Theory and Estimation of the Mortgage Payment Protection Insurance Decision

by

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ABSTRACT

This paper examines the decision to take out mortgage payment protection insurance (MPPI) in the UK. The paper explains how MPPI has increased in importance over the last decade due to the government stating that Income Support for Mortgage Interest (ISMI) has crowded-out MPPI. A theoretical model of the mortgage protection insurance decision is developed which takes account of the welfare system. The model is estimated using logit analysis on 1995 Glasgow and Bristol data. Elasticities of the probability of take-up with respect to a variety of arguments are calculated, including the level of ISMI. The estimated elasticity with respect to ISMI is found to be very low, which suggests that the crowding-out motivation for the restructuring of Income Support for Mortgage Interest in October 1995 had little support in the data available at the time of the policy decision, and explains the continued low take-up rates since the 1995 restructuring.

Key Words: mortgage insurance, unemployment insurance, crowding-out, welfare reform.

JEL Classification: C25, D12, D81, G21, G22

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I INTRODUCTION

Mortgage Payment Protection Insurance (MPPI) is the industry name for insurance products designed to protect mortgage borrowers against the risks of accident, sickness or unemployment. In the event of one or more of these zero-employment-income outcomes, the insurer is committed to cover the borrowers' monthly mortgage payments for up to twelve months. These products have moved up the political agenda in recent years as policy makers have justified restructuring of the state support for mortgage borrowers on the basis that it has *crowded-out* MPPI. State help has traditionally been provided through ISMI (Income Support for Mortgage Interest) which covers some fraction of monthly interest payments for owner occupiers eligible for Income Support (the UK's means tested welfare safety net). 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. On this basis, the waiting period before claimants receive ISMI – the 'ISMI gap' – has substantially increased on all new mortgages since October 1995.

Although research since then has started to evaluate the effectiveness of the changes by interviewing market participants (Ford & Kempson 1997), and by testing whether MPPI clients are paying above the actuarially fair premium (Burchardt & Hills 1997a, b; 1998), little work has been done to actually test the *crowding-out* conjecture, and as yet, no work has been done to specify a theoretical model of the MPPI take-up decision.

The aim of this paper is to address both these omissions by developing a theoretical model of the mortgage protection insurance decision, and estimating this model using data on Glasgow and Bristol from the 1995 ESRC Beliefs and Behaviour project: "Beliefs, Perceptions & Expectations in the UK Owner Occupied Market". 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 remedied by widening the ISMI gap, or whether take-up is driven largely by factors outside state control.

The paper is structured as follows: section 2 examines the nature of the ISMI changes and briefly summarises the literature, section 3 develops a theoretical model of the MPPI take-up decision, section 4 outlines the empirical estimation of the model, section 5 presents the regression and elasticity results, section 6 discusses the results and section 7 concludes.

II ISMI CHANGES AND PREVIOUS STUDIES

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). 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 & Kemp, 1996, p.44).

Since then, a number of studies have examined the efficacy of MPPI as a replacement for ISMI (Burchardt & Hills, 1997a,b; 1998; Ford & Kempson, 1997, Pryce and Keoghan 1999). The Burchardt & Hills study uses British Household Panel Survey data to estimate the actuarial premium for MPPI and to compare the gains/losses to mortgagors/outright owners of a move from tax funding to actuarial premium funding of a state-provided hypothetical mortgage protection policy (which would be more generous than ISMI). They found that the actuarial premium was around £2.42 per month – less than half the average premium charged on MPPI policies in 1996. Unsurprisingly, it was found that mortgagors would lose from a switch from general tax funding to a flat-rate premium, and other tenures would gain. They also found that the overall effect would be regressive: "the bottom 30% of the income distribution would lose, and only the top group would gain significantly" (Burchardt & Hills 1997a p. 30). The regressive effect is even stronger if the insurance were to be rationed, as is the case with current MPPI policies where the highest risks (those with poor employment histories) are excluded from cover. Burchardt and Hills also found little evidence of moral hazard or adverse selection as a result of MPPI: policy holders did not have significantly greater unemployment risks than uninsured mortgagors. Other studies (Ford, 1992; Ford et al 1995; Jenkinson 1992; Kempson et al 1999) have examined the quality of the MPPI products on offer, and questioned whether they are an adequate substitute for ISMI given the array of clauses written into MPPI contracts. Walker et al (1995) provides a good overview of the unemployment/mortgage insurance problem, and supplies a rationale from the insurer's perspective for why such clauses exist (and perhaps inevitable – see also Chiu and Karni 1998 for recent results on the problems of unemployment insurance). As a result of the negative research results and publicity surrounding the quality of MPPI, the government and mortgage industry have worked together to produce a baseline product with fewer clauses (Armstrong, 1999; Council for Mortgage Lenders, 1999).

The Ford & Kempson (1997) study was based on a series of interviews with borrowers, lenders and insurers with a view to assessing the impact of the October 1995 changes to ISMI on each of these three mortgage-market groups. They found that "substantially new insurance products have not appeared and take-up has been much lower than was hoped. At the same time, though, there has not been the rapid rise in mortgage arrears and possessions that was feared" (op cit p. 83). Their research also included a simple socio-economic model of MPPI take-up.

At first sight, it would seem that the crowding-out hypothesis can be rejected simply on the basis of the Ford & Kempson findings: ISMI has been reduced substantially but there has been only a marginal increase in take-up of MPPI. However, the sluggish response of take-up rates may not in themselves disprove the crowding-out hypothesis since it may have been the result of coincidental changes in other factors which also affect the mortgage insurance decision. In particular, falling unemployment during and since 1995 may have counteracted the effect of state cut-backs. In order to isolate the crowding-out effect, it would be necessary to simulate the effect of reducing ISMI cover whilst controlling for other determinants. The study by Pryce and Keoghan (1999) examines many of these issues, utilising the Scottish House Condition data to construct an econometric model. They do not, however, develop a formal theoretical basis for the model, and the data source has the disadvantage of not containing a MPPI premium variable (the premium had to be imputed from the Family Resources Survey). The current paper aims to rectify both these drawbacks by constructing the first well articulated model of the insurance decision, and by drawing on a unique data set collected at the time of the policy decision that provides MPPI premium information as well as detailed information on other household expenditures and household employment circumstances.

III 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[1]. 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.

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 $y_2 \geq y^*$, where y^* is the reservation wage, or is sick. w_a is defined as:

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

where m, S and y_1 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[2] 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:

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

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

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

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

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 = income from savings and investmets (termed “tariff income” in social security parlance).

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

$$W_0 = p(1\text{-}\Omega)(y_1 - m + S - \mathrm{C}) + (1\text{-}p)(1\text{-}\Omega)q(y2 - m + S - \mathrm{C}) + \theta(B + bm - m + S - \mathrm{C})$$

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

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

$$u(W_0) = p(1\text{-}\Omega)\mathrm{u}[\mathrm{y1}] + (1\text{-}p)(1\text{-}\Omega)qu[y_2] + \theta u[B + bm] - u[m] + u[S] - u[C]$$

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.

$$W_1 \quad = \quad p(1\text{-}\Omega)y_1 + (1\text{-}p)\,(1\text{-}\Omega)qy_2 \;+\; \theta(\mathrm{B} + lm(1+\psi)) - \psi m - m + S - C \qquad [12]$$

$$u(W_1) \;=\; p(1\text{-}\Omega)u[y_1] + (1\text{-}p)(1\text{-}\Omega)qu[y_2] \;+\; \theta\, u[B + lm(1+\psi)] - u[\psi m] - u[m] + u[S] - u[C] \qquad [13]$$

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),

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

where,

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

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:

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

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:

Marketing Differentials

Lenders may influence 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),[3] 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 paper 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 via 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 (Mar 95) 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 gaps 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.

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)[4]. Thus the equation for ξ becomes:

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

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.

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 Ford and Kempson's concern op cit regarding the claims procedure).

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.

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 was 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.

Insurers 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 & Kempson op cit survey suggests that simultaneity problems[5] can be overcome by truncating the sample to include only those customers who fit the criteria outlined by lenders as in Ford & Kempson op cit.

IV ESTIMATION

Data

The data was 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 & Expectations in the UK Owner Occupied Market". Sample sizes varied between 240 and 290 for most regressions depending on which variables were included in the model.

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.

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:

$$(1\text{-p}) = (1-\pi_1)(1-\pi_2) \qquad [18]$$

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. The logit models were constructed to estimate the determinants of being currently employed[6]. 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, level of educational achievement, and age.[7] Estimates of the probabilities were then obtained from the predicted values from these regressions, 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.

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.[8]

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.[9]

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.[10]

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 l 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 where computed for a total of twelve categories[11], and assigned to borrowers falling within each category.

Utility Function Assumptions

The assumption that borrowers are risk averse implies a 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 $u'[w] = 1/(1+w)$.

V RESULTS

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 1.

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 w_a (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 1 Definitions and Descriptives of Variables Appearing in Regression Results]

[Table 2 Regression Results for w_a Regressions]

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, $\partial\xi/\partial b = -\alpha\theta m / (1 + B + bm)$.

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. 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. A ten per cent cut in b would produce an increase in take-up of less than 0.01 per cent, which is even less elastic than the Pryce and Keoghan (1999) estimate of the ISMI elasticity (-.02). This result would appear to preclude the ISMI reforms on the basis of reducing crowding-out and may explain why take-up levels subsequent to the 1995 reforms have continued to remain low (Pryce and Keogan, 1999; Ford and Kempson 1997). 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 9.6 per cent for some individuals.

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 and of the Pryce and Keoghan (op cit) estimate of the premium elasticity (-.01 to -.07). 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. The less elastic result found by Pryce and Keoghan was probably due to the fact that they had to impute the premium from an external data source.

The elasticity with respect to theta, the perceived probability of zero employment income, 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. Interestingly, even though Pryce and Keoghan (op cit) also encountered data limitations in measuring this variable, their estimates were considerably larger, around 0.4. 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 Burchadt & Hills study *op cit* 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, for most people, do not appear responsive enough to changes in unemployment probabilities to attract a significantly higher proportion of unemployed mortgagors.

VI CONCLUSION

The model developed in this paper used 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 to gauge 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 & 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, 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 are generally making economically rational choices.

The paper 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 one 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).

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Table 1 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 2 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	261	261	261	261	261	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 Accuracy	72.41%	72.41%	70.11%	70.50%	70.11%	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 3 Regression Results -- w_a not Included

Variable	(7)	(8)	(9)	(10)	(11)
ρ	0.1685	0.1704	0.1793	0.1768	0.1662
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$D^{Glasgow}$	-0.2008	-0.1022	-	-	-
	(0.4539)	(0.6956)			
D^{ISMI_IMP}	0.8820	0.8280	0.8195	-	-
	(0.3836)	(0.4133)	(0.4183)		
D^{MPPI_USED}	8.0935	-	-	-	-
	(0.6205)				
D^{FTB}	0.2512	0.3056	0.3129	0.3065	-
	(0.3526)	(0.2463)	(0.2339)	(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]	62.768	50.824	50.671	50.032	49.856
(significance)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(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 4 Regression Results

Variable	(12) ρ_1	(13) ρ_1	(14) ρ_1	(15) ρ_1	(16) ρ_1	(17) ρ_2	(18)* 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^{ISMI_IMP}	0.8660	0.8119	0.8004	-	-	-	-
	(0.3922)	(0.4221)	(0.4289)				
D^{MPPI_USED}	8.1017	-	-	-	-	-	-
	(0.6203)						
D^{FIB}	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.

Table 5 Elasticity Results

Variable	Mean	Std Dev	Minimum	Maximum	N
$\varepsilon_{\xi[\psi]}$	-.5120	.04	-.60	-.37	347
$\varepsilon_{\xi[B]}$	-.0014	.00	-.02	.00	592
$\varepsilon_{\xi[b]}$	-.0009	.00	-.01	.00	592
$\varepsilon_{\xi[l]}$	.0110	.02	.00	.13	347
$\varepsilon_{\xi[\theta]}$	.0600	.13	.00	.98	347
$\varepsilon_{\xi[\psi]1}$	-.4980	.03	-.58	-.37	353
$\varepsilon_{\xi[b]}1$	-.0007	.00	-.01	.00	592
$\varepsilon_{\xi[B]}1$	-.00069	.00	-.01	.00	598
$\varepsilon_{\xi[l]}1$	.0100	.02	.00	.12	353
$\varepsilon_{\xi[\theta]}1$	.0500	.12	.00	.96	353
$\varepsilon_{\xi[\psi]}2$	-.4980	.03	-.58	-.37	353
$\varepsilon_{\xi[b]}2$	-.0007	.00	-.01	.00	592
$\varepsilon_{\xi[B]}2$	-.0006	.00	-.01	.00	598
$\varepsilon_{\xi[l]}2$	.0100	.02	.00	.12	353
$\varepsilon_{\xi[\theta]}2$	.0500	.12	.00	.96	353
$\varepsilon_{\xi[\psi]}3$	-.5120	.04	-.60	-.37	347
$\varepsilon_{\xi[B]}3$	-.0009	.00	-.01	.00	592
$\varepsilon_{\xi[b]}$ 3	-.0008	.00	-.01	.00	592
$\varepsilon_{\xi[l]}3$	.0110	.02	.00	.13	347
$\varepsilon_{\xi[\theta]}3$	.0500	.13	.00	.98	347

B represents state benefits other than help with housing costs (Income Support).
b is ISMI cover (means tested state help with mortgage interest payments).
l is insurance cover
ψ is the insurance premium
θ is the probability of unemployment/ill health

Footnotes:

[1] to avoid confusion, square brackets are used to indicate the arguments of a variable.

[2] It is assumed that W_0 can be negative as well as positive since the consumer can disave.

[3] 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 LTVs and YTVs 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.

[4] 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'.

[5] 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 (at least in models of the short run) simply by appropriately restricting the sample.

[6] Because of the dichotomous nature of the variable, an arbitrary threshold of sixteen hours per week was assumed in the computation of the proxy using logit modelling.

[7] Estimates were based on the following logit regression results: $\pi_1 = 2.03 + 0.75$ PERM $+ 0.20$ EDUC $- 0.07$ AGE; and $\pi_2 = 0.62 + 1.99$ PERM $+ 0.37$ EDUC $- 0.05$ AGE where PERM denotes whether or not the borrower had a permanent employment contract, and EDUC is the level of educational achievement.

[8] $\phi_1 = 1.368 + 0.481\text{EDUC} - 0.093\ \text{EDUC}^2 - 0.0639\text{AGE} + 0.548\text{ETYPE} + 0.379\text{AREA}$; and $\phi_2 = 2.080 - 0.050\text{AGE} + 0.261\text{ETYPE}$, where ETYPE = {1 if employer/manager in large/small establishment or professional employee, 0 otherwise} and AREA = {1 if live in Glasgow, 0 otherwise}.

[9] 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}

[10] 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 Oct '95; 126/365 if S < 8,000 and date of mortgage before Oct '95; 365/365 if S < 8,000 and date of mortgage before Oc'95 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.

[11] 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).