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Incomplete Risk Adjustment and Adverse Selection in the German Public Health Insurance System

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ABSTRACT

Incomplete Risk Adjustment and Adverse Selection in the German Public Health Insurance System

by Thomas Knaus and Robert Nuscheler[*]

The German statutory health insurance market was exposed to competition in 1996. To avoid adverse selection, a prospective risk compensation scheme was introduced in 1994. Due to their low contribution rates, company-based sickness funds were able to attract a lot of new members. We analyze – using data from the German Socio-Economic Panel – the determinants of these transitions from 1995 to 2000. By estimating a simultaneous two equation system, we find that health status positively, and significantly, affects the probability of changing to a company-based sickness fund, especially after controlling for age. Thus the risk compensation scheme does not fully control for the health status of the changers. Consequently, the comparative advantages of company-based funds will increase over time. This observation provides evidence for the standard Rothschild-Stiglitz separating equilibrium.

Keywords: Health insurance choice, adverse selection, risk compensation, bivariate probit model, health production
JEL classification numbers: C31, C35, I11, I18

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ZUSAMMENFASSUNG

Unvollständiger Risikostrukturausgleich und Adverse Selektion in der Gesetzlichen Krankenversicherung Deutschlands

In der Gesetzlichen Krankenversicherung wurde 1996 Wettbewerb zwischen den Krankenkassen eingeführt. Um Adverse Selektion zu verhindern wurde 1994 ein prospektiver Risikostrukturausgleich eingeführt. Aufgrund ihrer niedrigen Beitragssätze konnten die Betriebskrankenkassen eine Vielzahl neuer Mitglieder gewinnen. Wir nutzen Daten des Sozio-Oekonomischen Panels (SOEP), um diese Wechselbewegungen für den Zeitraum von 1995 bis 2000 zu analysieren. Ein Zweigleichungssystem wird simultan geschätzt. Es zeigt sich, dass der Gesundheitszustand, nachdem insbesondere für Alter kontrolliert wurde, die Wahrscheinlichkeit zu einer Betriebskrankenkasse zu wechseln signifikant positiv beeinflusst. Der Risikostrukturausgleich gleicht also Unterschiede im Gesundheitszustand nicht vollständig aus. Die komparativen Wettbewerbsvorteile der Betriebskrankenkassen werden somit über die Zeit ansteigen. Dies liefert Evidenz für das bekannte separierende Gleichgewicht von Rothschild und Stiglitz.

1 Introduction

During the last decades there have been many health care reforms in Germany. Most of these reforms were aimed at cost-containment. With the Health Care Reform Act 1989 the movement towards more competition in the health care market began. The Health Care Structure Act 1993 introduced more competition among the statutory health insurance companies.

About 90 percent of the German population are insured in statutory sickness funds (in Germany the health insurance companies are called sickness funds), most of them compulsorily. Since 1996 essentially free choice of sickness funds exists. To avoid adverse selection, sickness funds are not allowed to reject new applicants. Furthermore a risk compensation scheme was introduced in 1994. In this transfer scheme the contributions to the funds are redistributed according to the risk structure of the funds. The scheme is based on income, age, gender, sick pay claims, and incapacity for work. It was introduced to prevent sickness funds with better risk structures from having comparative advantages. Nevertheless, the fear of adverse selection as a consequence of sickness fund competition has been expressed quite often (see Lauterbach and Wille, 2001, p. 209).

As about 95 percent of the benefits of the funds are regulated by the Social Code Book V, it is usually argued that competition between sickness funds is mainly in terms of contribution rates (see e.g. Lauterbach and Wille, 2001, p. 29). If this were true, then health status would not have any effect on health insurance choice. However the remaining 5 percent of benefits may be decisive. The company-based sickness funds provide only very few of these extra benefits, while a substantial amount is provided on average by all the other funds. Since the healthy are more likely to switch to company-based sickness funds, the standard Rothschild/Stiglitz separating equilibrium arises where bad risks get full coverage at high premiums and good risks have partial coverage and low premiums.

The central research question of this paper is whether the introduction of competition between funds and free choice for individuals has led to adverse selection in the German Public Health Insurance System. To answer that question, we distinguish four different types of sickness funds: regional funds, substitute funds, company-based funds, and other

funds. As the company-based sickness funds, known as Betriebskrankenkassen (BKKs), have substantially lower contribution rates than all the other funds, it is usually argued that there is adverse selection in favor of the BKKs. Consequently we only analyze the movement towards the BKKs and its determinants.

A major issue in our analysis is disentangling health effects and age effects. Younger people are, on average, more likely to switch to a BKK. These people may be better informed about the possibility of switching or may simply have lower transaction costs of doing this. Healthy people are also more likely to change. As age is the most important determinant of health, a multivariate analysis is necessary to judge whether there is still a health effect after controlling for age. Potentially, a standard probit model is able to separate health effects from age effects. However, the results will be biased due to endogeneity. The health status variable in our data set is a discrete variable rather than continuous like actual health. Thus, health is measured with an error. Since age is a major determinant of health and of the probability of switching to a BKK, this is a source of endogeneity. We solve that problem by applying a simultaneous two equation probit model.

In our first equation we measure health status. As a proxy for individual health and especially for health care use, we use the self-assessed health status. Regressing more objective measures of health, such as visits to a doctor and hospital stays, on self-assessed health we obtain a continuous index measuring individual health. Other determinants affecting health are, e.g., age, gender, and disability. In our transition equation we include the variables used in the risk compensation scheme, the fitted health index, and some control variables. The resulting recursive bivariate probit model is estimated by a two-stage maximum likelihood procedure.

Using 1995 to 2000 data from the German Socio-Economic Panel (GSOEP) we find a significant effect of individual health on the probability of switching to a BKK, i.e., there is adverse selection. Since we control for the variables used in the risk adjustment scheme, risk compensation is incomplete. The adjusters are imperfect signals of actual health. Our analysis shows that the scheme can be improved simply by additionally adjusting for the health status index obtained from our first equation. Moreover, we find hazardous

dynamics in the German public health insurance market. The willingness to switch to a BKK increases rapidly over time and with it the distortions caused by comparative advantages due to risk structure.

The contribution of the paper is threefold. First, we control for endogeneity of health in the transition equation. Second, we use a generated continuous health index instead of the discrete health measure usually used. We thus provide a measure that can be used to improve the risk adjustment scheme. And third, we find a clear cut health effect in the transition equation using GSOEP data.

The paper is organized as follows: section 2 discusses the related literature in more detail. In section 3 we provide some more institutional details for the German health care system. In section 4 we present a theoretical model. The data set used, namely the GSOEP, and sample selection is described in section 5. Some descriptive statistics will also be shown. The econometric model is presented in section 6. Estimation results are discussed in section 7. Section 8 concludes.

2 Related literature

There is a large ongoing public policy debate on the issue of adverse selection and incomplete risk adjustment in Germany. In their recent report, Lauterbach and Wille (2001) analyze whether those individuals who change their sickness fund entail lower health care costs than individuals who stay with their fund. They use micro data provided by several sickness funds and find that changers have a positive effect on profits after risk compensation is carried out. This result still holds when controlling for age.[1] Moreover, Lauterbach and Wille (2001) use data from the German Socio-Economic Panel (GSOEP) to underline this result. As there are no health care cost figures in the data set but several variables explaining health status and health care use, they employ a factor analysis to

[1]Following Lauterbach and Wille (2001) the risk compensation scheme is incomplete. As the sickness funds have a positive profit margin when attracting new members, they propose to include a "change-status" variable in the scheme to remove these profits. Using a different data set, Jacobs et al. (2002) also find that changers cause lower health care costs than non-changers.

figure out the relationship between age and health status and age and health care use. They find that, on average, changers have better health. As changers are younger and as age is highly correlated with individual health, it is per se not clear whether there is still a positive health effect after controlling for age. But this is essential when judging on the risk compensation scheme. As mentioned above, the scheme offsets differences in age structures by transferring money from funds with a good (young) age profile to funds with a bad (old) age profile. If the health effect is not significant after controlling for age, then the risk compensation scheme completely controls for different health structures via offsetting age differences. The current paper fills this gap using a different econometric model, namely, a simultaneous two equation probit model. Thereby we are able to disentangle health and age effects and can assess the completeness of the risk adjustment scheme appropriately.

Andersen and Schwarze (1999) also analyze the determinants of a sickness fund change using GSOEP data. They concentrate on 1997 and 1998. In their single probit equation model, individual health satisfaction positively and significantly affects the probability of changing. At the same time, they obtain a significant negative effect of self-assessed health on the probability of transition. As both variables are measures of the actual health status, the overall effect of health remains unclear. Moreover, the different signs raise doubts about the appropriateness of the specification. In the recent work of Schwarze and Andersen (2001), the effect of the contribution rate on the probability of changing is analyzed. Using 1999 and 2000 GSOEP data and matched contribution rates of the sickness funds, they find that a higher contribution rate in 1999 significantly increases the probability of changing the sickness fund. Since contribution rate data is not available before 1999 we cannot include them in our analysis. As a proxy we use dummies for the different types of health insurance companies. Concerning health status, the effects in Schwarze and Andersen (2001) are ambiguous and insignificant.

In both papers by Andersen and Schwarze, a standard single equation probit model is applied. They use the discrete health status variable from the GSOEP as an explanatory variable. This causes an endogeneity bias. The actual (self-assessed) health status is a continuous rather than discrete variable. Consequently, when using the discrete variable,

health is measured with an error. Since the health status affects the probability to change to a sickness fund the error of health status is likely to be correlated with the error of the transition equation. We solve this endogeneity problem by applying a simultaneous two equation probit model. In a retirement model, Dwyer and Mitchell (1999) also control for the endogeneity of self-assessed health. We use a fitted health index, derived from a probit regression, as an explanatory variable in the transition equation. Using health indexes rather than the discrete variable obtained from surveys is common in recent research. Van Doorslaer and Jones (2002), for example, obtain a continuous health index from an ordered probit regression and use this index to measure inequality in self-assessed health. For a similar approach see Wagstaff and van Doorslaer (1994).

Since the self-assessed health status plays a central role in our analysis, our paper is related to the literature using or explaining self-assessed health. Bound (1991), for instance, uses the self-assessed health status as an explanatory variable in a retirement model. Pohlmeier and Ulrich (1992) derive a health index using self-assessed health. Most important is the recent work of Crossley and Kennedy (2002) on the reliability of self-assessed health. They find a substantial error in rating and also find that this error is highly correlated with observable variables like age, gender, and income. Thus, as already argued above, using a single probit procedure leads to a serious bias. This underlines the importance of our simultaneous approach.

Furthermore, the current paper is related to the econometrics literature on bivariate probit models. Heckman (1978) also treats the bivariate probit model without structural shift (his case 3). This model goes back to Ashford and Sowden (1970), Amemiya (1975), and Zellner and Lee (1965). Mallar (1977) provides a consistent two-stage estimator of the bivariate probit model. This estimator and its covariance matrix is shown in Maddala (1983, pp. 246-247).

There are very few applications of the bivariate probit model with endogenous regressors in the field of health economics. One exception is Holly et al. (1998). They study the relation of health insurance coverage and health care utilization in the Swiss health care market, i.e. they are concerned with moral hazard where we focus on adverse selection. Their econometric model differs from ours in that they apply a bivariate probit

model with an endogenous dummy variable while we consider the latent variable to be endogenous.

3 Institutional background

In 1977 the rapid growth of health care expenditure was stopped by the Health Insurance Cost-Containment Act. With this reform, an advisory body to the government, the so-called Concerted Action Committee in Health Care, was created. Its major task is to keep contribution rates constant. This essentially means that the increase in health care expenditure is limited to the increase in contributory income. Nevertheless, in the 1980s the contribution rates increased from 11.4 percent of gross income to 13 percent.[2] This pressure led to several additional health care reforms. 1989 can be seen as a starting point for introducing more competition into the health care market. Blue collar workers were put on par with white collar workers. They were now allowed to opt out the statutory health insurance if a certain threshold income is exceeded and buy private health insurance.[3] At this time, there was no free choice of sickness funds within the public health insurance system. Depending on their profession, members of the regional based funds were allowed to change to substitute funds and other funds (including guild funds, farmers' funds, the miners' fund, and the sailors' fund).[4] They were only allowed to change to a company-based fund (BKK) if they were actually employed in the company the fund was designed for. As a result of this limited competition, the contribution rates of the regional funds were significantly higher than those of the BKKs and the substitute funds (see figure 1).[5]

[2]See Bundesministerium für Arbeit und Sozialordnung, Federal Ministry of Labour and Social Affairs, 2001 (table 7.7).

[3]The information presented here and in the following is mainly taken from European Observatory on Health Care Systems, EOHCS (2000). For a more detailed description see EOHCS (2000, pp. 21-37, 107-116).

[4]The Techniker Krankenkasse (technicians sickness fund), for example, was designed for technicians and engineers only.

[5]In 1991 the average contribution rate in Western Germany of the regional funds was 12.75 percent of gross income, while it was 10.84 and 12.04 for the BKKs and substitute funds, respectively (Bundesmin-

[figure 1 about here][6]

With the Health Care Structure Act of 1993, competition in the health insurance market was intensified. All insured people were allowed to choose their sickness funds freely from 1996 onwards. To offset comparative advantages due to risk structure, a risk compensation scheme was introduced in 1994. Competition and the risk compensation scheme led to an adaptation of the contribution rates of the non-BKK funds. Unfortunately, we are not able to separate the competition effect from the compensation effect. In 2001 the BKKs depart substantially from the average contribution rate of all other funds. Since 1993 the BKKs have, on average, the lowest contribution rates. As is shown in table 1, competition between the sickness funds has led to a consolidation of the health insurance market. Due to mergers and market exits, the number of funds fell from 1,209 in 1991 by more than two thirds to 396 in 2001.

[table 1 about here]

More interesting for the question addressed in this paper are the transitions from one sickness fund to another. For the sake of presentation, we only show the trend for the members of the three main types of sickness funds, namely, regional funds, substitute funds, and BKKs (see figure 2). The regional funds continuously lost members from 1991 onwards. This trend actually started much earlier. In 1970, 52.4 percent of the statutory insured population in Western Germany were insured by regional funds. This number dropped to 42.8 percent in 1991 and 37.0 percent 2001. This was due to the higher average contribution rates (see figure 1). Members facing the high premiums changed to substitute funds if they were allowed to do so. In 1970, 22.9 percent of West Germany's statutory insured population were insured in substitute funds. The share increased to 34.0 percent in 1991, peaked in 1997 (37.1 percent), and then dropped back to 33.9 percent in 2001 (all numbers were taken from BMG, 2001, p. 345).

isterium für Gesundheit, BMG, Federal Ministry of Health, 2001, p. 396).

[6]In this version of the paper all figures and tables have been relegated to the appendix.

[figure 2 about here]

The increase in members in BKKs, together with the drop of the average BKK contribution rate from 1997 onwards, may be interpreted as an indication that risk separation favors the BKKs. From figures 1 and 2 one may conclude that the risk compensation scheme does not fully control for the different risk structures. There is a big political debate in Germany about this issue. The risk compensation is done in the following way: the contributions of each fund are multiplied by a factor that measures the average contribution rate over all funds that is used for health care benefits. This amount is transferred to the clearing authority (Bundesversicherungsamt, Federal Insurance Office). The amount remaining to the funds is used to cover administrative costs. With this step, different income profiles are offset. Each member of each fund is then assigned to one of more than 100 risk groups that are created on the basis of three variables: age, gender, and incapacity for work. Differences in sick pay claim expenses are offset separately. For each person insured the fund gets back the average amount of health care expenditure over all funds in the respective risk group. If a fund has a good risk structure then there is a positive net payment to the clearing authority that benefits a fund with a bad risk structure. Thereby, different risk structures should be offset and with them comparative advantages due to risk structure. A sickness fund obtains positive profits when health care expenditure is below the average or if administrative costs are low. Thus the risk compensation scheme rewards relative competitiveness and cost-containment. Whether this compensation scheme completely controls for health status and/or health care use is the question addressed in the current paper. Reports using data provided by sickness funds usually conclude that the risk adjustment scheme is incomplete, i.e. that there is still a health effect after risk compensation is carried out (see Breyer and Kifmann, 2001, and Lauterbach and Wille, 2001). The federal government plans to include a morbidity measure into the transfer scheme in 2007. Using a bivariate probit model, we show that this result is also obtained when using GSOEP data. We thus underline the necessity of including a kind of morbidity measures in the transfer scheme. Moreover, we show that a simple health status index can be used to reduce the distortions found the German

statutory health insurance market.

4 A theoretical model

As mentioned above, it may be concluded from figures 1 and 2 that there is adverse selection in the German statutory health insurance market even though risk compensation is carried out. The average contribution rate of the BKKs are significantly lower than those of all the other funds. This points to a better health structure of the BKKs.

In the introduction, we mentioned that it is usually argued that competition between sickness funds is in terms of contribution rates since 95 percent of the health care benefits are regulated by the state. If the benefits were really the same, then healthy and unhealthy people should have the same incentive to switch since both can benefit from the lower contribution rate without losing any health care benefits. It can be argued that sick people and bad risks have higher transaction costs of changing. Sick people usually have better things to do, e.g. undergoing treatments, than changing their fund. Bad risks may have lower benefits from changing. When they need some treatment for which they must have an approval from their fund in order to be reimbursed, they are informed how to apply, and whom to ask, since it is likely that they have previously applied for a treatment. This information would be lost if they changed the fund. The weakness of this argument is that transaction costs are not observable.

The unobservability of transaction costs, together with the substantial variation in extra benefits, mean that it would seem very likely that these extra benefits are decisive for health insurance choice. When insurance coverage matters, simple insurance theory can be applied to characterize the movement of the German public health insurance system. Consider a competitive health insurance market and two types of potential health insurance buyers: bad risks with a high probability of health care use and good risks with a low probability. Then the standard Rothschild/Stiglitz separating contract (see Rothschild and Stiglitz, 1976) would have fair premiums for both types, but only part coverage for the good risks while the bad risks receive full coverage. Part coverage prevents selection of the bad risks although the premiums are lower. It turns out that the BKKs

only provide very few of these 5 percent extra benefits whereas all other funds provide quite a lot (see AFW Dienstleistungsgesellschaft, 2002). Hence, the BKKs only provide part coverage and all other funds (nearly) full coverage. The healthy individuals care less about health benefits than sick people as they are unlikely to demand any treatments. On the other hand, health care benefits are decisive for bad risks as they are likely to need them. Thus, by reducing benefits the BKKs can set a lower premium than all the other funds without attracting the bad risks. Adverse selection is used for cream skimming.

Given that transaction costs are negligible and that the health care benefits are not decisive for health insurance choice, it is difficult to explain in economic terms why more healthy people are more likely to be in a BKK or are more likely to change to a BKK. One potential argument is: when a person is sick and consumes treatments, he does not want to switch since he wants to pay back the costs of the current treatment with future contributions. This is not very convincing, since an individual who is sick today is more likely to be a bad risk. So if the person insured wants to do his fund a favor he should switch rather than staying with the fund. Another non-standard explanation is loss aversion. Sick people are informed about the health care benefits of their fund, but uninformed about the benefits of all the other funds. Healthy people are also uninformed about the benefits of their funds as they have not yet purchased any treatment. The asymmetry for the sick people makes it more likely that they will stay with their fund than the healthy who find themselves in a symmetric situation. Since information on benefits can easily be obtained from the internet for a lot of funds (see AFW Dienstleistungsgesellschaft, 2002), loss aversion cannot explain the situation of the German public health insurance.

After other potential explanations are ruled out, the Rothschild/Stiglitz equilibrium remains as the only convincing theoretical prediction. The BKKs reduce their benefits and simultaneously cut their contribution rates. Thereby the BKKs mainly select the healthy. All the other funds are left with the bad risks and, consequently, with high premiums. Since this equilibrium forecasts the situation observed in Germany exactly, the hypothesis for our empirical model is a positive (and significant) health effect in the transition equation. This hypothesis will be confirmed. This implies that the risk adjustment scheme is incomplete and thus makes risk selection beneficial.

5 Data, sample selection, and descriptive statistics

To explore health and health insurance choice in Germany after the natural experiment in 1996 we use the German Socio-Economic Panel (GSOEP). The GSOEP is a representative longitudinal study of private households in Germany. The same private households, persons and families have been surveyed annually since 1984. This micro data panel provides extensive information on the individual characteristics needed to analyze health and health insurance choice in Germany.[7]

The empirical results presented in this study are based on the waves from 1995 to 2000. In 1998 the GSOEP was extended by the Supplementary Sample E. The Sample F was a major extension of the GSOEP in 2000. Both samples are included in our analysis. The different waves are pooled into one sample.

The two dependent variables to be explained by our empirical model are health status and health insurance choice. Health status is collapsed into a discrete dummy variable representing good health ($y_1 = 1$) and bad health ($y_1 = 0$). It is constructed from the variable "(self-assessed) health status at present", which is dicretized into five categories, by collapsing good health and very good health to $y_1 = 1$. The second dependent variable to be explained is the switch to a company-based sickness fund (BKK) which became possible after 1995. The dummy variable is constructed to equal one for individuals who were not member in a BKK in one year but are members in the following year. These are the two generated dependent variables in our two equations system. We analyze the flow to the BKK and not the stock of individuals in the BKK. We thereby explicitly take the dynamics in the public health insurance system into account.

As a sub-sample of these six waves of data we selected only individuals who were not privately insured. Only individuals who were members of the statutory health insurance are included, since they were the only ones who had new incentives to change to a BKK after the 1993 reform. Since we are interested in the determinants of movements to BKKs we selected only individuals who were not members of a BKK before the change, i.e. we

[7]For more information on the GSOEP see Wagner, Burkhauser and Behringer (1993) and also Projektgruppe Sozio-oekonomisches Panel (1995).

do not consider movements from one BKK to another. Since family insured members have only limited freedom to choose their health insurance, they were excluded. Finally, we restricted our sample to the working population aged between 25 and 54. This is done in order to exclude special incentives for individuals in the education system and for those close to retirement. The sample sizes before and after selection are shown in table 2. In this table we also show the percentage of changers in every year, calculated from the selected samples. From 1995 to 1996 only 1.23 percent of the sample changed to a BKK. This number increased continuously to 4.17 percent in 1999 with an average over all years of 2.8 percent. These numbers show the increasing willingness to change. This may be due to incentives increasing over time, since the contribution rate differential was also increasing (see figure 1). But it may also reflect the fact that the information about the possibility of changing has spread over time. In the transition equation, taking 1995 as the reference year, positive coefficients for the year dummies that increase over time would be expected for the estimation results. Explanations of the variables (table 4) and the entire sample statistics based on the pooled selected sample (table 5) are shown in the appendix .

[table 2 about here]

Table 3 shows the main relationship we focus on in this paper. On average, 2.8 percent of the population in our sample enrolls in a BKK every year during our period of analysis. This proportion is declining with age. 4 percent of the youngest age group, between 25 and 29 years old, change to a BKK. On the other hand, only around 2 percent of the two oldest age groups between 45 and 54 years old change. We can also see from table 3 that around 70 percent of the changers are healthy, while only less than 60 percent of the non-changers say they are healthy. This means that changers are likely to be healthier. Thus, changers are not only younger, they are also healthier. The question is whether the transition probability is significantly affected by age, health, or both. When controlling for age, it is unclear whether a significant health effect remains. To disentangle age effects and health effects, a multivariate analysis must be used. Because of its major advantages

over single probit procedures, as argued before, we use a simultaneous two equation system as an empirical specification to address this issue.

[table 3 about here]

6 The empirical model

Usually the transition from one sickness fund to another is modelled by a standard probit model[8] of the form

$$y_2^* = \beta_2 x_2 + \alpha \cdot (\text{health status}) + \epsilon_2,$$

where y_2^* is an unobserved latent variable that assumes a positive value when the underlying observable indicator variable y_2 is equal to one and a negative value when y_2 equals zero. $y_2 = 1$ indicates that the individual actually switched to a BKK and zero if not. The set of exogenous variables is denoted x_2. It contains controls such as age, gender, income, and so forth. Usually health status is included as an additional discrete exogenous variable. But, as already argued in the introduction, the estimates are biased due to endogeneity. The actual (self-assessed) health status is a continuous variable rather than a discrete one. The discrete variable measures health with an error. Since health status affects the probability of changing a sickness fund, the error of health status is likely to be correlated with the error of the transition equation. This argument is supported by the recent work of Crossley and Kennedy (2002). They analyze the reliability of self-assessed health for Australian data. Individuals are asked to rate their health twice, before and after an additional set of health related questions. As about 28 percent change their rating, there is a reasonable error in self-assessed health. They find that the error is strongly related to observable variables such as age, gender, income, and so forth. Since we use all these variables as regressors in our transition equation, introducing the discrete health measure as an additional explanatory variable would lead to seriously biased estimates. In contrast, our simultaneous approach provides consistent estimates.

[8]For the standard probit model see for example Greene (1997, pp. 873-888).

Moreover, active individuals are likely to be more healthy. We try to capture this by including the variable "active sport" in the health status equation. However, although this variable is not a very accurate approximation of activity, it is the best measure available in the GSOEP. Since the transition itself is also a measure of activity, there is potentially another source of correlation between the error terms, i.e. another source for endogeneity.[9]

To control for the endogeneity, and to obtain consistent estimates, we consider the following recursive bivariate probit model:

$$y_1^* = \beta_1 x_1 + \epsilon_1, \tag{1}$$

$$y_2^* = \beta_2 x_2 + \alpha y_1^* + \epsilon_2. \tag{2}$$

Both latent variables y_1^* and y_2^* are not observed. Only the dichotomous variables satisfying

$$y_i = \begin{cases} 1 & if \quad y_i^* \geq 0 \\ 0 & if \quad y_i^* < 0 \end{cases} \qquad \text{for } i = 1, 2$$

are observable. The first equation describes the individual (self-assessed) health status. Latent health, denoted y_1^*, is estimated by a couple of more objective measures for health, such as doctor visits, hospital stay, long periods of absence from work due to illness, and so forth. A number of control variables are also included, e.g. age, gender, and income. As mentioned in the preceding section, $y_1 = 1$ indicates good health or very good health.

As in the ordinary probit model, the parameter values are only identified up to constants. Actually, equation (1) is a standard probit model. Let λ_i, $i = 1, 2$, denote the standard errors of the reduced form residuals, then—as in the standard probit model—only β_1/λ_1 can be estimated. For equation (2), we have to distinguish between the exogenous variables x_2 and the endogenous variable y_1^*. For the exogenous variables, as for the first equation, only β_2/λ_2 can be estimated. For the endogenous variable we have $\alpha\lambda_1/\lambda_2$. For the structural form disturbances ϵ_1 and ϵ_2 let $Var(\epsilon_i) = \sigma_i$, $i = 1, 2$ and $Cov(\epsilon_1, \epsilon_2) = \sigma_{12}$. Then only σ_1/λ_1, σ_2/λ_2, and $\sigma_{12}/(\lambda_1\lambda_2)$ are identified. Of course, $\sigma_1 = \lambda_1$ since the structural form of equation (1) coincides with its reduced form.[10] For

[9] Including y_2^* as an explanatory variable in the health status equation does not change the results. We excluded it from the paper since the effect is insignificant.

[10] For a more general treatment see Maddala (1983, pp. 93-96, 246).

identification of the model, there must be at least one variable in x_1 that is not in x_2 in order to obtain some variation for the estimation of α. x_2 may contain a number of additional variables not included in x_1.

Following Maddala (1983, p. 246), the bivarate probit model given by equations (1) and (2) is estimated by a two-stage maximum likelihood procedure. First, the health status equation (1) is estimated by ordinary probit. Second, the fitted values are used in the transition equation (2). The estimate of the structural equation is again obtained by ordinary probit. As was shown by Mallar (1977), this estimator is consistent. The covariance matrix is provided in Maddala (1983, p. 247). As a consequence of the estimation procedure, we control for endogeneity of health status in the transition equation but neglect potential correlation between the error terms.

Note, that is is also possible to estimate an ordered probit model for the first equation. However, the estimation results of the transition equation are extremely robust. So, in principle, collapsing self-assessed health from 5 to 2 categories is unnecessary.

In contrast to Holly et al. (1998), we decided to use the unobserved latent variable as endogenous rather than the observed dichotomous variable. Individual health status is likely to be a continuous variable not properly approximated by a dichotomous variable. Thus, the fitted health status index yields a much better explanation of actual health than the dummy variable.

7 Results

The estimation results are presented in table 6 (see appendix). The most important result is the positive effect of health status on the transition probability. The marginal significance level is about 7 percent. This means that there is a substantial amount of adverse selection in the system.

7.1 Health status equation

The variables measuring health care utilization, i.e. a doctor visit (visit to a doctor), the number of doctor visits, and a hospital stay, significantly reduce the individual health

status. Additionally, health status is also a product of the personal health and sickness history. This history is approximated by the likelihood of impairment due to illness, the probability of being disabled, being unable to work (incapacity for work), and being absent from work because of illness for at least six weeks during the last year (sick 6 weeks). All these events and characteristics influence the health status of the individual negatively and are highly statistically significant.

Health also decreases significantly with age. The effect of age on health already points to the difficulty of disentangling age effects and health effects in the transition equation. This relationship also shows the potential problems society will have to face when the demographic aging trend continues.

A very important variable is whether individuals are actively doing sport at least once a month. The effect on health is positive and highly significant. As mentioned in section 6, this variable may be source of endogeneity. This variable is also very important from the health production theory perspective, put forward in the seminal work of Grossman (1972), since active sport can be seen as a proxy for investments in health capital which increases health capital in a dynamic framework.

Higher education, measured by the time spent in the education system, yields significantly better health. This reflects the complementarity between education and health. Dummies indicating different levels of education were excluded due to their statistical insignificance. However, they did not change the pattern of results presented here.

Women report better health although this is statistically insignificant. Unemployment significantly reduces health. Of course, with unemployment there could be reverse causality. Since this relationship is not the main focus of our analysis, we do not follow this route and just include unemployment as a control variable. Foreigners report significantly better health. White collar workers are found to be significantly healthier on average. This is plausible because their jobs tend to be physically less demanding.

Finally, the log of net income is included in the health production function to measure the access to the economic resources of health production. Furthermore, net income is a proxy for education, since education affects wage earning abilities. Although it has the right positive sign, the coefficient is not statistically significant.

7.2 Transition equation

The most important result of our empirical investigation is that health status positively affects the probability of changing to a company-based sickness fund (BKK). We obtain a marginal significance level of around 7 percent. This result provides evidence for a substantial amount of adverse selection in the German statutory health insurance system. In the institutional background section, we argued that there is already adverse selection in the market, since the contribution rates of the BKKs are, on average, well below those of all other types of funds. Our analysis shows that this problem will become increasingly severe over time, since it is the healthy who are more likely to change. Note that health is significant, although we control for the variables included in the risk compensation scheme, i.e. gross income, age, gender, and incapacity for work.[11] Risk adjustment based on these variables does not fully control for health status, because, otherwise, the health effect would be insignificant. Therefore, the risk compensation scheme now in operation in Germany is not complete. The scheme should be reshaped to take better account of health, e.g. by including some measures of morbidity. This is on the political agenda and the discussion about it is lively. The current plans propose introducing a morbidity oriented risk compensation scheme in 2007. Our analysis shows the necessity of such a reform by presenting the dynamics of transition. Moreover, we provide a measure, i.e. the individual health status index, that can be used to improve the scheme.

Apart from their health status, individuals with higher gross income (measured in logs) are significantly more likely to change to a BKK. We have chosen gross income as an indicator of the financial state of an individual, since the contributions to the sickness funds in the German public health insurance system are payroll taxes. We thus capture the financial incentives for changing. In absolute terms, individuals with higher incomes benefit more from lower contribution rates.

Individuals in substitute funds, or funds other than regional ones, are significantly more likely to change to a BKK. Again, there is potentially a component which measures

[11] In our estimate we cannot control for the fifth variable included in the scheme, namely, sick pay claims. This variable is not available in the GSOEP. We are optimistic, however, that this does not change results.

incentives in these dummy variables: from figure 1 we know that substitute funds have slightly lower contribution rates than the regional funds. The latter are the reference category in our estimation. We would expect a negative sign, since members of regional funds benefit more from changing to a BKK, but what we observe is a positive and significant sign for the coefficients. Although this result is in contrast to the incentive interpretation, it does not raise doubts about it. It only shows that these highly aggregated dummy variables fail to measure the contribution rate effect properly. In the GSOEP, contribution rates are not available before 1999. Schwarze and Andersen (2001) take contribution rate effects into account for the 1999-2000 change.

More highly educated people (measured in years) are less likely to change although this effect is not significant. White collar workers are significantly more likely to change to a BKK than other workers. Both full-time and part-time workers are more likely to change to the BKK than the reference category (see the variable "less time" in table 4) although the effects are not significant. The unemployed are less likely to change. Again this effect is not significant. These variables are included anyway to control for the different labor market status of individuals which can also be related to the flexibility and activity level of individuals. Women are more likely to change and foreigners less likely. Neither effect is significant.

We included the probability of disability in the estimation as the only objective health variable affecting the health insurance decision. Our identifying assumption normally is that objective health variables affect the transition probability only via the health status equation. Probability of disability is an exception to this rule, since this variable is also included in the institutional risk adjustment scheme as outlined above. However, this variable has a positive but insignificant effect on the transition probability. Adjusting for disability may be important with regard to the stock of members. But it is not important when analyzing the flow to the BKKs.

The indicator for not being a single household affects the transition probability negatively. The variable may be interpreted as measuring higher transaction costs of changing when there are family insured members. However, the effect is statistically insignificant.

Older individuals are significantly less likely to change to a BKK. The reason for this

behavior can be found in the higher transaction cost at later stages of life. It may be more difficult for older people to become informed about the possibility of changing, and, more importantly, older people are better informed about their current sickness fund, because of their sickness history. If, for instance, they apply for a course of treatment they know exactly what to do and whom to contact. This knowledge is lost when the fund is changed.

As we expected from table 2, all coefficients for the year dummies are significantly positive and increasing over time. Over the years more individuals become informed about the possibility of changing. Additionally, diverging contribution rates increase the financial benefits of changing. This points to potential hazardous dynamics in the German health insurance system. This result is in line with Greß et al. (2002). They analyze the price sensitivity of sickness fund choice in Germany and find increasing price elasticities over time.

7.3 Public policy

The empirical model developed in this study accounts for many plausible economic effects. The goodness of fit measures suggest that the model fits the data reasonably well, especially considering that only about three percent of the non-BKK members actually change. Our conclusions for current public policy debate in Germany is that there should be some mechanism which takes account of the changing health structure of the different types of public sickness funds. According to our central result—that health affects the transition probability—the risk compensation scheme does not properly take account of the dynamics in the system, i.e. risk adjustment is incomplete. There are no alternatives to introducing some morbidity measures or health status measures, and these should be introduced as soon as possible, since the distortions increase over time. We provide a simple measure, namely the continuous health index, that can be used to improve risk adjustment. From the predictive power perspective, health status is not the most preferred variable (see Van de Ven and Ellis, 2000). However, adding health status as a third explanatory variable to age and gender significantly improves the risk adjustment (for U.S. data see Pope et al., 1998, and Newhouse et al., 1989).

8 Conclusion

In 1996, a natural experiment started by the opening of the German statutory health insurance market to competition. People insured were now allowed to choose their sickness fund freely. To avoid adverse selection, insurance companies are not allowed to reject new applicants. Moreover, a risk compensation scheme was introduced to offset comparative advantages resulting from differing risk structures. The transitions towards the company-based sickness funds (BKKs), together with the low contribution rates, raise doubts about whether the scheme fully controls for different risk profiles. The aim of the paper was to check this using data from the GSOEP.

Studies using micro data provided by sickness funds usually find that the risk adjustment scheme is incomplete (see e.g. Breyer and Kifmann, 2001). But this was never shown using GSOEP data. There is some evidence for incompleteness in the recent report by Lauterbach and Wille (2001) but they do not come up with any significance level. This is one advantage of our statistical model. Andersen and Schwarze (1999) and Schwarze and Andersen (2001) produce ambiguous and insignificant results for this issue. We show, using a econometric model different from those used in the studies cited above, that significant incompleteness of the scheme can be found using GSOEP data.

We used a recursive bivariate probit model to analyze the transitions to BKKs. In the first equation, individual health is estimated. Using the self-assessed health status as the dependent variable, we obtain a continuous health index from more objective determinants of health and health care use. This provides a much better approximation of the actual health status since health is continuous rather than discrete like the GSOEP variable. The discreteness of health together with the substantial measurement error causes an endogeneity bias when estimating the transition equation alone. We control for endogeneity and obtain consistent estimates by estimating a simultaneous two equation system.

We found that health status positively, and significantly, affects the probability of changing to a BKK. Since we controlled for the variables used in the risk compensation scheme, the scheme can be judged as incomplete. Using income, age, gender, sick pay

claims, and incapacity for work does not fully offset different risk structures. Thus, the problem of adverse selection, already present in the German health insurance market, will increase over time. We can conclude from our empirical model that both the younger and the healthier individuals are more likely to change to a BKK, i.e. there is not only an age effect but also a health effect.

Some health measures have to be included in the risk compensation scheme to reduce or to remove the distortions in sickness fund competition. This may be done by some measures of morbidity. Thus we underline the current plan of the government of introducing morbidity measures to the scheme. Since this reform is planned for 2007, and since there is a lively debate about this issue, it is still unclear whether this reform will really be established. Our analysis shows (i) the necessity of the reform, (ii) that it would be better to do it today rather than tomorrow, as distortions increase over time, and (iii) that a simple health status index could be used to mitigate the problem.

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Appendix

Figures

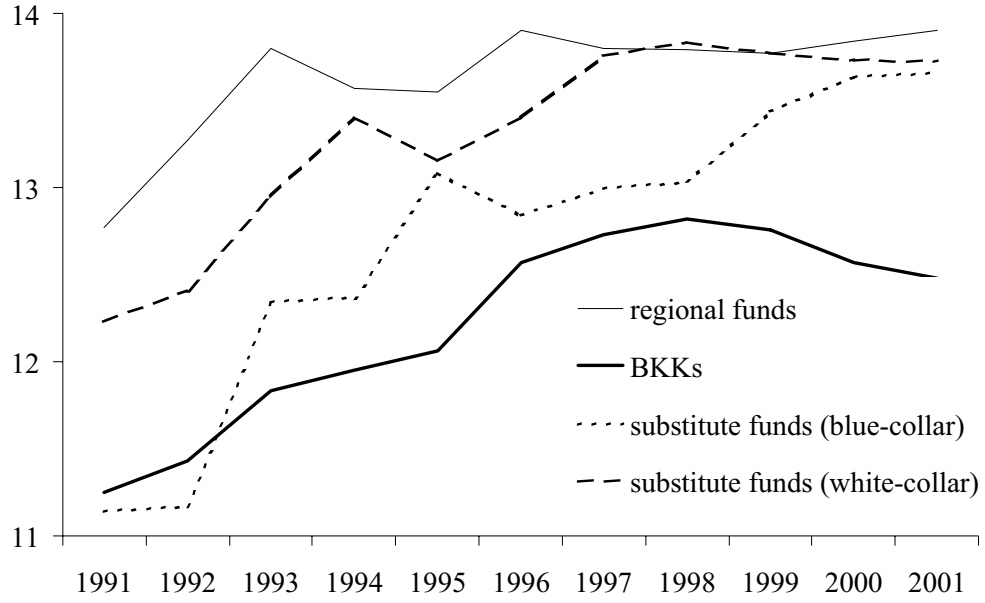

Figure 1: Percentage contribution rate averages for the different types of sickness funds. Source: BMG (2001, p. 396).

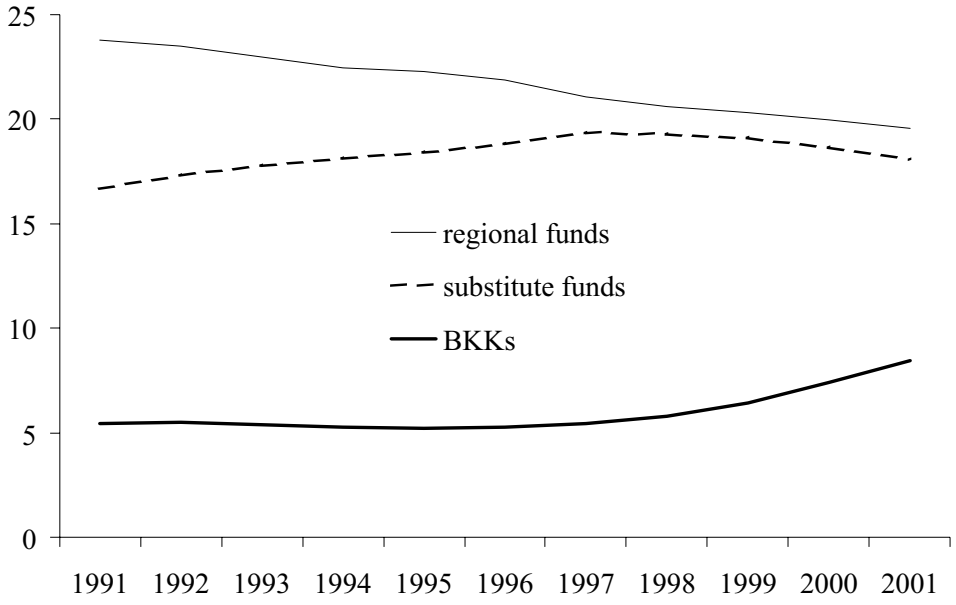

Figure 2: Members in 1,000,000 (without their dependants) of the different types of sickness funds. Source: BMG (2001, p. 344).

Tables

year	overall	regional funds	company-based funds	substitute funds
1991	1,209	276	721	15
1992	1,223	271	741	15
1993	1,221	269	744	15
1994	1,152	235	719	15
1995	960	92	690	15
1996	642	20	532	15
1997	554	18	457	14
1998	482	18	386	13
1999	455	17	361	13
2000	420	17	337	12
2001	396	17	318	12

Table 1: Number of active sickness funds in the German statutory health insurance market, other funds are omitted. Source: BMG (2001, p. 342).

year	N full sample	N after selection	percentage of changers
1995	13,768	1,713	1.23
1996	13,511	3,571	1.96
1997	13,283	3,431	2.80
1998	14,670	3,463	3.03
1999	14,085	3,550	4.17
overall	69,317	15,728	2.80

Table 2: Sample selection and the percentage of changers. Source: GSOEP 1995-2000, own calculations.

age	N	percentage of changers	percentage of healthy		
			all	changers	non changers
25 – 29	2,609	3.99	76.39	77.88	76.33
30 – 34	3,139	3.50	68.84	77.27	68.54
35 – 39	3,070	2.54	62.38	67.95	62.23
40 – 44	2,626	2.32	53.08	63.93	52.83
45 – 49	2,452	2.00	48.53	67.35	48.15
50 – 54	1,832	2.07	42.03	47.37	41.92
overall	15,728	2.80	59.91	70.23	59.62

Table 3: Age, health status, and the movement to the BKKs. Source: GSOEP 1995-2000, own calculations.

Variable	**Explanation**
health status	self-assessed health status, 1 = good or very good health, 0 else
wbkk	change to a BKK, 1 = yes, 0 = no
log(net income)	natural logarithm of net income
log(gross income)	natural logarithm of gross income
education time	years in the education system
age	age in years
number doctor visits	number of visits to doctors during the last three months
exogenous dummies:	
substitute fund	1 = membership in a substitute fund
other funds	1 = membership in other funds
regional fund*	1 = membership in a regional fund
full time	1 = full time employed
part time	1 = part time employed
less time*	1 = short working hours, self-employed, maternity leave,...
no single	1 = no single household
yearXX	1 = year 19XX, year95*
disabled/incapacity	1 = disability or incapacity for work
white collar	1 = white collar employee
unemployed	1 = unemployed
female	1 = female
foreigner	1 = non-German nationality
impair	1 = health status prevents from completing everyday tasks
doctor visit	1 = at least one visit to a doctor during the last three months
hospital stay	1 = hospital stay during the last year
sick 6 weeks	1 = work disability for longer than 6 weeks during the last year
sport	1 = active sport at least once a month

Table 4: Explanations of variables. Note: * indicates that the variable is a reference category in our estimation.

Variable	**Mean**	**SD**	**Min**	**Max**
health status	0.5991	0.4901	0	1
log(gross income)	8.1380	0.5021	4.6151	11.3767
substitute fund	0.4796	0.4996	0	1
other funds	0.0988	0.2984	0	1
full time	0.8362	0.3701	0	1
part time	0.1469	0.3541	0	1
no single	0.6804	0.4663	0	1
year96	0.2274	0.4189	0	1
year97	0.2181	0.4130	0	1
year98	0.2202	0.4144	0	1
year99	0.2257	0.4181	0	1
disabled/incapacity	0.0451	0.2075	0	1
education time	11.8831	2.4412	0	18
white collar	0.5238	0.4995	0	1
unemployed	0.0598	0.2372	0	1
female	0.4512	0.4976	0	1
foreigner	0.1307	0.3371	0	1
age	38.4865	8.1378	25	54
log(net income)	7.7008	0.4843	4.6151	10.3090
impair	0.2528	0.4346	0	1
doctor visit	0.6285	0.4832	0	1
number doctor visits	2.0167	3.4027	0	90
hospital stay	0.0828	0.2756	0	1
sick 6 weeks	0.0408	0.1977	0	1
sport	0.3384	0.4732	0	1
observations	15,728			

Table 5: Sample Statistics. Source: GSOEP 1995-2000, own calculations.

	Health Status		Transition	
Variable	**Coeff.**	**s.e.**	**Coeff.**	**s.e.**
health status			0.0578^{*}	0.0327
log(gross income)			0.1857^{***}	0.0588
substitute fund			0.1232^{**}	0.0558
other funds			0.3231^{***}	0.0641
full time			0.1665	0.1799
part time			0.1478	0.2121
no single			−0.0662	0.0472
year96			0.2048^{**}	0.1026
year97			0.3345^{***}	0.0923
year98			0.3607^{***}	0.0975
year99			0.5051^{***}	0.0921
disabled/incapacity	-0.2008^{***}	0.0625	0.0592	0.0944
education time	0.0106^{**}	0.0054	−0.0062	0.0098
white collar	0.0884^{***}	0.0280	0.1231^{**}	0.0579
unemployed	-0.0977^{**}	0.0483	−0.1341	0.1082
female	0.0144	0.0292	0.0169	0.0499
foreigner	0.1644^{***}	0.0364	−0.0329	0.0718
age	-0.0277^{***}	0.0014	-0.0124^{***}	0.0032
log(net income)	0.0318	0.0281		
impair	-1.3687^{***}	0.0284		
doctor visit	-0.2007^{***}	0.0282		
number doctor visits	-0.0591^{***}	0.0054		
hospital stay	-0.1697^{***}	0.0442		
sick 6 weeks	-0.2172^{***}	0.0676		
sport	0.1742^{***}	0.0250		
const	1.4449^{***}	0.2223	-3.5332^{***}	0.4378
Observations	15,728			
Log likelihood	-8047.00		-1929.45	
Pseudo R^2	0.2402		0.0388	
LR chisq(14/18)	5087.39		155.92	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 6: Simultaneous estimates of the recursive probit model.