WORST OF THE GOOD AND BEST OF THE BAD:
Adverse Selection Consequences of Risk Pricing

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Abstract:

Why do lenders shrink back from full risk pricing in certain credit markets, even when a sophisticated system of credit scoring is already in place? Fear of bad publicity is the usual reason cited but this paper offers a complimentary explanation which suggests that there may be an underlying financial process driving such behaviour. The key proposition of the paper is that risk pricing can cause adverse selection which has the potential to mitigate any positive benefits such a pricing strategy may bring to the lender. This explanation is developed by introducing risk pricing into the seminal Stiglitz and Weiss (1981) model and in so doing offers the first substantial link between the risk assessment and credit rationing literatures.

Key words: Risk pricing; credit rationing; risk assessment; asymmetric information

1 Introduction

Risk-pricing—the practice of charging a premium to higher risk[1] customers—is common in many areas of finance because it has the obvious benefit of helping to ensure that the expected revenues from lending to a particular risk-type exceed the expected costs. Thus, higher risk car owners pay higher insurance premiums, and less financially secure borrowers face wider interest rate spreads than their lower risk counterparts. For risk-pricing to be effective, however, the lender has to have a risk assessment procedure that accurately allocates borrowers to the relevant risk category.

[1] Throughout the paper the term "risk" is used to denote simply the probability of default/failure.

The more refined the risk assessment procedure, the narrower the risk bands that lenders can define, and the more specific the interest rate that can be charged.

For most lenders, this process entails some form of 'credit-scoring'[2] where each borrower is marked on a range of indicators thought to have some bearing on default risk. An overall score is then calculated and used to place the borrower in an appropriate risk group. Curiously, however, mortgage markets (particularly in the UK) have been slow to fully implement risk-pricing. Even though many mortgage lenders have been applying fairly sophisticated credit scoring techniques for a number of years, they have been reluctant to allow the results of the risk assessment to feed through into differentiated interest rates, choosing rather to use the information to ration credit by excluding the worst risks (according to Brown-Humes, 1997, three in ten people who apply for mortgages are turned away, for example).

What is the cause of the reluctance to price risk? The most obvious explanation is fear of bad publicity. Risk pricing in most mortgage markets would mean that a poorer individual in less stable employment would pay more for the same house than someone who is well off and enjoying secure employment. The implication? 'Those who are able to pay the most are required to pay the least' (Barnett, 1997, p.6). The social ramifications are heightened by the fact that employment and income brackets tend to fall along racial and gender lines. Hence, risk pricing in mortgage markets could be perceived as a form of class, racial or sexual discrimination, as some of the negative publicity surrounding the issue has recently suggested (Barnett, 1997; Kempson, 1996; Herbert and Kempson, 1996).

However, there may be an entirely financial explanation for the lack of risk pricing in certain markets, not based on fear of bad publicity or social concern, but on an objective, financial decision by lenders who seek to avoid deleterious effects on the risk of their lending portfolio. It is the articulation of this argument that is the main concern and contribution of this paper. Whilst a formal mathematical model underlies

[2] Credit scoring techniques were initially used in the US in the 1940s to aid decisions as to whether an applicant was creditworthy, but did not become popular until the late 1960s (Andrew, 1997). The UK credit industry started to use credit scoring in the 1970s and now 'almost all decisions to open personal

the theory presented here, an explanation is attempted without recourse to formulae. A more mathematical presentation can be obtained from the author upon request.

To summarize, the paper argues that, under certain conditions, risk pricing may cause "adverse selection", a term initially deployed in insurance theory literature, but now incorporated into common economic parlance, referring to any process that inadvertently increases the average risk of a lender or insurer's, portfolio. Written in full, the core proposition of the paper is that, by differentiating the interest rates charged to each identified group of risks, lenders may inadvertently worsen the average level of risk of loans in its portfolio as a whole. And if the lender is aware of the possible adverse selection effects, it will think twice about risk-pricing. If lenders are unaware of the possible adverse selection effects, then this paper offers a note of caution with regard to risk pricing.

It is worth drawing the reader's attention at this stage to an already well established finding in the theoretical literature, first put forward by Stiglitz and Weiss (1981 – henceforth, "S&W") and discussed or assumed in a long list of papers since.[3] In a pooled interest regime (that is, where all borrowers are charged the same rate of interest) and where there is "asymmetric information" (lenders do not know for sure how risky a particular borrower is, though the borrower herself does), S&W demonstrated that raising the rate of interest can cause adverse selection (inadvertedly attract bad risks and repel good risks). When there is excess demand, text-book economics tells us firms will benefit from raising prices, but this assumption may not hold in credit markets, argued S&W, because of the adverse selection effect.[4] This

bank accounts, issue a bank or credit card, or lend money to individuals, use credit-scoring as part of the process' (ibid).

[3] There has been relatively few attempts, however, to develop the S&W model – see Stiglitz and Weiss 1983; Bester 1985, 1987. Precursors include Hodgman (1960), Freimer and Gordon (1965), Jaffee (1971), Jaffee and Modigliani (1969, 1976), Smith (1972), and Azzi and Cox (1976), but the key inspiration for the S&W approach was the seminal work of Arrow (1964, 1968) and Akerlof (1970) which showed how markets could radically deviate from their conventionally ascribed patterns of behaviour when the traditional assumption of complete information was relaxed.

[4] The S&W model can equally be interpreted in terms of "moral hazard", as can the intuitive model presented here, but for sake of clarity, only adverse selection effects will be noted. Moral hazard differs from adverse selection in that it refers to the effect on incentives of existing borrowers of changing interest rates. S&W showed, for example, that raising interest rates may cause borrowers to invest the borrowed funds in projects with higher risk than originally intended. The incentive to invest more riskily arises because higher interest rates mean that borrowers need make a greater return on

consequence of raising interest rates, may provide lenders with an incentive to 'ration credit' rather than raise the interest rate. So even though borrowers would be willing to accept a loan at a higher interest rate, lenders choose to keep interest rates the same and either limit the amount of credit offered to each borrower or refuse to offer any credit at all to particular applicants.

The usual assumption in this literature, however, is that the option of moving from a *pooled* market (one interest rate charged to all risk types) to a *differentiated* market (different market rates for different risk types) will always be a desirable one for the lender if available. The premise is that a differentiated market will allow the lender to charge higher interest rates to higher risk categories of borrower and hence capture some of the borrower surplus. In a pooled interest rate regime, high risks benefit from being allowed access to an interest rate that is well below what they would be charged if the lenders knew just how risky such borrowers were. Thus, lenders only charge pooled interest rates if they have insufficient information to reliably distinguish good risks from bad. But lenders would rather not tar all borrowers with the same brush, and so, as the received wisdom goes, if lenders are able to reliably assess risk and charge different interest rates to different risk types, they will certainly do so.

This paper attempts to show, however, that if lenders are able to distinguish between categories of risk, but that their categorisation is not entirely precise (that is, if there is still a range of risks within each identified risk partition) then under certain circumstances lenders may find that risk-pricing may actually be disadvantageous. This proposition is particularly pertinent to residential mortgage markets which are often paradoxically characterised by both high levels of risk assessment and limited use of risk pricing.

The remainder of the paper is structured as follows. First the credit rationing and risk assessment literatures are briefly reviewed (section 2). A justification of the paper's methodology and an intuitive/non-technical summary of the S&W asymmetric information framework is then briefly described (section 3). A defining and limiting

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investments in order to meet the higher interest payments. Projects with higher returns if successful, however, also tend to be those with greater risk of failure.

feature of the S&W model is that it assumes pooled interest rates and no risk assessment and so section 4 of the paper attempts to extend the S&W framework to include risk assessment. It is shown that differentiated interest rates increase the return on loans to a borrower of a particular risk type, but at the same time, the move to risk pricing has a screening effect which may not always be favourable. The paper 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. Section 5 presents a heuristic discussion of the implications of the results and the effect of relaxing certain assumptions.

2 Background Literature

A peculiarity of the credit rationing and risk assessment literatures is that they have developed independently. Rather like siblings separated at birth, the two concepts are clearly related but have grown up and gone on to lead happy and successful lives without any real knowledge of one-another. It is the view of the author that it is time they were reunited and indeed, one way of perceiving the current paper is as an attempt foster an initial reunion.

The larger of the two literatures is the former, primarily because of the important implications of credit rationing for a wide range of economic decisions. The impact on the macroeconomy, for example, has been discussed at length (Greenwald, B. and Stiglitz, J., 1993; Baachetta and Caminal 1996, Bernanke 1993, Bernanke et al 1994) following concerns, for example, 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 (Bacchetta and Caminal, op cit).

Although credit rationing has been widely considered in the real estate literature,[5] the consideration has either been entirely empirical or preoccupied with the *consequences* of credit rationing (such as on the tenure choice decision), rather than the *causes*. This is somewhat paradoxical, given that real estate credit markets (particularly residential mortgage lending) raise some particularly interesting questions for credit rationing theory.

One characteristic of mortgage markets, for example, is the pervasive use of risk assessment[1] (mainly because of the relatively large size and long term nature of most mortgage arrangements). Yet, as discussed in the introduction, mortgage lenders appear to be more reluctant than most to apply risk premiums, even to borrowers who have already been ascribed credit scores. And even when different price categories are applied, some form of credit rationing usually persists. Although there exists a vast literature on credit rationing, and a growing real estate finance literature, to the author's knowledge, the questions raised by the conjunction of credit rationing and risk assessment have yet to be addressed and so it would seem that this paper really does provide the first (albeit incomplete) attempt at uniting the two literatures, certainly in the context of property finance at any rate.

Risk Assessment

Risk assessment studies, for the most part, have tended to fall into one of two categories: those that consider *actual* risk, and those that examine *perceived* risk. In analyses of *actual* risk, the focus is on borrower behaviour, and the dependent variable is usually a dichotomous one, reflecting the incidence of default. In the analysis of *perceived* risk, the focus is on lender behaviour and their attempts to model actual risk, and the dependent variable is some measure of perceived risk (such as published risk ratings or spread over the London inter bank offer rate).

Because of data limitations, researchers in this field have tended to focus on markets such as sovereign debt where both the *actual* risk of borrowers (such as Feder and

[5] See, for example, Haurin et al. 1996; Jones 1989, 1993; Linneman & Wachter 1989; Zorn 1989; Haurin et al. 1997; Jones 1993; Ling & McGill 1998; Duca and Rosenthal 1994; Hendershott et al. 1997; Meen 1990a,b,c; Leece 1995, 2000.

Just, 1977; Alesina and Tabellini 1988; Lee 1991; Moghadam and Samavati 1991;) and *perceived* risk (such as Feder and Just 1980; Calvo and Kaminsky, 1991; Seck, 1992; and Lee, 1993) can be analysed. Most of these papers are purely empirical, with little theoretical discussion, and with little reference to the possibility or implications of credit rationing (Seck 1992 is a notable but limited exception). This is a major oversight, particularly for those papers measuring perceived risk using interest rate spreads since perceived lack of credit worthiness may be reflected in rationed credit rather than a larger interest rate spread. Given that the credit rationing literature has a more robust theoretical base, it makes sense for any attempt to link the two literatures to introduce risk assessment into a credit rationing model, hence the presentation of the current contribution being grounded in the S&W model.

3 Basic Model

Purpose and form of the model

In the discussion below I attempt to extend the S&W model to include risk assessment. Because the focus here is on the impact of such assessment on credit rationing and on the selection effect of interest rates, and *not* on the particular form that credit rationing may take, and in order to keep the results as general as possible, a fairly simple representation of collateral is assumed and the manifestation of credit rationing left relatively unspecific. The collateral term is not dropped altogether, however, for although some commercial real estate finance markets are non-recourse, most residential mortgage markets contain a recourse element (as do most commercial loans – Ooi, 2000) and so it is appropriate to retain some form of security in the model.

This qualification is stated here because, as the reader may or may not be aware, more sophisticated treatments of collateral have been developed in the theoretical literature. Bester (1987), for example, has shown that where lenders can vary collateral requirements, credit rationing of the S&W variety does not necessarily occur, even if there is asymmetric information (for a discussion of the role of collateral in real estate see Ooi, 2000). Such considerations are something of a deviation from the purpose of the current paper, however, and in any case, for most real estate lending situations the requirements of the investment project tend to determine the proportion of debt financing and not visa versa. In that sense, one could argue that the variation of the collateral requirement by lenders itself amounts to a form of credit rationing. Indeed, this has usually been the view of real estate researchers who have tended to classify what Bester calls 'endogenous collateral' as LTV credit rationing (in Hendershott et al 1997, for example, credit rationing is represented in two ways: as a repayment to income constraint, and as a LTV limit).

It is also worth noting that the model developed below is very much in the asymmetric information tradition (where lenders are assumed to be poorly informed about the risks of individual loan applicants, even though those applicants may be fully aware of their own risks) and so many of the full information/efficient capital market results do not apply. Note, for example, that lenders cannot distinguish between the precise default probabilities of individual borrowers (only the distribution of all risks and the appropriate risk category of individual applicants), and so portfolio decisions of the kind examined in the Capital-Asset Pricing Model are not directly relevant. Thus, models in the asymmetric information tradition followed here (such as Bester 1985, 1987) tend not consider the impact of portfolio size on overall risk (they effectively assume a large number of loan applicants), neither do they necessarily adopt a rate of return approach.[6]

Initial Assumptions

The first step to explaining the possible adverse selection effects of risk pricing is to outline a simple credit market model of kind developed by S&W. This model describes a world where there are many risk neutral entrepreneurs (investors) seeking funding for an investment project. Each type of investor is distinguished only by the level of risk associated with its planned investment project, and each risk type is indexed by i (note that there may be many borrowers in each risk type i). For sake of

[6] See Hirschleifer and Riley 1995 for an elucidation of the differences between the full information and asymmetric information traditions in finance theory. Note, however, that the key findings of the paper still hold if we presented the model in terms of the rate of return since they are either independent of portfolio size or based on average borrower risk within particular risk categories which would still be relevant for a given portfolio size (our concern is primarily with lender decisions to assess risk and pool interest rates rather than overall portfolio size).

simplicity, assume that all projects require a fixed amount of investment capital, which we shall call K. Banks in turn demand fixed collateral C from borrowers (which could be interpreted as the equity required on the loan, for example), and charge interest rate r on each loan. For simplicity we assume C to be fixed in proportion to K. This is equivalent to saying that in the event of default, borrowers lose their fixed equity stake. Investor type i's project succeeds with a probability known to the borrower but not to the lender. Let this probability be denoted by p_i. If the investor's project succeeds it will yield the positive gross return $R^s{}_i$ (but out of this, she will need to meet the costs of loan repayment). There is a probability (equal to one minus p_i) that project will fail and in this event the borrower will receive zero return on her investment.

Now, a crucial characteristic of the model designed by S&W is that it assumes that higher risk projects receive a higher return. This is of course a widely accepted financial law and is typified, for example, by the borrower's decision of whether to use the borrowed sum K to purchase a fairly small property (sufficient perhaps to accommodate one tenant) in an already established (gentrified) area where the rental stream (either cash or imputed) is constant but at a moderate level; or to purchase a larger property (e.g. sufficient to house several tenants) in an area that is as yet relatively low prices but perceived by the borrower to be 'on the way up' and so has the potential to earn much higher total rental income. The former option is low risk and low return; the latter high risk, high return. Other real-estate scenarios that exemplify this law of finance include:

1. whether to develop houses on greenfield or brownfield sites: the latter are potentially highly profitable given their central location and established transport links, but often risky due to the uncertainties associated with the actual – as opposed to estimated – decontamination costs (see Pryce 2003)
2. whether to purchase a particular property when the property market is booming or in a slump: the latter offers the most substantial gains if the market picks up again within a reasonable timeframe, but there is no certainty that it will.

Let us assume for the purposes of the model that both lenders and borrowers are risk neutral (the main results of the model are not contingent on this assumption, however, since risk averse lenders would face the same selection implications of their price setting decisions as those explored below). Suppose also that lenders know the distribution of potential gross returns if successful and the distribution of the number of loans made to risk type i but they do not know the default probability of any individual loan applicant. *Other things being* equal, the corollary is that, given the total number of loan applications, the lender will be able to estimate the numbers of each risk type that will apply given they will reflect the distribution of risks in the market as a whole and/or the distribution of risks on its loan books in previous periods. The number of each risk type in the market is assumed to be large; as is the number of applications faced by each lender. It is further assumed that the interest charged on deposits is unrelated to the terms of the loan (which are held constant in the model).

Borrowers

Borrowers are assumed to maximise expected profits, defined as the expected difference between gross return on the project (which is either $R^s{}_i$ or zero) and the total cost of loan repayment (capital borrowed plus interest). If the project fails, the return is zero and so the borrower is unable to make any repayment – she loses only her collateral C.

It seems reasonable then that the entrepreneur will only take out the loan if expected profits (that is, after weighing up the potential returns against potential losses while taking into account the likelihood of each) are not negative. Thus, a necessary condition for an offer of a loan to be accepted, is that the return if the housing investment is successful has to be greater than the total repayment costs.

To illustrate, suppose net returns (i.e. after repaying the loan with interest = $R^s{}_i$ – (1+interest rate)K) to investor of risk type i are known to be £100,000 if the project is successful, and -£20,000 (the value of the collateral, C, required by the lender) otherwise. The probability of the project succeeding is known only to the borrower.

Let's say this probability is equal to 40% (the corollary is that there is a 60% chance of failure). Expected profits in this instance will be:

Expected profit	=	(40% x £100,000) + (60% x -£20,000)
	=	£40,000 - £12,000
	=	**£38,000**

This is obviously a fairly high risk borrower, who is happy to go ahead with the project since on average she is going to make £38,000 from borrowing and investing.

Now consider another borrower with a much higher chance of success (70%) associated with her project, but a corresponding lower net return (£50,000) if successful:

Expected profit	=	(70% x £10,000) + (30% x -£20,000)
	=	£7,000 - £6,000
	=	**£1,000**

We have assumed in the above example that both borrowers face the same interest rate because the lender does not know the difference in the probability of default between the two. If it did know, it would of course prefer to lend to the latter type of borrower who has a much higher chance of being able to repay the loan and would like to charge a much higher risk premium to the former.

Notice, though, that if the common interest rate were a little higher, the low risk borrower may not find it advantageous to invest at all and cancel her loan application (net return would only have to fall to £8,500 for her to cease, on average, to break even). It is not difficult to believe, then, that that raising the rate of interest can cause adverse selection when there is no risk assessment. Each time the lender raises the rate of interest there will be some class of low risk borrower for whom loan application is no longer worthwhile. High risks, on the other hand, make sufficiently high expected returns for their loan-decision to be unaffected.

One way to conceive of this problem is to say that for every level of interest there is a critical success probability $p_{i\#}$ equal to that of the "threshold investor", whom is defined as the borrower whom expects (on average) at that interest rate to just break even. All potential borrowers with probabilities of success greater than this threshold probability will have lower gross rates of return (because of the financial law relating risk and return) and so will not invest. Conversely, all potential borrowers with probabilities of success less than this threshold probability will have greater rates of gross return and will generally go ahead with the investment. So, in summary, investors will borrow from the bank if and only if $p_i \leq p_{i\#}$. That is, if and only if their probability of success is less than or equal to the threshold success probability associated with that interest rate.

Lenders

Having established that lower risks will not apply for a loan when the rate of interest increases (because it is not worth their while given the lower return on lower risk projects), now consider how lenders are likely to respond. Assume that competitive lenders know the distribution of success probabilities and associated levels of project revenue (that is, they know how p_i and $R^s{}_i$ are related). The corollary is that lenders know the value of $p_{i\#}$, the threshold probability associated with each interest rate. However, they cannot of course identify the value of p_i of a particular loan applicant. Lenders also wish to maximise profits. They finance their credit offers by funds from deposits on which they pay the going competitive savings rate. Lenders will only offer credit at a given interest rate if the expected gross return on such loans (taking into account the probability of default) is at least sufficient to cover interest payments on deposits and admin costs.

We can now see how credit rationing of the S&W kind is possible when lenders are imperfectly informed concerning the probabilities of success of individual loan applicants. For whilst raising the rate of interest increases the revenue received by the lender on those loans that are repaid, such an increase in interest will at the same time raise the proportion of loans that are not repaid at all (because some class of good risks have been screened out by the hike in interest rate). Consequently, in a situation of excess demand for funds, where because of adverse selection there is an expected net reduction in profits associated with raising the rate of interest to clear the market, the lender will avoid such a measure, and choose instead to leave the excess demand unabated.

Thus the increased utility from raising the rate of interest (due to the greater gross interest revenues) 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 Stiglitz & Weiss *op cit* in the context of risk neutral banks, shows how persistent credit rationing is *not precluded* under asymmetric information. (Note that traditional full information economics *does* preclude credit rationing).

4 Risk Assessment

Now suppose that the lender has the option of investing in risk assessment of a kind that allows the bank to distinguish between v^* risk groups and which costs a negligible amount to implement.[7] Essentially, credit scoring allows the lender to place each loan applicant in one of v^* categories of risk. Assume that risk assessment is "true" in the sense that borrowers are always correctly associated with the appropriate risk partition. This implies that the bank knows the risk interval to which each potential borrower belongs, and so 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, to surreptitiously make their way into the lower category. In other words, borrower type i cannot dupe the risk-assessing lender into believing that he/she belongs to anything other than in the allocated risk interval.

Of course, the lender can charge a different interest rate for each identified risk group v, and so there will also be a different associated threshold success probability for

[7] Costly risk assessment is introduced below, but this neither adds nor takes away from the key propositions of the paper. It simply introduces a decision as to whether (and to what extent) it is worthwhile going ahead with risk assessment.

each of the recognised categories, denoted by $p_{i\#v}$. This threshold success probability is equal to that of the category's threshold investor, defined as the borrower in partition *v* who expects (on average) at that interest rate to just break even. Now provided there are more risk types than lender-identified risk categories, there will be within each category *v* a range of risk types. The situation is analogous to the simple case described by S&W, but now each identified risk category becomes a separate market. All potential borrowers within partition *v* with probabilities of success greater than the threshold probability associated with that category will have lower gross rates of return (because of the assumed financial law relating risk and return) and so will not invest. Conversely, all potential borrowers in category *v* with probabilities of success less than the threshold probability associated with *v* will have greater rates of gross return and will generally go ahead with the investment. In summary, investors will borrow from the bank if and only if $p_i \leq p_{i\#v}$. That is, if and only if their probability of success is less than or equal to the success probability associated with the risk category in which the bank has placed them.

Now, if the lender sets r_v, the interest rate for partition *v*, such that the threshold success probability is greater than or equal to the least risky borrower (i.e. the investor with highest probability of success) in risk category *v*, then all risk types in that category will apply for a loan. On the other hand, if the bank sets r_v such that the threshold success probability is less than that of the worst risk in partition *v*, then no risk types in that category will apply, and the lender's revenue for that group will be zero. Since the lender knows the threshold probabilities associated with each interest rate, it can compute the interest rates in each *v* required to maximise profits.

Note that the lender's total profits are derived not from a single partition of risk, but from summation across all identified categories. The lender will thus have a suite of interest rates, one associated with each risk category it can identify, and each set sufficiently low to avoid few or zero loan applicants in that category, but sufficiently high to maximise revenue from each loan.

We are now ready to consider the main propositions offered by this paper:

Proposition 1: *Increasing risk assessment will always increase the return on individual loans to a borrower of particular risk type.*

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 move to 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. Borrower surplus will on average be reduced, therefore, when risk pricing is implemented. The corollary is that any increase in risk assessment that results in a greater number of identified risk categories, v^*, will imply narrower intervals for each interest rate, and this will cause the average consumer surplus in each identified risk interval to fall. This means that for every loan *actually made*, the bank is receiving a greater return.

Proposition 2: *Increased price differentiation produces favourable selection if good risks are no less numerous than bad.*

Assume, for a moment, that risk assessment allows the lender to classify borrowers into two groups: a low risk band (*Good Risks*) and a high risk band (*Bad Risks*), with two corresponding interest rates. Assuming there are still many risk types within each of the two identifiable bands, some of the borrowers whose reservation interest rate, $r_{\#i}$, was hitherto below the single pooled interest rate, r, will now be at the upper end of the *Good Risk* band. They will now find that the rate of interest being offered to them is below their reservation rate, and so, for the first time, will find it profitable to borrow and invest.

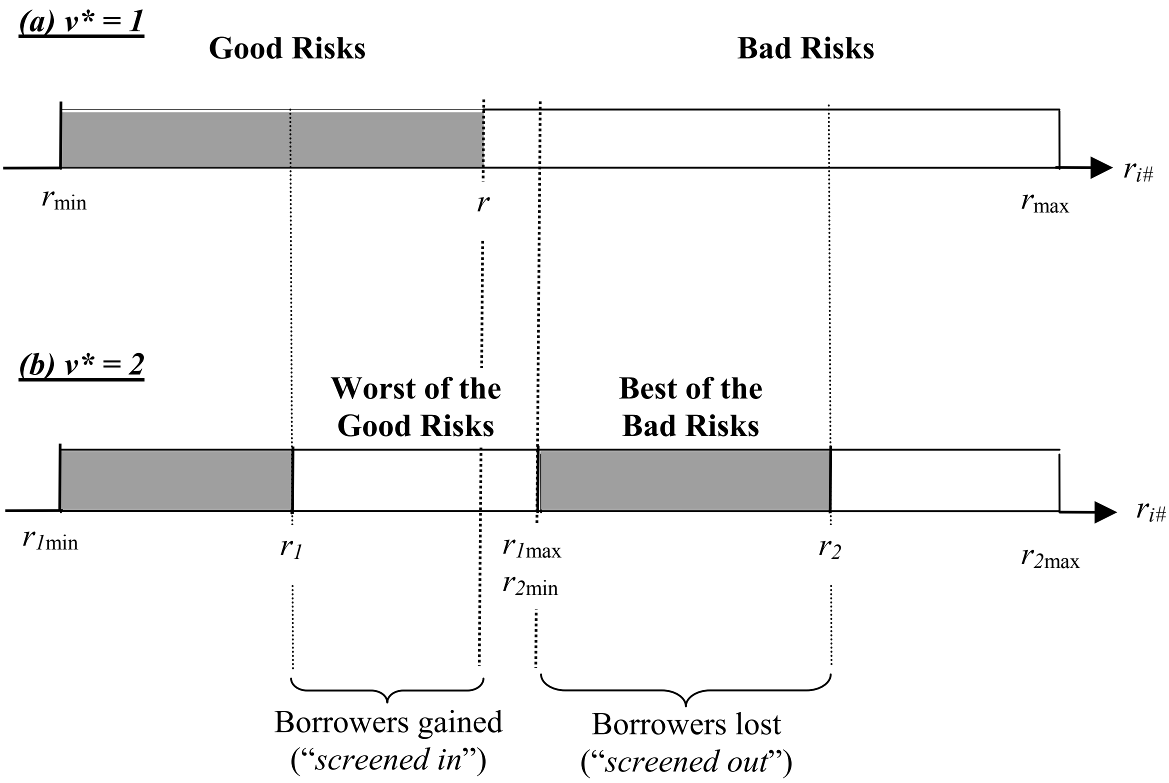
In contrast, some of those borrowers in the *Bad Risks* band, whose reservation interest rate was previously above the single pooled rate (and so willing to accept the loan offer) will be “screened out” by the new interest rate (no longer find it worthwhile to borrow). Note that the applicants in the lower end of the *Bad Risks* band now priced out of the market are more risky than those falling into the upper end of the *Good Risks* 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* (provided the former are more numerous than the latter).

This is demonstrated in Figure 1 below, where a greater number of partitions will result in some borrowers being priced out of the market, as well as others now being priced 'into' the market. The horizontal axis depicts the spectrum of reservation interest rates across $r_{\#i}$. Note that risk type i has has a unique reservation interest rate, above which it is not worthwhile investing. Super-imposed onto the axes are the (uniform) distribution of loan applications by reservation interest rate (the higher the applicant's reservation interest rate, the higher her risk) and the interest rates actually charged (denoted by r under no risk assessment, and r_1 and r_2 following risk assessment). For each risk category there will be a minimum (maximum) interest rate, $r_{v\ min}$ ($r_{v\ max}$), below (above) which the rational lender will not charge. If the lender sets the interest rate less than or equal to $r_{v\ min}$, then all risks in category v will apply and so there will be no incentive for the lender to charge less than $r_{v\ min}$. Conversely, if the lender were to charge a rate of interest above $r_{v\ max}$, no borrowers in that category would apply and there would similarly be no reason why the lender would set interest rates above $r_{v\ max}$.

All risk types with threshold interest rates less than r_v are effectively excluded by interest rate r_v (shown by the shaded area of the distribution in Figure 1) because their expected returns from their planned investment project will not be sufficient to warrant borrowing the cash necessary to fund that investment. Thus, when risk assessment is increased, as depicted in diagram (b), those investors with interest rates between $r_{2\text{min}}$ and r_2 will no longer find it profitable to invest and are "screened out" of the market.

The key concept to grasp at this stage is that there is no *a priori* reason, when the distribution of risks is uniform, why the good risks gained due to risk assessment (those with reservation rates lying between r_1 and r) will be greater in number than the number of bad risks that have been lost (those with reservation rates in the range r_{1max} to r_2). Because those gained will have a lower probability of default than those lost, the displacement produces a less risky loan portfolio for the bank (demonstrated in the diagram by the '*Worst of the Good*' being to the left of the '*Best of the Bad*').

Figure 1 The Favourable Selection Effect of Risk Pricing when Risks are Uniformly Distributed



The shaded areas represent those borrowers who find themselves screened out by the interest rate they are offered because it is greater than their reservation rate. The *Worst of the Good* are better (less risky) than the *Best of the Bad*, and so, provided that those screened in (*Worst of the Good*) are more numerous than those screened out (*Best of the Bad*), there will be favourable selection.

Proposition 3: *Increased price differentiation can have an adverse selection effect for non-uniform risk distributions*

In proposition 2 it was shown that the bank would benefit from the implementation of risk pricing if the distribution of risk types was fairly even (or if the distribution is decreasing in risk – that is, there are more good risks than bad). The most important contribution of this paper is to highlight the fact that the overall selection effect caused by risk pricing may actually be ***adverse*** if there is a predominance of bad risks in the market (that is, if the frequency of borrowers of each risk type *i* is greater the higher the risk associated with *i*).

This is illustrated in Table 1, which offers a worked example based on a market with five risk types (probabilities of default = 0.05, 0.1, 0.2, 0.25, and 0.9 respectively). The distribution of 100 potential borrowers between the risk types is given in row three (10, 10, 10, 50 and 20 thousand respectively). Assume that there is initially a pooled interest rate such that the first three risk types are screened out (indicated by the shaded squares of rows A and B). From the respective default probabilities and numbers of applicants of risk types 4 and 5 (i.e. those not screened out), the lender can compute the number of expected defaults (12.5 and 18 respectively), leading to a total default rate of 44% on all loans.

Suppose the lender then carries out risk assessment that allows it to correctly place borrowers in one of two risk categories, and the option to charge separate interest rates. Suppose also that if the lender does this, risk types 1 and 4 will be screened out, and the remaining risk types find it profitable to take the lender's loan offer. This leads to a total number of defaults of 21 out of 40 loans issued, a default rate of 53%, which is higher than the default rate when there was a single pooled interest rate. This numerical example is shown graphically in the first graph of Figure 2. The subsequent graphs depict the changes to the default rates as the distribution of risks changes.

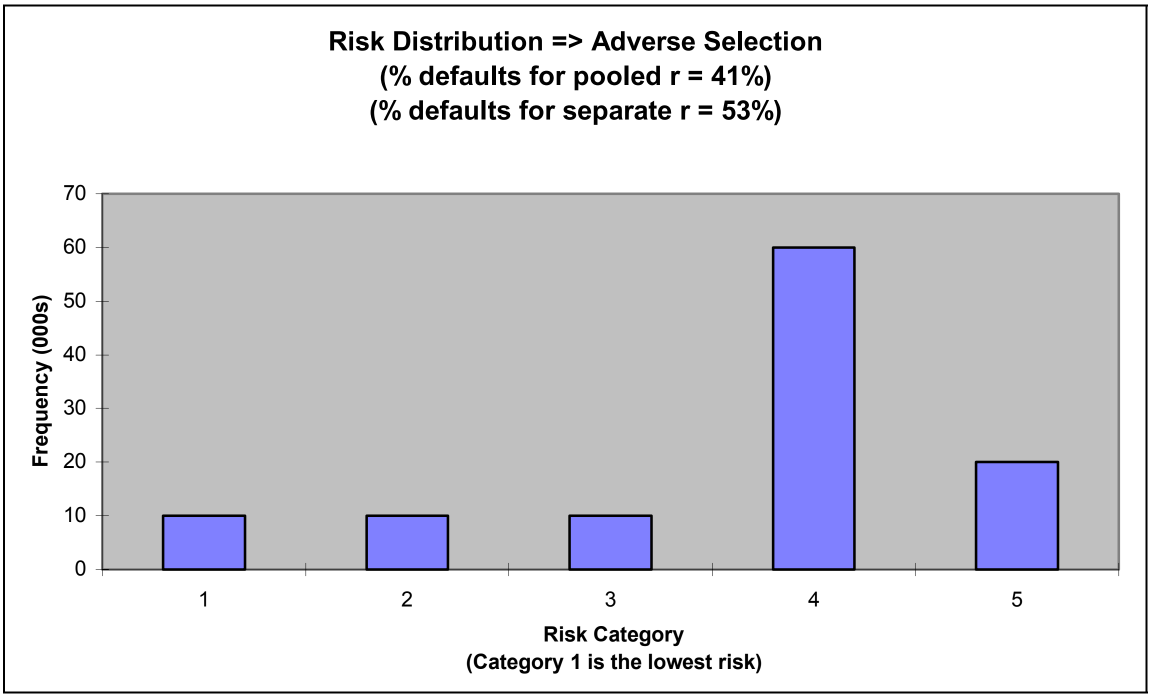
The final graph is particularly important because it not only illustrates how favourable selection begins to occur as the distribution of risks flattens, but also shows that the distribution does not have to be entirely uniform (nor strictly decreasing in risk) for favourable selection to occur. Put another way, adverse selection is a possibility but not inevitable when the risk-distribution of applicants is less than uniform.

Table 1 Worked Example of Adverse Selection

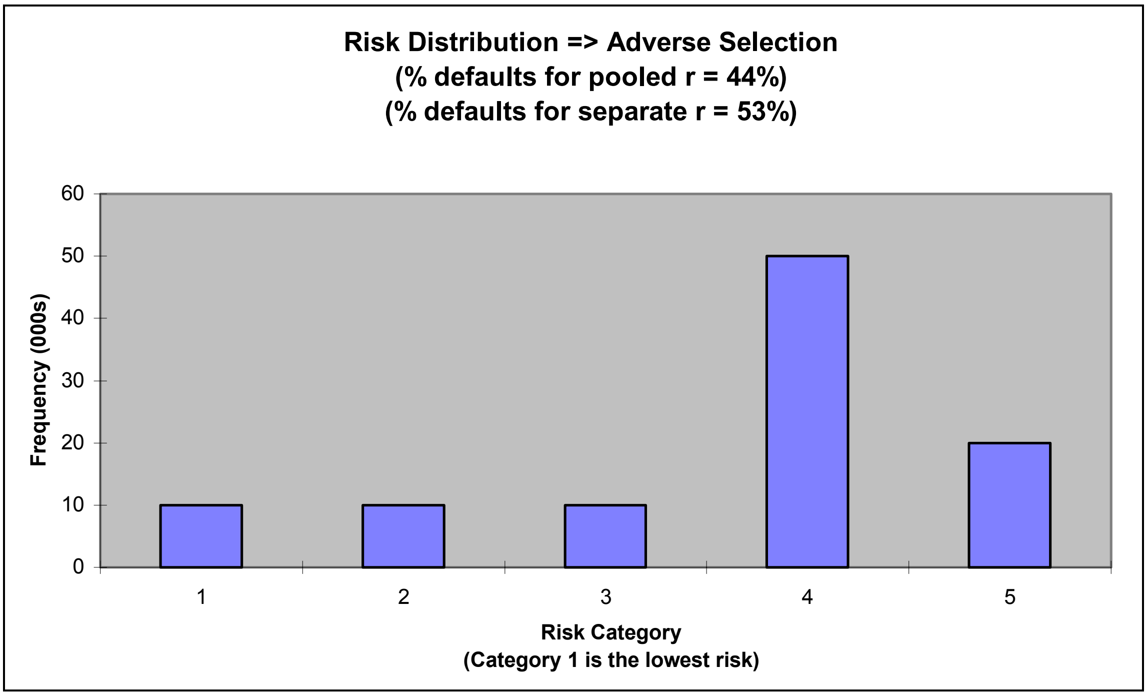
							Total
	Risk Category	1	2	3	4	5	
	Probability of default	0.05	0.1	0.2	0.25	0.9	
	Number of Potential Borrowers (000s)	10	10	10	50	20	100
Pooled r	A. Number of Actual Borrowers (I.e. not screened out) 000s	0	0	0	50	20	70
	B. Number of defaults (000s)	0.5	1	**2**	**12.5**	**18**	30.5
	Proportion of loans that default (B/A)						**0.44**
Separate r	C. Number of Actual Borrowers (I.e. not screened out) 000s	0	10	10	0	20	40
	D. Number of defaults (000s)	0.5	1	2	12.5	18	21
	Proportion of loans that default (D/C)						**0.53**

Figure 2 Graphical Representation of Numerical Example

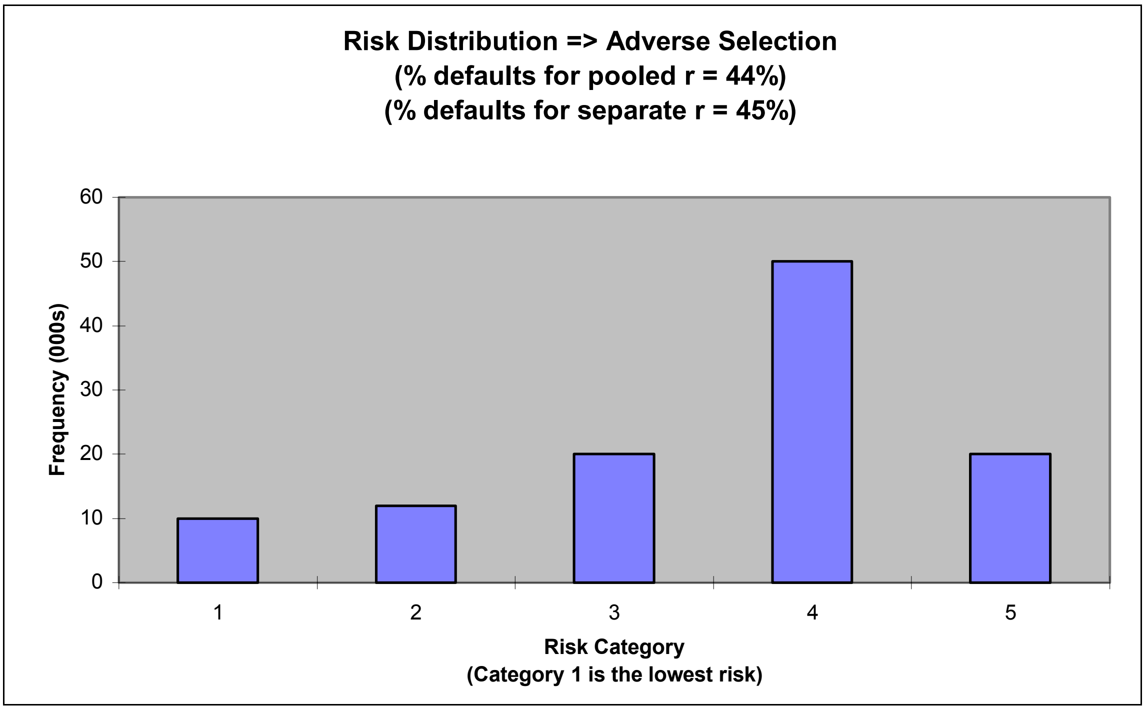
(a)



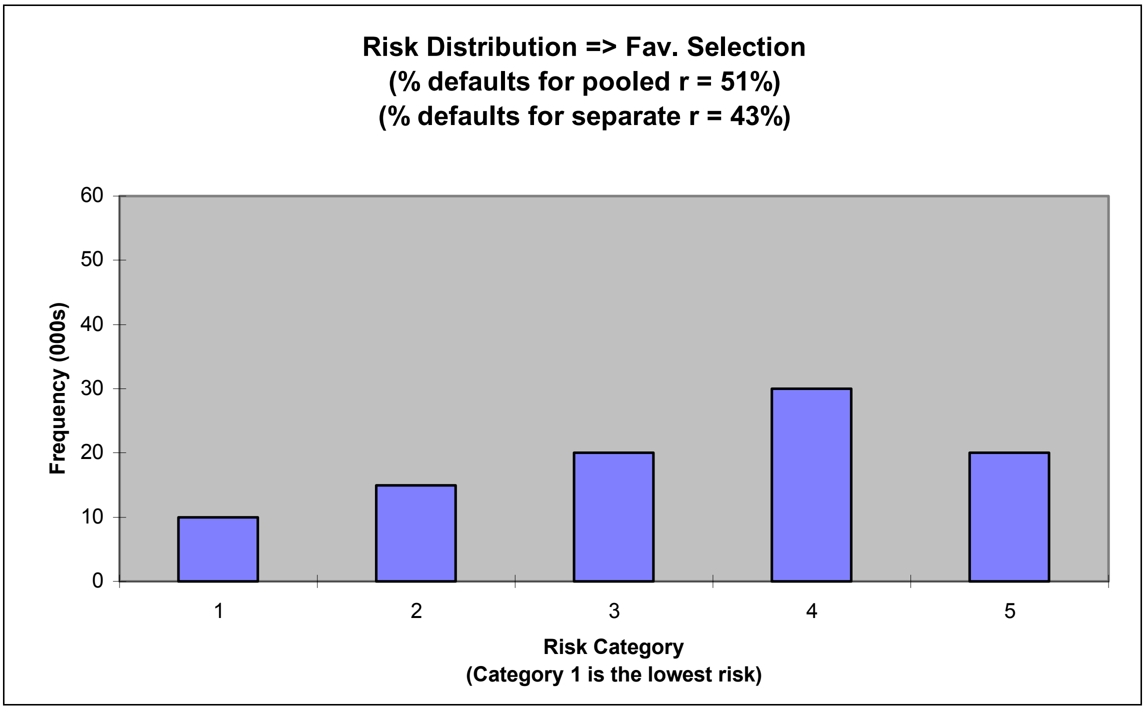
(b)



(c)


Risk Distribution => Adverse Selection
(% defaults for pooled r = 44%)
(% defaults for separate r = 45%)
60
50
40
30
20
10
0
Frequency (000s)
1
2
3
4
5
Risk Category
(Category 1 is the lowest risk)

(d)


Risk Distribution => Fav. Selection
(% defaults for pooled r = 51%)
(% defaults for separate r = 43%)
60
50
40
30
20
10
0
Frequency (000s)
1
2
3
4
5
Risk Category
(Category 1 is the lowest risk)

Costly Risk Assessment

Now assume that there is a cost schedule associated with assessing risk, ζ, where the cost of assessment rises with the total number of risk categories v^* identified by the lender (i.e. it costs more to have better risk assessment). 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 visa versa. The optimum level of risk assessment is denoted by ζ^*. Note that ***there exists an absolute limit for ζ^* given by $\bar{\zeta}$ so that $0 \leq \zeta^* \leq \bar{\zeta}$. This is because*** there exists some level of risk assessment that results in no more than one p_i in each lender-identified risk category 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 v, and so it knows that there is only one sort of p_i in each v). Beyond this level of expenditure, the bank gains nothing from additional investment in assessment, and so the rational lender will spend no further.

<u>Proposition 3:</u> *Only when risk assessment is sufficient to produce "near perfect" information will equilibrium credit rationing be precluded.*

"Near perfect" information is defined as the situation described above where the partitioning of risks is fine enough to include only one risk type in each partition (as is the case when expenditure on risk assessment is at the maximum reasonably possible: $\zeta^* = \bar{\zeta}$). Until the lender has achieved this level of risk assessment it will always have at least one partition within which it has to pool different risk types and where S&W type credit rationing is possible. However, once "near perfect information" is reached, lenders can charge separate interest rates to each i. Lenders in this enviable position are therefore able to respond to excess demand for funds in any category by raising the interest rate in that category, and to do so 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, under "near perfect information" 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.

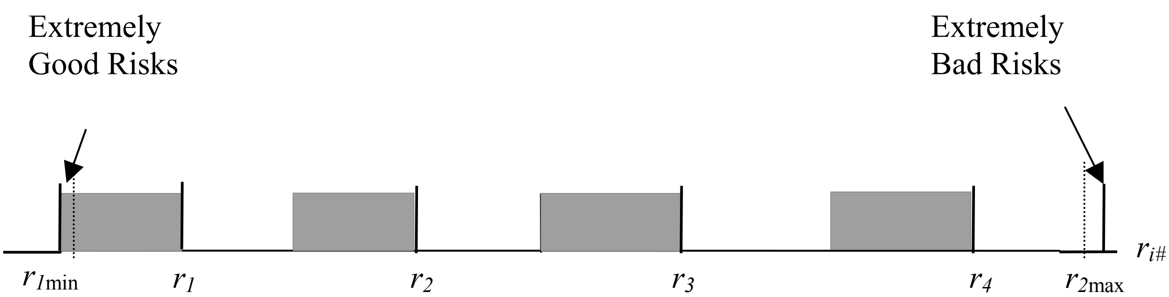
5 Implications of Results and Suggestions for Future Research

Niche Products

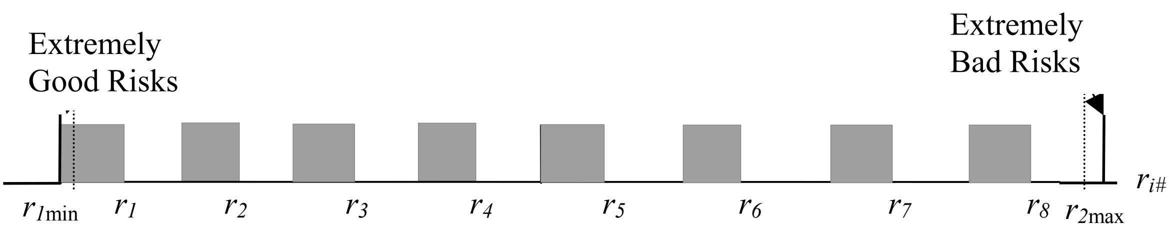
Although the possibility of adverse selection may make it sub-optimal for lenders to risk price a mainstream product, it does not preclude the emergence of pseudo-risk pricing through the development of niche products targeted at specific ranges of the risk spectrum, particularly borrowers lying at the extremes. The effect of introducing successive rounds of more refined risk categorisation is demonstrated in Figure 3 which introduces further risk categories into the diagram used in Figure 1. It can be seen that the very best risks are always screened out (depicted by the left edge of the leftmost shaded region), except for the limiting case explored above where lender's risk classification is so refined that there is only one risk type in each category and only one interest rate charged to each borrower. Conversely, the very worst risks are always screened in (depicted by the right edge of the rightmost *un*shaded area).

Figure 3 The Effect of Finer More Categories on Borrowers at the Extremes:

(a) Four Risk Categories



(b) Eight Risk Categories



Thus, the fate of those at the extremes of the risk spectrum are for the most part unaffected by changes in risk assessment and risk pricing. As a result, there exists no ambiguity regarding the selection effect of risk pricing for these two extreme categories of borrower. Those who are always *screened out* because of their low risk and hence low return, comprise a niche market, ripe for 'cherry picking'. Those at the other extreme are always *screened in* by interest rates, and so are also a clearly identifiable niche group whose demand for mortgage finance is likely to remain unrealised by mainstream products, opening the way for custom products to be developed specifically for this group. This is to some extent borne out by the recent entrance of new lenders into the UK mortgage market offering either very low interest rates to low-risk groups (dubbed '*cherry-picking*' by the financial press-- see Goldsmith 1994, Pandya 1997, Scott 1995, Hunter 1995, and Berwick 1999), or high interest mortgages to particularly bad risks ('*impaired credit market*' – see Berwick 1998, Brown-Humes 1998, Gosling 1997, Levene 1998, O'Connor 1998, Wyllie 1998, and Taylor 1996), although evidence on the magnitude of these developments is ambiguous (Pryce, 2000; Kemp and Pryce 2001).

Uncertainty over the Distribution of Risks

The main proposition of the paper (Proposition 3) has stated that, for non-uniform risk distributions, risk pricing can cause adverse selection, making the financial case for risk pricing more ambiguous. However, even where there is a uniform distribution of risks, lenders may remain reluctant to price risks if they are uncertain of the true shape of the distribution. It is possible, for example, that the numbers of potential borrowers in each of the risk categories could vary considerably over time. So although the lender may have some working estimate that points to a uniform distribution of risks, an added layer of uncertainty in the lending decision may deter lenders from actually implementing risk pricing. A similar outcome may arise if the lender is unable to clearly distinguish risk categories. If risk assessment procedures can only place a borrower in the correct risk category with a probability less than unity, then cet par, the narrower the risk category, the lower the accuracy. It may be that in some markets, lenders can allocate risks more effectively than in others because of well established and easy to measure relationships between observable client characteristics and anticipated probability of default. If this is true of mortgage markets, lenders may not apply risk pricing because they are not confident of their ability to allocate risk appropriately. Or it may be that the story told in this paper holds true: that they can categorise risks but know that the distribution of risks is positively skewed and that adverse selection is the likely outcome. Either way, explicit knowledge of the adverse selection effect is not needed to produce an aversion to risk pricing: lenders may simply know from experience that its introduction in certain circumstances does not optimise profits. Other factors, such as anticipated negative publicity, only compound their reluctance.

Further Unexplored Avenues

Possibilities that have not been explored in the above model but which warrant further investigation include:

(1) Lenders varying collateral requirements in conjunction with interest rates to produce an incentive compatible lending strategy. This has been explored by Bester (1987) in a pooled interest rate model with no risk assessment. However, the implications have not been modelled for lenders who have the option to assess risk directly (such as through credit scoring) and charge differentiated interest rates. One avenue for future research, therefore, would be to develop a model of lending that fully endogenises not only interest rates but also the collateral requirement and also the classification of risks/differential pricing.

(2) An additional complicating factor is the existence of credit insurance. This exists in various forms in different markets. In the mortgage market, for example, there are Mortgage Indemnity Gaurauntees (which insure the lender against losses made in the event of default), and Mortgage Payment Protection Insurance (which insures the borrower against repayment difficulties due to ill-health or unemployment). The effect of these products on credit rationing and risk assessment have yet to be explored in the literature and offer another avenue of future research.

(3) The model of risk assessment and risk pricing developed above was based on discrete classifications of risk and interest rates. In certain contexts, however, it may be more appropriate to model risk assessment as a continuous process—resulting in specific estimates of default probabilities for each borrower, each estimate having an associated standard error. This raises the question of whether increased risk assessment is best thought of as an activity that reduces the standard errors on risk estimates, and whether this kind of heteroskedasticity in risk assessment has particular theoretical implications for optimal lending behaviour. Again these questions have not, to the author's knowledge, been explored in any depth in the existing theoretical real estate literature.

5 Conclusion

In this paper I have considered the conditions under which risk pricing may not be advantageous to lenders, the awareness of which may partly explain the absence of fully risk-priced mortgages (and other financial products). In so doing, the paper has also ventured to bridge the gap between the risk assessment literature and the credit rationing literature by considering the implications of risk assessment for the S&W (Stiglitz and Weiss 1981) model. The paper began with a discussion of the emergence of credit scoring and risk-pricing and an overview of the credit rationing and risk assessment literatures. A discrete version of the S&W model was then developed which demonstrated that raising the rate of interest causes adverse selection when there is no risk assessment, providing a rationale for equilibrium credit rationing. Risk assessment was then introduced into the model and it was shown that risk assessment, and its corollary, differentiated interest rates, will always increase the return on loans to a borrower of particular risk type. However, it was also shown how pricing of loans (based on the partitioning of applicants into broad categories of perceived risk) can have a selection effect, producing favourable selection if the number of borrowers is uniformly distributed across risk categories; but potentially producing *adverse selection* if there are more bad risks than good.

The rationale for favourable selection was that the borrowers "screened out" by the introduction of risk-pricing would on average have higher default probabilities than those "screened in" because *the worst of the good are better than the best of the bad*. The rationale for adverse selection is that if the number of "worst of good" risks is significantly greater than the number of "best of bad" risks, and it "worst of good risks" are screened out by the risk pricing, the lender may find itself receiving loan applications only from the extremes of the risk spectrum: i.e. the best of the good and the worst of the bad. If the latter group outnumbers the former, then adverse selection can occur. This provides an additional explanation for lenders' reluctance to introduce risk-pricing, and may prove to be the deciding factor in markets such as the UK mortgage market which have so far resisted the introduction of fully differentiated products. The paper also demonstrated that there is an absolute limit for optimal risk expenditure, and that S&W will be possible until this limit is reached. Thus, even when risk pricing is implemented by lenders, equilibrium credit rationing is not precluded, except in the extreme case of near perfect information where the lender's risk assessment is so refined as to allow it to allocate each borrower type to a unique category. The paper also discussed how the model may indirectly provide a rationale for the marketing of niche products targeted at the extremes of the risk spectrum.

References:

Akerlof, G. (1970) The market for lemons: quality uncertainty in the market mechanism, *Quarterly Journal of Economics*, **84**, 488-500.

Alesina, A. and Tabellini, G. (1988) External Debt, Capital Flight and Political Risk, *Journal of International Economics* **27**, 199-220.

Andrew, J. (1997) Lenders Know the Score, *The Independent*, 7th May 1997, p. 12ff.

Arrow, K. (1964) The role of securities in the optimal allocation of risk-bearing, *Review of Economic Studies*, **31**, 91-6.

Arrow, K. J. (1968) The economics of moral hazard: Further Comment, *American Economic Review*, **58**, 537-39.

Azzi, C. F. and Cox, J. C. (1976) A Theory and Test of Credit Rationing: Comment, *American Economic Review*, **66**, 911-17.

Baachetta, P. and Caminal, R. (1996) Do Capital Market Imperfections Exacerbate Output Fluctuations?, Centre for Economic Policy Research, London, Discussion Paper 1422.

Barnett, A. (1997) Policy Forum: Poor Kept on the Outside Looking In, Business section, *The Observer*, p.6ff.

Bernanke, B. S. (1983) Nonmonetary effects of the financial crisis in the propogation of the Great Depression, *American Economic Review*, **73**, 257-276 [reviewed in Baachetta & Caminal (1996)].

Bernanke, B. S. (1993) Credit in the Macroeconomy, Federal Reserve Bank of New York, *Quarterly Review*, Spring 1992-3 [reviewed in Baachetta & Caminal (1996)].

Bernanke, B., Gertler, M. and Gilchrist, S. (1994), The Financial Accelerator and the Flight to Quality NBER Working Paper No. 4789 [reviewed in Baachetta & Caminal (1996)]

Berwick, I. (1998) Theres hope for mortgage misfits, *The Independent on Sunday*, 31st May 1998.

Berwick, I. (1999) Cherry picking widens credit gap, *The Independent on Sunday*, Personal Finance, 31st January.

Bester, H. (1987) The Role of Collateral in Credit Markets with Imperfect Information, *European Economic Review*, **31**, 887-899

Bester, H. (1985) Screening vs. Rationing in Credit Markets with Imperfect Information, *American Economic Review*, **75**(4), 850-855.

Brown-Humes, C. (1997) Weighting the risk, *Financial Times*, 25 June, Midweek Money p.24.

Calvo, G. A. and Kaminsky, G. L. (1991) Debt Relief and Debt Rescheduling, the Optimal Contract Approach, *Journal of Development Economics*, **36**, 5-36.

Clemenz, G. (1986) *Credit Markets with Asymmetric Information* Lecture Notes in Economics and Mathematical Systems: Springer-Vorlag, New York.

Duca J.V. & Rosenthal S. (1994) Borrowing Constraints And Access To Owner-Occupied Housing. *Regional Science and Urban Economics* **24,** 301-322.

Feder, G. and Just, R. (1977) An analysis of credit terms in the Eurodollar market, *European Economic Review*, **9**, 221-43.

Feder, G. and Just, R. (1980) A Model for Analysing Lender's Perceived Risk, *Applied Economics*, June, **12**, 125-44.

Freimer, M. and Gordon, M. (1965) Why Bankers Ration Credit, *Quarterly Journal of Economics*, **79**, 397-410.

Goldsmith, V. (1994) Tailor-made home deals, *Independent on Sunday*, Personal Finance, 23rd October, p. 10.

Gosling, P. (1998) Lending an ear to bad risk borrowers, Independent on Sunday, 8 March, Business section p. 11.

Greenwald, B., and Stiglitz, J. (1993) Financial market imperfections and business cycles, *Quarterly Journal of Economics*, **108**, 77-114.

Harrop, R. (1998) Japan's step towards risk-priced lending, Letters to the Editor, 11 Nov 1998, p.18

Haurin D.R., Hendershott P.H., & Kim D.K. (1996) Wealth Accumulation and Housing Choices of Young Households: An Exploratory Investigation. *Journal of Housing Research* **7,** 33-57.

Haurin D.R., Hendershott P.H., & Wachter S.M. (1997) Borrowing Constraints and the Tenure Choice of Young Households. *Journal of Housing Research* **8,** 137-154.

Hendershott P.H., LaFayette W.C., & Haurin D.R. (1997) Debt usage and mortgage choice: The FHA-conventional decision. *Journal of Urban Economics* **41,** 202-217.

Herbert, A. and Kempson, E. (1996) *Credit Use and Ethnic Minorities*, Policy Studies Institute.

Hillier, B. & Ibrahimo, M. V. (1993) Asymmetric information and models of credit rationing, *Bulletin of economic research*, Oct 1993, **45**(4), pp.271-304.

Hirshleifer, J. and Riley, J.G. (1995) "*The analysis of uncertainty and information*", Cambridge Surveys of Economic Literature, CUP:Cambridge.

Hodgman, D. (1960) Credit Risk and Credit Rationing, *Quarterly Journal of Economics*, **74**, 258-78.

Hunter, T. (1995) Double-tier home loans on the way, *The Guardian*, Home News, 25th February, p. 1.

Jaffee, D. and Modigliani, F. (1969) A Theory and Test of Credit Rationing, *American Economic Review*, **59**, 850-72.

Jaffee, D. & Modigliani, F. (1976) A Theory and Test of Credit Rationing: Reply, *American Economic Review*, **66**, 918-20.

Jaffee, D. M. & Russell, T. (1976) Imperfect Information, Uncertainty and Credit Rationing, *Quarterly Journal of Economics*, **90**, 651-666.

Jaffee, D. M. (1971) *Credit Rationing and the Commercial Loan Market*, John Wiley and Sons, New York.

Jones L. (1989) Current Wealth and Tenure Choice. *Areuea Journal-Journal of the American Real Estate & Urban Economics Association* **17,** 7-40.

Jones L.D. (1993) The Demand for Home Mortgage Debt. *Journal of Urban Economics* **33,** 10-28.

Kempson, E. (1996), Money: Black spot on high street, Independent on Sunday, 27th October 1996, Business section p. 22.

Lee, S. H. (1991a) Ability and willingness to service debt as explanation for commercial and official rescheduling cases, *Journal of Banking and Finance*, **15**, 5-27.

Lee, S. H. (1991b) Using Terms of Rescheduling as Proxy for Partial Reneging on LDCs Debt in a Test of Willingness-to-Pay Model, *Journal of International Money and Finance,* 10(3), September 1991, pp. 457-77.

Lee, S. H. (1993) Are the Credit Ratings Assigned by Bankers Based on the Willingness of LDC Borrowers to Repay?, *Journal of Development Economics*, **40**, pp. 349-359.

Leece, D. (1995) Rationing, Mortgage Demand And The Impact Of Financial Deregulation *Oxford Bulletin of Economics and Statistics* **57**(1): 43-66

Leece, D. (2000) Choice of mortgage instrument, liquidity constraints and the demand for housing debt in the UK *Applied Economics* **32**(9): 1121-1132

Levene, T. (1998) UK lender will challenge US dominance in mortgages to those with bad credit ratings, *The Guardian*, 21st March, Business, p.14.

Ling D.C. & Mcgill G.A. (1998) Evidence on the demand for mortgage debt by owner-occupants. *Journal of Urban Economics* **44,** 391-414.

Linneman P. & Wachter S.M. (1989) The Impacts of Borrowing Constraints on Homeownership. *Areuea Journal-Journal of the American Real Estate & Urban Economics Association* **17,** 389-402.

Meen, G.P. (1990a) The Ending Of Mortgage Rationing And Its Effects On The Housing-Market *Urban Studies* **26**(2): 240-252

Meen, G.P. (1990b) The Measurement Of Rationing And The Treatment Of Structural-Change In The Uk Mortgage Market *Journal of Applied Economics* **5**(2): 167-187

Meen, G.P. (1990c) The Removal Of Mortgage Market Constraints And The Implications For Econometric Modeling Of Uk House Prices *Oxford Bulletin of Economics and Statistics* **52**(1): 1-23

Moghadam, M. R. and Samavati, H. (1991) Predicting Rescheduling by Less developed Countries: A Probit Model Approach, *Quarterly Review of Economics and Business*; **31**(1), 14-30.

O'Connor, G. (1998) Lending up a storm, *Financial Times*, Finance Week, 28 March, p.22.

Ooi, J.T.L. (2000) "An Empirical Investigation on the Incidence of Secured Debt", Journal of Property Research, **17**(3), 185-201.

Pandya, N. (1997) Take the slog out of mortgages, *The Guardian*, 12 July, p.91.

Pryce, G. (2003) Greening by the market? Distortions caused by fiscal incentives to build on brownfield land, *Housing Studies*, 18(4) p.563-585.

Scott, M. (1995) Cherry-picking time is here, *The Observer*, 26th March, p.22.

Seck, D. (1992) Optimal Economic Policy and the Cost of Euro-Credit Loans for African Countries, Part 4 of Roe, A. ed (1992) *Instruments of Economic Policy in Africa*, African Centre for Monetary Studies.

Smith, V. (1972) A Theory and Test of Credit Rationing: Some Generalizations, *American Economic Review*, **62**, 477-83.

Stiglitz, J. E. and Weiss, A. (1981) Credit rationing in markets with imperfect information, *American Economic Review*, **71**, 393-411.

Stiglitz, J. E. and Weiss, A. (1983) Incentive effects of terminations: Applications to the credit and labour markets *American Economic Review* **73**, 912-927.

Taylor, R. (1996) Loans of Last Resort, *Financial Times*, 3rd August, p.6.

Wyllie, A. (1998) Borrowers get raw deal from specialists, The Sunday Times, 20 September 1998, Money, p.1.

Zorn P. (1989) Mobility-Tenure Decisions and Financial Credit: Do Mortgage Qualification Requirements Constrain Homeownership? *Areuea Journal-Journal of the American Real Estate & Urban Economics Association* **17,** 1-16.