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ABSTRACT

The Demand for Private Medical Insurance in the UK: A Cohort Analysis*

This Paper examines the determinants of the demand for private health insurance in the UK from 1978 to 1996. The focus is the impact of public and private sector quality on demand. Use of a pseudo-cohort panel allows examination of generational change and the investigation of dynamics. The results indicate that there has been generational change. Further, changes in the contractual status of senior doctors employed in the public sector has had impact on demand for the private alternative. Once these factors are taken into account, there is limited evidence of habit in purchase.

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NON-TECHNICAL SUMMARY

This Paper examines the determinants of the demand for private health insurance in the UK from 1978 to 1996. This period is one in which there have been major reforms to the structure of the public sector as provider of health care and to the role of the private sector in the provision of welfare in general. Understanding the purchase of private health care is of interest as governments continue to promote greater private finance of health care. Thus, the focus of this Paper is the impact of public and private sector quality on demand.

Individual purchase of private medical insurance (PMI) has shown a steady increase since 1978, from just over 600,000 policies sold in 1978 to 1.4 million in 1996. However, most of this growth took place before the 1990s; since 1991, the year of the internal market reforms to the NHS, the number of individual policies sold has risen by only 5%.

We use data from the Family Expenditure Survey (FES) to construct a pseudo-cohort panel data set. The FES provides data on household purchase of private medical insurance, household income and expenditure as well as other household demographics. We use the data to follow the experience of 7 birth cohorts, which we can track through the 19 years of data. Use of this panel allows us to examine generational change and investigate dynamics. The data was then matched with NHS and private sector measures of quality and availability of supply, at a regional level.

Our results suggest that the growth in PMI can be explained by demographics, income, the quality of the public and private sectors and generational change.

- Age and cohort have significant effects on PMI purchase. At an aggregate level purchase increases with age, but there has also been generational change. Purchase increases with age but decreases with cohort. At any given age older cohorts are less likely to purchase than younger ones.

- We find income to be positively and significantly related to the decision to purchase, confirming earlier analyses.

- We examine several measures of the quality of the public and private sectors on purchase. We find contrary to previous analysis (Besley *at al* 1999) all except waiting lists have a significant effect on purchase. Most of the impact of these variables arises in the 1990s. Further, the most important determinants of purchase appear to be measures of private sector care; changes in the contractual status of senior doctors employed in the public sector has had the greatest impact on demand for the private alternative. It is this, more subtle, link rather than perceived (or published) NHS quality measures that appears to affect purchase the most.

- Aggregate data suggests a strong impact of past purchase. However, our investigation at a more disaggregate level indicates there is only a limited effect for habit.

Introduction

Since the mid-1980s governments in the UK have sought to increase the extent of private finance for welfare provision. The state has withdrawn from the public finance of housing and made widespread changes to pension provision. While public funding for hospital and primary health care has been maintained, the scope of state financed care has been reduced at the margins. The result has been a considerable growth in the numbers buying private health care (Burchardt *et al* 1999).

This paper examines the determinants of the demand for private health insurance in the UK. Understanding the purchase of private health insurance in the UK is of interest because many governments are trying to encourage greater private finance of health care, but more specifically because it provides an understanding of the interaction between public and private welfare provision. Private medical insurance in the UK is supplementary to NHS care. Purchase is optional and purchase does not preclude use of the NHS nor, with the exception of the minor amount of tax relief to the over 60s, does it reduce the buyer's contributions to the tax-financed NHS. At a theoretical level, models of the demand for a private alternative to state provision in which public and private are alternatives may have no stable equilibria (Stiglitz 1974). But where private provision is supplementary to public provision a stable equilibrium may exist (Gouveia 1997, Epple and Romano 1996). In these latter models equilibrium is the result of a coalition between rich and poor who want less public provision (for different reasons) against a middle income group who want greater public sector provision. Supplementary provision allows the co-existence of both publicly and privately financed care. These models highlight the interactions between the sectors: the challenge for empirical analysis is to identify their importance.

In the UK set up the interactions are somewhat less direct than in health care systems where private medical insurance is given tax relief (for example the USA) or where individuals above a certain income threshold are not entitled to public care (for example, the health care system in the Netherlands during the 1980s[1]). The interactions, from the point of view of the demander, are dependent on the relative (perceived) quality of care in the two sectors. If measures of outcomes were available relative quality could be assessed using these. However, use of outcome data is in its infancy in the health care sector. Quality may be signalled by the level of resources voted to the NHS. The perception of the NHS and its quality as distinct from the actual sums spent or the throughput of the service may be as important. The NHS is a highly visible institution in the UK. Provision of direct information about its quality, or the generation of rather noisier signals (for example, the introduction of funding or structural

[1] Other parts of the welfare state in the UK also have such eligibility criteria.

changes that are thought to impact on quality) are likely to change the demand for the private alternative.

At a more micro level, interactions between the sectors will be affected by the conditions of employment in the two sectors. Senior hospital doctors in the NHS have contracts that allow them to work concurrently in both the private and public sectors. Other medical staff are trained in the NHS, but may work in either sector. So a shock that reduces resources in the public sector will reduce the quality of the NHS but may also increase the resources available to the private sector and so may increase the demand for private care.

This paper examines the determinants of the demand for private medical insurance over the last 20 years in the UK. During this time there was a period of relatively little change to the NHS (the late 1970s through to the mid-1980s), a period of considerable political discussion but no actual change (the late 80s) and a period in which there were major reforms to the structure of the NHS (the internal market reforms which came on stream in 1991). It is also a time during which the role of the state in the provision of welfare has changed considerably, and when attitudes to the role of the state in welfare provision have become generally less favourable (Taylor-Gooby 1998). Attitudes may also differ across the generations as younger consumers who have not experienced the 'cradle-to-grave' ideal of the welfare state begin to make welfare choices.

The aim of the paper is to identify the impact of changes in NHS and private sector quality, controlling for household income, demography and the business cycle, on the demand for private medical insurance. We allow explicitly for different responses to these factors by different generations. We use a pseudo-panel derived from repeated cross-sections of an annual household survey (the Family Expenditure Survey) for the period 1978 to 1996. The survey contains information on household expenditure on private medical insurance as well as detailed information on household expenditure and income and household demographics. It has been used extensively for the analysis of consumption in the UK. To these data we match several measures of the quality of both the NHS and private health sector. Data of this length at the micro level allow us to isolate the impact of generational and demographic change and to separate the effect of income change at the household level from business cycle changes. In addition, the panel nature of the data allow us to examine for the first time the effect of past purchase on current purchase at the household level.

Our results indicate that the growth in private medical insurance can be explained by demographics, income, the quality of the public and private sectors, and generational change. In contrast to some earlier work (Besley *et al* 1999), we find little evidence of an effect on purchase of published (and highly massaged) NHS quality indicators relating to NHS waiting times. Instead, we find evidence of a more subtle link between the public and the private sector, one which operates through the availability

of NHS staff to the private sector and through the supply of private sector facilities. Earlier research hypothesised such links but did not have microdata with which to investigate at an individual level (MacAvinchey and Yannopolous 1993, Martin and Smith 1999). We also find that there has been a change in the propensity of individuals to buy health insurance. Younger generations are more likely to purchase insurance than older ones, controlling for household demographics, income and the state of the NHS. Finally, we also identify a small role for habit, but a role much smaller than would be suggested by looking at aggregate data.

The organisation of the paper is as follows. In Section 2 we discuss the determinants of health insurance purchase in the UK. Section 3 presents the data and our estimation strategy. Section 4 presents the results. The final section concludes.

2. The determinants of private medical insurance demand

Private medical insurance in the UK is supplementary to public insurance. Purchase is voluntary, does not remove entitlement to NHS care, and nor does its purchase reduce tax contributions to the NHS with the exception of a small amount of tax relief on purchase by the over 60s introduced in 1991 and since withdrawn. Private medical insurance buys private care, which is most commonly supplied within the private sector, but can be taken within the NHS.

Over the last 25 years, the demand for private insurance, financed by the individual and/or by employers has risen. Overall, growth has not been rapid. Industry estimates (Laing 1997) indicate that company paid purchase has shown the largest absolute increase in policies sold, from just under half a million in 1978 to just over 2 million in 1996. Individual purchase has shown a steady but smaller rise. The number of policies sold rose from just over 600,000 in 1978 to 1.4 million in 1996. However, for both types of purchase most of the growth took place before the 1990s. Since 1991, which is the year of the introduction of the internal market reforms to the NHS, the number of corporate and individual policies sold has risen by only 6 and 5 percent respectively. The NHS reforms created a separation within the public sector between the suppliers of health care (hospitals) and buyers of health care (designated bodies responsible for populations in geographical areas). The reforms themselves did not embody any changes in the source of funding of public sector care[2].

In this paper we examine only individual purchase, as we have no information in our data set on individuals wholly covered by corporate policies[3]. The individual considering purchase of private

[2] The reforms were also accompanied by intense political debate.

[3] Data on corporate cover at the household level is not available for a sufficiently long period to undertake the panel analyses we carry out here.

insurance to cover the financial costs of private sector care will consider purchase relative to their NHS entitlement. Purchase will therefore be determined by the relative benefits of care in the two sectors.

Let V^1 be the net benefit of private care and V^0 the net benefit of public care where

$$V^1(y-p,q_1)$$

and

$$V^0(y, q_0)$$

where y is income, p is the insurance premium, and q_j is the quality of care in the two sectors, $j = 0, 1$.

The individual deciding whether to purchase insurance will evaluate the sign of

$$(1) \qquad [sV^1(y-p, q_1)+(1-s)U(y-p)] - [s V^0(y, q_0)+(1-s)U(y)]$$

where $U(.)$ is utility when not in need of health care, and s the probability of requiring health care. Individuals for whom (1) is positive will purchase insurance. Demand will therefore depend upon income, the quality of care in the two sectors, the price of the premium, and the probability of being in a state of health for which insured care is available. As the private sector in the UK does not provide accident and emergency treatment, and has fewer facilities with which to undertake major operations, s is in fact the probability that the individual will experience those sets of health for which private sector care exists.

The benefit from care depends both on the quality of care and income. Besley *et al* (1999) put forward a similar model of demand and show that under standard assumptions about the utility derived from income and quality, demand is increasing in income. This receives considerable empirical support (Besley *et al* 1999, Propper 1989, 1993). Quality of care depends on the quality of the medical staff and the hospital and the costs of access to this care. For a given quality of staff and plant, the higher the access costs, the lower the quality. Access costs include the costs of time spent waiting for care (either in person or on a waiting list) and the availability of facilities in a local area. The quality of NHS care will be determined in part by resources available to the NHS and waiting lists.

The dominant position of the NHS in the UK health care market (85% of health care is publicly funded) means the quality of care in the private sector is in part determined by the quality of the NHS. For the private sector to exist alongside a public health care system which is free at point of demand, perceived quality in the private sector must be at least as high as that of the public system. In addition, there is a link between NHS and private health sector employment. Senior hospital doctors in the NHS (known as consultants) are allowed to work concurrently in both the private and public sectors. Since 1980

consultants have had full time contracts which allow them to earn up to 10 percent of their gross NHS salary from private practice and part time contacts which allow unlimited amounts to be earned from private sector work. So a shock which increases the number of consultants who have part time NHS contracts will increase the availability of consultants in the private sector. This will decrease access times, so increasing the quality of private care. During the last 20 years the contractual hours worked within the NHS by consultants on part time contracts has fallen. Other medical staff can work in either sector, though they do not have contracts that officially allow concurrent employment in both sectors. So a decrease in the pay of other NHS staff may lead them to leave to work in the private sector, or to work concurrently in both sectors. In addition, an increase in the labour resources available to the private sector may also lead to a fall in price of insurance if the price of labour falls[4].

The NHS is a highly supported institution in the UK. Its politicised nature means that use of the private sector has been seen as a political statement. On one hand, use of the private sector relieves pressure on the NHS. On the other hand, supply of medical staff is limited in the short (and possibly) medium run, so increased demand for private care may lead to a shift of resources from the public to the private sector, so leading to a decrease in NHS quality. 'Going private' may thus be seen as affecting care for others, and an individual's propensity to do this may be linked to their political beliefs about the NHS. Thus for a given level of care and net cost, individuals with different political beliefs may value public and private care differently. And we might expect there to be generational change in these attitudes, as attitudes may have changed as the role of the private sector in welfare provision has increased. Generational differences will also arise because the need for health care is age related.

Finally, habit or persistence in purchase is likely for several reasons. Individuals may believe their contracts are linked through time. They are likely to incur search costs in finding a medical care supplier that may make them stay in the private sector once they have found a private supplier. They may also re-evaluate the purchase of health insurance infrequently as it is purchased on an annual basis.

In summary, the empirical specification of the demand for private medical insurance by individual *i* in cohort *c* is:

$$(2) \qquad p_{it} = \alpha_1 age_{it} + \beta_2 income_{it} + \gamma Cohort + \delta Quality\ of\ NHS\ and\ private\ sector_t + \psi_1 trend + \psi_2 region + \theta p_{it-1} + \varepsilon_{it}$$

where p_{it} is the probability of purchase in year *t* by *i*. All coefficients may be cohort specific.

[4] Proponents of 'supply induced demand' in medical care would argue that a shock which increased the availability of consultants would not lead to a price fall, because consultants would 'induce demand' to prevent their incomes from falling.

3. The Data and Estimation Strategy

The analysis uses 19 years of repeated cross sections from 1978 to 1996 and we follow the experience of 7 birth cohorts: those with a head of household[5] born in 1930-34, 1935-39, 1940-44, 1945-49, 1950-54, 1955-59 and 1960-64 (the youngest cohort). To allow for dynamic effects and to match to regional measures of health care supply, we estimate the model by aggregating household purchase by cohort, region and time. This forms a pseudo-panel of birth cohorts. Repeated cross-section data does not suffer from attrition problems that plague true panel data sets. In addition, the data we use gives a long time series component to the panel that does not exist in current UK panel data sets.

The data are from the UK Family Expenditure Survey (FES) which is a large, annual survey of a cross-section of UK households and the members of these households. The overall sample size is 77,601. In the data purchase of medical insurance is recorded at household level as an annual purchase[6,7]. A comparison of aggregate individual purchase from industry sources with purchase from the FES (Figure A1) shows the two series to be close, although interestingly, the aggregate data from industry sources show a levelling off of purchases in the 1990's which is not reflected in the FES data. For reasons of commercial confidentiality industry data does not always have complete coverage.

To construct our grouped data set, we divided each year's observations into 7 date of birth groups and 10 regions, then averaged the relevant variables over the year within cohort and region. So, for example, we take all heads of household aged 18-25 in 1978 in region *r* and compute the average household private medical insurance purchase. In 1979 this 'cohort' will be aged 19-26 and in 1980 it will be 20-27 and so on. In this way we construct a series of 'means' from 1978 to 1996 for households who are members of the same birth cohort. We define other cohorts by looking at all those aged 26-30 in 1978, or aged 31-35 in 1978 etc. The choice of the width of the birth cohort is a matter of trade-off between the need to have a large number of observations per cell and the desire to have as much informative data as possible. The narrower the birth cohort the greater the number of birth cohorts and hence the number of data points, but the smaller the number of observations per cell and hence the greater the potential error in the estimate of the cohort mean. Our choice of cohorts gives a balanced

[5] Defined by the FES as an individual who must be a member of the household and is, in order of precedence, the husband of the person or the person who owns, or is legally responsible for the rent of, the household accommodation.

[6] Respondents are asked if any of them have paid any premiums on any insurance policies. If the answer is yes then they are asked the type of policy, the insurance company, the amount paid and the period which this covers. Since 1978 the equivalent annual policy payment has been recorded as a household purchase even though the information is collected at a personal level.

[7] Note that any positive purchase is recorded so we don't know whether the purchase is for a personal medical insurance policy or a corporate policy where the individual picks up part of the cost.

pseudo-panel of 7 cohorts, in 10 regions, over 19 years. The size distribution of each cohort is given in Table A1.

To the pseudo-panel we match data on quality of the NHS and the private sector at regional level. Measures of NHS quality are expenditure on health care services, the length of waiting lists for treatment and the number of NHS beds. Not all these measures are available for all years, and the precise definition, sources and lengths of series are given in Table A2. As measures of quality of the private sector, we use the number of private hospitals[8], and the number of consultants on part-time contracts in the NHS. As discussed above, this is best interpreted as a measure of the relative quality of the private sector, as consultants who work part-time in the NHS decrease their formal time input into the NHS in return for the ability to undertake unlimited private work[9]. Finally, we match two measures of the price of private medical insurance to the pseudo-panel. Both are annual measures and are derived from the sales of insurance policies. The first is average premium per policy, the second average premium per individual covered by insurance. As neither series is available at regional level price is constant across all cohorts within a year.

Our aim is to determine whether trends in purchase can be explained by changes in cohort behaviour and the impact of economic factors of income, price and lagged purchase. To estimate equation (2) using the cohort data, the dependent variable is the proportion of household with medical insurance purchase in cohort *c* in region *r* in period *t.* Deaton (1985) suggested treating the observed cohort means as estimates of the true population cohort means with a measurement error. He proposed a measurement-error corrected within-groups estimator with individual effects which is consistent for a fixed number of observations per cohort. If the number of observations per cell in each cohort is large and the model is static then the errors-in-variables problem can be ignored and standard procedures for a genuine panel data set applied. Collado (1997) extended the analysis to a dynamic model with a lagged dependent variable. She showed that consistency by using a measurement error corrected within groups is achieved if the number of time periods tends to infinity. In addition, if the number of observations per cell is large the error-correction becomes irrelevant. In what follows we ignore the measurement error problem but use least squares weighted for number of observations per cell.

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[8] This is a more reliable series of private sector availability than the number of private sector beds.

[9] The analysis has a strong time series component involving the estimation of relationships between time series variables. As such we have to be interested in the existence or non-existence of an equilibrium relationship between these series and must first test whether the variables are integrated to the same order. With this in mind we subjected the supply side variables to Dickey-Fuller tests and showed that a substantial number suffered from non-stationarity. First differencing would lose us a number of observations because the differencing has to be done on each cohort so we detrended each supply measure using a linear trend.

4. Results

4.1 Age, cohort and time effects

The dynamics of private medical insurance purchase in the UK have not been explored to date using microdata. We therefore begin by using the panel to determine whether age, cohort and time effects can be identified. To do this we combine regions within the pseudo-panel data so that each observation is for a cohort in a year. Figure 1a plots the smoothed age profile of the proportion with private medical insurance. It shows that purchase initially increases with age, and then plateau's around the age of 50 with some fall thereafter (observable only for the older cohorts). There also appears to be a cohort effect: at any age the proportion with cover amongst younger cohorts is higher than amongst older cohorts. If we plot the same data against time, Figure 1b (where cohort 1 is the youngest and cohort 7 the oldest) shows that growth for all cohorts was strongest in the 1980s with some decline during the 1990s. But again there appear to be differences between the cohorts: the rate of growth is less for the older three than the younger four cohorts. The age profile from a single cross-section of data will confuse the real age profile with these generational effects.

On top of these generational effects, there may also be secular effects as purchase is dependent on economic status and hence may be business cycle determined. Following Deaton (1997) the purchase of medical insurance can be decomposed into age effects, cohort effects and year effects. The implicit assumption in this approach is that there are no interaction effects between age, cohort and years which implies that the *shape* of the age profile is constant, although the profile may well shift. We estimate a restricted version of equation (2) in which we examine only age, cohort and time effects i.e.

$$(3) \qquad p_{ct} = \beta + \alpha_a + \gamma_c + \psi_t + u_{ct}$$

for cohort c at time t, where a refers to age. We could assume some functional form for the three components but the simplest approach is to dummy each of the effects. As there is a linear relationship between age, date and cohort, to estimate the impact of age, cohort and time the first cohort and age dummies and $T-2$ year dummies must be omitted.

Figure 2 plots the coefficients from this regression to present decompositions into age, cohort and year effects. The age and cohort effects are significant as a group and almost all individual coefficients are well defined. Figure 2a shows that purchase increases with age. While purchase does not rise monotonically, broadly the age effect appears to be linear. Figure 2b shows purchase decreases monotonically with cohort. Differences between the oldest three and the youngest three cohorts are statistically significant at the 5 percent level. Figure 2c plots the estimated time effects. The plot shows some volatility in time effects, but with the exception of one year (1991) none of these are statistically

different from zero. There is a large fall immediately after the introduction of the internal market in 1991. The large rise in the late 70s and early 80s and the fall in 1991 coincide with changes in price. Prices, as measured by average subscription per subscriber fell in the late 70s and early 80s and rose sharply between 1990 and 1991.

These effects are not observable from the aggregate data plotted in Figure A1. That picture gives the impression of a gradual upward trend in purchase with some change in the early 90s. The analyses here show that this trend can be explained by a combination of age and cohort effects.

4. 2 The impact of economic factors

We now turn to the full regression estimates of equation (2). Each observation represents a cohort within a region within a year. We drop the trend term since the analysis above has shown the year effects to be insignificant. We allow for the impact of income, public and private health sector quality, and lagged purchase to differ across cohorts. In addition we allow the 1990s to be different from the earlier years. The 1990s are the period in which the NHS reforms have been in operation. We therefore allow for structural change from 1991 onwards to identify whether there are significant changes in the impact of generational or economic factors following the NHS internal market reforms. A dummy variable for 1991 onwards was interacted with all the quality measures, cohort and income.

All models were estimated using weighted least squares as the cohorts differ in size. Our measures of NHS and private sector quality, as noted above, are missing observations at various points in the overall period 1978-96. The missing values for different variables do not occur in the same year, so estimates which use all the supply variables together use relatively few observations. In addition, there is considerable collinearity between the measures of supply quality. These data deficiencies mean that it is not possible to identify the impact of supply quality by using all the measures together. We therefore estimate equation (2) using the different measures of supply quality separately. We also present estimates using all measures together. We allow for unobserved differences between regions in addition to the supply side measures[10].

Table 1a presents these regression results. Each column presents results for one of the five measures of supply side quality. All models include an interaction between the supply side measure and the years after the 1991 reforms. While we allowed for interactions between the reform years and income and between the reform years and cohort, these interactions did not add significantly to the explanatory power of the model. They are therefore not reported here. Finally, price was never significant and of the expected sign in any of the specifications so was also omitted.

[10] These regional effects could be picking up differences in attitudes to the public sector or unobserved health differences. Measures of observed health vary across region but the pattern of variation is pretty constant over time.

The results in Table 1a indicate that age and cohort effects are well identified. The coefficients confirm the analyses undertaken at the national level and show that the effects of cohort and age are robust to inclusion of income, supply side factors and unobserved regional effects. Purchase rises monotonically with age of head of household, but falls across the generations. Older cohorts are less likely to purchase than younger ones, and the effect is monotonic.

Income is positively and significantly associated with the decision to purchase, confirming earlier analyses of insurance purchase in the UK (Propper 1989, 1993; Besley *et al* 1999). These cross-sectional studies of private medical insurance have found significant coefficients on the quadratic income term, but the cohort results presented here do not pick up this non-linearity. This is probably the result of the averaging that occurs when cohorts are defined, so that the behaviour of individuals with high incomes relative to their cohort cannot be identified.

The results indicate an effect for past purchase, controlling for income, supply, age and cohort effects. However, the impact of past purchase is much smaller than would be suggested from any analysis that looked only at aggregate data. The coefficient from a regression of annual national purchase on lagged purchase is close to 1 and the R^2 of this regression is 0.73. This would suggest a strong impact for lagged purchase. However, once income, cohort, age and the quality of supply are allowed for, the importance of lagged purchase falls considerably. The coefficient is substantially less than one indicating some 'habit' effect but not a unit root. The long run dynamics suggest a rapid adjustment to any changes in the determining variables since the lag coefficient is always less than 0.1 and positive. The mean lag length is of the order just over 1 month.

Table 1a shows that supply variables do appear to effect the purchase of private medical insurance but, controlling for unobserved regional effects, most of the impact of the supply variables arises in the 1990s. For three of the measures of supply side quality the interaction between the variable and the post 1991 period is significant. For a fourth supply side variable - NHS expenditure - the joint hypothesis of zero coefficients on expenditure and expenditure/dummy interaction is rejected by an F test, even though the coefficients are not significant at conventional levels. Only for waiting lists is there neither a linear nor an interaction effect.

Of the supply variables it is the measures of availability of facilities - the number of NHS beds, the number of part-time consultants, and the number of private hospitals - which appear to be the most important determinants of private medical purchase. The latter two variables are both measures of the availability of private sector care, since the more consultants work part time, the more they can be available to undertake private work. The signs of these coefficients are of the expected sign if relative quality matters for purchase. The coefficients indicate that a rise in the quality of private care, as measured by the availability of senior doctors and hospital facilities, is positively associated with an

increase in purchase of private medical insurance in the 1990s, while an increase in the availability of NHS beds is associated with a decline. Note that the analysis for part time consultants is only from 1987.

Contrary to an earlier analysis which examined 5 years from the mid 1980s to the early 1990s (Besley *et al* 1999), we find little evidence of a positive effect of NHS waiting lists on purchase. For most of the period studied, the estimated effect of NHS waiting lists on private purchase is actually negative. In other words, as waiting lists rose and so the quality of the NHS fell, purchase of the private alternative fell. There appears to have been some change post the NHS reforms, but even allowing for this, there is no significant positive impact of waiting lists during the period. On the other hand, total expenditure on the NHS does appear to affect private insurance purchase, but with a lag: an increase in the amount spent in year t results in a decrease in the probability of purchase in year $t+1$. The regression coefficients on lagged total NHS expenditure themselves are not significant, but the F test shows that the lagged expenditure and the lagged expenditure with dummy interaction together are significant. There is, however, no clear relationship between current NHS expenditure and private health insurance purchase. These results appear to suggest that if there is an interaction between the NHS and private insurance purchase, it comes as much from an increase in the availability of care in the private sector as from a perceived fall in the quality of the NHS.

These supply side effects are conditional on the inclusion of regional dummies to allow for unobserved differences across regions. The estimates of the unobserved regional effects change little across the different specifications of supply-side quality. The regional dummies are jointly significant for all specifications of the supply side variables. Purchase is significantly higher in the South-East than in all other regions, and lower in the Scotland, Wales and the far North of England. To explore the effect of inclusion of these regional effects on the results, we re-estimated the models in Table 1a without regional effects. The results are presented in Table 1b. They indicate that if we do not control for regional effects, the standard errors of the estimates of all the quality variables fall. Almost all the linear terms in quality measures are well-defined, and the interactions with the post-1991 dummy are all well defined. The size of the coefficient estimates are similar with and without regional dummies, with the exception of the coefficients for the part-time consultants measure which increases. Waiting lists remain poorly defined and close to zero in magnitude. The results are therefore similar to those which allow for unobserved regional effects. The coefficient estimates are less well defined when we allow for unobservable regional effects.

Table 2 explores the robustness of the results to inclusion of all supply side measures. The first regression in Table 2 reports the results of all the supply variables without the regional dummies. The presence of collinearity can be seen from the insignificance of all of the supply side variables, but the

null hypothesis of zero coefficients is strongly rejected by an F test. However, this model can be estimated on only around 1/5 of all the observations[11].

To try to pin down joint effects, we consider combinations of supply variables that have sufficient number of observations to produce robust results. The second column in Table 2 shows that NHS expenditure, NHS beds and waiting lists are not themselves significant when their effects are jointly estimated, but that the F test on the restriction that they are all zero is strongly rejected. This is a further indication of the extent of collinearity. These variables are all measures of NHS quality. The third regression allows for one measure of private sector quality, the number of private hospitals, with waiting lists and NHS beds. (We did not include part time consultants because missing variables for that measure mean the overall sample size drops considerably). The null hypothesis of no effect for the combined supply variables is strongly rejected. NHS expenditure and the waiting lists variables are again insignificant, while the impact of private sector hospital availability is strongly positive in the 90's. Again, it appears that the private sector 'pull' factors are the ones with more impact on purchase.

It is possible that these measures of quality are endogenous. An increase in purchase of private health insurance might lead private hospital operators to build more facilities and doctors to choose to take part-time contracts in the NHS. NHS waiting lists may fall as more individuals use the private sector. It is slightly more difficult to construct a direct link between private insurance purchase and the resources given to the NHS at regional level, since these are allocated with reference to a formula which does not adjust for either private sector facilities or private insurance cover, but the two could be linked through the political process. The effect of such endogeneity would be to upwardly bias the estimates of private sector quality and downwardly bias the impact of NHS waiting lists.

There are no obvious instruments for these measures other than the lagged value of the measures themselves. While the panel is long, the presence of missing observations in the part time consultant and private hospital series meant we could not form instruments from lags greater than two year without loss of considerable number of observations. Table 3 presents the results using the twice lagged supply quality variable as an instrument for itself. The results are very similar to those in Table 1a.

5. Conclusions

This paper uses pseudo-panel data to examine the determinants of the demand for private medical insurance in the UK. Use of a pseudo-panel allows us to look at demand over a significantly longer time period than any existing analyses that have used either microdata or aggregate data. The period we

[11] Inclusion of regional dummies decreases further the precision of the estimates, but the overall explanatory power of the model, as measured by the R^2 changes little.

examine is one in which there have been major reforms to the structure of the dominant public sector provider against the backdrop of major reforms of the role of the private sector in the provision of welfare more generally. Our interest centres on the impact of interactions between the NHS and private demand, both in terms of a direct effect through the impact of the quality of the two sectors on demand and an indirect effect through generational change. We were also able to explore the dynamics of purchase, again for the first time for UK data.

Our results indicate the importance of the generational change and the effect of supply side quality on purchase. We find that, controlling for age and income, there is a cohort effect in private medical insurance purchase. Purchase increases with age but decreases with cohort i.e. older cohorts are less likely *ceteris paribus* to purchase medical insurance. This may indicate a change in tastes: younger individuals who have grown up in an era where the political aim has been to 'roll back the frontier of the state' may be more willing to contemplate bypassing the NHS system than their older counterparts. It is known that those who use private care are less supportive of the equity goals of the NHS (Burchardt and Propper 1999). This change in propensity to 'go private' may in time erode support for tax finance of the NHS, or open the way to greater political acceptability of greater private finance for health care.

We find that private demand appears to respond more to changes in the availability of private care than to changes in either aggregate NHS resources or to NHS waiting lists. As the latter are widely believed to be 'massaged' for political purposes, the lack of impact of these is perhaps not surprising. Finally, past purchase does, conditional on age, income, measures of supply side quality and cohort, appear to affect purchase. However, the magnitude of the effect of last purchase is small and considerably smaller than would be suggested from analysis of aggregate annual data. In general, the results differ considerably from what could be gleaned using annual aggregate data.

Our results suggest that the availability of private sector facilities - in terms both of hospitals and availability of senior doctors - is more strongly associated with demand for private medical insurance than the total level of resources available to the NHS. The effect of a rise in the number of senior doctors who opt for part time employment in the NHS probably operates on both the NHS and private sector. It depresses the quality of NHS care since the stock of senior doctors is fixed in the short term, and raises the quality of private care by increasing the supply of doctors to the private sector (assuming all the part-time workers do not simply increase their leisure time). This increase in relative quality will make the private sector more attractive. There may also be a further effect on demand if doctors can increase their own business to maintain their incomes in the face of the usual supply effect which would be to depress returns from private consultancy (so-called 'supply induced demand'). In general, regardless of whether 'supply induced demand' exists, our findings suggest the continued use of labour contracts which allow senior doctors to be employed in both sectors will allow growth in private

demand, and that any changes in the nature of the contracts offered to NHS senior doctors are likely to spill-over into a change in demand for the private alternative.

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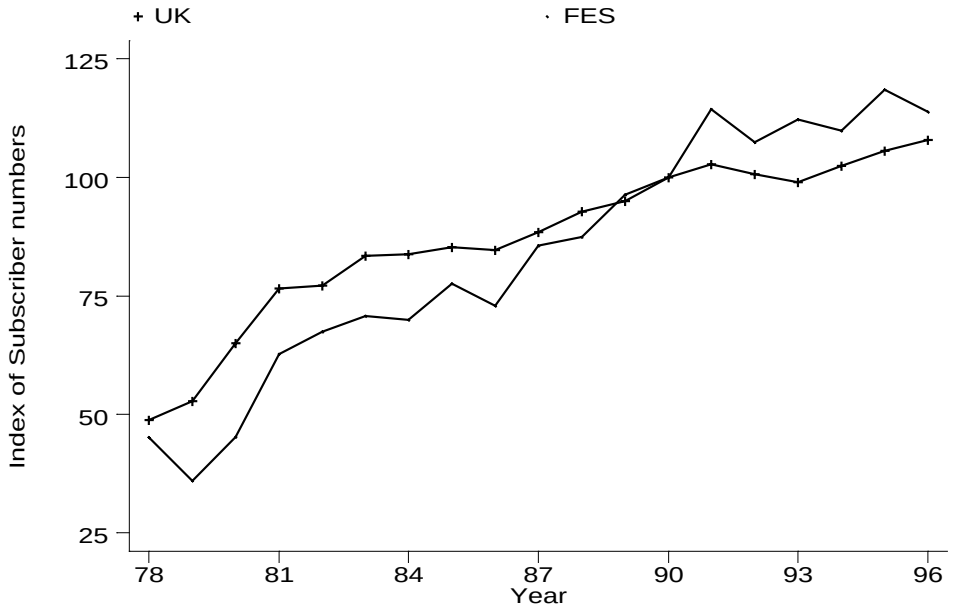
Appendix

Figure A1: Individual PMI subscribers, UK & FES Data, 1978-1996 (1990=100)



Source: UK Index: Laing 1997. FES Index: Family Expenditure Survey 1978-1996/97.

Table A1: Size distribution of cohorts

Cohort age in 1978	Northern	Yorks & Humber	North West	East Midlands	West Midlands	East Anglia	South East	South West	Wales	Scotland
	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)	Average (min)
18-22	33 (13)	52 (11)	66 (19)	41 (9)	51 (9)	18 (2)	174 (49)	46 (15)	25 (3)	54 (14)
23-27	37 (23)	60 (45)	70 (58)	45 (33)	60 (39)	24 (8)	199 (155)	50 (26)	32 (20)	57 (41)
28-32	41 (30)	64 (49)	81 (55)	55 (38)	65 (50)	27 (14)	222 (181)	61 (47)	38 (28)	65 (47)
33-37	35 (21)	49 (31)	67 (47)	46 (35)	60 (43)	24 (16)	180 (136)	49 (40)	31 (22)	53 (29)
38-42	32 (19)	49 (39)	64 (47)	38 (29)	53 (37)	19 (9)	158 (125)	42 (35)	28 (19)	48 (38)
43-47	32 (25)	46 (30)	55 (40)	39 (26)	49 (31)	20 (12)	146 (120)	42 (30)	29 (18)	50 (38)
48-52	37 (29)	49 (35)	61 (50)	37 (26)	56 (37)	20 (12)	156 (105)	44 (35)	30 (20)	51 (35)

Table A2: Regional supply-side data measures

Supply Side Variables	Data	Notes	Source
NHS Expenditure	Annual NHS current and capital expenditure excluding expenditure on family practitioner services. Deflated by the Hospital & Community Health Services (HCHS) index, and by population. (Available 1978-96)	Data is presented in published sources for financial years. We have matched the data to the nearest whole year; i.e. expenditure in financial year April 90-April 91 is matched to 1990.	England; Regional Trends (78-84), Health and Personal Services Statistics (HPSS) England (85-94), Dept. Health (95, 96). Wales; Regional Trends (78-84), HPSS Wales (85-92), Dept. Health Wales (93-96). Scotland: Scottish Health Statistics.
NHS Beds	Total number average daily available beds in NHS hospitals, acute specialties. Deflated by population. (Available 1979-94)	At 31st December in each year to 1986, from 1987 at 31st March in each year.	All; OHE Compendium of Health Statistics 1987(78-83), OHE Compendium of Health Statistics 1997 (84-94).
Part-time Consultants	Number of NHS hospital medical consultants on part time contracts. This includes those on 'maximum part-time' contracts also. Deflated by population. (Available 1987-89 & 1992-96)	At 30th September in each year. England figures rounded to nearest 10.	England: Dept. Health (Medical and Dental Workforce Census). Wales; HPSS Wales (87-94), Health Statistics Wales (95 & 96). Scotland; Information & Statistics Division, NHS in Scotland (Medical Dental Manpower Census).
Private Hospitals	Number of private, acute hospitals. Deflated by population. (Available 1979,1980, 86,88,1990-92, 94 & 95)	Numbers are of private hospitals operating during that year.	All: Independent Hospitals Association Acute Hospital Survey. 1979,86 & 88 are also reprinted in Laing's Review of Private Health Care (Laing & Buisson, 1987 & 1988/89).
Waiting Lists	Number of patients on NHS hospital inpatient waiting lists, all specialties, excluding day-cases. Deflated by population. (Available 1978-96)	At 30th September in each year.	England; Office of Health Economics (OHE) Compendium 1987 (78-86), Dept. Health (87-92), Regional Trends (93-96). Wales; Dept. Health Wales (78-92), Regional Trends (93-96). Scotland; Scottish Health Statistics (78-92), Regional Trends (93-96).

Figure 1a: Mean proportion purchasing PMI by age cohort, 1978-1996

Figure 1b: Mean proportion purchasing PMI by cohort, 1978-1996

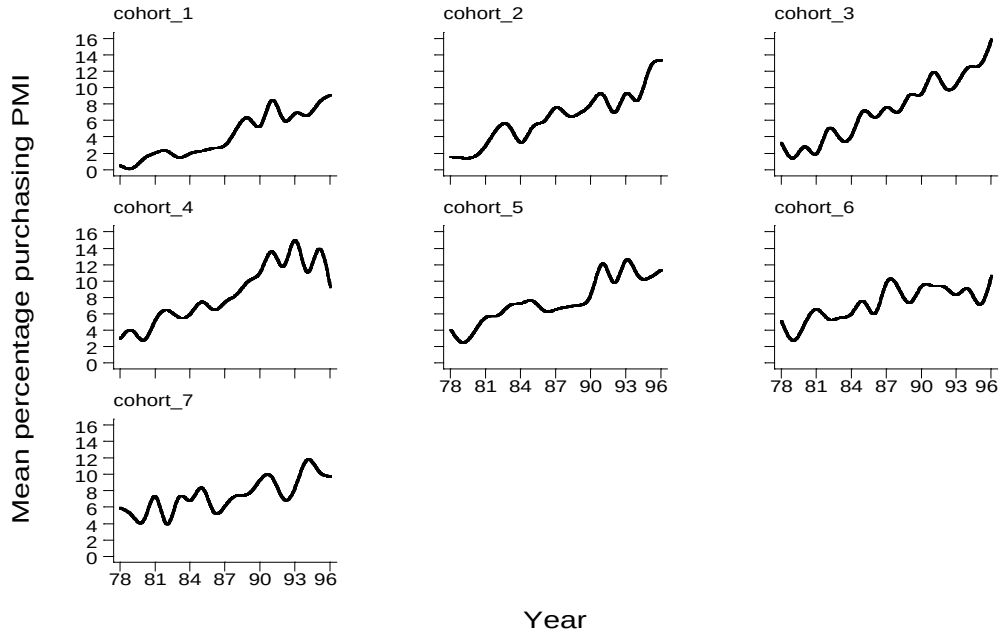


Figure 2a: Age effects

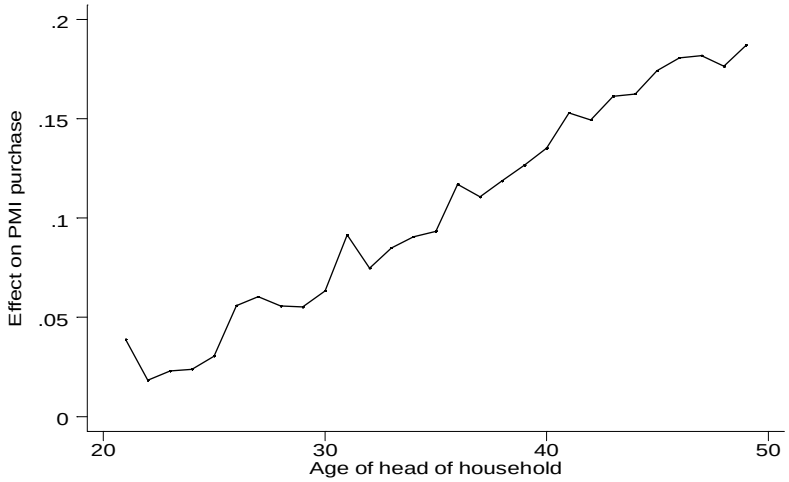


Figure 2b: Cohort effects

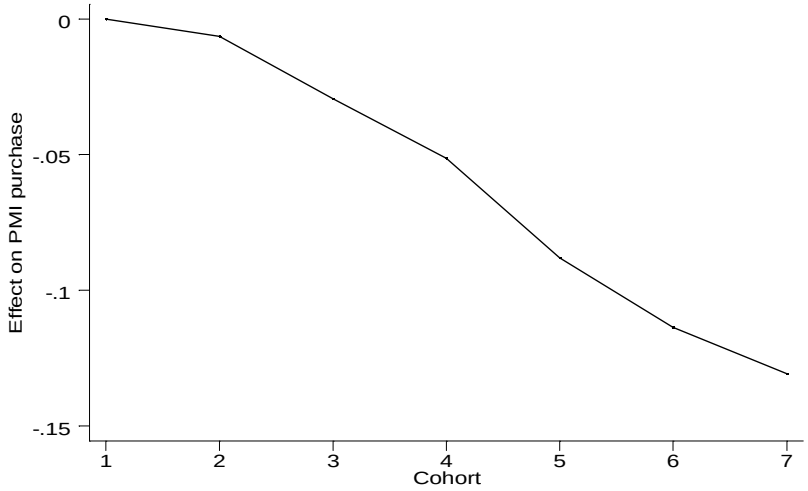


Figure 2c: Time effects

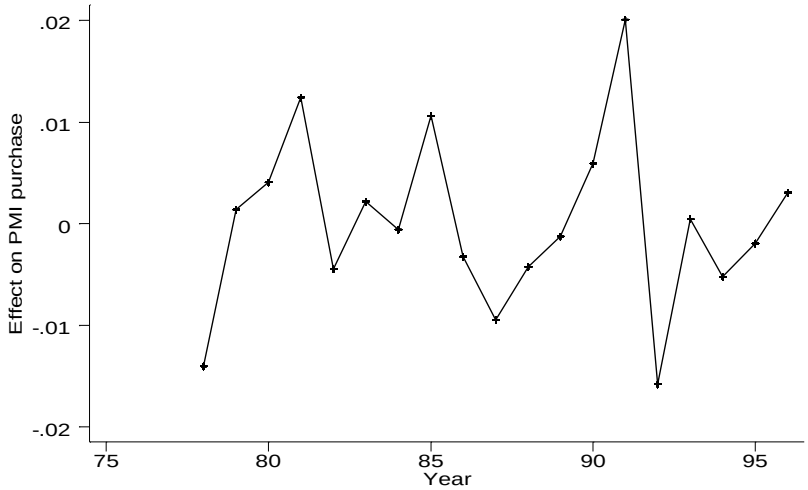


Table 1a: Weighted least squares regressions of private medical insurance purchase

Supply side variables	NHS Expenditure	NHS Beds	Part time Consultants	Private Hospitals	Waiting Lists
Age of head	0.0038**	0.0034**	0.0054**	0.0040**	0.0039**
	(0.0003)	(0.0003)	(0.0006)	(0.0004)	(0.0003)
Income (£000's per year)	1.6798**	1.6912**	2.4264*	2.9564**	1.6543**
	(0.5583)	(0.577)	(1.1547)	(0.775)	(0.5595)
Income^2 (£m per year)	-5.852	-4.7903	-7.5079	-13.3535*	-5.3829
	(3.9752)	(4.0348)	(8.3226)	(5.2985)	(3.9978)
Cohort 2	-0.002	-0.0015	-0.0085	-0.0073	-0.0026
	(0.0037)	(0.0037)	(0.0061)	(0.0052)	(0.0036)
Cohort 3	-0.0104*	-0.0083	-0.0275**	-0.0162**	-0.0117**
	(0.0041)	(0.0043)	(0.0081)	(0.0055)	(0.0039)
Cohort 4	-0.0210**	-0.0144**	-0.0519**	-0.0256**	-0.0228**
	(0.0049)	(0.0052)	(0.0105)	(0.0065)	(0.0047)
Cohort 5	-0.0455**	-0.0378**	-0.0894**	-0.0554**	-0.0479**
	(0.0061)	(0.0064)	(0.0132)	(0.0079)	(0.0057)
Cohort 6	-0.0707**	-0.0610**	-0.1154**	-0.0794**	-0.0734**
	(0.0073)	(0.0077)	(0.0154)	(0.0094)	(0.0069)
Cohort 7	-0.0863**	-0.0729**	-0.1396**	-0.0945**	-0.0893**
	(0.0086)	(0.0094)	(0.0177)	(0.0111)	(0.0082)
PMI *t-1*	0.0881**	0.0604*	0.0614	0.05	0.0920**
	(0.0281)	(0.0295)	(0.0406)	(0.0389)	(0.0281)
NHS Expenditure *t-1*	-0.0002				
	(0.0002)				
NHS Expenditure*91-96 dummy *t-1*	-0.0002				
	(0.0001)				
NHS Beds		0.0119			
		(0.0073)			
NHS Beds*91-96 dummy		-0.0283**			
		(0.0066)			
Part time Consultants			-0.0357		
			(0.2285)		
Part time Consultants*91-96 dummy			0.2965**		
			(0.093)		
Private Hospitals				-0.0033	
				(0.0045)	
Private Hospitals*91-96 dummy				0.0087**	
				(0.002)	
Waiting Lists					-0.0009
					(0.0008)
Waiting Lists*91-96 dummy					0.0008
					(0.0011)
Intercept	-0.1699**	-0.1605**	-0.2539**	-0.2186**	-0.1720**
	(0.0188)	(0.0186)	(0.0449)	(0.0271)	(0.0187)
Regional effects	YES	YES	YES	YES	YES
R^2	0.5665	0.5625	0.513	0.6029	0.5646
N	1260	1120	567	630	1260
F test of supply variables	3.45	9.71	5.27	9.33	0.73

*Significant at the 5% level, **significant at the 1% level. Standard errors in parentheses

Table 1b: Weighted least squares regressions of private medical insurance

Supply side variables	NHS Expenditure	NHS Beds	Part time Consultants	Private Hospitals	Waiting Lists
Age of head	0.0026**	0.0022**	0.0055**	0.0038**	0.0027**
	(0.0002)	(0.0003)	(0.0006)	(0.0004)	(0.0003)
Income (£000's per year)	2.9870**	2.9929**	3.2320**	3.1229**	2.9011**
	(0.5661)	(0.5604)	(1.142)	(0.7883)	(0.5745)
Income^2 (£m per year)	-11.7251**	-12.0803**	-14.645	-14.6920**	-11.6467**
	(4.0891)	(4.0079)	(8.184)	(5.3911)	(4.1499)
Cohort 2	0.0013	0.0023	-0.0091	-0.0072	0.0002
	(0.0038)	(0.0038)	(0.0061)	(0.0053)	(0.0038)
Cohort 3	-0.0039	-0.00004	-0.0279**	-0.0155**	-0.0058
	(0.004)	(0.0042)	(0.0079)	(0.0056)	(0.0041)
Cohort 4	-0.0112*	-0.0024	-0.0517**	-0.0243**	-0.0140**
	(0.0047)	(0.005)	(0.0102)	(0.0066)	(0.0048)
Cohort 5	-0.030**	-0.0205**	-0.0888**	-0.0527**	-0.0335**
	(0.0056)	(0.006)	(0.0129)	(0.008)	(0.0058)
Cohort 6	-0.0488**	-0.0386**	-0.1156**	-0.0757**	-0.0529**
	(0.0066)	(.0072)	(.0152)	(.0097)	(.0069)
Cohort 7	-0.0559**	-0.0432**	-0.1409**	-0.0903**	-0.0611**
	(.0076)	(.0084)	(.0176)	(.0113)	(.008)
PMI *t-1*	0.2073**	0.1424**	0.0943*	0.0911*	0.2322**
	(.0269)	(.0287)	(.04)	(.0391)	(.027)
NHS Expenditure *t-1*	-0.0002**				
	(.0001)				
NHS Expenditure*91-96 dummy *t-1*	-0.0002*				
	(.0001)				
NHS Beds		-0.0123**			
		(.0031)			
NHS Beds*91-96 dummy		-0.0296**			
		(.0067)			
Part time Consultants			0.2517**		
			(.0895)		
Part time Consultants*91-96 dummy			0.2387*		
			(.0927)		
Private Hospitals				0.0050**	
				(.0017)	
Private Hospitals*91-96 dummy				0.0084**	
				(.0021)	
Waiting Lists					-0.0001
					(.0006)
Waiting Lists*91-96 dummy					0.0006
					(.0011)
Intercept	-0.1667**	-0.1554**	-0.2655**	-0.1981**	-0.1676**
	(0.019)	(0.0187)	(0.0448)	(0.0265)	(0.0194)
Regional effects	NO	NO	NO	NO	NO
R^2	0.5243	0.5313	0.4890	0.5755	0.5104
N	1260	1120	567	630	1260
F test of supply variables	18.33	29.55	24.45	28.53	0.16

*Significant at the 5% level, **significant at the 1% level. Standard errors in parentheses

Table 2: Weighted least squares regressions of private medical insurance purchase

Supply side variables	All supply variables	NHS Exp., NHS Beds & Waiting Lists	NHS Exp., Private Hosp. & Waiting Lists
Age of head	0.0044**	0.0033**	0.0038**
	(0.0013)	(0.0003)	(0.0004)
Income (£000's per year)	4.2183*	1.7931**	2.9149**
	(1.7485)	(0.5801)	(0.7776)
Income^2 (£m per year)	-21.0435	-5.7917	-13.1650*
	(12.3116)	(4.0794)	(5.3271)
Cohort 2	-0.0136	-0.001	-0.0062
	(0.0105)	(0.0038)	(0.0053)
Cohort 3	-0.0254	-0.0071	-0.0141*
	(0.0156)	(0.0045)	(0.0059)
Cohort 4	-0.0423	-0.0125*	-0.0225**
	(0.0216)	(0.0056)	(0.0073)
Cohort 5	-0.0710*	-0.0354**	-0.0513**
	(0.0282)	(0.007)	(0.0091)
Cohort 6	-0.0878*	-0.0581**	-0.0742**
	(0.0345)	(0.0084)	(0.0111)
Cohort 7	-0.1088**	-0.0697**	-0.0884**
	(0.0408)	(0.0102)	(0.0131)
PMI *t-1*	0.0295	0.0597*	0.0518
	(0.0598)	(0.0295)	(0.0391)
NHS Expenditure *t-1*	-0.00003	-0.0002	-0.0004
	(0.0005)	(0.0003)	(0.0003)
NHS Expenditure*91-96 dummy *t-1*	-0.0002	0.0001	0.0001
	(0.0006)	(0.0002)	(0.0002)
NHS Beds	0.0016	0.0148	
	(0.0332)	(0.008)	
NHS Beds*91-96 dummy	-0.0183	-0.0313**	
	(0.0398)	(0.0077)	
Part time Consultants	0.2065		
	(0.4242)		
Part time Consultants*91-96 dummy	0.908		
	(0.6421)		
Private Hospitals	0.0047		-0.004
	(0.0092)		(0.0048)
Private Hospitals*91-96 dummy	-0.0236		0.0075**
	(0.0169)		(0.0023)
Waiting Lists	-0.0027	0.0003	-0.0005
	(0.0053)	(0.0008)	(0.0013)
Waiting Lists*91-96 dummy	0.006	0.0025	0.0009
	(0.0057)	(0.0013)	(0.0016)
Intercept	-0.2624**	-0.1610**	-0.2151**
	(0.073)	(0.0189)	(0.0278)
Regional effects	NO	NO	NO
R^2	0.5397	0.5646	0.6042
N	224	1120	630
F test of supply variables	3.88	4.10	3.42

*Significant at the 5% level, **significant at the 1% level. Standard errors in parentheses

Table 3: Weighted least squares regressions of private medical insurance purchase using twice lagged quality measures

Supply side variables	NHS Expenditure	NHS Beds	Part time Consultants	Private Hospitals	Waiting Lists
Age of head	0.0037**	0.0037**	0.0053**	0.0035**	0.0038**
	(0.0003)	(0.0003)	(0.0009)	(0.0004)	(0.0003)
Income (£000's per year)	1.7068**	1.8149**	2.7739*	1.4005	1.6690**
	(0.5786)	(0.6034)	(1.1813)	(0.8939)	(0.5802)
Income^2 (£m per year)	-6.1777	-6.7187	-10.3906	-2.5702	-5.9412
	(4.1114)	(4.2714)	(7.9126)	(6.387)	(4.136)
Cohort 2	-0.0006	0.00003	-0.0163*	-0.0016	-0.0013
	(0.0038)	(0.0039)	(0.0081)	(0.0057)	(0.0038)
Cohort 3	-0.0088*	-0.0076	-0.0266*	-0.0077	-0.0102*
	(0.0043)	(0.0044)	(0.0122)	(0.0062)	(0.0041)
Cohort 4	-0.0190**	-0.0180**	-0.0544**	-0.0177*	-0.0210**
	(0.0053)	(0.0053)	(0.0162)	(0.0074)	(0.005)
Cohort 5	-0.0428**	-0.0418**	-0.0898**	-0.0391**	-0.0455**
	(0.0065)	(0.0064)	(0.0205)	(0.0089)	(0.006)
Cohort 6	-0.0675**	-0.0670**	-0.1193**	-0.0614**	-0.0707**
	(0.0079)	(0.0078)	(0.0241)	(0.0107)	(0.0073)
Cohort 7	-0.0833**	-0.0821**	-0.1325**	-0.0786**	-0.0872**
	(0.0094)	(0.0093)	(0.0276)	(0.0127)	(0.0086)
PMI *t-1*	0.0842**	0.0770*	0.0527	0.0487	0.0885**
	(0.0292)	(0.0301)	(0.0496)	(0.0429)	(0.0292)
NHS Expenditure *t-2*	-0.0002				
	(0.0003)				
NHS Expenditure*91-96 dummy *t-2*	-0.0002				
	(0.0001)				
NHS Beds *t-2*		0.0027			
		(0.0077)			
NHS Beds*91-96 dummy *t-2*		-0.0285**			
		(0.0072)			
Part-time Consultants *t-2*			-0.1817		
			(0.3316)		
Part-time Consultants*91-96 dummy *t-2*			0.3243**		
			(0.1169)		
Private Hospitals *t-2*				-0.0002*	
				(0.0001)	
Private Hospitals*91-96 dummy *t-2*				0.0088**	
				(0.0024)	
Waiting Lists *t-2*					-0.0001
					(0.0008)
Waiting Lists*91-96 dummy *t-2*					0.0015
					(0.0014)
Intercept	-0.1684**	-0.1699**	-0.2690**	-0.1725**	-0.1697**
	(0.0196)	(0.0206)	(0.0574)	(0.0306)	(0.0196)
Regional effects	YES	YES	YES	YES	YES
R^2	0.5490	0.5369	0.4718	0.5332	0.5470
N	1190	1120	427	560	1190
F test of supply variables	3.15	7.83	3.85	7.36	0.64

*Significant at the 5% level, **significant at the 1% level. Standard errors in parentheses