theory in that this is when the market-wide risk levels were changing most rapidly (certainly, perceived average risk were changing most rapidly around this period, as Figure 4-3 shows).

In

Table 4-11, of the six ANOVA tests on fixed effects regressions, five rejected the null hypothesis of constant coefficients. Again, the largest structural breaks (indicated by the lowest significance levels on the F-test) appear to occur earlier rather than later in the sample time frame (compare the results of test [2] with test [3]; compare test result [4] with [5] and [6]).

Table 4-10 ANOVA Tests For Parameter Stability: Pooled OLS Regressions

	Restricted	*Unrestricted*	*F-value*	*Sig. Level*
	12 year pool:	**6 year pool:**		
	1979-1990	1979-1984 1985-1990	**5.966***	0.000
	8 year pool:	**4 year pools:**		
	1979-1986	1979-1982 1983-1986	**7.265***	0.000
	1983-1990	1983-1986 1987-1990	**5.019***	0.9E-06
	4 year pools:	**2 year pools:**		
	1979-1982	1979-1980 1981-1982	**3.104***	0.001
	1983-1986	1983-1984 1985-1986	1.231	0.383
	1987-1990	1987-1988 1989-1990	1.686	0.182
	2 year pools:	**1 year regressions:**		
	1979-1980	1979 1980	1.950	0.054
	1980-1981	1980 1981	**12.761***	0. 7E-4
	1981-1982	1981 1982	2.139	0.0949
	1982-1983	1982 1983	**7.764***	0.7E-3
	1983-1984	1983 1984	**3.203***	0.025
	1984-1985	1984 1985	1.652	0.1963
	1985-1986	1985 1986	**4.468***	0.007
	1986-1987	1986 1987	1.081	0.390
	1987-1988	1987 1988	1.339	0.321
	1988-1989	1988 1989	**3.617***	0.016
	1989-1990	1989 1990	**2.663***	0.047

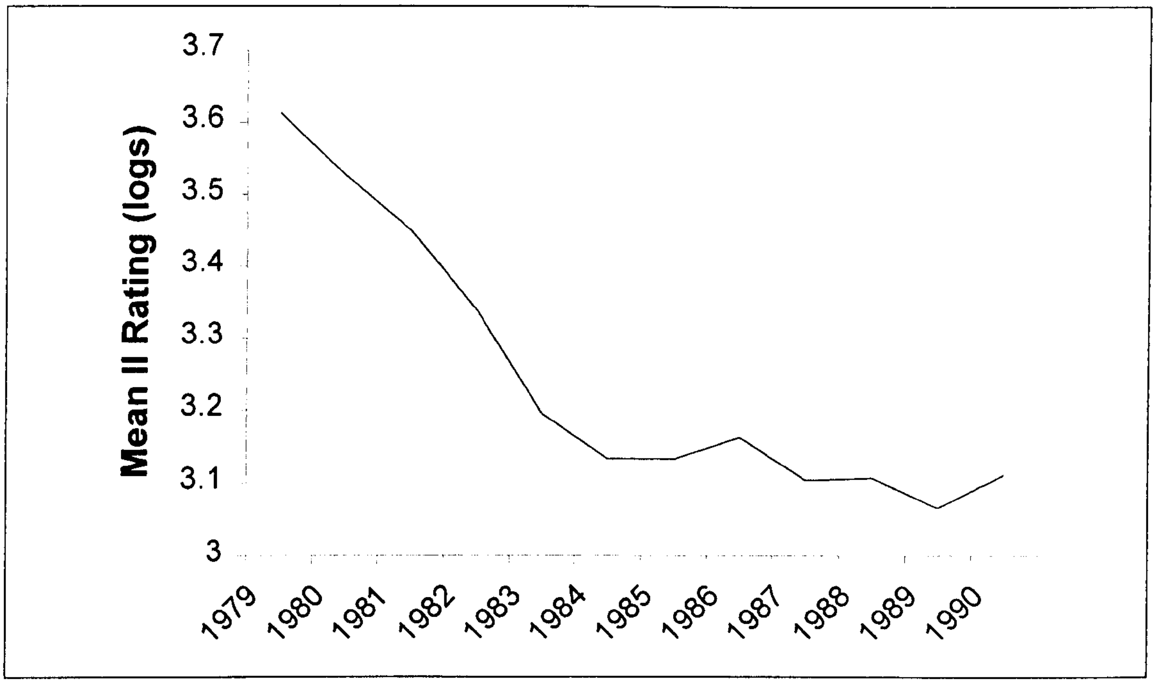
* Null can be rejected at 95% level of confidence.

Table 4-11 ANOVA Tests For Parameter Stability: Fixed Effects (FE) Regressions

Test No.	*Restricted*	*Unrestricted*	*F-value*	*Significance Level*
	12 year FE:	**6 year FE:**		
[1]	1979-1990	1979-1984 1985-1990	**3.219***	0.4E-5
	8 year FE:	**4 year FE:**		
[2]	1979-1986	1979-1982 1983-1986	**3.666***	0.4E-4
[3]	1983-1990	1983-1986 1987-1990	**2.902***	0.2E-3
	4 year FE:	**2 year FE:**		
[4]	1979-1982	1979-1980 1981-1982	**2.331***	0.009
[5]	1983-1986	1983-1984 1985-1986	1.911	0.103
[6]	1987-1990	1987-1988 1989-1990	**2.920***	0.020

* Null can be rejected at 95% level of confidence.

<u>Figure 4-2 Perceived Market Risk: Annual Average Institutional Investor Ratings</u>



4.9 Summary

We noted in the previous chapter how the fluidity of lenders' perceptions may result in borrowers finding it difficult to identify the cocktail of economic policies that will minimise risk premiums on external borrowing because there is no stable relationship between perceived credit risk and determinants. This chapter has demonstrated that lender perceptions are indeed unstable, with considerable movements over time in the weights given to a number of economic variables. Perhaps the most striking implication, however, of these results, is the mixed signals given by lenders to debtor nations as to the efficacy of democratic development. In the early 1980s, authoritarian governments were seen as a positive advantage, in the mid 1980s the effect of democracy was seen as ambiguous, and at the end of the period, democracy was seen, once more, as marginally detrimental to credit risk.

These results also have implications for lenders. It seems highly unlikely that the relationship between actual risk and economic variables is as unstable as the relationship between perceived risk and economic variables found in this chapter. Such variation must mean that low risks have been denied credit or charged excessive risk premiums, and more importantly for lenders, high risk countries will have been lent inappropriate amounts of credit at inappropriately low risk premiums. That the structural breaks continued right up until the most recent period considered in the analysis, suggests that the inaccuracies and uncertainties that led to the early 1980s debt crisis had not been fundamentally resolved by the end of the decade.

Thus, the theory and results presented in this chapter are potentially important to both the academic literature and to those directly involved in the sovereign debt problem. The implication for borrowers is that risk assessment is not fixed in stone and this suggests that there should be room for maneuver when bargaining over loan terms. For lenders, the results highlight the need for them to be aware of their own capriciousness (particularly with regard to political factors) and to treat with some skepticism the results of risk assessment. It is also important for lenders to fully appreciate the complex nature of the relationship between the probability of charging the optimal rate of interest and the level of risk assessment expenditure. Greater risk assessment expenditure only alters the shape of the error distribution—it does not remove it. Moreover, the changed shape may actually reduce the probability of setting an inappropriate interest rate. The implication for the academic literature is that coefficients on linear parameterizations of perceived risk cannot be assumed constant over time and this precludes the hitherto ubiquitous use of data pooling.

Notes:

[i] The precise relationship between default probability and LIBOR spread was assumed to be:
$s = [p/(1-p)]$, where s is spread over LIBOR, p is the (subjective) default probability.

[ii] Namely: interest rates on international lending, growth of GNPPC, the ratio of total foreign debt to GNP, the growth rate of industrial countries, variability in changes in per capita GDP, and the ratio of government debt to GDP.

[iii] 1 if a major borrower, 0 if not. Based on World Bank classification, Lee's (1991b) major borrowers consist of Argentina, Brazil, Chile, Egypt, India, Indonesia, Israel, Korea, Malaysia, Mexico, Turkey, and Venezuela.

[iv] 1 if a highly indebted country, 0 if not. According to World Bank classification, Lee (1991b) includes the following as HICs: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Ivory Coast, Jamaica, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela, and Yugoslavia.

[v] Presumably this is because the stronger the trade link, the more vulnerable is the borrower. For example, if the bank promotes a negative publicity campaign against the borrower, the country may lose export earnings.

5 Classificatory Risk Assessment and Favourable Selection

5.1 Introduction

The previous two chapters examined the rationale behind, and evidence for, fluctuations in risk assessment and their impact on default risk as perceived by borrowers, assuming that risk assessment produced continuous scale of perceived creditworthiness for each borrower. This chapter will go on to examine the implications of *classificatory risk assessment*, where the monitoring procedure yields bands of risk rather than a continuum.

The chapter will begin by examining ASCRE (Adverse Selection induced Credit Rationing Equilibria), which is the explanation put forward by S&W. It is based on the observation that raising the rate of interest may cause adverse selection when there is no risk assessment, and so there may be occasions when it is optimal for lenders to ration credit. The chapter then introduces risk assessment and shows how monitoring, and its corollary, differentiated interest rates, will always increase the return on loans to a borrower of particular risk type.

I then aim to show that risk-differentiated pricing can produce favourable selection, producing an overall utility gain for the lender if the number of borrowers in each risk category is uniformly distributed or monotonically increasing with risk. The chapter also demonstrates that there is an absolute limit for optimal risk expenditure, and that there will be less scope for S&W type credit rationing as risk assessment approaches this limit.

5.2 Basic Model

Consider a credit market with n types of risk neutral entrepreneur (investor) i, where $i \in I$, and $I = \{1, 2, \ldots n\}$, each with the opportunity to invest in a project requiring a fixed amount of fixed capital, K. Banks in turn demand fixed collateral C, and charge interest rate r on each loan. Investor i's project succeeds with probability p_i yielding the positive return R^s_i ; and fails with probability $(1-p_i)$ yielding zero return, where higher risk projects receive a higher return: $1 > p_1 > p_2 > \ldots p_n > 0$ and $K < R^s_1 < R^s_2 < \ldots. < R_n$ where the increments of p_i and R^s_i are proportionately of similar magnitudes.[i] It is assumed that lenders are risk averse, $U(.)' > 0$, $U(.)'' < 0$, and know the distribution of R^s_i and the distribution of N_i, the number of loans made to risk type i. It is further assumed that the interest charged on deposits is unrelated to the terms of the loan.

5.2.1 Borrowers

The elementary objective function of borrowers is given by max $[R^s_i-(1+r)K, -C]$ and expected returns are given by,

$$\pi^b_i = p_i[R^s_i-(1+r)K]-(1-p_i)C. \qquad [1]$$

It is assumed that the entrepreneur of type i only takes out the loan if,

$$\pi^b_i \geq 0. \qquad [2]$$

Thus, a necessary condition for an offer of a loan to be accepted, the return if successful has to be greater than the total repayment costs: $R^s_i>(1+r)K$. This is obvious from equations [1] and [2] which imply that, $p_i[R^s_i-(1+r)K]\geq(1-p_i)C$, yielding the necessary and sufficient condition,

$$\Rightarrow \qquad p_i \geq \frac{C}{R_i^s-(1+r)K+C}. \qquad [3]$$

Since $0<p_i<1$, it follows that $R^s_i>(1+r)K$. The number of loans demanded by risk type i is thus given by

$$N_i^D = \begin{cases} N_i^T \text{if } \pi_i^b \geq 0, \\ 0 \text{ if } \pi_i^b < 0, \end{cases}$$

where N_i^T is the total number of firms of type i.

<u>Proposition 1:</u> *Raising the rate of interest causes adverse selection when there is no risk assessment.*

<u>Proof:</u> First assume that, for a given interest rate r, there is a threshold success probability $p_{i\#}$ (i.e. threshold type of investor) such that the entrepreneur borrows from the bank if and only if $p_i\leq p_{i\#}$ (i.e. $i\geq i_\#$) where $p_{i\#}'(r)<0$ ($i_\#$ is positively related to r).

The proof can be shown by contradiction. First note that $p_{i\#}$ is given where the borrower just breaks even. For $\pi^b_i=0$ the weak inequality [3] becomes an equation,

$$p_{i\#} = \frac{C}{R_{i\#}^s-(1+r)K+C}, \qquad [3.1]$$

where $R^s{}_{i\#}$ is the return if successful associated with $p_{i\#}$, given the fixed relationship between R^s and p. Given that the loan is only applied for if $R^s{}_{i\#} \geq (1+r)K$, it follows that higher rates of interest will raise $R^s{}_{i\#}$,

$$R^s{}_{i\#}(\mathrm{r} + \varepsilon) > R^s{}_{j\#}(r), \quad \text{where } \varepsilon > 0,$$

$$\Rightarrow i_{\#}(r + \varepsilon) > j_{\#}(r) \qquad [4]$$

because of the negative relationship between $R^s{}_i$ and i. In other words, lower risks will not apply for a loan when r increases because it is not worth their while given the lower return on lower risk projects, and the greater cost of repayment when r increases. Now assume that $p_{i\#}$ is <u>not</u> strictly decreasing in r, $p_{i\#}(r+\varepsilon) \geq p_{i\#}(r)$ $\Rightarrow i_{\#}(r+\varepsilon) \leq i_{\#}(r)$ which contradicts [4].

5.2.2 Lenders

Competitive lenders know the distribution of p_i and $R^s{}_i$, and so know the value of $p_{i\#}$, but cannot identify the p_i of a particular loan applicant. Lenders are risk averse and wish to maximise U where

$$U = \sum_{i=i_{\#}}^{i=n} u_i \qquad [5]$$

and u_i is the utility obtained from loans to borrowers of type i. Banks finance their credit offers by funds from deposits. If θ is the interest paid on deposits, the bank's utility of net profits on a loan to investor i is given by,

$$u_i = N_i[p_i u\{(1+r)K - (1+\theta)K\} + (1-p_i)u\{C - (1+\theta)K\}]. \qquad [6]$$

Banks will only lend to borrowers where $u_i > 0$.

Proposition 2: *Equilibrium credit rationing is possible if the lenders are imperfectly informed concerning* p_i .

Proof: Credit rationing is defined as a situation where $N_i < N_i^D$, where $N^D{}_i$ is the number of loans demanded from risk type i (where $N_i^D = N_i^T$ or 0). This implies that $\exists i$ such that $\pi_i^b(r) \geq 0$ and $N_i < N_i^T$. Such rationing can be sustained in equilibrium provided $\exists i$ such that,

$$U(r + \varepsilon) < U(r) \quad \text{and} \quad N_i < N_i^D$$

where $\varepsilon \in \Re^+$. Thus, raising r in certain circumstances will reduce overall lender utility for the lender, and so allow for the possibility that raising the interest rate will not be optimal, even when there is excess demand for credit. Proof can be established by contradiction. Suppose $U(r+\varepsilon) > U(r)$ for some ε, p_i, N_i and r, then,

$$\Rightarrow \sum_{i=i_\#}^{i=n} u_i(r+\varepsilon) > \sum_{i=i_\#}^{i=n} u_i(r)$$

which implies that one of two possibilities must always be true when r rises: either utility per loan type does not diminish when r rises and higher interest rates always imply a lower threshold risk group $i_\#$; or utility per loan type is strictly greater when r rises, but the threshold risk group is weakly lower,

$$\Rightarrow \left(u_i(r+\varepsilon) \geq u_i(r) \text{ and } i_\#(r+\varepsilon) < i_\#(r)\right) \text{ or } \left(u_i(r+\varepsilon) > u_i(r) \text{ and } i_\#(r+\varepsilon) \leq i_\#(r)\right),$$

both of which contradict [4]. So for credit rationing to be precluded it has to be shown, not only that n - $i_\#$, the number of risk groups which the bank can sum across, remains the same or increases, but also that the utility to the lender of each loan to type i always increases. However, because lower risk groups are less likely to make a profit when interest rates rise, the bank will effectively screen out lower risk borrowers ($i_{\#}$ always rises when r rises). Also, it should be noted that the bank gains more utility from lending to good risks *cet. par.* and so its average utility per loan type diminishes when good risks are screened out. The preference for good risks (*cet. par.*) can be shown by contradiction: if $u_i > u_k$ and $N_i = N_k$, where $i > k$, then,

$$p_i u\{(1+r)K-(1+\theta)K\}+(1-p_i)u\{C-(1+\theta)K\} >$$

$$p_k u\{(1+r)K-(1+\theta)K\}+(1-p_k)u\{C-(1+\theta)K\},$$

$$\Rightarrow \; p_i > p_k \;,$$

which contradicts the ordering of probabilities. Thus the increased utility from raising r (due to the greater gross interest) has to be balanced against the lost utility from screening out good risks and the riskier loan portfolio that it implies. Notice that the bank will not *always* ration credit, but the above, first put forward by S&W in the context of risk neutral banks, shows how credit rationing is *not precluded* under asymmetric information.

5.3 Risk Assessment

Investing in risk assessment allows the bank to distinguish between v^* risk groups amongst borrowers where v^* takes only positive integer values: $v^* \in [1,\infty]$. The interval to which the lender can allocate borrower type i following the assessment of risk is given by, $P_v = \{p_i : p_v \leq p_i < p_{v+1}\}$ where $p_v = v/v^*$ and $v \in V$; $V = \{0, 1, 2, \ldots, \underline{v}\}$, $\underline{v} = v^*-1$; and $\mathbf{P} = \{P_v : v \in V\}$. Qualities of $\mathbf{P}$ include (1) $\forall\, v : P_v \subset \mathbf{P}$; (2) $v_1 \neq v_2 \Rightarrow P_{v1} \cap P_{v1} = \varnothing$; and (3) $\cup_{v(V} P_v = \mathbf{P}$. In other words, every point of $\mathbf{P}$

belongs to one and only one P_v (each subset P_v of **P** is therefore disjoint), and so the family of sets **P** is a partition. Risk assessment is 'true' in the sense that borrowers are always correctly associated with the appropriate partition of **P**. Since the bank knows the risk interval to which each potential borrower belongs, it is not possible for borrowers at the lower end of each interval, who may be faced with a rate of interest that makes borrowing unattractive (i.e. $R^s_i<(1+r_v)K$) to surreptitiously make their way into the lower category. Thus, borrower type i cannot pretend to be anything other than $\{i : p_v \leq p_i < p_{v+1}\}$.

5.3.1 Costless Risk Assessment

For a given level of risk assessment, the lender aims to max $\widetilde{U}$, where

$$\widetilde{U} = \Sigma_v \widetilde{u}_v, \qquad [7]$$

where $\widetilde{u}_v$ is utility gained from a particular risk interval, P_v, which the bank can identify. This utility will comprise the sum of utilities from loans to all borrowers relevant to that risk interval, ranging from the highest risks admitted (determined by risk assessment) to the lowest, defined either by the upper bound of P_v, or by the risk group that just breaks even given r_v, whichever is the greatest. Note that, for each identified interval, there will be a different interest rate and so there will be a different associated threshold success probability $p_{i\#v}$ and associated $i_{\#v}$, where $p_{i\#v} = p_{i\#v}(r_v)$, $p'_{i\#v}(r_v) < 0$; and $i_{\#v} = i_{\#v}(r_v)$, $i'_{\#v}(r_v) > 0$. Thus,

$$\widetilde{u}_v = \sum_{\max(i_{\#v}, i^*v)}^{i_v} N_i[p_i u\{(1+r)K - (1+\theta)K\} + (1-p_i)u\{C - (1+\theta)K\}], \qquad [8]$$

where i_{*v} is defined as $\{i: p_i = \max(p_i < p_{v+1})\}$, the lowest i admitted in P_v; i_v is the highest i admitted in P_v defined as $\{i: p_i = p_v\}$; and $i_{\#v}$ is the threshold risk group who will still find it profitable to apply for a loan given r_v (all $i < i_{\#}$ will not apply). Note also that for each risk type there is a threshold interest rate $r_{i\#}$ above which investors will not apply for a loan, and this is obtained by solving for r_v in the equation for $p_{i\#v}$, which is derived in a similar way to $p_{i\#}$:

$$p_{i\#v} = \frac{C}{R^s_{i\#v} - (1 + r_v)K + C}. \qquad [9]$$

Borrowers will only apply for a loan if $R^s_{i\#v} > (1+r_v)K$.[ii]

If the bank sets r_v such that the threshold success probability is greater than or equal to the *upper* bound of P_v,

$$r_v = \{r_v: p_{\#v} \geq p_{v+1}\} = \{r_v: i_{\#v} \geq i^*_v\},$$

then all risk types in the interval P_v will apply for a loan because,

$$R^s_i > (1+r_v)K,\ \forall i \in P_v.$$

The number of loans made to investors in P_v will be N_v where $N_v = \sum_{i_{*v}}^{i_v} N_i$. In general N_v is given by

$$N_v = \sum_{\max(i_{\#v},\, i_{*v})}^{i_v} N_i. \qquad [10]$$

Note that there is no incentive to set r_v below that which produces $i_{\#v} = i_{*v}$,

$$r_v = \{r_v: i_{\#v} < i^*_v\},$$

since the bank would lose revenue on each loan without gaining extra (low risk) loan applicants.

On the other hand, if the bank sets r_v such that the threshold success probability is less than the *lower* bound of P_v,

$$r_v = \{r_v: p_{\#v} < p_v\} = \{r_v: i_{\#v} > i_v\},$$

then no risk types in P_v apply, and $N_v=0$. Since the lender knows i^*_v and i_v, and hence the associated probabilities and returns (p_{i^*v}, p_{iv}, $R^s_{i^*v}$, R^s_{iv}), it can compute the interest rates in each P_v required to achieve p_{i^*v} and p_{iv}. Thus, the profit maximising bank will always set r_v such that $r_{v\min} \leq r_v \leq r_{v\max}$, where $r_{v\min} = \{r_v : i_{\#v} = i_{*v}\}$, and $r_{v\max}=\{r_v : i_{\#v} = i_v\}$. (NB: $i_{*v} < i_v$).

To recap, summation is across all investors at least as risky as the threshold risk, $i_{\#v}$ (determined by r_v), but less risky than the lower success probability bound p_v. If r_v is set such that $i_{\#v}>i_v$ then there will be zero loan applicants from the range P_v. If r_v is set such that $i_{\#v} \leq i_{*v}$ then all risks in the range P_v will apply.

Proposition 3: *Increasing costless risk assessment will always increase the return on loans to a borrower of particular risk type, and produce favourable selection, producing an overall utility gain for the lender if N_i is uniformly distributed, or monotonically increasing across i.*

Proof:

Increasing risk assessment allows the bank to obtain some of the surplus previously attributed to borrowers because it allows the bank to charge a greater number of differentiated interest rates. This inevitably means that borrowers (for whom investment is still profitable in the state of greater risk assessment) that enjoyed a large difference between their reservation interest rate, $r_{i\#}$, and the actual interest rate, r_v, will, under a regime of greater risk assessment, be faced with an interest rate that is closer to their reservation rate. Let S be the total borrower surplus for all $P_v \in \mathbf{P}$,

$$S = \Sigma_v s_v,$$

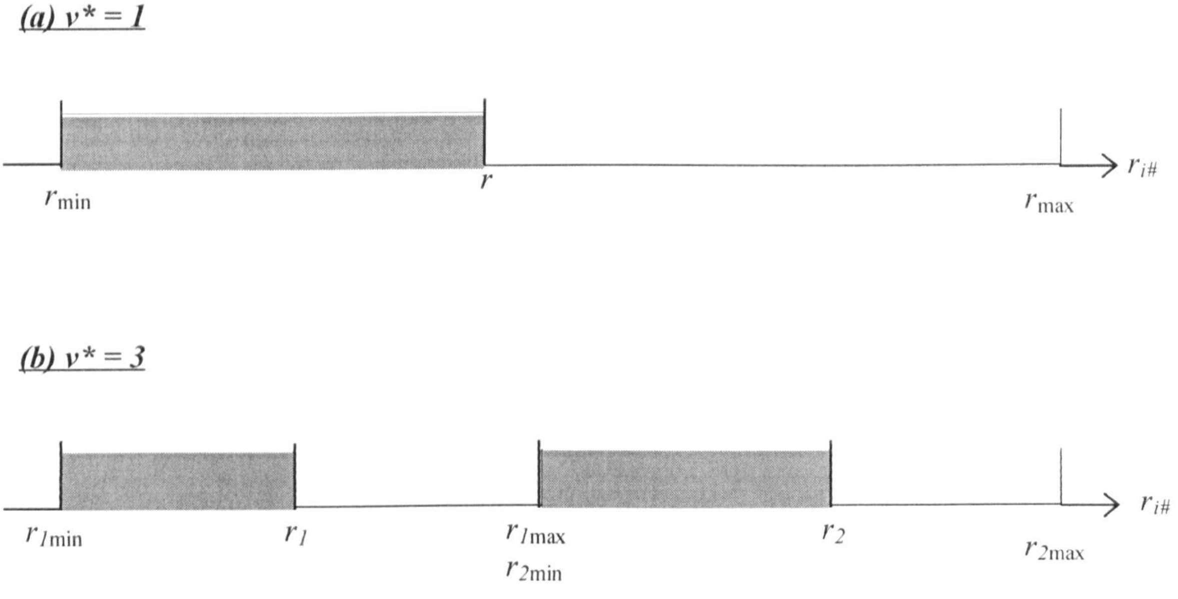
where,

$$s_v = \sum_{\max(i_{\#v},\, i_{*v})}^{iv} (r_{\#i} - r_v) N_i \,,$$

Raising v* results in a greater number of subsets of P, resulting in narrower intervals for each interest rate, $r_{v\min} \leq r_v \leq r_{v\max}$, and this will cause the average consumer surplus s_v/N_v in each identified risk interval to fall. This means that for every loan made, the bank is receiving a greater return.

However, as the diagram below shows, a greater number of identifiable risk categories will result in some borrowers being priced out of the market, as well as others now being priced 'into' the market. It is possible that the former group will dominate both the latter group and the utility gain from greater revenue per loan. The horizontal axis depicts the spectrum of threshold interest rates across i, given that each i has a unique threshold interest rate, above which it is not worthwhile investing. Super-imposed onto the axes are the interest rates actually charged, denoted by r under no risk assessment, and r_1 and r_2 following risk assessment. All risk types with threshold interest rates less than r_v are effectively excluded (shown by the shaded area in Figure 5-1). Thus, when risk assessment is increased, as depicted in diagram (b), those investors with interest rates between r_{2min} and r_2 will no longer find it profitable to invest. There is no a priori reason why the number of new borrowers due to risk assessment (i.e. those lying between r_1 and r) will be greater than the number of old borrowers that have been lost. However, those gained will have a lower probability of default than those lost, and so this displacement produces a less risky loan portfolio for the bank. Note that if N_i is uniformly distributed, or monotonically increasing across i, the discplacement results in an unambiguous utility gain for the lender since the number of borrowers displaced in higher risk subsets of **P** will outweigh the number displaced in lower risk subsets.

Figure 5-1 The Favourable Selection of Risk Assessment



5.4 Costly Risk Assessment

Now assume that there is a cost schedule associated with assessing risk, ζ, where:

$$v^* = v^*(\zeta); \qquad v^{*\prime}(\zeta) > 0; \qquad \text{and } v^*(\zeta = 0) = 1.$$

Banks will invest in risk assessment to the extent that the marginal gain just equals the marginal loss. Thus, factors which cause the gains to rise relative to costs, will result in a higher optimum level of risk assessment, and vice versa. The optimum level of risk assessment is denoted by ζ^*.

Proposition 4: *There exists an absolute limit for ζ^* given by $\bar{\zeta}$ so that $0 \leq \zeta^* \leq \bar{\zeta}$.*

Proof: This follows from the assumption that there exists some level of risk assessment that results in **P** becoming a family of singletons (that is, no more than one p_i in each P_v), and that the bank knows when it has reached this level of risk assessment (the bank can deduce this from the fact that it knows the range of R^s in each P_v, and so it knows that there is only one p_i in P_v when $R^s{}_{vmax} = R^s{}_{vmin}$ for all v). Beyond this level of expenditure, the bank gains nothing from additional investment in assessment.

Proposition 5: *If risk assessment is sufficient to produce 'near perfect' information then there will be no scope for ASCRE.*

Proof: 'Near perfect' information is defined as the situation where the partition of **P** is fine enough to include only one i in each partition (as is the case when $\zeta^* = \bar{\zeta}$)and so the bank does not have to pool different risk types, but can charge separate interest rates to each i. In which case, banks can respond to excess demand for funds in any category $p_i \in P_v$ by raising the interest rate in that category, without risk of adverse selection, provided the interest rate is not raised above $r_{i\#v}$. If r_v is raised above $r_{i\#v}$ then no investor in P_v will apply. Thus, every risk type is treated as a separate market, each market having homogenous-risk loan applicants and an interest rate determined through the traditional interaction of demand and supply.

5.5 Summary

In the previous two chapters we examined the rationale and evidence for fluctuations in risk assessment and their impact on default risk as perceived by borrowers, assuming that risk assessment produced a continuous scale of creditworthiness for each borrower. This chapter has examined the implications of classificatory risk assessment, where the monitoring procedure yields bands of risk rather than a continuum.

It began by reproducing the S&W result that raising the rate of interest causes adverse selection when there is no risk assessment, providing a rationale for equilibrium credit rationing. The chapter then introduced risk assessment and showed that risk assessment, and its corollary, differentiated interest rates, will always increase the return on loans to a borrower of particular risk type. I have aimed to show that risk-differentiated pricing can produce favourable selection, producing an overall utility gain for the lender if the number of borrowers in each risk category is uniformly distributed or monotonically increasing with risk. This is an important result since it adds to the rationale for risk pricing. Not only does the lender gain revenue through extracting more surplus from higher risks, but it also favourably influences the actual selection of risks. Surprisingly, this is not something which has been noted in the literature and so this is a significant contribution. The chapter also demonstrated that there is an absolute limit for optimal risk assessment expenditure, and that there will be less scope for S&W type credit rationing as risk assessment approaches this limit.

Notes:

[i] This is to preclude the possibility that $i+1$ has $R^s_{i+1} \approx R^s_i$, and $p_{i+1} << p_i$ which suggests the possibility that expected profits in equation [1] may actually be less for $i+1$ than for i. Stated in the positive, I assume that for a given rate of interest, p_i and R^s_i are related in such a way that expected profits are higher for higher risks. This is less restrictive that assuming a mean preserving spread (as in S&W) and yet is sufficient to reproduce the S&W result.

[ii] $R^s_{i\#} > (1+r)K \Rightarrow r < \frac{R^s_{\#}}{K} - 1$

6 Credit Insurance, Perverse Incentives and Credit Rationing

6.1 Introduction

Having developed a model of lending with risk assessment in the previous chapter, this chapter now introduces credit insurance into the model. Over the last quarter of a century, there has been considerable growth in the employment of loan insurance in a variety of credit markets. In return for an annual or front loaded premium, lenders can claim from the indemnity provider some proportion of the losses made in the event of default. As financial products and the loan base have diversified in a large number of credit markets, such coverage has proved to be an attractive way for lenders to share default risks and has resulted in loan insurance becoming a significant component of the insurance industry. Various types of credit insurance have also been suggested for the sovereign debt market: 'Many proposals for solving the foreign debt problem of developing countries contain some kind of contract in which part of the repayment to creditor banks is insured by a third party, such as a donor country or a multinational organization' (Borensztein and Pennacchi, 1990, p.806), although it is really in the personal sector that the loan insurance has burgeoned.

US private mortgage insurance, for example, grew rapidly during the 1970s from 5.1% of total conventional lending in 1970 to 18.2% in 1980, with 70% of mortgages with loan to value (LTV) ratios over 80% carrying private insurance by the end of the decade (Brueckner, 1985). UK mortgage insurance in the form of Mortgage Indemnity Guarantee enjoyed a similar expansion period during the 1980s, partly due to the increased availability of credit following financial deregulation and the consequent rise in the number of mortgages with LTVs over 75%. Loan insurance has also been employed in a range of other credit markets, often on an *ad hoc* basis, and sometimes underwritten by not-for-profit or government organisations, such as the UK Loan Guarantee Scheme, introduced in 1981 to improve access to credit by small firms constrained in their ability to borrow by lack of collateral. Firms pay an insurance premium - calculated as a proportion of the loan - to the government, and in the event of default, the state compensates the bank for the outstanding amount of the proportion guaranteed.[i] Credit insurance has also been widely employed by firms to indemnify against default risk of balance sheet receivables (Jackson 1996).

But such expansion has not been without its problems. Both in the US and the UK, mortgage insurance players have experienced severe losses during periods of high default rates. In the 1980s, for example, the collapse of Equity Programs Investment Corporation left private mortgage insurance firms in the US with combined exposures of over $400 million - approximately 18 % of the industry's total capital (Kau *et al.*, 1993). Similarly, following the massive surge in repossessions in the early 1990s, insurers of UK mortgages found themselves faced with losses estimated in excess of £3 billion (Douetil, 1994).

Despite the pervasiveness and size of loan insurance markets (the UK mortgage market alone is a sizeable entity, with gross mortgage advances of over £64 billion in 1988, and over £52 billion even in the recession of 1992, [Ford and Kempson 1997]), relatively little work has been done developing appropriate microeconomic theory to model their behavioural implications. The aim of this chapter, therefore, is to apply the techniques developed in the asymmetric information literature to the loan insurance market and to trace the connections between the three sets of agents involved: lenders, borrowers, and insurers. Because a brief review of the relevant literature was given in chapter 2, there is no need to discuss it here. As far as the author is aware, no asymmetric information study to date has examined the simultaneous interaction of both insurer incentives, lender incentives and borrower incentives, or considered the implications of loan insurance for lender decisions to offer credit, set interest rates, and assess risk.

It is the aim of this chapter to show that two types of moral hazard can occur in the presence of loan insurance; the first arising from lenders having insufficient incentive to assess borrowers; and the second arising from the incentive for banks to select deliberately high risks, knowing that such borrowers will pay higher interest rates, and that any losses will be covered by insurance. The chapter also examines the possibility of equilibrium credit rationing occurring in a near-perfectly informed credit market under various insurance regimes. A discrete model of lending with risk assessment and loan insurance is developed, where the insurer has to rely on the lender to identify and select low risk borrowers. Risk averse banks have the option to assess risk and to obtain loan insurance, and insurance companies, unable to observe borrowers directly, can process signals from the terms of the loan contract (such as interest rates), and if necessary make insurance coverage contingent upon these loan terms.

6.2 Loan Insurance with Flat Rate Premiums

Assume now that the bank is able to take out loan insurance against default losses which covers the difference between the outstanding capital balance and the value of collateral. Thus, in the event of default the bank claims back $\ell(K\text{-}C)$ where ℓ is the level of insurance cover. The cost of insurance is given by $\psi(\ell)$, where ψ is the premium and $\psi(0) = 0$, $\psi'(\ell) > 0$. It may not, however, be the bank who pays the premium, but the borrower - as in the case of the Mortgage Indemnity Guarantee (MIG) system in the UK, even though it is the bank who receives the insurance cover. We consider both possibilities below and examine the implications of each scenario.

6.2.1 Insurance Company

It is assumed that the insurer cannot observe the lender's utility function. It can, however, observe the terms of the borrowers' payoff functions such as interest rates, and knows the distribution of p_i and its relationship to $R^s{}_i$, but does not know the p_i of individual loan applicants. Irrespective of who pays the premium, the risk neutral insurance company aims to maximise expected profits given by,

$$\Pi_{\ell,\zeta} = \sum_v \pi_v , \qquad [11]$$

where,

$$\pi_v = \sum_{\max(i_{\#v}, i^{*}v)}^{i_v} \left(\psi - (1-p_i)\ell(K-C)\right)N_i \qquad [11.1]$$

Flat rate premiums such as these have been used in a number of credit market situations, most notably in the UK Mortgage Indemnity Guarantee market in the 1980s, and in the UK Loan Guarantee Scheme.

Proposition 6: *Insurance reduces the utility gain from lending to lower risks.*

Proof: In the uninsured state, more risk assessment increases the number of identified risk categories allowing a greater number differentiated interest rates, which in turn reduces the potential for adverse selection. If there exists a $k \in I$ such that $r_{k\#} < r_{\underline{v}}$, and $p_{k\#} > p_{\underline{v}\#}$, where $r_{\underline{v}}$ and $p_{\underline{v}\#}$ are respectively the interest rate and threshold success probability associated with the lowest recognised risk interval $P_{\underline{v}} \in \mathbf{P}$, then increasing v^* to the point where $r_{\underline{v}} < r_{k\#}$ will increase utility to the bank (if risk assessment is costless) because the average risk of loan portfolios will fall with the inclusion of p_k and the displacement effect will bring an overall utility gain provided the number of investors is uniformly distributed across risk types.

In contrast, under loan insurance the lender will gain less from having a less risky portfolio, and under full coverage, will not gain at all. Under no insurance, if $i > k$, and $N_i = N_k$, then $u_i > u_k$ would imply $Q_i > Q_k$, where Q_i and Q_k are the utilities from lending to individual investor of type i and k respectively. This is a contradiction given:

$$Q_i = p_i u(1+r)K + (1-p_i)u(C) - u[(1+\theta)K + \zeta],$$

and,

$$Q_k = p_k u(1+r)K + (1-p_k)u(C) - u[(1+\theta)K + \zeta].$$

This will still be the case under insurance, but the utility gain from having lower risks will be less when the bank can make a claim against default losses. Let $\hat{Q}_i$ and $\hat{Q}_k$ be the analogous utilities under insurance,

$$\hat{Q}_i = p_i u(1+r_i)K + (1-p_i)u(C + \ell(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

$$\hat{Q}_k = p_k u(1+r_k)K + (1-p_k)u(C + \ell(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

where $r_i \geq r_k$.

$$\hat{Q}_k - \hat{Q}_i = (p_i - p_k)\, u(C + \ell(K-C)) + p_k u(1+r_k)K - p_i u(1+r_i)K$$

It can be shown that $Q_k - Q_i > \hat{Q}_k - \hat{Q}_i$, that is, the gain in utility from lending to a lower risk is greater in the uninsured state. Assume the opposite: $Q_k - Q_i \leq \hat{Q}_k - \hat{Q}_i$

$$\Rightarrow \quad (p_i - p_k)\, u(C) + p_k u(1+r_k)K - p_i u(1+r_i)K$$

$$\leq (p_i - p_k)\, u(C + \ell(K-C)) + p_k u(1+r_k)K - p_i u(1+r_i)K$$

$$\Rightarrow \quad (p_i - p_k)\, u(C) \leq (p_i - p_k)\, u(C + \ell(K-C))$$

$$\Rightarrow \quad (p_k - p_i)\, u(C) \geq (p_k - p_i)\, u(C + \ell(K-C))$$

which is a contradiction $\forall \ell > 0$. More generally, it can be shown that the utility gain from lending to lower risks is less the higher the insurance coverage. Let $\ell_1 < \ell_2$, then

$$\hat{Q}_{k\,l_1} - \hat{Q}_{i\,l_1} \leq \hat{Q}_{k\,l_2} - \hat{Q}_{i\,l_2}$$

$$\Rightarrow \quad u(C + \ell_1(K-C)) \geq u(C + \ell_2(K-C))$$

which is a contradiction.

Proposition 7: Type A (Mild) Moral Hazard: *Insurance cover makes assessment of risk less appealing to lenders.*

Proof: This follows on from Proposition 6 which implies that the optimal level of risk assessment expenditure, ζ^*, will be lower under insurance because ζ^* is determined where the benefits from extra risk assessment just equal the costs. This break even point will be lower if the benefits are reduced in some way, as they are through loan insurance.

Proposition 8: Type B (Acute) Moral Hazard: *Insurance reduces the utility losses from raising interest rates and so results in a higher optimal interest rate, thus screening out good risks.*

Proof: Let r^*_v be the optimal interest rate charged to i: $p_i \in P_v$. For the rational lender r^*_v will be determined where the utility gain (due to extra revenue per loan) from raising r_v, just equals the utility loss (due to adverse selection). We already know from the bounds on r_v that $r_{v\max} \geq r^*_v \geq r_{vmin}$. Now it can be shown that the optimal interest rate will be lower at lower levels of insurance coverage: $r^*_{v\ell 1} \leq r^*_{v\ell 2}$, where $0 \leq \ell_1 < \ell_2 \leq 1$. This follows from the fact that r^*_v will be higher if the utility losses from raising r_v are in some way reduced as they are through loan insurance. To show this, compare the utility to the lender of a loan to the average risk in P_v, denoted by $\bar{p}_1$ when $r_v = r_{1v}$, and $\bar{p}_2$ when $r_v = r_{2v}$, where $r_{1v} < r_{2v}$. Average success probability is calculated as $\bar{p} = \frac{1}{N_v} \sum_{\max(i_{\#v}, i_{*v})}^{i_v} N_i p_i$, where $i_{\#v} = f(r_v)$ and $i_{\#v}'(r) > 0$. The gain in Q_i, the utility per loan from raising r_v, is greater when insurance is higher:

$$\hat{Q}_{ir_2\ell_1} - \hat{Q}_{ir_1\ell_1} < \hat{Q}_{ir_2\ell_2} - \hat{Q}_{ir_1\ell_2}$$

where,

$$\hat{Q}_{ir_1\ell_1} = \bar{p}_1 u(1+r_1)K + (1-\bar{p}_1)u(C + \ell_1(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

$$\hat{Q}_{ir_2\ell_1} = \bar{p}_2 u(1+r_2)K + (1-\bar{p}_2)u(C + \ell_1(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

$$\hat{Q}_{ir_1\ell_2} = \bar{p}_1 u(1+r_1)K + (1-\bar{p}_1)u(C + \ell_2(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

$$\hat{Q}_{ir_2\ell_2} = \bar{p}_2 u(1+r_2)K + (1-\bar{p}_2)u(C + \ell_2(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta],$$

$$\hat{Q}_{ir_2\ell_1} - \hat{Q}_{ir_1\ell_1} = [\bar{p}_2 u(1+r_2)K + (1-\bar{p}_2)u(C + \ell_1(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta]]$$

$$- [\bar{p}_1 u(1+r_1)K + (1-\bar{p}_1)u(C + \ell_1(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta]],$$

$$= (\bar{p}_1 - \bar{p}_2)u(C + \ell_1(K-C)) + \bar{p}_2 u(1+r_2)K - \bar{p}_1 u(1+r_1)K$$

$$\hat{Q}_{ir_2\ell_2} - \hat{Q}_{ir_1\ell_2} = [\bar{p}_2 u(1+r_2)K + (1-\bar{p}_2)u(C + \ell_2(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta]]$$

$$- [\bar{p}_1 u(1+r_1)K + (1-\bar{p}_1)u(C + \ell_2(K-C)) - u[(1+\theta)K + \psi(\ell) + \zeta]],$$

$$= (\bar{p}_1 - \bar{p}_2)u(C + \ell_2(K-C)) + \bar{p}_2 u(1+r_2)K - \bar{p}_1 u(1+r_1)K$$

Assuming the opposite of the proposition,

$$\hat{Q}_{ir_2\ell_1} - \hat{Q}_{ir_1\ell_1} > \hat{Q}_{ir_2\ell_2} - \hat{Q}_{ir_1\ell_2}$$

$\Rightarrow \quad (\bar{p}_1 - \bar{p}_2)u(C + \ell_1(K-C)) + \bar{p}_2 u(1+r_2)K - \bar{p}_1 u(1+r_1)K > (\bar{p}_1 - \bar{p}_2)u(C + \ell_2(K-C)) + \bar{p}_2 u(1+r_2)K - \bar{p}_1 u(1+r_1)K$

$\Rightarrow \quad (\bar{p}_1 - \bar{p}_2)u(C + \ell_1(K-C)) > (\bar{p}_1 - \bar{p}_2)u(C + \ell_2(K-C))$

Since $\bar{p}_1 > \bar{p}_2$,

$\Rightarrow \quad u(C + \ell_1(K-C)) > u(C + \ell_2(K-C))$

$\Rightarrow \qquad \ell_1 \geq \ell_2$

which is a contradiction. Thus $r^*_2 > r^*_1$.

Q.E.D.

Proposition 9: *Loan insurance weakens the S&W credit rationing result whether it is lenders or borrowers who pay the premiums.*

Another corollary of Proposition 1 is that because flat rate loan insurance reduces the utility loss of lending to bad risks, it weakens the effects of the adverse selection associated with raising interest rates to clear the market. Thus, when ℓ = 1, there is no utility loss from lending to bad risks, and so no disincentive to raising interest rates in the event of excess demand, and so equilibrium credit rationing is not feasible irrespective of the level of information asymmetry between banks and borrowers.

6.2.2 Borrowers pay the premium

Consider the case where it is investors, not lenders, who bear the cost of insurance (which is the most common arrangement for credit insurance). This yields an expected utility of lending to each risk type of :

$$u_i=N_i[p_i u(1+r_v)K+(1-p_i)u(C+\ell(K-C))-u[(1+\theta)K+\zeta]].$$

Borrower expected profits are now,

$$\pi_i^b=p_i[R^s_i-(1+r_v)K]-(1-p_i)C-\psi(\ell) \qquad [15]$$

It is assumed that the information collected by banks is strictly private—insurers do not know the extent of risk assessment or the results from it. Consequently, the moral hazards described in the 'banks pay premiums' scenario still apply, with the added problem for insurers that raising premiums to cover losses will exacerbate the adverse selection effects. The following proposition still holds under risk assessment and differentiated interest rates provided there is more than one $p_i \in P_v$ (i.e. P_v is not a singleton), which implies $\zeta^* < \zeta^-$.

Proposition 10: *When risks are pooled, and borrowers pay premiums, raising premiums causes adverse selection, and hence in a pooled risk regime where borrowers pay the premiums, insurance rationing is a feasible equilibrium outcome.*

Proof:

Intuitively, the reason follows from the fact that premiums can be viewed as adding to the cost of borrowing, and so raising premiums in a pooled risk environment has the effect of disqualifying good risks from obtaining credit since their project return if successful is lower than for high risks. Analogous to the S&W type *credit* rationing result, the proof follows from showing that the threshold success probability is positively related to ψ when risks are pooled. (There will always be some pooling of risks unless $\zeta^* = \zeta^-$ in which case the lender has the option of offering differentiated interest rates to each risk type). Assuming the opposite when the borrower pays gives,

$p_{i\#}(\psi + \varepsilon) < p_{i\#}(\psi)$

$p_{i\#}$ under indemnity guarantee can be obtained from augmenting [3.1] with the insurance premium to yield:

$$p_{i\#} = \frac{C + \varepsilon + \psi}{p_i[R_i^s - (1+r)K + C]} \qquad [14]$$

Thus, $\frac{C+\psi+\varepsilon}{p_i[R_i^s-(1+r)K+C]}<\frac{C+\psi}{p_i[R_i^s-(1+r)K+C]}$ which is a contradiction given that $\varepsilon > 0$. Although insurers do not know individual p_i, they know the distribution of p_i and its relationship with $R^s{}_i$ and as such can compute $p_{i\#}$ for a given interest rate and the effect on $p_{i\#}$ of changing ψ.

6.2.3 Lenders Pay Premium

Assume ℓ is determined exogenously and that the bank pays the premium.[ii] This gives an expected utility to the lender from lending to each risk type of:

$$u_i=N_i[p_iu(1+r_v)K+(1-p_i)u(C+\ell(K-C))-u[(1+\theta)K+\psi(\ell)+\zeta]]$$

Note that if premiums are flat rate, raising premiums will not alter the decision to raise interest rates even when it is lenders who pay (although the *threat* of increased premiums may well be effective - see section 7).

6.2.4 Applicability to the Mortgage Market

We cited the mortgage market in the introduction as an example of a sector where credit insurance has become prevalent. The applicability of the results of this chapter (and the next) to the housing market rests on the appropriateness of the assumptions, particularly the relationship between risk and return, which underlie the adverse selection/moral hazard processes of the S&W model. Does return really rise with risk in the housing market, and if so, in what sense?

First, it should be said that if no such relationship existed (i.e. greater returns were available in certain areas without any additional risks), then some kind of arbitrage process would come into play ensuring that the anomaly was only temporary. For example, if purchasing a house in Edinburgh was certain to result in substantial capital gains, there would inevitably be an influx of speculative purchases. This would drive the price of Edinburgh housing up further, fuelling another round of rising prices and speculation. As this process continues, and prices escalate, there becomes at some point a very real risk that the bubble will burst and substantial capital losses made, particularly for those who entered the market relatively late on. Eventually the bubble does indeed burst and prices adjust to their long-run equilibrium level.

Although it seems that those who bought early on (when prices were low) would have borne relatively little risk and made the greatest return, a number of points should be noted before one jumps to the conclusion that the textbook risk return relationship has been disproved:

1. risk-return choices cannot be compared at different points in time since each time period is accompanied by different information sets.
2. those who bought before the price rises were facing the greatest risk (i.e. greatest variance of possible returns given the contemporaneous information set) because they would have had the least historical information on rising house prices. Edinburgh would have been just one of many locations where prices could potentially rise in future. Those who came in later had more information on how the market was behaving and had the benefit of observing an upward price trend relative to other areas. Their lower risk (i.e. lower variance of possible returns) was accompanied by lower returns (they were purchasing nearer the peak).

3. even if a negative risk-return relationship were evident in a particular market at a particular point in time, one should not confuse temporary deviations from a general law (i.e. the adjustment process) with a contradiction of that law. Arbitrage opportunities do not last forever unless there are significant barriers to entry.

In the mortgage market, such barriers may well of course exist: downpayment requirements, credit rationing, illiquidity and immobility, may all limit the number of borrowers who can take advantage of potentially high returns with limited risks. But the market is sufficiently large to reduce this possibility to a time lag in adjustment rather than a permanent state of high returns with low risks. It should also be noted that high interest rates may, at the margin, screen out borrowers with pure consumption motives and attract only those who are willing to take the risk that future capital gains may not outstrip the high costs of repayment. Clearly, the higher the interest rates, the greater the gamble. Interest rate rises may also have a moral hazard since it may make borrowers more inclined to purchase in areas with rapidly rising—but more volatile—prices, in the hope of recapturing the costs of borrowing. Or it may force borrowers to locate in high employment-risk areas, or purchase a dwelling more likely to have structural faults, or buy in a difficult-to-sell locale where the escape route of rapid sale in the face of repayment problems is precluded, or locate further from work and increase the difficulties of holding down a steady job.

Raising interest rates also directly affects the borrower's ability to repay, and in the UK where so many mortgages are variable rate, this has proved to be a very real problem. Raising interest rates to clear the market increases the risk of repayment problems for existing mortgage borrowers.

Therefore, through a variety of processes and channels, it is likely that the assumptions underpinning the S&W model—particularly that of rising interest rates having a deleterious effect on the lenders' portfolio of risks—do indeed have some relevance to the UK mortgage market.

6.3 Summary

Although a vast corpus of literature exists on the operation of credit and insurance markets, apart from the considerable efforts devoted to analyzing deposit insurance, relatively little has been done to examine interaction of the two markets, particularly with respect to loan insurance. Nevertheless, loan insurance is a large and pervasive industry, employed in a range of markets, from mortgage insurance, to Government initiated small firm loan guarantee schemes, and the indemnification of balance sheet receivables.

This chapter has attempted to develop a suitable theoretical model to examine the agency and credit rationing issues associated with loan insurance. Loan insurance was introduced into the model developed in the previous chapter and shown to reduce the utility gain from lending to lower risks, with the corollary that insurance cover makes monitoring less attractive, which is bad news for the insurer given that risk assessment and differentiated pricing result in favourable selection. In addition, a further moral hazard was shown to exist, termed 'acute moral hazard'. This refers to the tendency for insurance to reduce the utility losses from raising interest rates and so results in a higher optimal interest rate, thus screening out good risks.

Loan insurance was also shown to weaken the S&W credit rationing result (whether it is lenders or borrowers who pay the premiums) because flat rate loan insurance reduces the utility loss of lending to bad risks, diluting the adverse selection effects associated with raising interest rates to clear the market. Thus, when coverage is 100%, there is no utility loss from lending to bad risks, and so no disincentive to raising interest rates in the event of excess demand. In this situation, equilibrium credit rationing is not feasible irrespective of the level of information asymmetry between banks and borrowers. This is a significant result because is shows that credit insurance could impose an important qualification of the S&W credit rationing result. I also showed how *insurance* rationing is a feasible equilibrium outcome when borrowers pay since raising premiums to clear the market increases the costs of borrowing, having a similar adverse selection effect as raising interest rates.

Notes:

[i] Cowling (1995) found take up rates to be highly contingent on guarantee and premium parameters, which have had at least three sets of values since inception. From June 1981 to May 1984, premiums and guarantee rates were 3% and 80% of the loan value respectively. These rates became 5% and 70% in June 1984; 2.5% and 70% in April 1986; and 1.5% and 85% in 1993 (Cowling *op cit.*).

[ii] A recent development of the UK MPPI market is that some lenders have started to offer to pay Mortgage Indemnity Guarantee premiums, to the extent that now the majority of large lenders are offering this facility on at least one of their mortgage products. However, MIG is not a straightforward example of credit insurance since borrowers remain legally liable for losses made upon default and repossession even though MIG has covered a large proportion of those losses for the lender.

7 Implications of Alternative Insurance Regimes

7.1 Introduction

This chapter will examine the implications for moral hazards and equilibrium credit rationing of different insurance regimes. Such regimes are not only different between different markets for credit insurance, but also evolve over time, as in the case of the UK MIG (Mortgage Indemnity Guarantee)[i] market. Indeed, for insurance regimes particularly susceptible to moral hazards, it is almost inevitable that the structure of the insurance contract will change if the industry is to remain sustainable.

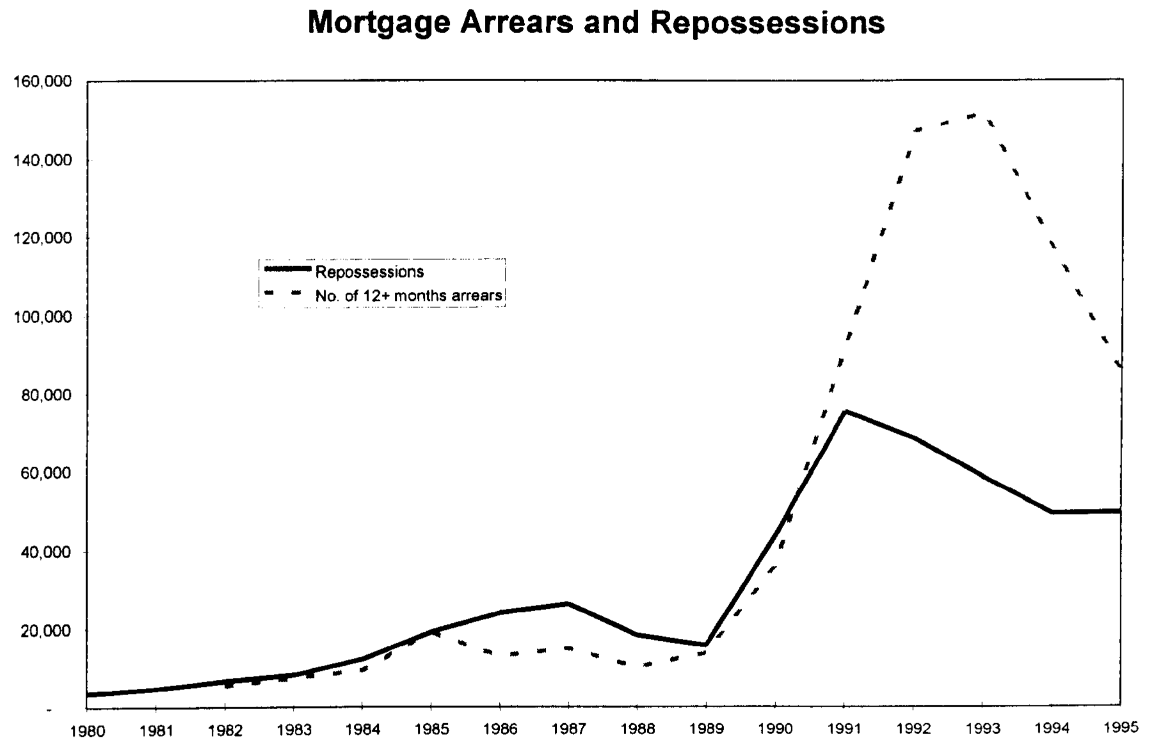
For example, it has been claimed that one of the reasons for the prolonged housing boom of the 1980s housing market was the significant improvement in access to credit, particularly to purchasers previously considered too risky to lend to. A possible contributory factor to the relaxed lending policy was the insurance cover provided by MIG. Recession in the wider economy in the early 1990s resulted in large scale repossessions, partly the result of the inadequate risk assessment and relaxed lending criteria of the previous decade.

That banks had inadequately assessed risk became evident when the UK economy moved into recession towards the end of 1990, resulting in widespread income and job losses. As Figure 7-1 illustrates, the subsequent arrears and repossessions reached unprecedented levels. The ubiquitous use of MIGs with 100% coverage and flat rate premiums meant that it was insurers rather than mortgage lenders that bore the associated losses, estimated at £1.8 billion for 1991 and 1992, plus a further estimated £1.8 billion between 1993 and 1996 (Boleat, 1994).

Following the massive increase in claims, there followed a process of radical restructuring of the insurance contract. This began in the latter half of 1991 with a substantial increase in premiums by as much as 60% (Douetil *op cit.* p.300; see also Building Societies Commission, 1994). Rationing has since been introduced in a variety of dimensions, including a cap on ℓ of 80% for most loans, and a cap of $\ell = 0\%$ for (i) loans on a semi-commercial business (e.g. dentists), (ii) 'loans called in for reasons other than non-performance' (Douetil *op cit.*, p.303), (iii) claims after five to eight years since inception, and (iv) claims in the event of compulsory purchase (see *ibid.* and Building Societies Commission, 1994).

As Proposition 5 of chapter 6 would predict, simply raising premiums in response to the crisis was insufficient because of the adverse selection effects when it is borrowers who pay premiums, and the impotency of such a measure in curbing the moral hazards for the lender. Consequently, insurance companies introduced co-insurance clauses, effectively reducing coverage, but also making premiums contingent on risk using information supplied/revealed by the lender. I now go on to consider a number of possible insurance regimes which may be adopted to alleviate moral hazards.

Figure 7-1



Mortgage Arrears and Repossessions
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Repossessions
No. of 12+ months arrears
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995

7.2 Interest Contingent Insurance Terms

In this section we explore the adverse selection, moral hazard and credit rationing effects of making insurance terms in some way contingent upon the observable characteristics associated with an insured loan. It is assumed that insurance companies can observe actions taken by the bank towards the borrower, such as the setting of interest rates, but cannot observe the characteristics of the borrower, and so do not know the risk of default or any other details regarding investors. In an attempt to alleviate the moral hazards described in the previous sections, the insurance company may make the terms of the contract dependent upon the rate of interest being charged in an attempt to alleviate the moral hazards. However, making insurance terms endogenous has different effects, depending on whether it is the bank or borrower who pays.

7.2.1 Banks Pay Contingent Premiums

Proposition 11: *Moral hazards are reduced but not eliminated when insurance terms are made endogenous.*

Proof: By making the premiums dependent not only on the level of cover, but also on the interest rate charged such that $\psi_v'(r_v) > 0$, banks are in effect penalised for lending to high risks (the only group prepared to pay high rates of interest). Thus, depending on the size of the interest rate multiplier applied by the insurance company in setting premiums, banks may have an added incentive to assess risk in order to limit themselves to low interest loans (i.e. only lend to good risks). However, insurance companies may actually profit from the bank lending to high risks if premiums are endogenous, and so the insurance company may not wish to set multiples so high as to eradicate the moral hazard completely. Thus there will be some optimal $\psi_v'(r_v)$, determined where the difference between the costs due to insurance claims from lenders having a risky loan portfolio, and the revenue from premiums gained from such a portfolio is greatest. The acute moral hazard effect, however, will still remain within a particular P_v provided P_v is not a singleton. Proposition 3 of chapter 6 still holds under contingent premiums because the interest rate within a particular P_v may still be higher under insurance than it would under no insurance.

Proposition 12: *CICRE (Contingent Insurance induced Credit Rationing Equilibria): Equilibrium credit rationing when $\zeta^* = \zeta^-$ becomes feasible if contingent premiums are introduced. When $\zeta^* < \zeta^-$, risk contingent insurance premiums provide a source of equilibrium credit rationing which is additional and complementary to the S&W explanation.*

Proof: We concluded in Proposition 4 of chapter 6 that adverse selection still occurs when the bank fully insures itself but it is not necessarily true that this will cause a reduction in utility. And if there is no utility loss associated with raising interest rates, then there is no reason why the bank should not raise the rate of interest when there is excess demand for credit in a particular P_v in order to clear the market. However, if insurance cover or premiums are tied to a risk indicator, such as the rate of interest, such a response may well be sub-optimal for the bank and so the possibility arises under endogenous insurance that the lender will prefer to ration credit, even if it is nearly perfectly informed about p_i ($\zeta^* = \zeta^-$). We term this CICRE (contingent insurance induced credit rationing equilibrium) as opposed to ASCRE (Adverse Selection induced Credit Rationing Equilibrium—the S&W source of credit rationing, summarised in Proposition 2 of chapter 5).

CICRE not only applies when risk assessment expenditure is at its maximum, but will occur whenever there is risk pricing in the credit market (differential interest rates), combined with risk contingent insurance premiums (or coverage). Note that where there is more than one $p_i \in P_v$, and less than 100% default insurance, CICRE reinforces—rather than supplants—ASCRE. Note also the connection with the moral hazards of loan insurance. When type B moral hazards bite, equilibrium credit rationing is less severe since there is an incentive for lenders to raise r, which in an excess demand situation, will help clear the market. Thus if insurers can reduce the moral hazards (by making premiums interest contingent for example) then CICRE will be more evident. The less the contingency policy is effective, the less scope exists for CICRE. Conversely, the more effective the contingency policy, the greater the scope for CICRE.

7.2.2 Borrowers Pay Contingent Premiums

Proposition 13: *If there is risk assessment and differentiated interest rates, 'favourable selection' may occur when insurers make premiums endogenous and it is borrowers who pay.*

Proof: If borrowers pay the premiums and insurers tie premiums to interest rates, and as a result, lower risks experience lower premiums, then the cost of borrowing to low risks will be reduced and cause $p_{\#iv}$, the threshold probability of success in

P_v, to fall. If $p_{\#iv}$ falls, then favourable selection occurs because investors with success probabilities at the upper end of a particular P_v will find it profitable to invest, having previously found it to be unprofitable. In other words, if $\psi_{i\#v}$ is the threshold premium above which $p_i \in P_v$ will not apply, then provided $\exists\psi_v < \psi$ such that $\psi_v \leq \psi_{i\#v}$, then there will be some p_i: $p_{a\#iv} > p_i > p_{b\#iv}$ where $p_{a\#iv}$ and $p_{b\#iv}$ are the threshold probabilities of success under flat rate and differential premiums respectively. Similarly, some high risks previously included are likely to be screened out if $\exists\psi_v > \psi$ such that $\psi_v \geq \psi_{i\#v} \Rightarrow \exists p_i$: $p_{a\#iv} < p_i < p_{b\#iv}$. Thus if in each P_v the mean risk of loan applicants remains the same or falls due to the introduction of ψ_v, and there is at least one $P_v \in \mathbf{P}$ in which average default risk falls, then overall riskiness of the insured portfolio will be reduced due to the introduction of contingent premiums.

Proposition 14: ***For high levels of coverage, banks may actually be made worse-off by charging differential interest rates, if it is the borrowers who pay insurance premiums, and premiums are risk contingent.***

Proof: Where banks pay the premiums, contingency clauses would simply make it more profitable for banks to lend to lower risks. However, in the case where borrowers pay the premiums, lenders are not penalised directly for lending to higher risks, but the risk-contingency of premiums implies that high risks may be discouraged (if the interest multiple is high enough), resulting in lower interest returns on average for the bank, and thus lower total revenue if insurance cover is high. Consequently, banks may have an incentive not to differentiate interest rates, thus diluting the motive to assess risk, and result in the lender genuinely pooling risks. Alternatively, it is feasible that, where insurance cover is high, it may be optimal for the lender to assess risk, charge one interest rate, and result in the lender rationing credit to low risks. Screening out good risks will raise the equilibrium pooled interest rate, and if there are as many high risks as low, raise the total revenue for the lender.

7.3 Contingent Coverage

Contingent coverage has similar implications to making premiums dependent upon interest rates where lenders pay. If $\ell_v = \ell_v(r_v)$ where $\ell_v'(r_v) < 0$, then CICRE is possible since there is once again a cost to the lender associated with raising r_v to clear the market. Acute moral hazards are again reduced, but may not be eliminated because within each P_v there remains the possibility that interest rate r_v is higher under ℓ_v than if there were no insurance. (By definition, type A moral hazard will exist under insurance, but may of course be counter-balanced by the gains to the lender of assessing risk, which are diluted when insurance terms are made interest-contingent).

7.3.1 Insurers Assess Risk

In some loan insurance markets insurers carry out their own risk assessment to differentiate premiums and to screen out high risks (an example of this is the US private mortgage insurance market), either by insisting that lenders reveal some information on the borrower (such as credit history details) or by collating its own information. If the insurer can distinguish between z* risk groups amongst borrowers where $z^* \in [1, \infty]$ and the identifiable risk interval is $P_z = \{p_i: p_z \leq p_i \leq p_{z+1}\}$, then the insurer can charge differential cover rates ℓ_z and/or charge a differentiated premium ψ_z either to lenders or borrowers for each borrower in P_z. Assessing risk will obviously reduce the moral hazards, but will not eliminate them unless insurer risk assessment is at least as good as lender risk assessment. Where insurers rely on lenders for information, ensuring superior information will be a problem since lenders can always be selective in what they reveal, although independent monitoring is not without drawbacks since the insurer will still not know whether it has superior information.

Proposition 15: *Acute moral hazards persist unless insurer monitoring is superior to lender monitoring*

Proof:

Let $\mathbf{P} = \{P_v: v \in V\}$ and $\mathbf{Q} = \{P_z: z \in Z\}$. Insurer monitoring is said to be superior to lender monitoring if $\mathbf{Q} \succ \mathbf{P}$, that is, if $\mathbf{Q}$ is finer than $\mathbf{P}$ in the interior sense.[ii] $\mathbf{Q} \succ \mathbf{P}$ if $\forall v \;\exists z : P_v \subset P_z$, which occurs when $p_i \in P_v \Rightarrow p_i \in P_z \;\forall v, z, i$.

If $\mathbf{Q}$ is not finer than $\mathbf{P}$ in the interior sense, then there exists some i and j $(i < j)$ that the lender cannot distinguish between (and so charges the same premium and offers the same coverage), but that the lender can distinguish between. This leaves the possibility that under insurance the lender will gain more from screening out i by charging a higher pooled interest rate to i and j than it would under no insurance. If, however, $\mathbf{Q}$ is indeed finer than $\mathbf{P}$ in the interior sense, then the insurer can differentiate premiums and coverage for every risk group identified by the bank and so eradicate acute moral hazards.

Independent monitoring has a number of interesting implications for the institutional structure between lenders, insurers and borrowers. First, if lenders know that insurers are assessing risk and that they will charge differential premiums and screen out high risks, there is an incentive for banks to cease risk assessment completely and tie interest rates to premiums, and credit rationing to insurance rationing (the exact reverse of the above). This is particularly appealing if risk assessment costs are high. Thus whilst independent monitoring may remove acute moral hazard, it will not remove type A moral hazard.

Such a move may have important disintermediation implications since if insurers who carry out their own monitoring have access to international wholesale credit markets, they will be in a strong position to bypass banks and lend to borrowers directly. Another possible development in the event of high monitoring costs and insurance rationing is that lenders set up their own insurance branch or establish joint ventures with an existing insurer to share the costs of risk assessment, whilst limiting the impact of large scale losses. There has recently been some evidence of this in the UK mortgage market where the larger lenders have established their own insurance companies, or used a variety of specialist insurers to undertake underwriting for its own insurance products (Stephens, 1997).

7.4 Observable Actions and Knowledge of Payoffs

7.4.1 Insurance Terms Contingent on Default Rates

Rather than making premiums and coverage interest contingent, insurers may simply make them dependent upon default rates of the previous period (a common practice in US private mortgage insurance). This implies a dynamic model of the form:

$$\psi_{t+1} = f\left(\frac{\sum_i (1-p_i)\ell_t (K-C) N_{it}}{\sum_i N_{it}}\right),$$

and/or of the form:

$$\ell_{t+1} = f\left(\frac{\sum_i (1-p_i)\ell_t (K-C) N_{it}}{\sum_i N_{it}}\right).$$

This allows the insurance company to penalise the bank for any action it undertakes that adversely affects the volume of claims, and indeed provides an incentive for the bank to minimise default risks. As such it may appear to be the most obvious arrangement to deal with the moral hazards of loan insurance. However, it can be shown that this arrangement will not necessarily remove the possibility of moral hazard.

Proposition 16: ***The possibility of acute moral hazards cannot be eliminated by threats of higher premiums or insurance rationing in the next period.***

Proof:

Where the bank anticipates a large proportion of risky loan applicants in period t and a much smaller proportion in period t+1, it may be preferable to set a high interest rate in period t knowing that the resultant riskier loan portfolio is covered by insurance, even if this means insurance is not obtainable / made unprofitable in the second period. To illustrate, consider the following example where there are two risk types p_1 and p_2 such that $p_1 > p_2$, with associated equilibrium loan quantities N_{1t}, N_{2t} in period t, and N_{1t+1}, N_{2t+1} in period t+1. Assume a pooled interest rate r_t and flat rate premium ψ_t and coverage ℓ_t. The lender maximises expected utility over the two periods:

$$U \quad = \max(U_t + U_{t+1})$$

$$= [N_{1t}Q_{1t} + N_{2t}Q_{2t} + N_{1t+1}Q_{t+1} + N_{2t+1}Q_{2t+1}]$$

where $N_{it} = \{0 \text{ if } r_t > r_{i\#}, N_{it} \text{ if } r_t \leq r_{i\#}\}$ and Q_{it} is the utility to the lender per loan. For sake of exposition assume further that the optimal pooled interest rate charged under no insurance, $r^{\neg\ell}_t$, is just equal to the threshold interest rate for p_1, $r_{1\#}$. Thus if under insurance the lender charges interest rate above $r^{\neg\ell}_t$ then p_1 will be screened out and only p_2 will apply. For all type B moral hazards to be removed, it must always be optimal for the bank to set $r_t \leq r^{\neg\ell}_t$. Assume that the bank can choose between two interest rates in period one, either r_{Lt} or r_{Ht}, where r_{Lt} = (0, $r_{1\#}$], and $r_{Ht} = (r_{1\#}, r_{2\#t})$.

If the bank chooses r_{Ht} rather than r_{Lt}, p_1 will be screened out and the total insurance claims at the end of period 1 will be $\sum_i (1-p_i)\ell_t(K_t - C_t)N_i$ = (1-p_2) $\ell_t(K_t - C_t)N_{2t}$. If the bank chooses r_{Lt}, then the total insurance claims will be $(1\text{-}p_1)\ell_t(K_t - C_t)N_{1t} + (1\text{-}p_2)\ell_t(K_t - C_t)N_{2t}$. Default rates after the two possible actions of the lender will thus be:

$$D_{Lt} = \{(1\text{-}p_1)\ell_t(K_t - C_t)N_{1t} + (1\text{-}p_2)\ell_t(K_t - C_t)N_{2t}\} / N_1 + N_2$$

$$D_{Ht} = (1\text{-}p_2)\ell_t(K_t - C_t)N_{2t}\} / N_2$$

It is clear that $D_{Ht} > D_{Lt}$ (assuming the opposite gives $1\text{-}p_1 \geq 1\text{-}p_2$ which is a contradiction), and so in the event of D_{Ht} the insurer only offers $\ell_{t+1} = \ell_L$, compared with $\ell_{t+1} = \ell_H$ in the event of D_{Lt}, where $\ell_L < \ell_H$. For acute moral hazards to be precluded, there must exist an ℓ_t that makes the insurance offer more profitable for the bank than no insurance, and there must exist an ℓ_{t+1} such that:

$$[N_{2t}(r_{Ht})Q_{2t}(r_{Ht}) \ + N_{1t+1}Q_{t+1}(\ell_L) + N_{2t+1}Q_{2t+1}(\ell_L)]$$

$$< [N_{1t}(r_{Lt})Q_{1t}(r_{Lt}) \ + N_{1t+1}Q_{t+1}(\ell_L) + N_{2t+1}(\ell Q_{2t+1})] \qquad \forall N_{it} \text{ and } \forall N_{it+1}.$$

But this can be shown to be a contradiction for some N_{it}. For example, if N_{1t} and is small and N_{2t} is large, and/or if r_{Ht} is considerably larger than r_{Lt} then it is possible that the inequality sign is reversed, even if the threat is maximised ($\ell_L = 0$).

A similar argument can be used to show that making second period *premiums* dependent upon first period default rates in a regime where lenders pay the premiums[iii] does not preclude moral hazards either since ψ_{t+1} has to be low enough to make insurance preferable to non-insurance in the second period. With this constraint on ψ_{t+1}, it is possible that choosing a risky portfolio in period 1 and no insurance in period 2 is preferable to setting $r_t = r_{Lt}$ and being insured in both periods.

This result is strengthened by the fact that the threat of prohibitively high premiums or rationing of coverage in period two may not be credible in a competitive insurance market, where banks can collectively opt for a risky portfolio in period 1. If insurers make the threat dependent upon each lender's default rate relative to other default rates (in an attempt to overcome the problem of penalising all borrowers in periods when all default rates rise due to cyclical exogenous factors), a 'prisoner's dilemma' scenario will develop. If lenders all opt for a risky portfolio in period 1, they will all benefit, but if one chooses to offer r_{Lt}, then the others will be worse off. Although in single shot games, the Nash outcome is that all choose r_{Lt}, Kreps *et al.* (1982) have shown that in repeated games co-operation may be optimal where there is incomplete information.

Proposition 17 ***The threat of future premium rises or insurance rationing makes CICRE possible***

Proof: Since (credible) threats pose a cost to the bank of raising r to the clear the market, it is possible that equilibrium credit rationing may arise, induced not by adverse selection, but by contingent insurance terms (CICRE). The rationale follows the same logic as the proof to Proposition 12.

7.5 Knowledge of Payoff Functions

So far we have assumed that the insurer cannot observe the lender's payoff function. However it could be argued that if the game is repeated over a number of periods, then the insurer will be able to deduce the nature of the lender (his risk aversion etc.), or lender behaviour is common knowledge derived from a history of responses to a variety of situations. Thus, although it may seem unrealistic to assume that insurers know the lender's utility function exactly, it could equally be contended that it is unrealistic to assume that insurers have no knowledge of the lender's utility. If we assume that the insurer does indeed know the payoff function of the lender, then insurers know that for every ℓ, ψ combination, there is an optimum r, N_i, and ζ for the lender. The insurer can then use its knowledge of the lender's reaction function to choose the most appropriate action, balancing the costs from adverse selection and moral hazard effects of high ψ and ℓ with the revenue gains. Such information results in the scenario of lenders paying the premiums having very similar adverse selection, insurance rationing and credit rationing results as when borrowers pay.

Proposition 18 ***Where there is common knowledge of payoff functions, equilibrium insurance rationing becomes possible even when lenders pay the premiums.***

A similar adverse selection result to that identified in Proposition 5 of chapter 6 is likely to arise when lenders pay the premiums if insurers and lenders have full knowledge of each other's payoff functions. Raising premiums implies greater marginal costs to the lender of extending credit, and so within a given P_v, the quantity supplied will shift inwards *cet. par.*. This will result in a higher equilibrium interest rate through the interaction of demand and supply, unless the effect of S&W type credit rationing is sufficient to preclude any movement in price (which is not feasible if ℓ = 1). Whether the adverse selection effect of raising premiums is stronger when banks pay or when borrowers pay will depend on the slopes of the demand and supply curves. Thus, transferring the premium burden from bank to borrower will result in lower interest rates, but this may not be sufficient to offset the increased costs to borrowers from having to pay the premium (so it is possible that insurers may be better off asking banks to pay). If the insurer can anticipate the effect on r_v, and hence on $i_{\#v}$, of raising ψ, it will be aware that it may be optimal to ration insurance rather than raising ψ to clear the market.

Proposition 19 ***Where there is common knowledge of payoff functions, equilibrium credit rationing will be feasible even when premiums are flat rate and risks are pooled.***

Proof: Because lenders can anticipate the effect of raising interest rates on the amount of coverage offered by the insurer, lenders perceive a cost associated with raising interest rates to clear the market and this threat of insurance rationing in some circumstances will be sufficient to induce equilibrium credit rationing, even though premiums, coverage and interest rates are all pooled (i.e. the same across different risk types).

7.6 Summary

In this chapter, we have considered a number of insurance regimes designed to alleviate the moral hazards highlighted in the previous two chapters. Moral hazards were found to be reduced but not eliminated when insurance terms are made contingent on interest rates. The chapter also showed how this type of contingency clause results in equilibrium credit rationing becoming feasible even if lenders are perfectly informed. This is an important result because it implies that risk contingent insurance premiums provide a source of equilibrium credit rationing which is additional and complementary to the S&W explanation, and operates when the S&W result does not. Contingent premiums have another interesting result in that if it is borrowers who pay the premiums, and there are differentiated interest rates, 'favourable selection' may occur when insurers make premiums endogenous since the insurer will be able to use the lender's risk categorisation to screen out bad risks. However, such screening may result in banks being worse off for charging differential interest rates, providing a disincentive to assess risk and/or to reveal information on borrowers.

Another possibility considered was that insurers themselves assess risk, but it was shown that acute moral hazards persist unless insurer monitoring is superior to lender monitoring. Neither can the threats of higher premiums or insurance rationing in the next period completely eliminate the possibility of acute moral hazards. Such threats would also have implications for access to credit in that they would provide a further motivation for rationing to exist in equilibrium even if premiums are flat rate, and risks are pooled. Similarly, where there is common knowledge of payoff functions, equilibrium *insurance* rationing becomes possible even if it is lenders who pay the premiums. All of these results enrich our understanding of how credit insurance affects credit markets, particularly given the scant attention paid to the topic in the existing literature.

Some credit insurance markets ration cover in an explicit and visible way through extensive exclusion clauses. This often results in a dichotomous insurance supply decision where a fairly uniform cover is offered to all borrowers who meet the specified criteria. This simplifies considerably the modeling of the demand side of the market since simultaneity problems can easily be overcome by restricting the sample to those borrowers that meet the supply-side criteria. This the approach taken in the next chapter which explores the determinants of credit insurance take-up and the influence of borrower's auto-perceived risk.

Notes:

[i] MIG is an insurance policy which covers lenders for any losses made on a reneged mortgage debt following repossession and resale.

[ii] See Berge (1963), chapter 1.

[iii] Whether borrowers face the threat of higher premiums is, of course, no disincentive to the lender, and may actually cause adverse selection.

8 Take-up of Flat Rate Credit Insurance:

Theory and Estimation of the Mortgage Protection Insurance Decision

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8.1 Introduction

So far I have examined the theory of perceived risk, the importance of credit rationing in deciding on a measure of perceived risk, the effect of credit insurance on credit rationing, and the implications of different insurance regimes (such as whether the lender pays and whether or not the premium is flat rate, for example). However, in modelling perceived risk, I have so far spoken of it only from the lender's perspective: that is, how the lender perceives the borrower's risk, and have overlooked the role of 'auto-perception', that is, how the borrower perceives his/her own risk. In effect, I have assumed that the borrower knows his/her own creditworthiness. Some consideration has been given to the case where the borrower pays the insurance premium (as opposed to the lender) but little space has been given to the demand decision itself (that is, the determinants of the borrower decision to take out credit insurance). It is to this subject I now turn, using one of the most important forms of loan insurance in the UK—mortgage payment protection insurance (MPPI)—as the focus of the analysis. Risk perception is now considered from the borrowers' perspective, who arrive at an estimate of their own risk on the basis of their knowledge of their economic characteristics and an understanding of the general relationship between these characteristics and risk. Risk also is considered from a different perspective since it is not so much risk of default which the borrower attempts to insure against as the risk of specific events which may conspire to induce default or temporary repayment difficulties in the absence of insurance.

8.2 Background to MPPI

Over a quarter of the UK creditor insurance market is accounted for by MPPI[i] products, which are designed to protect mortgage borrowers against the risks of accident, sickness or unemployment. In the event of any of these zero-employment-income outcomes, the insurer is committed to cover the borrowers' monthly mortgage payments for up to twelve months. MPPI policies have moved up the political agenda in recent years as policy makers have reduced the extent of state mortgage protection with a view to alleviating the apparent 'crowding-out'. State help is provided through ISMI (Income Support for Mortgage Interest) which covers monthly interest payments for owner occupiers eligible for Income Support (the UK's means tested welfare safety net). Income Support for Mortgage Interest (ISMI) was considered by the previous government to be fundamentally flawed because it exacerbated the unemployment trap, bailed out poor lending, failed to cover everyone in need, and discouraged further growth of private finance (Secretary of State for Social Security, 1995, quoted in Ford and Kempson, 1997). Changes introduced in October 1995 were thus intended to alleviate the apparent malaise. Before October 1995, IS (income support) claimants could claim 50 per cent of mortgage interest payments for the first two months of any claim, and 100 per cent thereafter. After October 1995, *existing* mortgagors receive no support for eight weeks, followed by up to 50 per cent of their eligible interest for the next 18 weeks and full coverage thereafter; and *new* mortgagors (including re-mortgagors) receive no support for 39 weeks followed by full eligible interest thereafter. The government anticipated that these modifications would induce the insurance market to provide new and innovative insurance products to meet the needs of mortgagors caught in the 39-week 'ISMI gap', even having the effect of reducing arrears and repossessions (Oldham and Kemp, 1996, p.44).

Thus, it was argued by the Secretary of State for Social Security in 1995 that ISMI discouraged further growth of private finance, and that a less generous state safety-net would increase the incentive for mortgagors to take out private insurance cover, and encourage insurance companies to provide a wider range of products. Thus, the substantial cut-backs in ISMI provision were introduced (*inter alia*) on the basis that they would reduce the 'crowding-out' of MPPI.

Research since then has started to evaluate the effectiveness of the changes by interviewing borrowers, insurers and lenders (Ford and Kempson 1997) and by testing whether MPPI clients are paying above the actuarially fair premium (Burchardt and Hills 1997a,b; 1998). Other research has examined the characteristics of those with the greatest odds of arrears (Burrows, 1997; Pryce, 2000) and the success of claims on insurance (Kempson *et al.*, 1999; see Ford and England, 2000, for a comprehensive survey of the literature). Little work has been done, however, to specifically test the 'crowding out' conjecture. Apart from

Pryce and Keoghan (1999, 2001) who have applied the methodology developed here to Family Resources Survey and Scottish House Condition Survey data (generally confirming the results presented in this chapter), no published research exists for the UK.

This chapter, therefore, aims to test the 'crowding-out' hypothesis by developing a theoretical model of the mortgage protection insurance decision, and to estimate this model using data on Glasgow and Bristol from the 1995 ESRC Beliefs and Behaviour project: 'Beliefs, Perceptions and Expectations in the UK Owner Occupied Market'. The data used here have the advantage over more recent work published by the author using the Scottish House Conditions Survey in that it includes a MPPI premium variable. Elasticities are used to measure responsiveness of the dependent variable (take-up of MPPI) to changes in its determinants (Income Support, ISMI, MPPI cover, MPPI premiums, mortgage costs, unemployment/ill health risks etc) and to establish whether the low take-up rates of MPPI can be addressed by widening the welfare gap, or whether take-up is driven largely by factors outside state control. Some of the results of the chapter have been published in Pryce (1998).

The chapter is structured as follows: first I develop a theoretical model of the MPPI take-up decision; then I outline the empirical estimation of the model and present the regression and elasticity results; the chapter concludes with a discussion of the results and a summary.

8.3 Theoretical Model

Mortgagors are assumed to make their decisions regarding whether or not to take out MPPI on the basis of perceptions regarding current and future states of world (employment, sickness, changes in interest rates, etc.) and their associated perceived probabilities. All variables are thus assumed to be 'as perceived by the borrower'. Insurance is taken out only if the expected utility under insurance is greater than that of not insuring. Consider a borrower *i* with perceived probability p of maintaining his current employment, perceived probability q of finding employment with remuneration above *i*'s reservation wage, and perceived probability Ω of being sick over the insurance period t. (Unless otherwise stated, all terms will be variable across borrowers and so the *i* subscripts will be omitted). y_1 is current income, and y_2 is income received from new paid employment in period t if the mortgagor loses her job and finds another, where q is the probability of finding a new job. The probability of zero employment income in period t is given by the probability θ, arising from the probability of being made unemployed and not able to find suitable new work or experiencing ill health:

$$\theta = (1\text{-p})(1\text{-q}) + \Omega - \Omega(1\text{-p})(1\text{-q}). \qquad [1]$$

Assume that the borrower is risk averse, $u'[W] > 0$, $u''[W] < 0$, and aims to $\max(u[W])$ where W is expected wealth at the end of period t before luxury consumption[ii]. The assumption that the consumer does not make any consumption expenditure on non-essential items until the end of period t is equivalent to assuming that luxury consumption decisions during period t are made on the basis of calculations of expected final net wealth made at the beginning of the period.

8.3.1 No insurance:

Expected wealth at the end of period t is given by,

$$W_0 = p(1\text{-}\Omega)w_a + (1\text{-}p)(1\text{-}\Omega)\, qw_b + \theta w_c \qquad [2]$$

where w_a is wealth at the end of period t if the borrower keeps his current job and remains in good health; w_b is wealth at the end of period t if the borrower loses his current job but finds a new one and remains in good health; and w_c is wealth if the borrower receives zero employment income in period t because he loses his current job and is not offered $y_2 \geq y^*$ or is sick. w_a is defined as:

$$w_a = y_1 - m + S - C, \qquad [3]$$

where m, S and y_l represent mortgage repayment costs in period t, savings at the outset of period t, and current income of the borrower in period t respectively (includes income from returns on savings and investments). It is assumed that borrowers have no control over mortgage repayment costs since they are predetermined at the point of purchase (the house purchase and mortgage decisions are not considered here, neither are decisions to extend the loan term). C is subsistence consumption[iii] and depends on the size of the household, age of household members, and their relationship to the respondent. (C is calculated using the standard Income Support definitions of personal allowances PA and premiums M which are defined below: C = PA + M).

w_b is wealth at the end of period t if the borrower loses his current job but finds a new one:

$$w_b = y_2 - m + S - C \quad [4]$$

w_c is wealth at the end of period t if the borrower loses his current job and is not offered $y2 \geq y*$:

$$w_c = B + bm - m + S - C \quad [5]$$

$$B = PA + M - y_3 \quad [6]$$

where,

b = perceived proportion of m covered by ISMI (b = 0 if savings are more than £8,000),

S = savings,

B = benefits received other than help with housing costs,

PA = Personal Allowances (subsistence income levels guaranteed by the state. Payments vary according to age, number of children and marital status),

M = Premiums (additional payments for families with children, lone parents, pensioners and long term disabled),

y_3 = tariff income (based on assumed income from savings and investments).

Thus total expected wealth in the uninsured state is given by,

$$W_0 = p(1-\Omega)(y_1 - m + S - C) + (1-p)(1-\Omega)q(y2 - m + S - C)$$

$$+\ \theta(B + bm - m + S - C)$$

$$W_0 = p(1\text{-}\Omega)y_1 + (1\text{-}p)(1\text{-}\Omega)qy_2 + \theta(B + bm) - m + S - C \qquad [7]$$

$u(.)$ under the uninsured state is given by,

$$u(W_0) = p(1\text{-}\Omega)u[y_1] + (1\text{-}p)(1\text{-}\Omega)qu[y_2] + \theta u[B + bm] - u[m] + u[S] - u[C]$$

8.3.2 Insurance:

Now consider the case where the borrower takes out MPPI cover. Expected wealth is given by,

$$W_1 = p(1\text{-}\Omega)w_d + (1\text{-}p)(1\text{-}\Omega)qw_e + \theta w_f \qquad [8]$$

where w_d is wealth if the borrower keeps his current job and remains healthy, w_e is wealth if he loses his current job but obtains another and remains healthy, and w_f is wealth if the borrower receives zero employment income in period t because he loses his current job and is not offered $y_2 \geq y^*$ or is sick.

$$w_d = y_1 - \psi m - m + S - C \qquad [9]$$

$$w_e = y_2 - \psi m - m + S - C \qquad [10]$$

$$w_f = B + lm(1+\psi) - \psi m - m + S - C \qquad [11]$$

where l is perceived insurance cover, $0 \leq l \leq 1$; and ψ is the insurance premium per £ of cover.

$$W_1 = p(1\text{-}\Omega)y_1 + (1\text{-}p)\,(1\text{-}\Omega)qy_2 + \theta(B + lm(1+\psi)) - \psi m - m + S - C$$

[12]

$$u(W_1) = p(1\text{-}\Omega)u[y_1] + (1\text{-}p)(1\text{-}\Omega)qu[y_2] + \theta\, u[B + lm(1+\psi)] - u[\psi m] - u[m] + u[S] - u[C]$$

[13]

8.4 The Insurance Decision

It is assumed that the borrower maximises utility,

$$u^*[W] = \max\,(u[W_1],\, u[W_0])$$

Thus, the mortgagor takes out insurance if:

$$u[W_1] \geq u[W_0], \qquad [14]$$

However, if there are factors other than $u[W_1]$ and $u[W_0]$ which influence the take up decision (see below), it follows that this analysis of the take up decision should be generalised into a continuous variable. Let ξ be the probability of take up and ρ the utility gain from taking out insurance (i.e. the financial incentive to insure),

$$\xi = \xi[\rho]\,; \qquad \partial\xi/\partial\rho > 0 \qquad [15]$$

where,

$$\rho = u[W_1] - u[W_0] = \text{utility gain from insurance} \qquad [16]$$

Equation [16] states that the greater the surplus of utility from expected wealth in the insured state compared to expected wealth in the uninsured state, the greater the probability of take up of MPPI. Because the greater is ρ, the greater the incentive to take out mortgage insurance, we would expect a positive coefficient in the logistic regression. Substituting [8] and [13] into [16] yields:

$$\rho = \theta\left(u[B + lm(1+\psi)] - u[B + bm]\right) - u[\psi m] \qquad [17]$$

8.5 Additional Factors

The model developed so far focuses on the financial rationale aspect of the decision whether or not to insure assuming constant risk aversion across consumers. However, there are a number of additional factors which affect the take-up:

8.5.1 Marketing Differentials

Lenders may affect the demand side factors by the extent to which they differentiate the marketing of the product across borrower types. For example, in recent years lenders have targeted first time buyers in the selling of MPPI since this species of borrower is most vulnerable under the new rules for ISMI (along with mortgage switchers),[iv] although this is likely to be more prominent in years since the changes, and so the data used here may not detect this trend. This chapter thus aims to test whether targeted marketing strategies were in place before the October 1995 changes.

Also, the October 1995 changes raised the profile of MPPI, and so the purchase date may have an effect on the decision other than simply the rational financial implications of ISMI. We wish to test whether the purchase date has a significant effect on take up, particularly if the purchase date is after the announcement (March 1995) or after the implementation of the change. Note that the financial effects are included in the ρ variable through the definition of b and so a coefficient significantly different from zero would confirm the existence of a non-financial component in the announcement / implementation of the change. For example, the publicity surrounding the change and its announcement may have plugged some of the information gap regarding the ISMI system and MPPI policies. If no information gap exists, then a dummy variable for mortgages taken out after the change would be statistically insignificant.

8.5.2 Myopia

Consumers may be more influenced by existing wealth (w_a) than expected wealth (W). This could be interpreted as cognitive dissonance (denial of any prospect of change in employment circumstances) or heavy weighting of current over future consumption if the model were two-stage (with the possibility of zero-employment income not occurring until the second stage)[v]. Thus the equation for ξ becomes:

$$\xi = \xi[\rho, w_a]$$

In this formulation of the decision process, choices are driven by the level of subsistence consumption as well as the expected utility gain from insurance. Subsistence consumption will vary according to the size of household, age of household members, and their relationship to the respondent. Dependants, for example, imply an additional expenditure for the household and greater subsistence consumption, and so may lower the reservation demand price for insurance relative to a household with no dependants but the same income. Net wealth in the event of no claim may thus be lower than if no insurance is taken out, and so respondents with 'tighter budgets' will feel they 'cannot afford' insurance. Thus if w_a is found to be statistically significant, this will provide evidence that consumers do in fact place a disproportionate emphasis on current non-zero income situation and do not simply base their decision on the net expected utility gain from taking out insurance which we assume in the main model. We test which of the two influences dominate in consumer's minds and whether both ρ and w_a are significant when included in the same regression.

8.5.3 Past Experience of MPPI

Another possible influence is the borrower's experience of claiming MPPI. The sign and significance of the coefficient on this variable is important since it will show whether claiming MPPI has had a positive effect on their perspective of whether mortgage protection insurance is worthwhile (particularly important given the number of clauses included in insurance contracts and the concerns of Kempson *et al.*, 1999, regarding the claims procedure).

8.5.4 Regional Differences

In addition to the bare financial differences (e.g. differences in premiums, unemployment probabilities etc) which are already accounted for in ρ, there may exist idiosyncrasies between the two cities which geographically differentiate the take-up decision. Such differences may arise due to different levels of risk aversion between the two regions, or due to marketing differentials in Scotland and England. This will be tested for using a location dummy.

8.6 Knowledge and Ignorance

In constructing *b* (the perceived proportion of mortgage costs covered by ISMI), assumptions have to be made regarding the household's knowledge of the ISMI changes. If, for example, consumers were unaware of the ISMI changes at the time the data were collected, then it is assumed they would base their MPPI decision on pre-1995 ISMI rules. If they were aware of the (forthcoming) October 1995 changes, then it is assumed that mortgagors would base their insurance decision on the new ISMI provisions. We run regressions both under the assumption of knowledge and of ignorance to test which implied better specification for the model.

8.7 Insurer and Supply

Insurance is offered by insurance companies provided the default risk of the borrower as perceived by the insurance company is no greater than the threshold risk the insurer is willing to insure. This suggests that supply can be assumed to be dichotomous: mortgagors meeting a list of criteria will be offered full insurance at a fixed rate (i.e. standardised insurance packages with flat rate premiums). Since the modelling of 'take-up' is effectively the modelling of realised demand, supply can be modelled by restricting the sample to those borrowers who meet the eligibility criteria. The discrete supply behaviour of insurers revealed in the Ford and Kempson (1997) survey suggests that simultaneity problems[vi] can be overcome by truncating the sample to include only those customers who fit the criteria outlined by lenders as in Ford and Kempson *op cit.*.

8.8 Estimation

8.8.1 Data

The data were chosen because most of the respondents were questioned before the October 1995 changes (allowing us to examine what could have been anticipated by policy makers at the time) and because of its rich detail, particularly with regard to questions on expected changes in economic variables (e.g. questions were asked regarding expected changes in mortgage interest, expected ease of finding new jobs etc.). Data was collated from the results of a questionnaire of 822 respondents from Glasgow and Bristol, commissioned under the ESRC Beliefs and Behaviours project: 'Beliefs, Perceptions and Expectations in the UK Owner Occupied Market'. It should be noted that the sample is not truly random – it is a stratified sample of first time buyers, recent movers and stayers. However, there is no intuitive reason why this should result in bias per se in the estimation of relationship between take-up and determinants. The only possible reservation is that estimates of elasticities, for example, that are based on calculations for the whole sample, where the parameters used to calculate those estimates arise from regressions run on a sub-sample (due to missing values, screening out of certain groups etc.), may be biased if the regression sub-sample does not exactly reflect the stratification structure. As a result, we report elasticity results based on both the full number of observations available and the limited regression sub-sample. Sample sizes varied between 240 and 290 for most regressions depending on which variables were included in the model.

8.8.2 Formulation of ρ: Multiplicative vs Additive Construction

It is often a matter of subjective methodological preference whether one first constructs a specific theoretical economic model and then embarks on estimation; or begins with an empirical investigation of the underlying data generating process, and then from the results infer theoretical implications. It is contended, however, that for the purposes of this chapter – namely estimation of the elasticities of take-up with respect to a range of arguments – a theoretical modelling approach (resulting in a multiplicative functional form) is preferable because an additive econometric model will result in estimates which have no economic meaning.

To illustrate, consider the following simple example. First, let $\rho = u[w_1] - u[w_0]$ be the basis of the theoretical (multiplicative) model, where ρ is the utility gain from taking out insurance, w_1 is wealth with insurance, and w_0 is wealth without. Assume that w_1 and w_0 will vary across individuals, and assume the expected utilities are determined as follows. Expected utility in the uninsured state is given by:

$$u[w_0] = p_x u[w_x] + (1\text{-}p_x)u[w_z] \qquad \text{[i]}$$

where p_x and w_x are the probability of the 'good' state of the world and the wealth in that state respectively, and w_z is wealth in the event of the 'bad' state occurring. Expected utility in the insured state is given by:

$$u[w_1] = p_x u[w_x] + (1\text{-}p_x)u[w_z + K] - u[y] \qquad \text{[ii]}$$

where y is the premium, and K is the pay out if event z occurs. Subtracting [i] from [ii] gives:

$$\rho = (1\text{-}p_x)(u[w_x + K] - u[w_z]) - u[y] \qquad \text{[iii]}$$

Now assume that the probability of take-up, P, is positively related to ρ:

$$P = \mathrm{P}[\rho], \quad \mathrm{dP/d}\rho > 0. \qquad \text{[iv]}$$

The estimated logit model would thus be of the form:

$$P = a_0 + a_1\left((1\text{-}p_x)(u[w_x + K] - u[w_z]) - u[y]\right) + e \qquad \text{[v]}$$

where a_0 and a_1 are the parameters to be estimated. The elasticities with respect to the various arguments would be calculated using the first derivative. For example, the elasticity of take-up with respect to p_x would be calculated as h_a = $(\mathrm{dP/d}_{px})(_{px}/\mathrm{P})$:

$$h_a = (\ a_1(u[w_z] - u[w_x + K])\ )\ (p_x/P) \qquad \text{[vi]}$$

Applying the additive approach, on the other hand, without recourse to expected utility theory, yields an estimated equation of the form:

$$P = b_0 + b_1 p_x + b_2 w_x + b_3 K + b_4 w_z + b_5 y + e_1$$

giving an elasticity with respect to p_x of:

$$h_b = b_1\ (p_x/P)$$

For sake of argument, assume that $h_a = h_b$,

$$\Rightarrow (\ a_1(u[w_z] - u[wx + K])\ )\ (p_x/P) = b_1\ (p_x/P)$$

$$\Rightarrow b_1 / a_1 = u[w_z] - u[w_x + K]$$

which states that the right hand side is constant across all observations since both b_1 and a_1 are constants. This is clearly a contradiction because w_z and w_x vary across individuals. Thus using the additive model to estimate elasticities is inappropriate when the theoretical structure is highly non-linear, as it is in this case. Additive regressions were run, but the coefficients had no clear economic interpretation and so the remainder of the chapter proceeds with the estimation of the multiplicative formulation of utility gain from insurance implied by equation [17].

8.8.3 *Joint Ownership/Decision Making and Time Horizons*

So far, we have referred to the decision-maker as an individual. However, even if not joint homeowners in a legal sense, partners may have been involved in the decision making process of whether or not to insure. And even if the partner was not explicitly involved in the decision, the partner's economic circumstances will no doubt have influenced the respondent's decision. Thus, it is assumed in the empirical analysis that the 'borrower' as referred to above, is in effect the 'household'. For respondents with partners, we thus take into account the employment and earnings characteristics of the combined decision making unit.

The time horizon t is the period over which the respondent is assumed to maximise expected utility. On the whole we assume this period is one year, although we also present results for $t = 2$ years.

8.8.4 Construction of Variables

Construction of p, the perceived probability of retaining existing job.

Unfortunately, no question was included in the questionnaire asking the respondent about the expected probability of losing their job, and so a proxy had to be constructed. Also, houses are purchased and mortgages obtained, on the basis of *household* income, not just that of the respondent. Thus the probability of the household being without employment income in period t includes partner probabilities of retaining his/her existing job and acquiring a new one:

$$(1-p) = (1-\pi_1)(1-\pi_2) \quad [18]$$

where π_1 is the probability that respondent keeps existing job and π_2 is the probability that partner keeps existing job. To derive proxies for π_1 and π_2 it is assumed that borrower's beliefs about remaining in employment will be determined by the same factors which determine the chances of being employed at the time of interview. For the purposes of this study, we are only interested in full time or near full-time employment – i.e. we would wish to discount employment below a certain number of hours because we are really only interested in the probability of the borrower having a job that will enable him/her to maintain his/her mortgage payments or at least contribute towards them in a substantial way. As a result, an arbitrary threshold of sixteen hours per week was assumed in the computation of the logit modelling. This also allowed us to include the effect of contract type on determining hours worked, which would not have been possible if the categorisation of work was limited to unemployment (i.e. zero hours) or employment (i.e. anything greater than zero hours) because no unemployed worker would have a contract. Using the threshold number of hours described above, we found that 53% of respondents working for less than 16 hours per week had a permanent contract, compared with 66% for those who worked longer hours. Of those with a permanent contract, 63% were working more than 16 hours per week.

The logit models were constructed to estimate the determinants of being currently full-time employed (as defined above). A number of regression structures and explanatory variables were experimented with, but the optimal model appeared to be determined by three key explanatory variables: whether or not the borrower had a permanent employment contract (PERM), level of educational achievement (EDUC), and age (AGE). Regression results are reported in the first two columns of figures in Table 8-1. Estimates of the probabilities were then obtained from the predicted values from these regressions following the linear structure of the regressions: π_1 = 2.03 + 0.75 PERM + 0.20 EDUC - 0.07 AGE; and π_2 = 0.62 + 1.99 PERM + 0.37 EDUC - 0.05 AGE ; and combined to produce an estimate of p,

$$p^{\#} = \pi_1^{\#} + \pi_2^{\#} - (\pi_1^{\#}\pi_2^{\#}), \qquad [19]$$

where $p^{\#}$, $\pi_1^{\#}$, and $\pi_2^{\#}$ are the estimates of p , π_1 , and π_2, respectively.

Table 8-1 Preferred Regression Equations for Predicting π_1, π_2, ϕ_1, and ϕ_2

DEPENDENT VARIABLE	π_1 Prob(respondent keeps current job)	π_2 Prob(partner keeps job)	ϕ_1 Prob(respondent finds a new job)	ϕ_2 Prob(partner finds a new job)
Constant	2.026	.617	1.368	2.079
	(.000)	(.038)	(.014)	(.000)
PERM = Dummy for permanent contract	.747	1.985	-	
	(.001)	(.000)		-
EDUC = Educational achievement	.201	.369	.481	
	(.000)	(.000)	(.065)	-
$EDUC^2$ = EDUC squared	-	-	-.093	-
			(.048)	
AGE = age of respondent/partner	-.066	-.049	-.064	-.050
	(.000)	(.000)	(.000)	(.000)
ETYPE = {1 if employer/manager in large/small establishment or professional employee}	-	-	.548	.261
			(.033)	(.265)
AREA = {1 if live in Glasgow, 2 if live in Bristol}	-	-	.379	
			(.051)	-
N	811	646	492	436
-2 Log Likel	880.689	608.484	622.905	567.685
Goodness of Fit	796.913	626.246	489.778	436.622
Model X2[k]	222.343	177.678	57.322	26.091
(Significance)	(.000)	(.000)	(.000)	(.000)
In sample prediction accuracy	73.00%	75.23%	64.63%	63.30%

Figures in brackets represent the significance level (for Wald statistics unless otherwise stated); the lower the significance level, the greater the confidence that the estimate is significantly different from zero.

Construction of q, the perceived probability of finding a new job.

Again the probability of the household not being able to find another job will be dependent upon the perceptions of both respondent and partner,

$$(1-q) = (1-\phi_1)(1-\phi_2) \qquad [20]$$

where ϕ_1 = probability that respondent finds a job.

ϕ_2 = probability that partner finds a job.

Logit estimates for ϕ_1 and ϕ_2 were calculated, this time based on the following question in the survey: 'If you lost your job, how easy do you think it would be to find a similar one?' with the set of options: {1) Very easy, 2) Relatively Easy, 3) Relatively Difficult, 4) Very Difficult}. A dichotomous dependent variable was constructed on the basis of: {1 if very or relatively easy, 0 otherwise} and regressed using logit procedures to obtain predicted values and an estimate of q,

$$q^{\#} = \phi_1^{\#} + \phi_2^{\#} - (\phi_1^{\#}\phi_2^{\#}), \qquad [21]$$

where $q^{\#}$, $\phi_1^{\#}$, and $\phi_2^{\#}$ are the empirical estimates of q , ϕ_1 , and ϕ_2 respectively based on the regression results reported in Table 8-1 (i.e. ϕ_1 = 1.368 + 0.481EDUC - 0.093 EDUC^2 -0.0639AGE + 0.548ETYPE + 0.379AREA; and ϕ_2 = 2.080 - 0.050AGE + 0.261ETYPE) where AREA and ETYPE are area of residence (either Glasgow or Bristol) and employment type, as defined in the table. As one would expect, being an employer/manager/professional, level of education and living in Bristol all have a positive influence on the perceived chances of finding another job, whereas age has a negative effect (interestingly, education has a non-linear effect for respondents, but not for partners, for whom education was not a significant determinant).

Construction of Ω, the perceived probability of ill health.

The perceived probability of ill health was defined as the probability that both the respondent and partner are unable to work due to ill health caused by accident or sickness. This was calculated as $\Omega = \omega_1\omega_2$, where ω_1 is the probability that the respondent is sick, and ω_2 is the probability that the partner is sick. Estimates $\omega_1^{\#}$

and $\omega_2^{\#}$ were obtained from the predicted values of logit regressions run on whether or not an individual was sick at the time of being interviewed.[vii]

Construction of b: the level of ISMI Cover

Since ISMI is linked to the Income Support benefit provision, the proxy for *b* (level of ISMI cover in time period *t*) has to include some modelling of income support payments. One complication is that the mortgage payment figure in the questionnaire does not separate out interest and capital payments, precluding precise calculation of mortgage interest relief.

The main determinants of *b* are whether the person is eligible for ISMI (in particular, whether they have over £8,000 savings and $B > 0$), whether the initiation date of the mortgage lies before or after the October 1995 changes, and the maturity of the loan if it is a repayment mortgage. This latter component arises because ISMI only covers interest payments, and lenders tend to front-load the interest component of repayment mortgages, leaving the bulk of amortisation until the latter half of the repayment period.

Let τ be the maturity of the mortgage = $\{1, 2, ..., T\}$, and P = the principal. The total amount to repay is denoted by Σ. Assume now that there is a fixed annual amount to pay to the lender: $m = \Sigma/T$. The amount of interest paid each year on a repayment mortgage r_τ can be simulated by the following algorithm: $r_\tau = m - \tau^*(m/T)$. This assumes that the interest component of mortgage payments increase by a regular discrete amount each year. This is used to compute the front loading ratio, F^R such that $F^R = r_\tau / m$. For fixed interest mortgages (endowments, PEP, pension mortgages etc.), this is assumed to remain constant at two thirds of mortgage payments (i.e. $r_\tau / m \approx 2/3$). Since most people in the sample are early on in their mortgage, those with repayment mortgages do better *cet. par.* under ISMI. The fraction of mortgage payments covered over the time horizon t by ISMI is thus given by: $b = F^R x$; where x is the number of full day equivalents of ISMI cover during t.[viii]

Since the changes to ISMI were announced in the spring of 1995, it could be argued that it is the new ISMI regulations that should be used in modelling their insurance decision. We also present results assuming ignorance of the changes and a longer time horizon based on: $b_1 = F^R x_1$; $b_2 = F^R x_2$; and $b_3 = F^R x_3$ where x_1 is calculated assuming a one year time horizon and ignorance of the ISMI changes; x_2 is calculated assuming a two year time horizon and ignorance of the ISMI changes; and x_3 is calculated assuming a two year time horizon and complete knowledge of the changes. b_1, b_2, and b_3 were used to construct corresponding expected utility gain variables ρ_1, ρ_2, ρ_3 using equation [17].

Private Insurance Cover I and Expected Mortgage Costs m

Although the level of insurance cover does vary between policies, most of the variation has arisen since the survey was completed and so we shall assume that borrowers anticipate a delay of thirty days before payments are made and when they are made, full cover of mortgage costs is received which seems to be the typical MPPI arrangement (Ford and Kempson *op cit.*). m is assumed to comprise three components: the existing mortgage payments, the expected change in mortgage interest tax relief, and the expected change in the rate of interest. The survey contains questions on all three components, although the latter two components are coded discretely as either *rise*, *fall*, *stay the same* or *don't know*. To make quantitative use of this information a value had to be assumed for each discrete choice as follows: if respondents indicated tax relief or interest rates increased (decreased) it was assumed that this implied an anticipated 10 per cent impact on mortgage costs, otherwise zero change.

Insurance Premiums per £ of cover, ψ

Since the majority of borrowers did not take out mortgage protection insurance, observations on ψ were limited to a small proportion of the sample. However, in the theoretical model constructed above, *all* borrowers (assumed to be price takers) base their insurance decision on the perceived premium offer. The average premium reported in the sample could be assumed to apply to all borrowers, but this would overlook any variation between the two regions and over time. Consequently, averages were computed for a total of twelve categories[ix], and assigned to borrowers falling within each category.

Utility Function Assumptions

The assumption that borrowers are risk averse implies particular restrictions on the shape for the expected utility function, namely it has to be concave to the origin. Consequently, $u[w]$ was assumed to take the form ln $[1 + w]$. (This captures the concavity of utility functions belonging to risk averse borrowers since $u'[w] = 1/(1+w)$).

8.9 Specified Model

The model estimated comprised the financial factor plus additional factors as follows:

$$\xi = \beta_0\Big(\theta\big(u\,(B + lm(1 + \psi))\big) - u(B + bm)\big) - u\,(\psi m)\Big) + \beta_1\omega_\alpha$$

$$+ \beta_2 D^{GLASGOW} + \beta_3\, D^{ISMI\_IMP} + \beta_4\, D^{MPPI\_USED} + \beta_5\, D^{FTB}$$

$$+ \beta_6\, D^{ISMI\_ANN}$$

Definitions of variables are given in Table 8-2.

8.10 Results

Intercept terms were introduced in each of the specifications but were found to be statistically insignificant. As the results tables show, for each of the specifications of ρ and combinations of dependent variables, regression elimination procedures always returned ρ as the only significant explanatory variable. This suggests that ρ is capturing the bulk of variation in the take-up probability. Of the four specifications of ρ (ρ_0, ρ_1, ρ_2 and ρ_3), regressions run under the assumption of no knowledge of the ISMI changes—i.e. with ρ_1 or ρ_2 as the explanatory variable (regressions [16] and [17])—had the better diagnostic results in terms of the log likelihood and SPSS goodness of fit results. But regressions run under the assumption of complete knowledge of the ISMI changes—i.e. with ρ_0 and ρ_3 as the explanatory variable (regressions [6] and [18])—did better in terms of the Chi-square and in-sample prediction accuracy results. All were highly significant in terms of the Wald statistic result. Consequently, there is no conclusive evidence that the model is better specified assuming ignorance of the changes. This is not entirely surprising given the very small elasticity calculated with respect to ISMI (see below). Because ISMI appears to have very little effect on take-up of MPPI, changing the knowledge of ISMI generosity also has little effect: consumers in similar circumstances who over-estimate the generosity of ISMI are likely to come to the same decision regarding MPPI as those who under-estimate the generosity of ISMI. Similarly, comparisons of regression [6] results with regression [18], and [16] with [17] indicate that extension of the time horizon from 1 to 2 years made no conclusive improvement to the results.

Supply was modelled by restricting the sample to those not rationed by standard insurance criteria. Comparison of regressions run on the full and restricted samples revealed that the sample restriction in fact had little effect on the results. Inclusion of wa (wealth at the end of period t if the borrower keeps his current job and remains in good health) was not found to be significant and the ρ effect clearly dominated (regressions [1] to [6]).

Table 8-2 Definitions and Descriptives of Variables Appearing in Regression Results

Variable	Definition	Mean
ξ	probability of take up – this is the dependent variable in all of logistic regressions and is proxied by a dummy variable based on whether or not respondents in the sample have taken out MPPI.	.20
$\xi^{\#}$	predicted values of ξ under the assumption of complete knowledge of ISMI changes and 1 year time horizon.	.30
$\xi_1{}^{\#}$	predicted values of ξ under the assumption of no knowledge of ISMI changes and 1 year time horizon.	.30
$\xi_2{}^{\#}$	predicted values of ξ under the assumption of no knowledge of ISMI changes and 2 year time horizon.	.30
$\xi_3{}^{\#}$	predicted values of ξ under the assumption of complete knowledge of ISMI changes and 2 year time horizon.	.30
ρ	expected utility gain from taking out private mortgage insurance.	-5.48
D^{ISMI_IMP}	Dummy variable = (1 if the respondent purchased house after October 1995; 0 otherwise).	.01
D^{MPPI_USED}	Dummy variable = (1 if the respondent has ever made claim on his policy; 0 if not).	.02
D^{ISMI_ANN}	Dummy variable = (1 if the respondent purchased house after the announcement of the ISMI changes in spring 1995; 0 otherwise).	.15
D^{FTB}	Dummy variable = (1 if the respondent is first time buyer; 0 if not).	.38
$D^{Glasgow}$	Dummy variable = (1 if the respondent lives in Glasgow; 0 if the respondent lives in Bristol).	.50
w_a	is wealth at the end of period *t* if the borrower keeps his current job and remains in good health.	20365.52

Number of valid observations (listwise not including supply side screening) = 311.00

Table 8-3 Regression Results for w_a Regressions

Variable	(1)	(2)	(3)	(4)	(5)	(6)*
ρ	0.3482	0.3368	0.3525	0.3768	0.3681	0.1543
	(0.1201)	(0.1278)	(0.1049)	(0.0763)	(0.0829)	(0.0000)
w_a	0.1136	0.1113	0.1220	0.1370	0.1239	-
	(0.3792)	(0.3877)	(0.3346)	(0.2662)	(0.3077)	
$D^{Glasgow}$	-0.2675	-0.2748	-0.1687	-0.1706	-	-
	(0.3481)	(0.3335)	(0.5411)	(0.5362)		
D^{ISMI_IMP}	0.6632	0.6581	0.5705	-	-	-
ISMI_IMP	(0.5274)	(0.5307)	(0.5863)			
D^{MPPI_USED}	8.1142	8.1404	-	-	-	-
	(0.6187)	(0.6175)				
D^{FTB}	0.0957(0.7367)	-	-	-	-	-
N=Number of cases included in the analysis	262	262	262	262	262	286
-2 Log Likelihood	303.308	303.421	315.662	315.954	316.338	347.808
Goodness of Fit	256.637	256.414	261.008	261.086	260.902	286.033
Model χ^2[k]	58.515	58.402	46.160	45.869	45.485	48.672
(significance)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
In-Sample Prediction	72.41%	72.41%	70.11%	70.50%	70.11%	70.28%

ACCURACY

Figures in brackets represent the significance level: the lower the significance level, the greater the confidence that the estimate is significantly different from zero.

Table 8-4 Regression Results -- w_a not Included

Variable	(7)	(8)	(9)	(10)	(11)
ρ	0.1685 (0.0000)	0.1704 (0.0000)	0.1793 (0.0000)	0.1768 (0.0000)	0.1662 (0.0000)
$D^{Glasgow}$	-0.2008 (0.4539)	-0.1022 (0.6956)	-	-	-
D^{ISMI_IMP}	0.8820 (0.3836)	0.8280 (0.4133)	0.8195 (0.4183)	-	-
D^{MPPI_USED}	8.0935 (0.6205)	-	-	-	-
D^{FTB}	0.2512 (0.3526)	0.3056 (0.2463)	0.3129 (0.2339)	0.3065 (0.2426)	-
D^{ISMI_ANN}	-	-	-	-	0.3528 (0.2715)
N	286	286	286	286	286
-2 Log Likelihood	333.712	345.656	345.809	346.448	346.625
Goodness of Fit	282.033	286.544	286.210	286.323	286.216
Model χ^2[k] (significance)	62.768 (0.0000)	50.824 (0.0000)	50.671 (0.0000)	50.032 (0.0000)	49.856 (0.0000)
In-Sample Prediction Accuracy	72.03%	70.28%	70.28%	70.28%	70.28%

Figures in brackets represent the significance level: the lower the significance level, the greater the confidence that the estimate is significantly different from zero.

Table 8-5 Regression Results

Variable	(12)	(13)	(14)	(15)	(16)	(17)	(18)*
	ρ_1	ρ_1	ρ_1	ρ_1	ρ_1	ρ_2	ρ_3
ρ_K	0.1593	0.1614	0.1728	0.1703	0.1516	0.1516	0.1543
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$D^{Glasgow}$	-0.2320	-0.1320	-	-	-	-	-
	(0.3839)	(0.6110)					
D^{ISM_IMP}	0.8660	0.8119	0.8004	-	-	-	-
	(0.3922)	(0.4221)	(0.4289)				
D^{MPPI_USED}	8.1017	-	-	-	-	-	-
	(0.6203)						
D^{FTB}	0.1983	0.2547	0.2641	0.2581	-	-	-
	(0.4600)	(0.3306)	(0.3117)	(0.3219)			
N	289	289	289	289	289	289	286
-2 Log Likelihood	339.203	351.204	351.463	352.074	353.052	353.052	347.809
Goodness of Fit	284.871	289.442	289.066	289.166	288.963	288.964	286.034
Model χ^2[k]	61.436	49.435	49.176	48.565	47.587	47.587	48.671
(significance)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
In-Sample Prediction Accuracy	71.97%	69.90%	69.90%	69.90%	69.90%	69.90%	70.28%

Figures in brackets represent the significance level: the lower the significance level, the greater the confidence that the estimate is significantly different from zero.

8.11 Elasticities

8.11.1 Construction of Elasticities

There are five elasticities that we are primarily interested in: the elasticity of take-up with respect to insurance premiums ($\varepsilon_{\xi[\psi]}$); with respect to the level of ISMI cover ($\varepsilon_{\xi[b]}$); with respect to Income Support entitlements ($\varepsilon_{\xi[B]}$); with respect to MPPI coverage ($\varepsilon_{\xi[l]}$); and with respect to the perceived probability of zero employment income ($\varepsilon_{\xi[\theta]}$). These were calculated using the variable elasticity approach: elasticities were calculated for each observation using predicted values of ξ, and then averaged across the sample. For example, $\varepsilon_{\xi[b]}$ = $E[(\partial\xi/\partial b)(b/\xi)]$, where, $\partial\xi/\partial b = -\alpha\theta m / (1 + B + bm)$.

8.11.2 Elasticity Results

Using regression results from the preferred regressions (i.e. on the restricted sample with only ρ as the independent variable) elasticities were calculated for each available observation using the above method. Elasticities were calculated using both the maximum number of observations possible and also the most restricted regression sample (regressions 1 to 5, $n = 262$). As the results in Table 5 show, there was very little variation between the various alternative definitions of ρ. The probability of take-up is shown to be inelastic with respect to all determinants, and all five elasticities were found to have the correct expected signs on average. By far the largest elasticity is $\varepsilon_{\xi[\psi]}$ with a value of around –0.5, which implies that a ten per cent reduction in premiums would produce a five per cent rise in the take-up of private mortgage protection insurance.

Most importantly, the probability of take-up is found to be highly unresponsive to changes in ISMI and the benefits system. A ten per cent cut in either b or B would produce an increase in take-up of less than 0.1 per cent. Take-up is more responsive to changes in private cover and in the probabilities of zero employment income, although these elasticities are also surprisingly small: the probability of take-up would only increase by 1 per cent and 5 per cent respectively if there were a ten per cent increase in l or θ. Interestingly, however, the standard deviation is much larger for the $\varepsilon_{\xi[\theta]}$ elasticity, with the response to a 10 per cent rise in θ being as high as 9.8 per cent for some individuals (.43 in the restricted sample).

Table 8-6 Elasticity Results

Variable	Mean	Std Dev	Min	Max	N
$\varepsilon_{\xi[\psi]}$ = elasticity of take-up with respect to insurance premiums (based on ρ)	-.5120 -.5192	.04 .03	-.60 -.58	-.37 -.41	347 262
$\varepsilon_{\xi[\psi]}1$ = elasticity of take-up with respect to insurance premiums (based on ρ_1)	-.4980 -.5048	.03 .03	-.58 -.56	-.37 -.40	353 262
$\varepsilon_{\xi[\psi]}2$= elasticity of take-up with respect to insurance premiums (based on ρ_2)	-.4980 -.5048	.03 .03	-.58 -.56	-.37 -.40	353 262
$\varepsilon_{\xi[\psi]}3$= elasticity of take-up with respect to insurance premiums (based on ρ_3)	-.5120 -.5192	.04 .03	-.60 -.58	-.37 -.40	347 262
$\varepsilon_{\xi[B]}$ = elasticity of take-up with respect to IS entitlements (based on ρ)	-.0014 -.0026	.00 .00	-.02 -.02	.00 .00	592 262
$\varepsilon_{\xi[B]}1$ = elasticity of take-up w.r.t. IS entitlements (based on ρ_1)	-.0007 -.0012	.00 .00	-.01 -.01	.00 .00	598 262
$\varepsilon_{\xi[B]}2$= elasticity of take-up w.r.t. IS entitlements (based on ρ_2)	-.0006 -.0010	.00 .00	-.01 -.01	.00 .00	598 262
$\varepsilon_{\xi[B]}3$= elasticity of take-up w.r.t. IS entitlements (based on ρ_3)	-.0009 -.0016	.00 .00	-.01 -.01	.00 .00	592 262
$\varepsilon_{\xi[b]}$ = elasticity of take-up w.r.t. level of ISMI cover (based on ρ)	-.0009 -.0014	.00 .00	-.01 -.01	.00 .00	592 262
$\varepsilon_{\xi[b]}1$ = elasticity of take-up w.r.t. level of ISMI cover (based on ρ_1)	-.0007 -.0011	.00 .00	-.01 -.01	.00 .00	592 262
$\varepsilon_{\xi[b]}2$ = elasticity of take-up w.r.t. level of ISMI cover (based on ρ_2)	-.0007 -.0011	.00 .00	-.01 -.01	.00 .00	592 262
$\varepsilon_{\xi[b]}3$ = elasticity of take-up w.r.t. level of ISMI cover (based on ρ_3)	-.0008 -.0012	.00 .00	-.01 -.01	.00 .00	592 262
$\varepsilon_{\xi[l]}$ = elasticity of take-up w.r.t. MPPI cover (based on ρ)	.0110 .0074	.02 .01	.00 .00	.13 .05	347 262
$\varepsilon_{\xi[l]}1$ = elasticity of take-up w.r.t. MPPI cover (based on ρ_1)	.0100 .0072	.02 .01	.00 .00	.12 .05	353 262
$\varepsilon_{\xi[l]}2$ = elasticity of take-up w.r.t. MPPI cover (based on ρ_2)	.0100 .0072	.02 .01	.00 .00	.12 .05	353 262
$\varepsilon_{\xi[l]}3$= elasticity of take-up w.r.t. MPPI cover (based on ρ_3)	.0110 .0074	.02 .01	.00 .00	.13 .05	347 262
$\varepsilon_{\xi[\theta]}$ = elasticity of take-up w.r.t. percieved probability of zero employment income (based on ρ)	.0600 .0321	.13 .08	.00 .00	.98 .43	347 262
$\varepsilon_{\xi[\theta]}1$ = elasticity of take-up w.r.t. percieved probability of zero employment income (based on ρ_1)	.0500 .0295	.12 .07	.00 .00	.96 .42	353 262
$\varepsilon_{\xi[\theta]}2$ = elasticity of take-up w.r.t. percieved probability of zero employment income (based on ρ_2)	.0500 .0293	.12 .07	.00 .00	.96 .42	353 262
$\varepsilon_{\xi[\theta]}3$ = elasticity of take-up w.r.t. percieved probability of zero employment income (based on ρ_3)	.0500 .0309	.13 .08	.00 .00	.98 .43	347 262

NB: First row of figures in each cell relate to results from the full sample, whereas the second row relate to the restricted sample.

8.12 Discussion

8.12.1 MPPI Premium Elasticities

Of the five elasticities, the elasticity of ξ with respect to private insurance premiums was consistently more than ten times larger in absolute terms than any of the other elasticities. Even so, all the estimates would be classified as inelastic, a ten per cent fall in premiums producing an approximately five per cent increase in take-up. This suggests that take-up, although being relatively unresponsive to changes in any of the variables considered here, is driven largely by insurance premiums.

Indeed, if the Burchardt and Hills (1997a,b; 1998) results are accurate, then insurers could cut premiums by 49 per cent and still break even with expected payouts (the actuarial premium for their hypothetical unemployment-only MPPI policy was found to be £2.42 per month per £100 of cover; compared with an average of £4.02 for actual premiums surveyed in January 1996). Even a 20 per cent fall in premiums would result in a 10 per cent rise in take up. However, although this would be beneficial in social policy terms, it is obviously not beneficial in revenue terms, since the inelasticity is still less than one and so any fall in premiums would, at least on the average, result in a fall in revenue.

8.12.2 Theta Elasticities – the Role of Auto-Perception

Sensitivity of take of MPPI to borrower auto-perception was measured by the elasticity with respect to theta, the perceived probability of zero employment income. The estimate was unexpectedly low (for every ten per cent rise in the perceived probability of zero household employment income, MPPI take up only rises by around 0.5 per cent). This may be due to the underestimation of theta in the model, arising largely out of the limitations of the data set and from the simplicity of the model.

However, it should be noted that although the elasticity is small, there still could be large fluctuations in θ in response to changes in the economic cycle. θ represents perceived risk of unemployment, not actual risk, and it is likely that cycles in perceived risk will have substantially greater amplitude than actual. Whether or not this is the case will only be verifiable following the onset of the next recession, although it should be noted that even if perceived unemployment risk is five times greater than actual, the elasticity with respect to the shift in actual risk will only be unitary, and this will be insufficient to stem the tide of people caught in the ISMI gap.

If 0.05 is in fact a reliable estimate of the elasticity with respect to theta, then it would go some way to explaining the absence of moral hazard and adverse selection in the Burchardt and Hills study (1997a) which 'found no evidence ... that the difference between the actuarial premium and the commercial premium was due to the insured population having higher unemployment than the uninsured population' (p.30). The financial benefits of MPPI are, for most people, simply not responsive enough to changes in unemployment probabilities to attract a significantly higher proportion of mortgagors.

8.13 Summary

The model developed in this chapter uses data relating largely to homeowners who took out mortgages before the October 1995 changes. In addition to constructing demand elasticities, the model aimed to identify the extent to which rational economic incentives drive the decision to take out insurance, and the role of other factors (such as the timing of the purchase decision in relation to ISMI changes; marketing differences between regions and borrower types; and ignorance of the ISMI changes). Supply was modelled by assuming all mortgagors which meet the usual criteria stipulated in MPPI policies (see Ford and Kempson *op cit.*) will be entitled to full protection for one year.

It was found that the expected utility gain variable, ρ, as constructed from the theoretical model, is the only statistically significant explanatory variable in the regressions. Given the reasonable explanatory power of this variable, it would appear that, despite the considerable uncertainty and ignorance surrounding ISMI and MPPI, borrowers are generally making economically rational choices.

The chapter also aimed to estimate the responsiveness of the take-up decision to a number of the key variables which make-up ρ, including auto-perception (the expected probability of zero employment income), insurance premiums, ISMI cover, MPPI cover and IS entitlement. It is found that probability of take-up will rise by less than 0.01 per cent following a 10 per cent fall in ISMI cover – suggesting that the sluggish response to the ISMI cuts could have been anticipated. This undermines one of the key motivations for the 1995 changes, namely the alleviation of the claimed crowding out of private mortgage protection insurance. Conversely the inelasticity of MPPI take-up to ISMI cover also implies that significant reinstatement of the safety net for mortgage borrowers could be achieved without any deleterious effect on MPPI take-up.

Comparison of regressions run under various assumptions about mortgagor knowledge of ISMI changes, revealed that there was no conclusive evidence that the model is better specified assuming ignorance of the changes. This is not entirely surprising given the very small elasticity calculated with respect to ISMI. Because ISMI appears to have very little effect on take-up of MPPI, changing the knowledge of ISMI generosity also has little effect: consumers in similar circumstances who over-estimate the generosity of ISMI are likely to come to the same decision regarding MPPI as those who under-estimate the generosity of ISMI.

In summary, this chapter has contributed to the existing literature in the following ways. First, it has developed the first theoretical model of the MPPI purchase decision, providing a sound analytical basis for subsequent empirical work. Second, the work presented in this chapter is the first to consider in a systematic way the crowding-out of MPPI by ISMI and has presented a methodology for doing this. Third, the chapter has presented the first estimates of elasticities of take-up of MPPI to price, ISMI and a range of other variables. The results will be of interest to policy makers and also to lenders and insurers given that the chapter presents the first robust estimates of the price elasticity of demand for MPPI.

Notes:

[ii] the remainder of the market is comprised as follows: 12% Credit/Store card insurance, 52% Personal Loan insurance, 7% Motor Finance insurance, 2% other (Ford and Kempson 1997, p.26, based on net written premiums as calculated by Consolidated Financial Services).
[ii] to avoid confusion, square brackets are used to indicate the arguments of a variable.
[iii] It is assumed that Wo can be negative as well as positive since the consumer can disave.
[iv] High-risk groups may also be specifically targetted. Since many lenders appear to make the bulk of their mortgage lending decisions on the basis of loan and income to value ratios it seems plausible that these variables may have an additional influence on the take up decision. However, they were not found to be statistically significant when included in addition to ρ.
[v] i.e. there would be some initial time period where the consumer perceives the risk of zero employment income to be zero (e.g. immediately following the take-up of MPPI). The borrower may discount future periods sufficiently to make current wealth the overiding factor in deciding whether insurance is 'affordable'.
[vi] In a traditional demand and supply economic model, quantity and price are both determined simultaneously through the intersection of the demand and supply curves. This means that both the effect of demand and the effect of supply have to be included in any model which attempts to explain quantity or price, and so special simultaneous equation estimation techniques usually have to be used. However, if supply is dichotomous, this 'simultaneity problem' can be overcome simply by appropriately restricting the sample.
[vii] ω_1 = 1.3668 - 0.4005 EDUC - 1.5066 AREA -1.4483 FEMALE; ω_2 = -5.5887 + 0.0349 AGE where FEMALE = {1 if female; 0 if male}
[viii] If t = 1 year and the new rules are used, then: x = (0 if S > 8,000 or B < 0; 100/365 if S < 8,000 and date of mortgage after October 1995; 126/365 if S < 8,000 and date of mortgage before October 1995; 365/365 if S < 8,000 and date of mortgage before October 1995 and either respondent or partner over 60) where the 100/365 and 126/365 figures are calculated from the number of full day equivalents of cover as a proportion of the one year horizon, starting from the point of completing the questionnaire.
[ix] six time periods of when the mortgage was taken out (before 1986, between 1986 and 1990, 1991 and 1992, 1993, 1994, 1995) across two areas (Bristol, Glasgow).

9 Conclusion

Assessing, Perceiving and Insuring Credit Risk

9.1 Introduction

It was noted in Chapter 2 that the major omissions in the literature lie not *within* the selected strands of financial economics but *between* them. The aim of this thesis, then, has been to make some advancement at a number of points of interface of these disciplines (particularly the risk assessment, credit insurance and credit rationing literatures) as well as making a number of contributions within existing literatures (notably the perceived risk sovereign debt literature, and the MPPI literature). Core themes of the thesis, as indicated by the title, have included the *assessment, perception* and *insurance* of credit risk, concepts which straddle at least four substantial literatures (objective risk analysis, perceived risk analysis, credit rationing, credit insurance). From the outset, it was considered unfeasible (if not undesirable) to attempt a single unifying thesis that synthesised all these elements. Instead, a series of partial models (both theoretical and empirical) have been developed to analyse particular points of connection. The aims of this final chapter are: (1) to summarise the results of these models and their contribution to the literature(s); (2) to highlight any obvious connections that exist between the different models and concepts so-far explored; and (3) to point to possible areas of further research.

9.2 Results and Contributions of the Thesis

I summarise below the main themes and findings of the thesis and attempt to highlight the most significant contributions to the literature(s).

9.2.1 Risk Assessment and Perceived Risk

The first research question explored was how movements in credit market risk feed through to changes in risk assessment efforts and risk premia. This was investigated theoretically in chapter 3 on the basis that lenders use risk assessment in an attempt to set interest rates at a level that will maximise revenue, but also one that will not exceed the maximum rate the borrower is willing to pay. This 'maximum rate' (referred to as the 'threshold' interest rate in Chapter 3) is indirectly affected by the riskiness of the borrower's intended project because a known positive relationship between risk and return is assumed. Thus, in setting interest rates, lenders attempt to estimate the borrower's threshold interest rate by using risk assessment to estimate the borrower's risk. The borrower is then offered a rate less than or equal to the bank's estimate of this threshold.

Assuming that the lender knows the risk distribution of loan applicants, or at least has some perception of it (based, for example, on previous risk assessments), the lender's maximum profits will be driven *inter alia* by the expected number of loan applicants, itself the product of the probability, p_i, of charging risk type i an acceptable interest rate (i.e. one that is less than or equal to i's threshold rate), and N_i, the number of applicants in risk category i. Risk assessment is crucial in the calculation because it determines the probability of charging an appropriate interest rate (assuming that the greater the risk assessment, the smaller the variance and bias associated with the lender's risk assessment errors). The optimal level of risk assessment is also affected by the numbers of borrowers in each risk category since it is these numbers which determine how much of an effect reduced risk assessment errors have on bank revenue. Surprisingly, rises in the level of risk assessment do not necessarily feed through to rises in p_i. This is because, if the *error-bias* in risk assessment falls rapidly relative to the fall in *error-variance* as risk assessment increases, then it is possible (for normally distributed errors, for example) that p_i actually falls. This leads to the conclusion that optimal risk assessment may actually fall as market risk rises (i.e. as number of borrowers in high risk categories increase relative to numbers in low risk categories, it may be optimal for lenders to actually reduce risk assessment).

It should be noted that an implicit assumption of the model, that borrowers do not go elsewhere for a loan, can be interpreted as assuming that the lender is a monopoly. However, this assumption is not as restrictive as it might first appear, since the model could be extended to represent a competitive market by introducing a probability that for a given $r <= \hat{r}_{\#}$, borrowers find an offer from elsewhere and reject the loan offer. The relationship between r and $\hat{r}_{\#}$ would nevertheless be positive, and the implication would remain that risk assessment may either rise or fall as market risk deteriorates. The model could also be modified to represent existing long-term loans with fluctuating r, where the lender is estimating the r to charge without exceeding the threshold at which the borrower defaults, again producing the same result of fluctuating risk assessment.

Interestingly, it was found that if risk assessment changes over time, then it is possible that the lender's perception of the creditworthiness of a particular borrower may fluctuate, even if the actual default risk of that borrower remains constant. Because it is not possible to observe actual risk *directly*, the hypothesis that the relationship between perceived and actual fluctuates over time, could not be tested directly. However, the hypothesis could be tested *indirectly* by assuming that the relationship between actual risk and its determinants remained constant. The corollary of this assumption is that any movements in the relationship between *perceived* risk and the estimated weights would suggest that the connection between perceived and actual risk may be fluid. The results of chapter 4 confirm that this is indeed the case for the sovereign debt market, with substantial and multiple structural breaks over time in the coefficients of perceived risk regressions. This is a significant contribution to the existing literature which has almost unanimously assumed constant parameters in perceived risk models. The results therefore strongly suggest that Thapa and Mehta's (1991) finding that there was no structural breaks between two time periods was nothing more than an anomaly and that the usual practice of pooling data across years is not appropriate when analysing the sovereign debt market. The results also have important implications for debtor nations trying to optimise their creditworthiness and minimise risk premiums since it is clear that the goal posts are not fixed when it comes to setting risk premia in sovereign debt markets. The results also have implications for lenders in that it highlights their own capriciousness in assessing risk and the likelihood that good risks have been inappropriately rationed/charged high interest rates and vice versa for bad risks.

Perceived risk is also important because it affects foreign direct investment decisions, since published ratings reflecting lender perceptions are used to gauge the background risk of investment in projects located in a country. That such ratings may have a fluid and even tenuous relationship to actual risk has implications, therefore, not only for sovereign debt markets, but for a country's ability to attract institutional investment generally.

9.2.2 Credit Rationing

Endogenising the rate of interest, in the theoretical model developed in chapter 3, would have allowed for the possibility of credit rationing. The impact of r on default risk[i] was, in the event, excluded from the model for the sake of simplicity. However, there is no reason to expect the endogenisation of r to alter the result that risk assessment (and hence perceived risk) changes over time. Although the inclusion of credit rationing would not have affected the perceived risk results, its existence does have profound implications for empirical estimation because it affects the choice of dependent variable. For if interest rates do not simply *reflect* perceived risk, but actually *determine* it, then LIBOR spreads cannot be used as measures of risk perception, as has become common practice in the literature. It was noted in chapter 4 that high-risk borrowers may, in principle, be offered a similar rate of interest to lower risks, but in practice, be credit-rationed. This led to the conclusion that, only by directly soliciting from lenders the credit ratings they ascribe to particular borrowers, can a reliable measure of perceived risk be compiled. And this was the very approach used to compute the *Institutional*

Investor country risk ratings, the measure chosen in chapter 4 to represent perceived risk.

Although the model in chapter 3 was not extended to include credit rationing, the phenomenon was studied in detail in chapters 5, 6 and 7. In the model developed in chapter 5, it was shown that credit rationing can arise because of its *adverse selection* effects of raising interest rates in a market for new loans (rather than the moral hazard effects – i.e. raising the rate of interest increases the probability of default of *existing* borrowers).[ii] The use of adverse selection to explain credit rationing was first put forward by S&W, and it is their model which forms the basis of the first proposition of chapter 5.

In essence, the ASCRE (Adverse Selection induced Credit Rationing Equilibrium) result put forward by S&W arises from the assumption that there exists a positive relationship between risk and return (the riskier the project, the higher the return if successful) and the assumption that lenders cannot distinguish between the risks of new loan applicants. Thus, if interest rates are raised, good risks are screened out of the market. Even if their intended project is successful, the return will not be sufficient to repay the loan capital plus the rate of interest. The screening out of good risks may make lenders think twice about raising the rate of interest when there is excess demand for credit, and hence the possibility of ASCRE.

9.2.3 Worst of the Good, and the Best of the Bad

In S&W's model, however, there is no possibility for lenders to assess risk, and so, one of the aims of chapters 5 and 6, was to bridge the gap between the credit rationing literature and the risk assessment literature by exploring the possible implications of introducing risk assessment into a credit rationing model. It was assumed that by assessing risk, lenders can distinguish between a discrete number of risk groups amongst borrowers. The greater the risk assessment effort, the greater the number of identifiable groups. It was shown (*cet. par.*) that classificatory risk assessment of this type can produce favourable selection where there is still more than one risk type in each identifiable category. The existence of multiple interest rates, rather than a single pooled rate, will result in some borrowers being priced out the market who were previously willing to borrow (on the basis that the return on investment for good risks would not be sufficient to cover the loan capital plus interest), and others being priced 'into' the market, who previously considered borrowing to be too expensive. However, the displacement would not be 'like for like', for the borrowers gained would have a lower probability of default than the borrowers lost. This is because each category of risk identifiable by the lender will still contain more than one risk type (unless the lender is perfectly informed), and so the differentiated interest rates would continue to be 'pooled' prices, but pooled across a less diverse set of risks.

Assume, for example, that risk assessment allows the lender to classify borrowers into two groups: a high risk band and a low risk band, with two corresponding interest rates. Assuming there are still many risk types within each of the two identifiable bands, some of the borrowers whose threshold interest rate was below the single pooled interest rate will now be at the upper end of the low risk band, and find that the rate of interest they are offered is below their threshold rate. In contrast, some of those borrowers whose threshold interest rate was previously above the single pooled rate (and so willing to accept the loan offer) will now fall into the lower end of the high risk band and so be screened out by the new interest rate. However, the borrowers falling into the lower end of the high risk band (and now priced out of the market) are more risky than those falling into the upper end of the low risk band (priced into the market by differentiated interest rates). Favourable selection occurs because the worst of the good are better than the best of the bad. This is an important result in that it adds to the known advantages of risk pricing in that it suggests that lenders will only gain revenue from extracting more surplus from higher risks, but risk pricing favourably influences the actual selection of risks. This is something which has been overlooked in the existing literature, which is perhaps surprising given the equity implications of risk pricing: those who are able to afford the most pay the least for a given level of credit.

The remainder of chapter 5 demonstrated that there will be a limit to the level of risk assessment, simply because, once risk assessment has categorised each borrower to the extent that each identifiable risk band contains only one risk type, then lenders will gain nothing from additional investment in risk assessment. One property of operating at the maximum worthwhile level of risk assessment (termed 'near perfect' information in chapter 5) is that there will be no scope for ASCRE because every risk type would effectively be treated as a separate market, each market having homogenous-risk applicants, and an interest rate determined through the traditional demand and supply. Although a fairly intuitive result, it is an important one because it initiates an exploration of the implications of risk assessment for credit rationing, which again has been overlooked in the literature.

9.2.4 Credit Insurance

Although the moral hazards of *deposit* insurance have been discussed at length in the literature, the perverse incentive implications of *credit* insurance have been all but overlooked. Certainly, no previous study to the author's knowledge has considered the implications of insurance for credit rationing, or for risk assessment. It is these three elements (credit insurance, credit rationing and risk assessment) which chapters 6 and 7 attempted to connect. A number of possible links were made, including the impact of insurance on the lender's motivation to assess risk. If the lender is fully insured against default on all its loans, and insurance premiums are flat rate, then there is less incentive to lend to low risks. Hence, monitoring becomes less worthwhile (this was termed the 'mild' moral hazards of credit insurance). Rather more insidious is the possibility that insurance reduces the utility losses to the lender from lending at higher interest rates, and so results in a higher interest rate and the screening out of good risks (referred to as the 'acute' moral hazards of credit insurance).

Interestingly, if it is borrowers who pay the insurance premium (as in Mortgage Payment Protection Insurance) and the insurance is compulsory for all borrowers (as has been recommended by a number of commentators for the mortgage market) then raising premiums to clear the market effectively results in a rise in the cost of borrowing, and the screening out of good risks from the mortgage market (in the same way as raising the rate of interest screens out good risks). If insurance is voluntary, and it is again borrowers who pay, then adverse selection amongst the pool of insurees (but not borrowers) may result, with only the riskiest borrowers finding it worthwhile to take out insurance. This results in the possibility of equilibrium *insurance* rationing in a form that is analogous to ASCRE.

These are significant results in that they indicate the implications of credit insurance for risk assessment and credit rationing decisions and so qualify many of the existing theoretical results in the literature which have tended to overlook the existence and influence of credit insurance even though it is prevalent in many credit markets.

9.2.5 CICRE: Insurance Causes Credit Rationing

Suppose lenders pay the premiums on the loan insurance, and the terms of the loan insurance are in some way contingent upon the terms of the loan contract. Thus, credit rationing (termed CICRE – Contingent Insurance induced Credit Rationing Equilbria) can result, even if lenders are 'near perfectly informed' about borrowers (i.e. can charge a different interest rate to each risk type). This is because the threat of future increases in the premium, or the tying of premiums based to interest rates, may discourage lenders from raising or pooling interest rates in a way that results in higher premiums.

A particularly significant result was that loan insurance was found to weaken the S&W credit rationing result (whether it is lenders or borrowers who pay the premiums) because flat rate loan insurance reduces the utility loss of lending to bad risks, diluting the adverse selection effects associated with raising interest rates to clear the market. Thus, when coverage is 100%, there is no utility loss from lending to bad risks, and so no disincentive to raising interest rates in the event of excess demand. In this situation, ASCRE is not feasible irrespective of the level of information asymmetry between banks and borrowers. It was also shown how *insurance* rationing could be a feasible equilibrium outcome when it is borrowers who pay, since raising premiums to clear the market increases the costs of borrowing, having a similar adverse selection effect as raising interest rates.

9.2.6 Take-up of Flat Rate Credit Insurance: Borrower Perceptions

Chapter 8 considered how perceptions of risk are not only important in determining the behaviour of lenders and insurers, but also in determining the behaviour of borrowers since they too face uncertainty. A theoretical model of the take-up of credit insurance was developed where the borrower pays the premium. For the purposes of empirical investigation, the chapter focussed on a particular market for loan insurance, namely Mortgage Payment Protection Insurance (MPPI) market in the UK. The model was estimated using cross-sectional data on mortgagors in Glasgow and Bristol relating largely to homeowners who took out mortgages before the October 1995 reforms of ISMI, the state safety net for mortgage borrowers. One of the aims of the analysis was to examine the role of auto-perception and identify the extent to which rational economic incentives drove the decision to take out insurance, compared with the impact of other factors (such as the timing of the purchase decision in relation to ISMI changes; marketing differences between regions and borrower types; and ignorance of the

ISMI changes). Supply was modeled by assuming all mortgagors which meet the usual criteria stipulated in MPPI policies (see Ford and Kempson *op cit.*) will be entitled to full protection for one year. Underlying assumptions included: the independence of access to credit markets and interest rates from MPPI; the assumption that insurers do not assess risk themselves. Both of these assumptions reflect the state of the mortgage insurance market over the designated period, and were confirmed in conversations with senior representatives of Consolidated Financial Insurers (the largest supplier of MPPI in the UK) and of the Council of Mortgage Lenders.

It was found that the expected utility gain variable, ρ, as constructed from the theoretical model, was the only statistically significant explanatory variable in the regressions. Given the reasonable explanatory power of this variable, it would appear that, despite the considerable uncertainty and ignorance surrounding ISMI and MPPI, borrowers were generally making economically rational choices.

The chapter also aimed to estimate the responsiveness of the take-up decision to a number of the key variables which make up ρ, including the expected probability of zero employment income, insurance premiums, ISMI cover, MPPI cover and IS entitlement. It was found that probability of take-up rises by less than 0.01 per cent following a 10 per cent fall in ISMI cover – suggesting that the sluggish response to the ISMI cuts could have been anticipated. This is an important result because it undermines one of the key motivations for the 1995 government reforms, namely the alleviation of the claimed crowding out of private mortgage protection insurance. Conversely, the inelasticity of MPPI take-up to ISMI cover implies that significant reinstatement of the safety net for mortgage borrowers could be achieved without any deleterious effect on MPPI take-up. Comparison of regressions run under various assumptions about mortgagor knowledge of ISMI changes, revealed that there was no conclusive evidence that the model would have been better specified assuming ignorance of the changes. Interestingly, it was found that the take-up of MPPI was not particularly sensitive to the borrower perception of his/her own risk, which suggests that fluctuations in market risk do not have much impact on the take-up of credit insurance.

These results were particularly significant given that they constitute the output of the first systematic investigation into these issues in the UK MPPI market. The theory and methodology developed here has already pathed the way for more empirical work to be done in this field (Pryce and Keoghan, 1999, 2001).

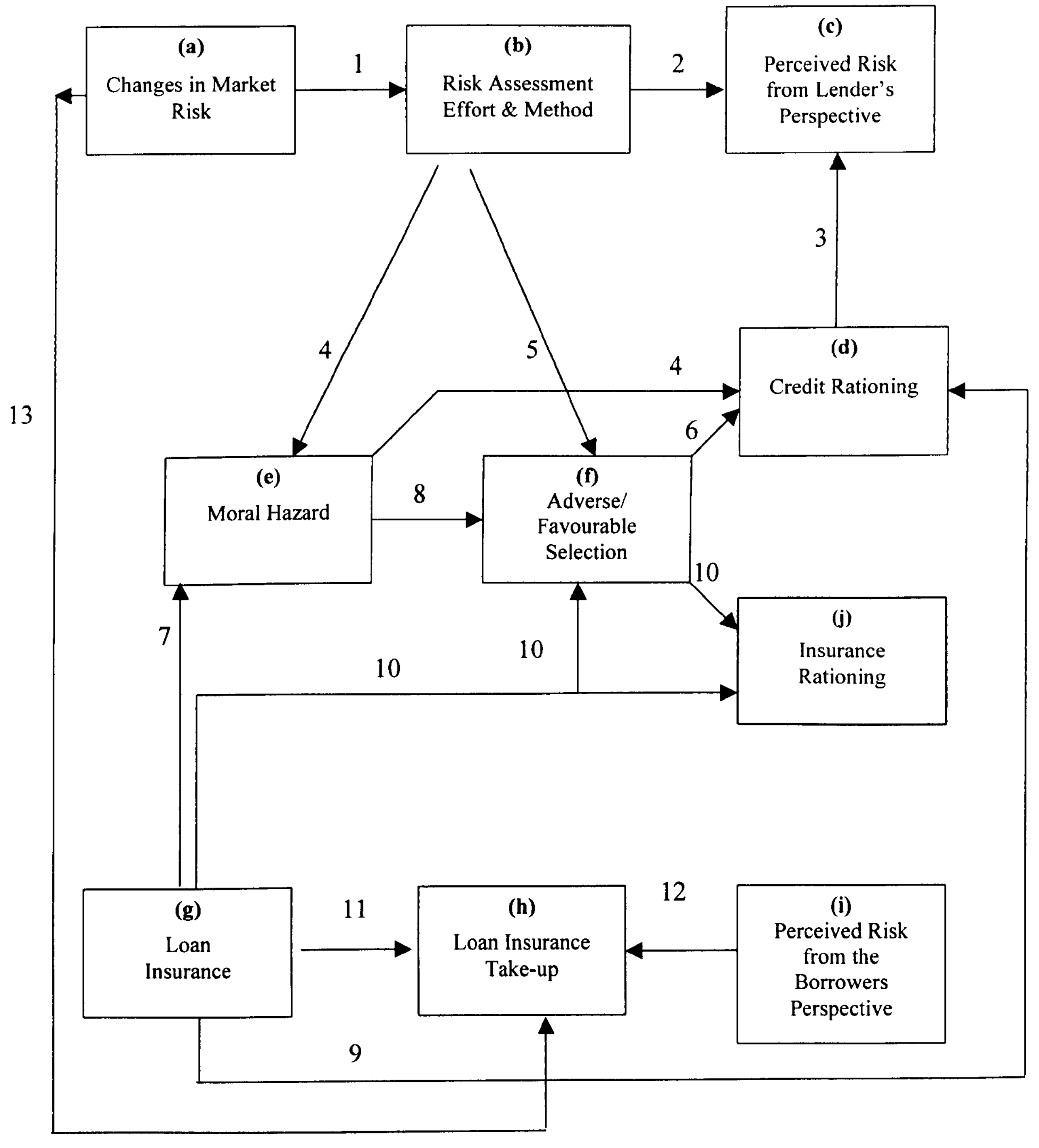
9.3 Connections between the Models

Each of the models summarised above were developed as fairly distinct entities, each developed to investigate particular connections between aspects of the perception, insurance and assessment of credit risk, which either were within existing literatures, or were straddled between them. This seemed to be the most appropriate way of tackling the issues of interest since a general equilibrium theory, if at all achievable, would become so cumbersome as to defy the *raison d'être* of modeling—i.e. to simplify reality with a view to enhancing our understanding of particular processes and relations. However, it is possible that a general model, if desirable, could be developed, perhaps at the expense of some of the detailed insights of the more disaggregated approach presented here. As such, the diagram depicted in Figure 9-1 may constitute the first step in developing a more general model of these related topics. However, the main function of the diagram for the purposes of this chapter, is as a means of summarising the content of the thesis, presenting an at-a-glance overview of the conceptual connections examined.

The various text boxes represent particular concepts that have been pursued to varying degrees in the existing literature. The arrows between them denote the connections studied in the thesis. Their location in the text, and rationale, are summarized in the accompanying notes, indexed by the numerical references attached to the connecting arrows. Where chapter references are not listed, the arrows refer to connections that are either implicitly assumed, or not studied in depth by the thesis. It should be noted that this is not intended to be a causal or general equilibrium diagram but simply an inventory of what has been examined although, as suggested in the previous paragraph, it may provide useful pointers for future development of such a model. As a guide to which connections are most important/explored in most depth in the thesis, it may be of help to know that it is my view that the most significant contributions of the thesis have been to explore the connections between changes in market risk, risk assessment and perceived risk (arrows 1 and 2); between risk assessment, credit insurance and credit rationing and (arrows 4, 5, 7, 10 and 6); and between perceived risk and insurance take-up (arrow 12).

It will be noted that there are a number of important omissions from the diagram, and hence from the models developed in the thesis, such as the endogeneity of collateral, which Bester (1987) has shown to be significant in affecting credit rationing. It seems appropriate, therefore, to now consider some pointers for future research.

Figure 9-1 Conceptual Connections



Notes on Conceptual Connections Diagram:

1 Changes in market risk levels affect the optimal level of risk assessment (chapters 3 and 4).

2 Movements in the optimal level of risk assessment effort cause movements in perceived risk, even if actual risk is constant (chapters 3 and 4).

3 The measurement of perceived risk is profoundly affected by the existence of ASCRE (Adverse Selection induced Credit Rationing Equilibrium) since interest rates may not fully respond to changes in perceived creditworthiness (chapters 4 and 5).

4 If the model in chapter 3 were to be modified to represent existing loans with variable interest rates, credit rationing could still result due to the moral hazard implications of raising the rate of interest.

5 Classificatory risk assessment can produce favourable selection (chapter 5).

6 Where risk assessment effort is sufficient to classify each risk type into an identifiable risk category, the adverse selection effects of raising the rate of interest are eliminated because every risk type is effectively treated as a separate market, each market having borrowers with homogenous risk and an interest rate determined through the traditional interaction of demand and supply. Thus, ASCRE is precluded (chapter 5).

7 Loan insurance can produce two types of moral hazard for lenders: (i) insurance makes monitoring less attractive (= 'mild moral hazard'); (ii) insurance reduces the utility loss from lending to high risks (= 'acute moral hazard'). (Chapters 6 and 7).

8 The acute moral hazards arising from credit insurance can result in adverse selection of <u>borrowers</u>.

9 Loan insurance has a number of implications for credit rationing, depending on the nature of the insurance regime: (i) flat rate 100% cover precludes ASCRE; but (ii) contingent insurance terms, where the lender pays the premium, introduces a new source of credit rationing – CICRE (Contingent Insurance induced Credit Rationing Equilibrium) where lenders may be reluctant to raise the rate of interest when there is excess demand, not because of adverse selection, but because of the implications for insurance premiums (chapters 6 and 7).

10 Insurance rationing may result if it is borrowers who pay the premiums. Raising the premium to clear the market may cause adverse selection in the insurance market (chapters 6 and 7) and hence equilibrium <u>insurance</u> rationing.

11 In most credit insurance markets, insurance is not a requirement for access to credit, and so is in not usually compulsory. This means that the demand for loan insurance is itself endogenous, and so the impact of the results listed above (most notably the impact of credit insurance on credit rationing and on the risk assessment effort of lenders) will be contingent upon the extent of <u>take-up</u> (chapter 8).

12 Take-up will be driven, *inter alia*, by the borrower's perception of his own risks. Insurance will be taken out if the perceived probability of adverse events and costs incurred in occurrence of such events are sufficiently large, and if the premium is sufficiently low. The borrower is assumed to base his estimation of risk on the incidence of adverse events amongst other borrowers with similar characteristics (chapter 8).

13 *A priori*, one would expect changes in labour market risk to affect the take-up of MPPI so that, *cet. par.*, take-up rises during recessions and falls during booms. However, empirical estimation showed that take-up was relatively insensitive to changes in risk of unemployment/ill health (chapter 8).

9.4 Possibilities For Further Research

In the introductory chapter, I attempted to highlight the areas of neglect in interdisciplinary credit market research. It was noted, however, that to point out the unresearched links between the different fields presupposes knowledge of what these connections might be. Hence, an epistemological problem emerges: delineation of our ignorance of an area is constrained by our ignorance of where the boundary between potential knowledge and the unknowable actually lies. Ignorance about the boundaries of knowledge curtails the knowledge of ignorance and precludes an exhaustive list of under-researched connections between our four fields of interest. So the attempt that follows to highlight areas for future research suffers the same limitation as the attempts in chapters 1 and 2 to highlight the main gaps in the various disciplines. It is inevitably an incomplete list, arising out of questions and ideas that occurred to the author whilst investigating each subject field.

The first suggestion for future research is the development of duration models for rescheduling of sovereign loans. Most of the literature attempting to estimate actual risk employs logit or probit techniques, and little work has been done to develop survival models in this field. Such models would allow the researcher to calculate hazard rates for the various loan maturities on country debt. Second, it may be possible to apply time-varying, fixed-effects, panel-estimation techniques to perceived risk analysis, with a view to capturing the dynamic behaviour of signal weights over time. This could perhaps include the development of a simultaneous equation model which explores, for example, the endogeneity of democracy and growth as determinants of perceived risk. A similar application could be made to the analysis of actual risk, although, to the author's knowledge, a time-varying coefficient panel model has yet to be developed for dichotomous dependent variable analysis.

On the theoretical front, much is still to be done in integrating credit insurance and risk assessment into models of credit rationing. For example, the models presented in this thesis assume exogenous collateral, but it has been shown by Bester (*op cit.*) that *endogenous* collateral has profound implications for the credit rationing results. There is also considerable scope within these fields to apply existing results to previously separate areas of research. One possibility, for example, would be to explore the credit rationing implications of the recent proposals put forward by the UK government to introduce tax concessions/subsidies to brownfield development (i.e. former industrial sites) to boost housing supply and discourage building on greenfield. If there are greater risks of contamination on the brownfield sites, then the introduction of the government subsidy would induce a positive relationship between risk and return, and so ASCRE could become a possibility. The impact of contamination insurance could then be explored in this context applying the results developed in chapters 6 and 7 of this thesis.

Fourth, as already hinted at earlier, the heteroscedastic risk assessment model could be extended to include credit rationing by encompassing the effect of a change in interest on the probability of default of existing loans. Lenders would then assess the threshold interest at which the borrower defaults. The model would show explicitly that LIBOR spread is stifled for those countries thought to be approaching their threshold.

Fifth, the heteroscedastic assessment errors model could have both housing market and labour market applications. House buyers, for example, spend time and energy building up knowledge of the market in order to offer a price for a dwelling that minimizes the seller's surplus, but which does not fall below the seller's threshold price or the expected value of competing offers. Greater search effort reduces the variance of assessment errors and also the bias. However, if both the bias and variance fall, with increased search effort the probability of the offer being accepted does not necessarily fall.

Employers deciding on the level of wage offers may face similar dilemmas, as might job applicants in deciding on wage requests. In fact, the theory is generally applicable to any sealed bid auction where bidders expend effort gathering market information in order to decide on the price that will minimize seller surplus, but also want to take into account the chances of being out-bid by other bidders (i.e. they gather information on the likely prices other bidders will offer). It could also be applied to any situation where sellers set a minimum price and buyers either accept or reject that price; in this case, sellers may search for information about the likely reservation prices of buyers. In all these cases, the common result would be that greater information search effort, if it reduces both the variance and bias of assessment errors, will not necessarily increase the probability of offering the optimum price.

Seventh, it would be interesting to examine the effects of credit insurance on work incentives, particularly in the context of MPPI. In the UK, for example, the borrower receives no state help with interest payments for the first nine months following a zero income event. Consequently, any job offer than pays more than Unemployment Benefit plus travel costs will be accepted by the borrower since (unless he/she has savings), refusal to accept the job leaves his house at risk of repossession (a large negative utility for most individuals). If the borrower has MPPI, however, then his/her house is not at risk for twelve months at least (even after the twelve months of MPPI cover he/she will be eligible for ISMI). He/she thus has the option to turn down job offers below his/her expected wage. The longer he/she waits, the more chance that a higher paid job will be offered (incurring an upward effect on the cumulative probability of being offered a higher wage). This may be offset by the depreciation of human capital whilst unemployed (incurring a downward effect on the cumulative probability). The combination of the two effects would result in a shallow upward cumulative probability function of being offered a job with higher wage.

Option pricing techniques could be used to place a value on the 'option' that MPPI policy have to reject initial job offers and it would be interesting to see how the 'option price' varies for different employment categories. It may be further possible to examine whether this explains the high premiums associated with MPPI and why relatively low risks are applying (if the wage offers have a far greater variance for the well-educated, for example, the option will be of greater value to them). The hypothesis could also be tested by examining wage rates of first jobs following insurance (controlling for educational/previous employment characteristics) and by considering whether the higher wage rates of MPPI claimants remain greater, or whether wage rates converge over time as the uninsured take first job, then find a new job after six months or so. It would also be interesting to test whether uninsured mortgagors change jobs more frequently following such an event.

9.5 Summary

This chapter has summarised the main findings of the thesis which has attempted to examine three financial concepts—the assessment, perception and insurance of credit risk—making contributions both within these areas, and at specific points of interface between them. No attempt has been made to develop a single unifying thesis. Rather, a series of partial models are developed, both theoretical and empirical, that develop and connect particular facets of financial economics.

The main contributions of the thesis are as follows: the development of a rationale for the fluctuation of perceived risk over time; a new explanation for equilibrium credit rationing; and the first analytical model of MPPI (mortgage payment protection insurance). Empirical investigations yielded: the first systematic test results for structural breaks in perceived risk coefficients in the sovereign debt market; and the first price, risk, and welfare elasticities of the take-up of MPPI.

Suggestions for further research included: applying the heteroscedastic risk assessment errors model to other fields; the employment of time-varying parameter and survival estimation techniques to the analysis of perceived and actual default risk, respectively; an analysis of mortgage insurance for work incentives. If nothing else, the thesis has shown that there is no shortage of interesting work to be done both within and at the interface of the respective subject fields and that developments that arise from such research have a good chance of finding application in other economic disciplines.

Notes:

[i] the interest rate then becomes endogenous because it becomes influenced by the lender's desire to avoid raising the risks of default.

[ii] although S&W show how their model can be interpreted in terms of moral hazard.

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