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Health Relevant Behavior and its Impact on the Physician-Patient Relationship

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Abstract

The importance of the physician-patient relationship for the health care market is beyond controversy. Recent work emphasizes a two-sided asymmetric information relationship between physician and patient. In contrast to most work looking only at the physician's perspective, our paper concentrates on the patient's view. Estimation results support the hypotheses that physician consultation and health relevant behavior are not stochastically independent. In the recursive bivariate probit model, patient’s health relevant behavior has a significant influence on the probability of a physician visit. This means that health care demand and not only the contact decision is determined by both, patient and physician.

Keywords: physician-patient relationship, health behavior, bivariate probit panel

JEL-classification: I 12, C 33, D82

1 Introduction

In the political discussion about reforming the health care sector in Germany and especially the Statutory Health Insurance (SHI) the focus is on health expenditures and financing health care. In detail, this corresponds to questions concerning the dynamics of expenditures and the slackness of revenues raised as percentage of wage income. Proposals that focus on the relationship between physician and patient play an underpart in the debate about the future design of the health care system. In the last years, regulation has taken place in the benefits catalogue and levels of coinsurance but not in the physician-patient relationship. In contrast to health politics, the advisory council for the health care system has stressed the importance of patient's personal responsibility (cf. Advisory Council for the Concerted Action in Health Care (2001)). In fact, the responsibility is often misconceived as only financial participation of the patient on his health care expenditures.

The patient's special attitude in his relation to the physician can be described by the keyword patient orientation (cf. Advisory Council for the Concerted Action in Health Care (2003), p. 38). Compared to other parts of the service sector, the health care sector has some characteristics that prevent a better patient orientation. On the one hand, 99 % of the patients demand for medical services is based on their status as insured persons. Therefore, it is not possible to speak of free consumption because of the regulations of this market. On the other hand, asymmetric information is prevalent in the physician-patient relationship. Moreover, the medical services can be classified as experience goods, so that the patient's role in the health production is one of a "co-producer of health care" (Advisory Council for the Concerted Action in Health Care (2003), p. 40). [1]

From a theoretical point of view, patient's influence on the physician-patient relationship can be analyzed from the perspective of economics of information. Most of the theoretical models in this field are based on the physician's behavior whereas the patient's health related behavior is neglected. Our paper emphasizes the patient's view of the physician-patient relationship. Therefore, we focus on models that incorporate explicitly the patient's health related behavior. It is important to keep in mind that the term health related behavior has a broader meaning than the term compliance, which indicates the patient's complimentary treatment behavior. From an empirical perspective, especially the analysis of the determinants

[1] In many cases, the services supplied can be denoted as confidence goods because the patient is not able to monitor their quality ex post.

of patient's behavior as well as the determination of factors influencing the relationship between a patient and his physician are at the center of interest.

The paper is organized as follows: The second chapter discusses the German health care system and presents some theoretical models of the physician-patient relationship that deal explicitly with the patient's behavior. With the results of these models in mind testable hypotheses about patient's behavior are developed. The econometric techniques and the data used are presented in the third part of the paper. The determinants of individual health relevant behavior and physician consultation are investigated using a bivariate probit model for panel data. The fourth chapter presents and discusses the obtained results. The paper ends with a conclusion.

2 The relationship between physician and patient and the market for health care services in Germany: some theoretical background

The German health care system is characterized by a Statutory Health Insurance system (SHI) with competing sickness funds and a private/ public mix of providers. Recently, around 90 % of the population is covered by comprehensive SHI. In addition, approximately 9 % have a private health insurance including insured in governmental schemes and only 0.2% of the population is not covered by any third-party payer scheme (Busse and Riesberg (2004)). Ambulatory health care is mainly delivered by private for-profit providers working in single practice. Since 2004, sickness funds have been obliged to offer gate-keeping models to their insured up to now on a voluntarily basis (disease management programs, integrated health care). Patients have free choice of services, including dental, mental, and emergency services. SHI-affiliated physicians offer almost all medical specialties in ambulatory care. A user charge of 10 Euro for the first physician contact per quarter and any further non-referred visit has been introduced to raise funding and reduce unnecessary visits.

The physicians are members of regional associations of SHI-accredited physicians. They are obliged to secure the provision of ambulatory care in their particular region. Regional physicians' associations negotiate contracts for ambulatory services collectively for all SHI-affiliated physicians in their region on an annual basis. Sickness funds transfer fixed per-capita amounts according to the number of SHI-insured living in the region, which results in de facto budgets for ambulatory physician services. The regional physicians' associations divide the financial resources in separate funds for general practitioners and specialists and distribute the resources among their members according to the nationally uniform scale of relative point values and regionally adapted rules. Limitations of service volumes apply by specialty and age structure of the patients treated. They are controlled for and sanctioned by regional physicians' associations or joint committees with sickness funds. In turn, they traditionally have a monopoly to provide ambulatory primary and secondary care and negotiate collective contracts with the various sickness funds.

The problems of the German health care system resulting from these points can be characterized by inefficient incentive structures, quality problems, and organizational deficits. The German Advisory Council of Economic Experts states that the main incentive problems in the health care system are present in the physician-patient relationship and focuses on the question of health care demand. In this context, the decision whether a discomfort can be regarded as an illness or not depends on each person's own discretionary power. The more liberally the choice of the physician is organized and the lower the costs the patient has to bear, the higher is the probability of a physician consultation even in the case of a small discomfort. Moreover, in case of a consultation, the physician determines not only the illness diagnosis but also, because of his medical knowledge, the relevant therapy, and therefore the patient's demand for medical services. Potential excessive supply behavior is facilitated because the possibility to control the supplied medical services as well as the treatment quality is limited up to now. In addition, the excessive demand behavior of the patient benefits from the lack of cost transparency concerning the level and the distribution of the treatment costs. Finally, the predominant non-constrained and non-coordinated choice of physicians leads to duplicate or multiple examinations and results in a rise in health care expenditures because of not coordinated parallel treatments.

These stylized facts of the German health care system can be related to the international discussion of health care demand that can be divided into two categories. One line focuses on the physician-inducement hypothesis while the second line highlights patient's moral hazard behavior.[2] The common feature of both types of models is the problem of asymmetric information prevalent in the health care sector.

In more detail, as the physician usually performs both, diagnosis and therapy, he has a discretionary scope concerning his decisions (cf. Arrow (1963), p. 949). As a result, it is possible that the physician is able to use medical services and his therapeutic advice to

[2] There exists a broad literature on the topics of supplier-induced demand and patient's moral hazard starting with the works of Evans (1974) and Pauly (1968). An overview about the problems of physician behavior and consumer incentives in health care is presented in McGuire (2000) and Zweifel and Manning (2000).

maximize the resulting profit (cf. Gaynor (1994), p. 299ff.). The physician's scope for profit maximizing activities depends crucially on the remuneration system and the existence of a treatment monopoly even if it is temporary limited. As regards patient's behavior, he suffers from an information deficit and a lack of consumer sovereignty (cf. Ryan (1994) and Gaynor (1994)). The quality of the credence good medical services is not verifiable for the patient neither before medical treatment nor after (cf. Arrow (1963), p. 949 and Richard (1996), p. 201). Hence, the patient is not informed about the medical process. Therefore, he cannot infer the adequate therapy from the disease symptoms. Like in other service industries, production and consumption of the good are not separable. The treatment outcome is not solely determined by physician's actions but is also influenced by the patient's treatment accompanying behavior, his compliance, because in most cases the treatment would not result in a satisfactory outcome without patient's cooperation. Thus, health outcome can be described as joint production between physician's medical services and patient's behavior (cf. Leonard and Zivin (2001), p. 2). Consequently, each actor has a discretionary scope concerning the actions he can make use of for his own advantage. Ma and McGuire (1997, p.687) include two inputs in their model of a health care production process, one that is patient-controlled and one that is physician-controlled.

The adequate theoretical background for investigating the information relation between physician and patient is the so-called principal-agent theory (cf. Arrow (1985), Zweifel and Breyer (1997) and Zweifel, Lehmann and Steinmann (2002)).[3] Most of the principal-agent models in health economics focus solely on the physician's behavior. Some newer approaches explicitly integrate the health relevant behavior or compliance of the patient and its influence on physician activities and health outcome into the analysis (cf. Ma and McGuire (1997), Leonard and Zivin (2001) and Schneider (2004)). Here, in addition to the analysis of the physician behavior also the patient's health relevant behavior is important for the health outcome. In such a framework, the decisions of physicians and patients are correlated and cannot be analyzed separately. The so-called double moral hazard approach presented in Schneider (2004) is the theoretical basis of the following analysis. It is based on a model by Cooper and Ross (1985) about product care and warranties. The basic structure of the model is presented in figure 1.

[3] An agency relationship is illustrated by preferences of principal and agent that fall apart and the informational advantage of the agent (cf. Gaynor (1994)). Besides the physician-patient relationship, there exist other principal-agent relations in the health care sector, e. g. between insurer and physician or between patient and insurer.

<insert figure 1 here>

The model incorporates a contract and a treatment stage. At the first stage, the insurer signs an insurance contract with the patient and a remuneration contract with the physician or his association. From the insurer's point of view, these contracts are not independent because changes in the remuneration contract lead to a revision of the insurance contract with the patient. After contracting, nature decides about the health status of the patient. If he is seriously ill or if he beliefs that he needs medical treatment, he visits a physician (contact decision); in the other case, the game ends. In contrast, the physician dominates the treatment stage. He chooses the adequate therapy that depends on patient's health status, the remuneration systems, the chosen coinsurance rate, and the insurance premium. Nevertheless, not only the physician is important for the resulting health outcome but also the patient who influences the outcome through his health related behavior.

One central element of the treatment stage of the model is the strategically interaction of physician's medical services and patient's compliance. In detail, one has to distinguish three possible cases: First, medical services and compliance are strategic independent. This means that a higher level of medical services has no effect on the marginal productivity of patient's compliance and vice versa. Second, in the case of strategic complements the marginal productivity of one input factor in the medical process increases as the level of the other factor rises. Third, given strategic substitutes, a decrease of the marginal productivity of one input is the result of an increase in the other input. As a consequence, the probability of a recovery depends not only on the level of medical services and compliance but also on the kind of strategic interaction. As an example, when introducing a demand-side coinsurance, health outcome depends crucially on the concrete form of strategic interactions.

On basis of this model structure, we have in the following a closer look at the determinants of physician visits and the health relevant behavior of the patient. It is important to note that the results of the treatment stage cannot be adopted straightforwardly to an empirical model. First, it is necessary to look at the entire health production process i.e. that besides the compliance of the patient his health relevant behavior without a physician visit is important, too. This implies that all health related activities have consequences for health status and health seeking behavior. Second, the insurance contract has an influence on the behavior of physician and patient, especially if we look at a demand-side coinsurance that influences the contact decision. Therefore, it follows that it seems necessary to extent the analysis to the entire health production instead of focusing only on the treatment process.

3 Empirical analysis of the physician-patient relationship

3.1 Basic considerations

The empirical analysis centers around the health care triangle between physician, patient, and insurer (see figure 2). In all of these relationships, asymmetric information is prevalent. For our study, the consumption of medical services is essential and can be reflected by the decision to visit a physician.[4] On the one hand, the patient's choice is up to his discretionary power; on the other hand, it is driven more indirectly by his own health related behavior. Therefore, estimation of patient's health related behavior has to keep two things in mind: First, the determinants of the health relevant behavior itself and second, its influence on the contact decision. These two decisions are influenced by factors like socioeconomic factors, current health status, and the conditions of the insurance contract.

Second, one has to consider the influence of the physician's actions on patient's behavior. Hence, the relevant question is in how far the physician determines the frequency decision and what the driving factors behind it are. Physicians may respond to this question by explaining that patient's health status and well-being are central for their job. In addition, physician's self-interest seems to be important, e.g. the influence of the remuneration system, income and leisure goals, and their advantages physicians take from their specialized medical knowledge (cf. e. g. Evans (1974) or Eggleston (1999)). A possible last influencing factor is the medical infrastructure. Here, the access to general practitioners, specialists, and hospitals plays an important role.

<insert figure 2 here>

[4] The structure of the decision process can be empirically tested by separating the contact from the frequency decision (cf. Pohlmeier and Ulrich (1995), Jones (2000)).

On basis of the described relation between physician and patient, the following four hypotheses can be used as starting point for the empirical analysis of the physician-patient relationship in the German health care system.

H1: There is empirical evidence for a cooperative model of health production between physician and patient in the German health care system.

The question behind this hypothesis is whether the physician's supply of medical services is the driving factor for health outcome or whether there is some significant influence of patient's behavior in the production of health.

H2: The supply of medical services influences patient's demand for medical treatment as well as patient's behavior.

This hypothesis about the ability of physicians to determine the amount of services demanded by patients follows the literature on physician-induced demand and applies to the physician density. Moreover, it is possible that the physician has also an impact on the general behavior of the patient, not only with respect to health seeking but also with respect to patient's attitude towards health. However, it should be mentioned that the used variable physician density, which is imported from the level of federal states, might not be the adequate indicator of health care supply because it displays only the federal average and does not show the differences within the states. Instead, one can think of using the physician visit as an explanatory variable in the equation of health behavior. However, as is shown in section 3.2, a model of simultaneous equations including both dependent variables as explanatory factors lead to inconsistent estimates.

H3: The health insurance system has an impact on patient's behavior and his demand for medical services.

Following the literature on moral hazard behavior, patients are consuming too much health care because the marginal costs of health care are too low compared to the case without insurance. One possibility to deal with this moral hazard behavior is to introduce a demand-side cost-sharing (cf. Zweifel and Breyer (1997)). In Germany, the level of co-payments differs between the types of insurance. Hence, the status whether the patient is fully private, standard SHI or SHI insured with supplemental private insurance may have an impact on patient's behavior.

In contrast to the first three hypotheses, which deal with the specific situation in the German health care market, our final hypothesis refers to the applied estimation technique:

H4: The equation specifying the demand for medical care and the equation for patient's health behavior are stochastically dependent.

A first more formal interpretation of this hypothesis is that there is a correlation between the error terms of the two equations that has to be taken into account in the empirical model (see section 3.2). A more informal interpretation of this relationship is that the patient's health behavior is also determined by general environmental factors that are not captured by the data but that also simultaneously influence the demand for medical care via the correlation of the two error terms.

One remaining question for the empirical analysis is the measurement of health relevant behavior and medical services. Both variables are multidimensional constructs. Therefore, it is necessary to develop appropriate indicators for the empirical analysis. As regards medical services, the treatment expenditures or the number of physician visits are possible indicators. For the health relevant behavior, the situation is more complex. We construct an indicator that may include patient's attitude towards health, his consumption pattern, or his sport activities.

3.2 Estimation method

Besides aspects that deal with the topic of choosing variables the choice of the estimation method is of relevance. Here, it is necessary to decide if the actions of physician and patient occur simultaneously or sequentially. This distinction is important if the sequence of actions has an impact on the result. If the health outcome does not depend on the timing structure or if it is not possible to sort the data with respect to the sequence of actions the simultaneous structure fits better. Moreover, besides this simultaneity it is necessary for the estimation method to account for the interdependency of the actions of physician and patient.

Given the results of the theoretical approaches presented in chapter 2 we use an empirical model for simultaneous equations. The advantage of this procedure is that we are able to estimate two equations that seem to be independent at first view. Moreover, there might exist a correlation between them due to the structure of the errors.

Starting with the dependent variables, we are in need of an estimation technique for qualitative dependent variables because we use binary endogenous variables as proxy for health relevant behavior and health care demand. Our estimation approach considers a potential endogeneity of the dependent variables. If one starts with a mutual influence of both dependent variables the structural equations of the model are given by (cf. Maddala (1983), p. 242ff.):

$$y_1^* = \gamma_1 \; y_2^* + \mathbf{x}_1' \, \boldsymbol{\beta}_1 + \varepsilon_1 \;,$$
$$y_2^* = \gamma_2 \; y_1^* + \mathbf{x}_2' \, \boldsymbol{\beta}_2 + \varepsilon_2 \;. \qquad (3.1)$$

If both dependent variables appear to be binary, we are able to write Maddala's approach alternatively as:

$$\text{Prob}\left[y_1 = 1 \,, y_2 = 1\right] = \Phi_2 \left(\gamma_1 \; y_2 + \mathbf{x}_1' \, \boldsymbol{\beta}_1 \;, \gamma_2 \; y_1 + \mathbf{x}_2' \, \boldsymbol{\beta}_2 \;, \rho\right) . \qquad (3.2)$$

Here, y_1 and y_2 are binary dependent variables. Equation (3.2) gives the probability if both variables take the value one. The probabilities for the other cases are calculated in the same manner. Φ_2 is the bivariate normal conditional distribution function. Unfortunately, the above model is not consistent and not estimable in the presented form (Maddala (1983), p. 117f.). One possible modification of the approach is to calculate the probabilities for two binary dependent variables if γ_1=0 holds. With respect to this problem, part two of hypothesis 2 that is based on the influence of medical supply on patient's behavior is not testable in our specification.

The resulting model is a recursive bivariate probit model (cf. Maddala (1983) or Greene (2003)).[5] For cross-section data, we can write the specification using the following two-equation model: [6]

$$y_1^* = \mathbf{x}_1' \, \boldsymbol{\beta}_1 + \varepsilon_1 \;, \qquad y_1 = 1 \qquad \text{for } y_1^* > 0 \;,$$
$$y_2^* = \mathbf{x}_2' \, \boldsymbol{\beta}_2 + \gamma_2 \; y_1 + \varepsilon_2 \;, \qquad y_2 = 1 \qquad \text{for } y_2^* > 0 \;,$$
$$E\left[\varepsilon_1 \;|\mathbf{x}_1 \;, \mathbf{x}_2\right] = E\left[\varepsilon_2 \;|\mathbf{x}_1 \;, \mathbf{x}_2\right] = 0 \;, \qquad (3.3)$$
$$\text{Var}\left[\varepsilon_1 \;|\mathbf{x}_1 \;, \mathbf{x}_2\right] = \text{Var}\left[\varepsilon_2 \;|\mathbf{x}_1 \;, \mathbf{x}_2\right] = 1 \;,$$
$$\text{Cov}\left[\varepsilon_1 \;, \varepsilon_2 \;|\mathbf{x}_1 \;, \mathbf{x}_2\right] = \rho \;.$$

[5] There exist other models using a binary dependent variable for the first equation and a continuous dependent variable for the second equation (cf. Maddala (1983)).
[6] A model in which the vector of explaining variables is different in both equations can be characterized as a seemingly unrelated bivariate probit model (cf. StataCorp (2001), p. 139).

Here, the parameter ρ is the covariance between the error terms. It measures in how far the unobserved factors influence both, the health relevant behavior, and the physician visit. Both equations in (3.3) can be estimated separately as single probit models but the estimated coefficients are inefficient because the correlation between the error terms is neglected. Only in the case that the error terms ε_1 and ε_2 are independent (ρ is not significantly different from zero) it is possible to deal with the above model as two independent equations (cf. Maddala (1983), p. 123). Knapp and Seaks (1998) provide a Hausman test for the exogeneity of a dummy variable in a probit model. Using the same model structure as above, they show that the difference between the joint estimation of both equations and the separate estimation of two individual probit models is controlled by the parameter ρ. The estimation of model (3.3) then provides an estimate of the asymptotic standard error of $\hat{\rho}$. Therefore, it is possible to compute the statistic $z = \hat{\rho} / s_{\hat{\rho}}$ to test the hypothesis H_0 : ρ=0. The square of this value z converges to a χ^2 distribution with the same limits as the proposed Hausman test.

The equations in (3.3) form a recursive, simultaneous equation system. Greene analyzes a two-step approach proposed by Burnett, in which the reduced form equation is estimated by maximum likelihood methods (cf. Greene (1998)). The predicted values from the first equation then enter the maximum likelihood estimation of structural equation in the second step. However, it is possible to show that this approach does not account for a possible correlation of the error terms. Instead, we use a bivariate probit model to estimate the equations above. Here, the endogeneity can be ignored in formulating the log-likelihood. To start with, the joint probability of an outcome y_1=y_2=1 can be written in terms of the conditional and marginal probabilities as:

$$\begin{aligned} \text{Prob}\left[y_1 = 1, y_2 = 1\right] &= \text{Prob}\left[y_2 = 1 \mid y_1 = 1\right] \times \text{Prob}\left[y_1 = 1\right] \\ &= \Phi_2\left(y_1 = 1, y_2 = 1\right) / \text{Prob}\left[y_1 = 1\right] \times \text{Prob}\left[y_1 = 1\right] . \end{aligned} \tag{3.4}$$

Here, Φ_2 is the cumulative distribution function of the bivariate normal distribution. Together with the variables and parameters of the model in (3.3) one gets:

$$\text{Prob}\left[y_1 = 1, y_2 = 1\right] = \Phi_2\left(x_1' \beta_1, \gamma_2 y_1 + x_2' \beta_2, \rho\right) / \Phi\left(x_1' \beta_1\right) \times \Phi\left(x_1' \beta_1\right) . \tag{3.5}$$

This results in the following bivariate probability:

$$\text{Prob}\left[y_1 = 1, y_2 = 1\right] = \Phi_2\left(x_1'\beta_1, \gamma_2 y_1 + x_2'\beta_2, \rho\right). \tag{3.6}$$

The remaining probabilities are then:

$$\text{Prob}\left[y_1 = 1, y_2 = 0\right] = \Phi_2\left(x_1'\beta_1, -\left(\gamma_2 y_1 + x_2'\beta_2\right), \rho\right).$$
$$\text{Prob}\left[y_1 = 0, y_2 = 1\right] = \Phi_2\left(-x_1'\beta_1, x_2'\beta_2, \rho\right).$$
$$\text{Prob}\left[y_1 = 0, y_2 = 0\right] = \Phi_2\left(-x_1'\beta_1, -x_2'\beta_2, \rho\right).$$

These are the probabilities that enter the likelihood function for the bivariate probit model (cf. Greene (1998), p. 295). Therefore, the problem of endogeneity in the second equation is not relevant for the calculation of the log-likelihood function and in contrast to a linear regression model, the simultaneity can be neglected (cf. Greene (2003), p. 715).

With respect to the panel structure of the data, the above model has to be adjusted. To deal with individual heterogeneity of the respondents, a random effects specification is required. For the bivariate probit model for panel data, we use a generalization of a random effects model proposed by Greene. Since the random effects specification of a bivariate probit model is nontrivial, the specification used here applies to a random parameters approach proposed by Greene (2001). The advantage of this specification is that in general, all variables including the constant term can be treated as random variables. In our specific case, we use a specification where only the constant terms of the two equations are assumed to be random. In effect, this implementation of a random parameters model is equivalent to a random effects bivariate probit model for panel data.[7]

The basic structure of a random parameters model for binary choice is based on the following conditional probability:

$$\text{Prob}\left[y_{it} = 1 \mid \mathbf{x}_{it}, \boldsymbol{\beta}_i\right] = F\left(\boldsymbol{\beta}_i'\mathbf{x}_{it}\right), \quad i = 1, \ldots, N, t = 1, \ldots, T, \tag{3.7}$$

with $F(\cdot)$ as the normal distribution. The underlying specification of the coefficients vector is:

$$\boldsymbol{\beta}_i = \boldsymbol{\beta} + \boldsymbol{\Delta}\mathbf{z}_i + \boldsymbol{\Gamma}\mathbf{v}_i,$$

[7] For an application of a random parameters approach see Greene (2002a), Greene (2004) and Björnsen (2004).

where β is the vector of unconditional means. Furthermore, Δ is a matrix of unknown location parameters, z_i is a vector of individual characteristics (heterogeneity term), Γ a matrix of unknown variance parameters and v_i the vector of random latent individual effects, with a mean of zero.

In the general random parameters model, it is assumed that parameters are randomly distributed across individuals with possibly heterogeneous mean and variance:

$$\mathrm{E}\left[\boldsymbol{\beta}_i \mid \mathbf{z}_i\right] = \boldsymbol{\beta} + \Delta\,\mathbf{z}_i\ ,$$
$$\mathrm{Var}\left[\boldsymbol{\beta}_i \mid \mathbf{z}_i\right] = \Sigma\,.$$

The second term is optional which means that the parameter matrix Δ=0. In this case, if the mean of the coefficient β_i is constant, the parameter in view is non-random. In our estimation of a bivariate probit model, we assume that all parameters are non-random except for the constant terms in both equations. In this formulation, the random parameters model is equivalent to a random effects model:

$$\begin{aligned} y_{it}^1 &= x_{it}^1\,\beta^1 + \alpha_i^1 + \varepsilon_{it}^1 \qquad \forall\ i\,,t\ ,\\ y_{it}^2 &= x_{it}^2\,\beta^2 + \alpha_i^2 + \varepsilon_{it}^2 \qquad \forall\ i\,,t\ . \end{aligned} \tag{3.8}$$

Here, y^j_{it} is the binary dependent variable of equation j.[8] The vector β^j is the coefficient vector that is constant over individuals and time. The heterogeneity between individuals is represented by the parameter α^j_i that is random over individuals and ε^j_{it} is the true disturbance. The parameters α^j_i are binormally distributed with a zero mean and a standard deviation equal to $\sigma_{\alpha j}$. Moreover, we allow the random parameters to be correlated with a correlation coefficient of θ. For the true error terms ε_{it}, the same assumptions are made as in equation (3.3): the standard deviation is equal to one and the covariance or correlation between these error terms is ρ. Furthermore, there exists no correlation between the true errors and the individual heterogeneity parameters. The estimation is carried out using LIMDEP Version 8.0. For the random effects bivariate probit model, we use the random parameter specification with only constant terms as random. Moreover, instead of the random draws we use the Halton sequence for the simulated maximum likelihood to reduce the number of draws and the computation time.

[8] The recursive effect of y^1 and y^2 in the second equation of (3.8) is neglected here.

The estimation of a recursive bivariate probit model is carried out using simulated maximum likelihood techniques and requires some consideration for the identification of the model parameters. Maddala (cf. 1983, p. 123) shows that given the model in equation (3.3) the number of parameters to be estimated is larger than the number of probabilities, even if constant terms are the only exogenous variables. In this case, the parameters in the structural equation are not identified. Maddala proposes that at least one variable in x_1 is not included in x_2. On the contrary, x_2 may contain variables not included in x_1. In contrast to this common approach, Wilde 2000 states that Maddala concentrates on the special case of constant exogenous regressors and only for this case the argumentation is valid. Consequently, the parameters of the model are identified if there exists at least one varying exogenous regressor. According to Wilde, there is sufficient variation in the data to identify the parameters even in this simple case. He concludes that for the standard case with varying exogenous regressors the full rank of the matrix is sufficient for identification purposes (cf. Wilde (2000), p: 311). The identification problem and the choice of exclusion restrictions is discussed in more detail in section 4.

3.3 Previous studies

Literature about applications of bivariate probit models in health economics is scarce. One of the first studies is Holly et al. (1998) who use a simultaneous two equation probit model to estimate the effect of supplemental health insurance on health care utilization. They find that the choice of supplemental health insurance has a positive effect on the probability of a hospital stay. Knaus and Nuscheler (2002) apply a bivariate probit model to the question of the impact of health status on changing the insurer. They analyze company-based sickness funds in the German SHI System after introducing competition between insurers and a risk-adjustment scheme. In contrast to the specification presented in section 3.2, they use a two-stage procedure to control for the endogeneity of the health status. First, the health status equation is estimated using an ordinary probit model and second, the fitted values from the first equation are inserted in the second equation. Again, a simple probit model estimates this structural equation. Thereby, they assume that the error terms of both equations are uncorrelated.

Jones, Koolman and von Doorslaer (2005) estimate the impact of private health insurance on the use of specialist visits using the first four waves of the European Community Household Panel. They carry out the analysis for various European countries using different estimation methods. One of them is a FIML estimator of a bivariate probit model. It is worth mentioning that insurance coverage in the previous year influences the probability of a specialist visit in the subsequent year in order to avoid a simultaneity bias. They find that the existence of a private health insurance plan increases the probability of visiting a specialist. The analysis of Fabbri, Monfardini and Radice (2004) focuses on the hospital choice and the case of cesarean section delivery. Moreover, they present different tests of exogeneity in the bivariate probit model. They find evidence that the exogeneity status should be evaluated using a likelihood ratio test. Balia and Jones (2005) estimate a recursive multivariate probit model to analyze the effect of lifestyle and self-assessed health on mortality, which can be viewed as an extension of the bivariate model.

3.4 Data

The data we use are two waves from the German Socio-Economic Panel Study (GSOEP), the years 2002 and 2004.[9] Together with these data, we make use of the variable physician density in each of the German federal states. Our dependent variables are the health relevant behavior of the patient and the physician visit as a proxy for the usage of medical services.

Patient’s health relevant behavior is a multidimensional construct that has the character of a latent variable. It is therefore necessary to construct an adequate indicator that covers the various aspects behind the variable health relevant behavior. On the one hand, we use indicators like smoking and drinking which can be interpreted as non-medical determinants of individual’s health. On the other hand, we use a measure for health condition like overweight which can be understood as indicator of the past health behavior. In the following empirical analysis, individual’s overweight is mapped by the body mass index (BMI) (cf. World Health Organization (2003), p 69). The idea behind the health behavior indicator is shown in figure 3. Health relevant behavior is a latent variable that can be measured by the corresponding indicators, while other influencing factors are summarized in the disturbance term.

<insert figure 3 here>

[9] The data used in this publication were made available to us by the German Socio-Economic Panel Study (SOEP) at the German Institute for Economic Research (DIW), Berlin. For the year 2003 no information about individual height and weight is available.

With respect to the health relevant consumption only data about tobacco consumption are included in the GSOEP while other consumption patterns like alcohol drinking and specific health related consumption expenditures are not included in the questionnaire. Moreover, variables concerning sports and nutrition are only available for the year 2004. Therefore, we restrict ourselves to variables that are included in the years 2002 and 2004. With respect to tobacco consumption, the first question in the GSOEP asks generally if the respondent smokes or not. Second, it is asked for different kinds of smoking like cigarettes, pipes or cigars and how much the respondent smokes. We concentrate ourselves on the question of smoking or not and use the binary nature of the variable. Together with the information about tobacco consumption, we use the BMI to construct an indicator concerning the health relevant behavior. Therefore, we compute the standard BMI from the data about body height and body weight and adjust the BMI for an age-specific changes (cf. National Research Council (1989), p. 564). Recent literature gives evidence that smoking behavior in combination with heavy overweight increases the mortality risk for people aged less than 65 (cf Freedman et al. (2006)). They find that for all groups obesity and smoking behavior have an impact on all-cause mortality. The combination of both indicators leads to a 6- to 11-fold increase in circulatory disease mortality for people younger than 65 years, compared to those with normal weight and never smokers. Even if we cannot generalize this result with respect to morbidity and the demand for health care, we use this information to build an indicator of adverse health behavior that takes the value one if the respondent is smoking and has overweight according to the age-adjusted BMI.

The second endogenous variable is a proxy for the demand for medical services. Again, this behavior is not directly observable and therefore not included in the GSOEP dataset. Only some indicators for the utilization of health services are available, e.g. the numbers of physician visits in the last quarter, the number of overnight stays in hospital or whether the respondent received any treatments towards medical rehabilitation, both in the last year. Since hospital stays and rehabilitation measures are probably based on a different decision process compared to ambulatory care, we use the number of physician visits in the current year as a proxy for the demand for medical services.[10] It is important to notice that in the German SHI-system the quarter provides the base for the accounting period in ambulatory care. Moreover, the GSOEP data only has questions for this period. To test the possibility that the date at which the interview takes place influences the results we run estimations of the model with

[10] This variable does neither make any distinction between treatment and preventive visits nor between visits of a general practitioner and a specialist.

dummy variables for each quarter but none of them had a significant effect. Since more than 80 % of the individuals in the sample have at most one consultation during the quarter, we infer that multiple illness spells are a rare event. Moreover, for the majority of the patients in ambulatory care their illness spell seems to be well covered by the observation period, so that we regard the problem of a possible bias using quarterly data as being of only minor importance in ambulatory care. Basically, we would prefer a model combining count data aspects (physician visits) with aspects of binary variables (health relevant behavior). To our knowledge, such a model for simultaneous equations does not exist. Instead, we use binary indicators and therefore a bivariate probit model (cf. Maddala (1983) or Greene (2003)) for panel data where our indicator for physician visits takes the value one if there has been at least one visit in the last quarter.

The independent variables are predisposing variables like age, age squared and cubic, gender, nationality, family status, and an interaction term of age and gender. The group of socioeconomic variables consists of variables for the household's income position, educational dummy variables, and variables concerning the employment status. For the income position, we use the logarithm of the net household income to correct for the skewness of the density function. As the size of the household differs for the respondents, we correct for this effect using the household equivalent income. One version is the OECD equivalent income scale that uses relative weights for household members. The first member gets a weight of one, additional members of 0.5 if older than 14 years and 0.3 if younger than 14. The household income is than divided by the sum of the individual weights. Another approach is to divide the income by the square root of the household size. The German Council of Economic Experts used both equivalence scales with the result of different averages but no effect on the income distribution. Here, we compute the equivalent income using the square root of the household size as divisor. In addition to the correction of the household size, we construct several interaction terms with our income variable, namely interaction of income with employment status. Moreover, we integrate a dummy variable for being very concerned about the own economic situation. Furthermore, we use three dummy variables for the respondent's highest education: university degree, high school degree, and O-level. The latter two variables only take the value one if the respondent has not graduated from university or high school respectively. The employment status is included in the GSOEP via several variables. We use a generated variable that classifies the labor force status for all survey members into 11 categories and restrict ourselves to the case of being registered as unemployed, having a regular employment and being retired. Therefore, three dummy variables for the employment status are included and the reference scenario are those not seeking employment. The last variable in this section is ‘living in East Germany’ that indicates whether the respondent has his residence in the so called New Laender.

Additionally, we include health and insurance variables like a hospital stay in the previous year, the physician density, a measure of self-assessed health, and the insurance status. The first health variable is an indicator for being rushed or pressed for time during the last four weeks. Moreover, a dummy variable for respondents legally classified as handicapped is included. Self-assessed health is a variable with five categories ranging from very good to bad. The first four categories are transformed into dummy variables and the status bad serves as reference case. Additionally, strong worries about health are included in the dataset. As regards insurance status, we distinguish between respondents having supplemental, private and no health insurance. The standard SHI contract serves a reference scenario. In Germany, almost 90 % of the population is covered by this system, only 9 % have a full private health insurance (incl. self-employed and high earning voluntarily insured). The private health insurers provide full insurance and supplementary coverage for SHI-insured individuals. Private insurers have also been not very successful in containing health care costs. This is partly due to existing forms of cross-subsidization of SHI-sickness funds by private health insurers and partly to health expenditures effects of the ongoing aging process combined with the possibilities of the technological-medical progress. Present health reform legislation tries to make opting out of SHI into private health insurance more difficult.

Since information on the state of residency is available, we are able to include the physician density at the state level. The physician density variable can proxy both demand response (higher physician density lowers opportunity costs of visiting a doctor) and supplier-induced response (it is essentially up to the physician to determine the intensity of treatment once the patient has decided to contact a physician). An overview over the variables in the dataset is given in table 1.

<insert table 1>

4 Estimation results

Overall, the dataset consists of 8153 individuals for two years (16306 observations). First, if one takes a look at the descriptive statistics it is obvious that 61.8 % of the respondents have visited a physician in the last quarter on average. 10.9 % of the individuals claim to smoke and simultaneously have age-adjusted overweight. Therefore, we state that their health related behavior is inadequate (cf. table 2).

The average age of the sample is 46.9 years whereas only adults both employed and not working are included in our dataset. Overall, 51.7 % are female, 27.1 % do not live together with a partner and 10.9 % are not German. Concerning the socioeconomic variables, it is evident that 6.1 % are unemployed at the time the survey was conducted, 58.8 % have a regular employment and 10.9 are already retired. The average net equivalent income of a household is about 1500 Euro per month. Regarding the education of the individuals, 17.4 % tell a university or comparable degree as their highest certificate, 10.2 % have only a high-school graduation, and 32.4 % a first public examination in secondary school. The remaining 40 % of the respondents possess another kind of certificate or they did not graduate from any kind of school. The fraction of people living in East Germany is 31.6 % in the dataset, which means that they are overrepresented compared to the fraction of about 20 % in the whole population.

<insert table 2>

For the health and insurance variables, it follows that less than 5 % answered the question whether they had always stress or hurries during the last four weeks with yes. For the disability status, 12.4 % are legally classified as handicapped and about 12 % of the respondents stayed at least once in hospital the year before. More than 80 % of the respondents rate their own health status as satisfactory or better, only 14 % as poor and less than 4 % as bad. The physician density in Germany in the years 2002 and 2004 has an average of 35.6. This means that there are about 36 physicians per 10,000 residents. Only 9.8 % of the respondents in the sample are fully privately insured and just 9.0 % have supplemental private insurance. Less than 1 % claim to have no insurance coverage at all.

These low values correspond to the actual levels in Germany mentioned above. This is a result of the dominance of the compulsory SHI that covers more than 90 % of the population.

The recursive effect between the two equations is modeled as follows: We assume that the individual adverse health behavior has an impact on the decision to visit a physician. This health behavior reflects patient's long-run preferences towards his health status, his perception of his behavior and the intertemporal consequences of his actions. A physician visit does not necessarily lead to a change in the corresponding health behavior of the patient. As an example, one could think of preventive visits with no clinical findings and no therapeutic recommendation. Therefore, we neglect a possible endogeneity of the variable physician visit and model the recursive effects so that individual adverse health behavior is causal to a physician visit.

To identify the model parameters, we estimate different specifications and compare the corresponding fit using two measures of information criteria, the Akaike information criterion (AIC) and the Bayesian (or Schwarz) information criterion (BIC) (cf. Long (1997) and Greene (2002b)). Both, the Akaike information criterion and the Bayesian criterion make use of the log-likelihood of the estimated model.[11] They represent the trade-off between goodness of the estimation, given by the log-likelihood and parsimony of the specification, which is given by the number of estimated parameters. Compared to the AIC, the BIC puts more weight on the parsimony of the models. The information criteria are often used to compare different model specifications. The model with the lowest value of the AIC or BIC is chosen as the preferred one (cf. Verbeek (2000), p. 54 and 254). In addition, we use a likelihood ratio test to analyze the influence of the imposed restrictions.

We compare four different specifications concerning the exclusion restrictions. First, we follow the approach proposed by Wilde that due to the variation in the data no exclusion of variables is necessary. Second, we exclude the variable stress in the equation for the physician visit. The idea behind this is that stress only indirect affects the probability of a visit through the health relevant behavior. Third, the variable economic worries is added the next excluded variable. Here, we argue that the comprehensive coverage of the German health care system removes economic pressure from those in need of medical care. Finally, we exclude the variable for living in Eastern Germany for the physician equation. The reason is that the

[11] The Akaike Information Criterion is defined as $AIC=(-2LogL+2K)/N$ and the Bayesian Information Criterion as $BIC=-2LogL+KLog(N)$, where K is the number of parameters in the Model and N the number of observations.

variable physician density already captures regional differences between east and west. The measures of fit for the different specification are presented in table 3.

<insert table 3>

It is obvious that the presented measures of fit are relatively close together. Moreover, the order of the criteria is the same for both, AIC and BIC. The preferred model III. in table 3 excludes the variables stress, economic worries, and east in the equation for the physician visits. Here, the values of the information criteria show the lowest values. This result is important with respect to the choice between the specifications of Maddala and Wilde. According to our results, the Maddala approach that uses exclusion restrictions is preferable because of the better fit given by the information criteria. Furthermore, we cannot reject the null hypothesis of differences between the restricted and unrestricted model using a likelihood ratio test. Apart from these specifications issues, the estimation results of the different models are comparable, implying small differences in the estimated parameters and standard errors.

The estimation results are obtainable from table 4. The first two columns give the results for the adverse health behavior equation and the second two columns for the physician equation. For each equation, the first column shows the estimated coefficient and the second column the related z-value of the parameter, the ratio of estimated coefficient and estimated standard deviation. The estimation sample consists of 16306 individuals, 8153 in each year. As regards the estimation, we exclude the three variables stress, economic worries, and east from the second equation. To test for an effect of the supply of physician services on the demand of medical care, we add the variable physician density to the second equation. In addition, we introduce a dummy for the year 2004, which measures the individual time invariant effect.

Starting with the adverse health behavior equation, the coefficient for the year 2004 is not significant. Estimation results show that health relevant behavior depends positively on the individual's age. The effect is significant at the 1 % level. The quadratic age term is significant negative and the cubic term significant positive. However, the cubic age term has an influence on the relationship between age and adverse health behavior not until the very high age classes. This means that for the age classes in the sample, we observe the well-known inverse u-shaped relationship for the relevant age in the sample between 17 and 99 years. Adverse health behavior in terms of a combination of smoking and overweight reaches its maximum around the age of 37 years. If we look at the gender variable, the significant negative effect indicates that women's health behavior is better compared to men. This effect occurs because differences in smoking behavior between women and men (27.6 % to 36.6 %) whereas the differences in the age-adjusted BMI in the normal range are relatively small (48.6 % to 51.2 %). The interaction variable between female and age is not significant. Foreigners show a worse health related behavior, which might be related to different living habits. The effect for singles is not significant at all.

The unemployment variable shows no significant effect whereas the dummy variables for working and retirement status have a significant positive coefficient. This result indicates that in contrast to people that do not seek an employment, those in the labor force and those already retired are more eligible for unhealthy behavior. For the working group, this may indicate a negative impact of a high workload. The equivalent household income has a negative effect as well as a better education does. All three educational dummies show a negative effect with respect to the reference case, i.e. to a lower school graduation certificate. Moreover, for the estimated model we find a gradient in people's education implying that the probability of an adverse health behavior decreases with a better education. In addition to the effect of the household income, people facing strong economic worries tend to have a higher probability of an adverse health behavior. The three interaction terms between income and labor force status show no significant impact on the probability of an adverse health behavior. Respondents who live in Eastern Germany surprisingly exhibit a better health behavior pointing to the fact that even after more than 10 years of reunification there are still behavioral differences between the two parts of Germany.

<insert table 4>

In the group of the health and insurance variables, for handicapped respondents a significant negative impact is observable. This means that respondents facing severe health problems care more about their health. Moreover, people facing stress regularly do not show an adverse health behavior compared to those without stress. A hospital stay in the last year leads to a worse health related behavior. The coefficient is significant at the 1 % level. All health dummy variables show a significant negative influence on the adverse health behavior except for the poor health status dummy. The interpretation is that a self-assessed health better than poor goes along with a better behavior. Moreover, we observe no significant effect for the health worries. There is no significant difference between standard SHI insured people and respondents with supplemental private insurance, but a significant difference for people with private insurance or no coverage. The last group shows a higher probability for an adverse health behavior whereas the full private insurance negatively influences the probability. All things considered, these results support *hypothesis 3* about the influence of the health insurance system on patient's health behavior even if we control for the health status of the individuals in our sample. A possible explanation is that there exist differences in the benefits catalogue and the level of co-payments between an individual in the SHI system and an individual that is fully private insured.

The estimation results of the second equation (physician visit) are presented in the columns three and four of table 4. With the exception of the exclusion restrictions, all variables of the first equation are used as explanatory factors. In addition, the dependent variable of the first equation, the binary variable for adverse health behavior is included. The inclusion of this endogenous variable is characteristic for a recursive bivariate probit model. This unhealthy behavior has a positive effect on the probability of a physician visit. In other words, if the respondent shows a bad health related behavior this goes along with a higher probability for a physician visit. It seems plausible that individuals who do not care much about their health status visit doctors more regularly rather in need of medical treatment than seeking prevention. This result gives weak evidence that patient's health related behavior is one important factor for the demand of medical care and emphasizes the relevance of the cooperative view of health production (*hypothesis 1*). As regards health politics, it follows that future health care reforms should center more on the patient and his health relevant behavior, which can be seen as a driving factor of future demand for medical care.

The dummy for the year 2004 shows a significant negative sign. This can be interpreted as a reaction to the 2004 health care reform act that introduced for the SHI system a co-payment of 10 Euro for each quarter of the year with a visit. This resulted in a lower number of physician visits in the year 2004. All three age terms are significant and result in a u-shaped relationship between the age of the patient and the probability of a physician visit given the age between 17 and 99 years. Again, the impact of the cubic age term is only relevant for age classes beyond 100 years. One possible explanation is the co-morbidity of older patients. The gender variable shows a strong significant positive effect but the coefficient for the interaction term is significantly negative. The latter implies that women demand less medical services than men with an increasing age do, a result also found in German risk adjustment data or in Gilleskie and Mroz (2004) who analyze health expenditures for women and men at different ages. Overall, physician visits reach its minimum at the age of 24 year for men and 36 years for women. Individuals without a partner show a different behavior compared to individuals with a partner but the coefficient is only significant at the 10 % level. Foreigners tend to visit a physician with a lower probability than Germans do. One explanation for the negative coefficient may be a language problem for this population group.

With the exception of the variables for economic worries, stress and east, we use the same set of socioeconomic variables as in the health behavior equation. The significant negative coefficient for individuals with regular employment supports the assumption of higher opportunity costs of time for this group. Interestingly, we observe the same effect for unemployed respondents. Retired individuals do not differ in their demand for a physician visit from the reference group. The household income has a significant positive effect.[12] Having the comprehensive coverage against health risks in Germany in mind, this positive effect is not to be expected. About 90 % of the German population is covered in the Statutory Health Insurance where only contributions are income related but benefits are not related to income and given in kind. The interaction term of regularly employment and income has a significant positive effect stating that those employees with a high family income visit a physician more often than those with lower incomes do. The educational dummies all show the same positive effect stating that the demand for medical services depends positively on the achieved qualification. Moreover, we find a gradient in the different qualifications implying that the probability of a physician visit increases with a higher educational level.

Considering the group of health and insurance variables, it is not surprising that handicapped persons are more likely to visit a physician and that a hospital stay in the previous year leads to a higher probability of a physician visit in the current year, indicating a higher demand for aftercare or post-operative treatments. As expected, all dummy variables for the self-assessed health have a significant and negative influence indicating that people who suppose to have a bad health status seek medical care more likely than other people do. We observe the same effect for strong health worries. The variable physician density per state is positive and

[12] This corresponds with the effect of the income in the Grossman model where a higher income leads to a higher consumption of medical services (cf. Grossman (1972), p. 243).

significant at the 1 % level. This confirms to our first economic intuition that a better supply of medical services leads to a higher demand (*hypothesis 2*). Since we do not distinguish between a contact and a frequency decision, a significant positive impact of the variable physician density should not only be interpreted as supplier-inducement because it captures both, demand and supplier response (cf. Pohlmeier and Ulrich (1995), p. 356). The insurance parameters show different results. A supplemental private insurance increases the probability of a physician visit while it is reduced if the individual is fully private insured. An explanation for the first effect is that supplemental insurance enhances the benefits catalogue or reduces the co-payments one has to bear. Therefore, medical services will be relatively cheaper. The lower demand of fully private insured individuals may have its cause in the existence of co-payments for medical services that are higher than for standard SHI insured individuals.[13] Additionally, people who claim to have no insurance tend to visit a physician with a lower probability. These results point to the relevance of *hypothesis 3* stating an impact of the health insurance system on patient's health behavior and the demand for medical services.

Finally, we have a short look at the error structure and the different measures of fit at the bottom of table 4. The covariance parameter ρ has the value -0.1355. A χ^2 test rejects the null hypothesis that the parameter does not differ from zero. This result implies that the two equations are not independent and that two single probit estimates would have led to inefficient standard errors, which supports *hypothesis 4*. The unobserved factors that influence both dependent variables have different effects in the two equations. If we interpret one factor as the propensity to take risks then the negative covariance parameter states that an individual with a higher preference for risky activities has a higher probability of an adverse health behavior and a lower probability of visiting a physician.

There exist several measures for the goodness-of-fit for the estimation. First, the McFadden pseudo-R^2 measure and second, the Akaike and Bayesian (or Schwarz) information criterion (AIC and BIC) that were already used to compare the different identification assumptions. Generally, the McFadden-R^2 is a kind of "likelihood-ratio index" (Long (1997), p. 104) that informs about the relation of the likelihood of the estimated model and the likelihood of the restricted constant-only model. An unambiguous interpretation is only possible for the case of the McFadden-R^2 equal to zero because none of the estimated coefficients then differs from zero. In contrast to this, the measure never reaches the value of one. Moreover, it is not

[13] Another interpretation of this result is that the private insured individuals represent better risks compared to members of the SHI.

possible to give a comprehensible interpretation for values between zero and one. Despite this, the measure is useful for comparing the goodness-of-fit of different models. Given the results presented in table 4, we have a value for the McFadden-R^2 of 0.173, for the adjusted McFadden-R^2 of 0.168, for the AIC of 1.442010, and for the BIC of 23998.47, which are used to decide on the model specification (see table 3).

To conclude, our findings support the view that the health related behavior of the patient and the probability of a physician visit are dependent decision processes and the estimation of the recursive model gives incidence that the patient's adverse health behavior has a positive impact on the demand for medical services. In addition, this result also emphasizes the increasing importance of the so-called patient empowerment. A patient with more power or more information about the consequences of his individual health related behavior can play a more substantial part in the health care triangle between insurer, physician, and patient. Consequently, future health care reforms should put more weight on the patient, his behavior, and his interaction with other agents in the health care system. With respect to the relationship between therapeutic and preventive measures, a better health relevant behavior does not necessarily lead to fewer physician visits since the importance of preventive contacts will increase at the expense of curative visits. As a consequence, one can not expect decreasing health care expenditures in the near future even if the importance of the individual health relevant behavior will increase and therapeutic care is substituted by preventive care.

5 Conclusion

The importance of the physician-patient relationship for the health care market is beyond controversy. Most theoretical work is done in a principal-agent framework, dealing with moral hazard problems. Recent work emphasizes a two-sided asymmetric information relationship between physician and patient. In contrast to most work looking only at the physician's perspectives, our paper concentrates on the patient's view. We look at patient's behavior and his impact on health and health care demand.

Based on evidence from the German health care system and on results of a double moral hazard model, we formulate four hypotheses to test the physician-patient relationship. Data basis is the German Socio-Economic Panel (GSOEP), a representative longitudinal study of private households in Germany. We use the two years 2002 and 2004 to estimate a recursive bivariate probit model for panel data. Dependent variables are the probability of a physician visit and an index of patient's health related behavior. The applied recursive bivariate probit model allows considering the simultaneous decision of individual health related behavior and physician consultation. The set of independent variables includes predisposing and socio-economic variables as well as variables concerning health status, type of health insurance and living conditions.

Estimation results give some support for the four hypotheses. First, we find weak evidence that patient’s health related behavior is an important factor for the demand of medical care, which emphasizes the relevance of the cooperative view of health production, which would be a new approach to health care pointing to more self-responsibility of the patient. Second, a better supply of medical services leads to a higher demand for a physician visit. However, it is not possible to distinguish between a contact and a frequency decision in the data so that a significant positive impact of the variable physician density could be interpreted as either demand or supplier response. Third, the design of the health insurance system has an impact on patient’s health behavior and on the demand for medical services. With respect to future health care reforms, especially different cost-sharing models for SHI insured are of interest, which are up to now not allowed for this group of insured. Fourth, in our recursive bivariate probit model, the patient’s health relevant behavior has a significant positive influence on the probability of a physician visit stating that physician consultation and health relevant behavior are not stochastically independent. This means that in addition to the physician’s influence on health care demand, patient’s characteristics and health related behavior are important for a physician consultation and therefore for health outcome.

One conclusion of our empirical findings is that existing literature underestimates the patient’s role in the health care market with respect to the demand for physician services. Therefore, future health policy should concentrate more on the patient’s needs and behavior. It is important to note that a better health relevant behavior does not necessarily lead to fewer physician visits since the importance of preventive contacts will increase at the expense of curative visits. Therefore, one cannot expect health care expenditures to decrease in the near future even if governments strengthen the role of patients and their individual health relevant behavior.

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Figures and Tables:

Figure 1: Model structure of the double moral hazard problem

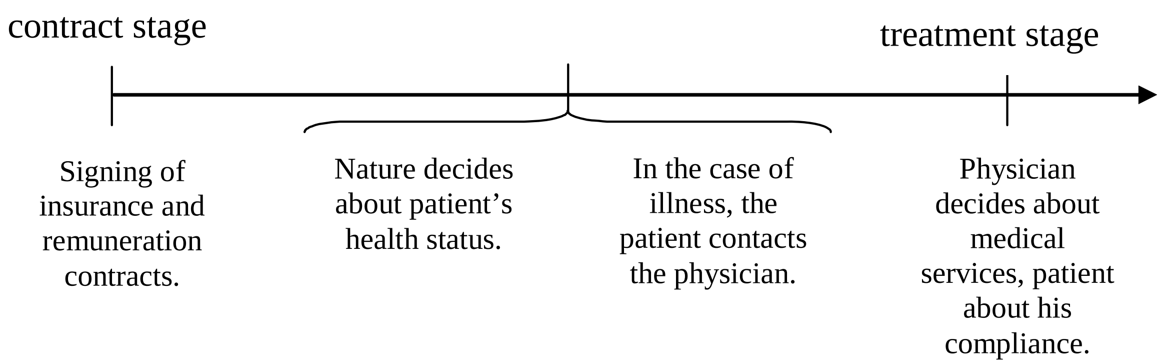

Figure 2: Influencing factors of the medical decision process

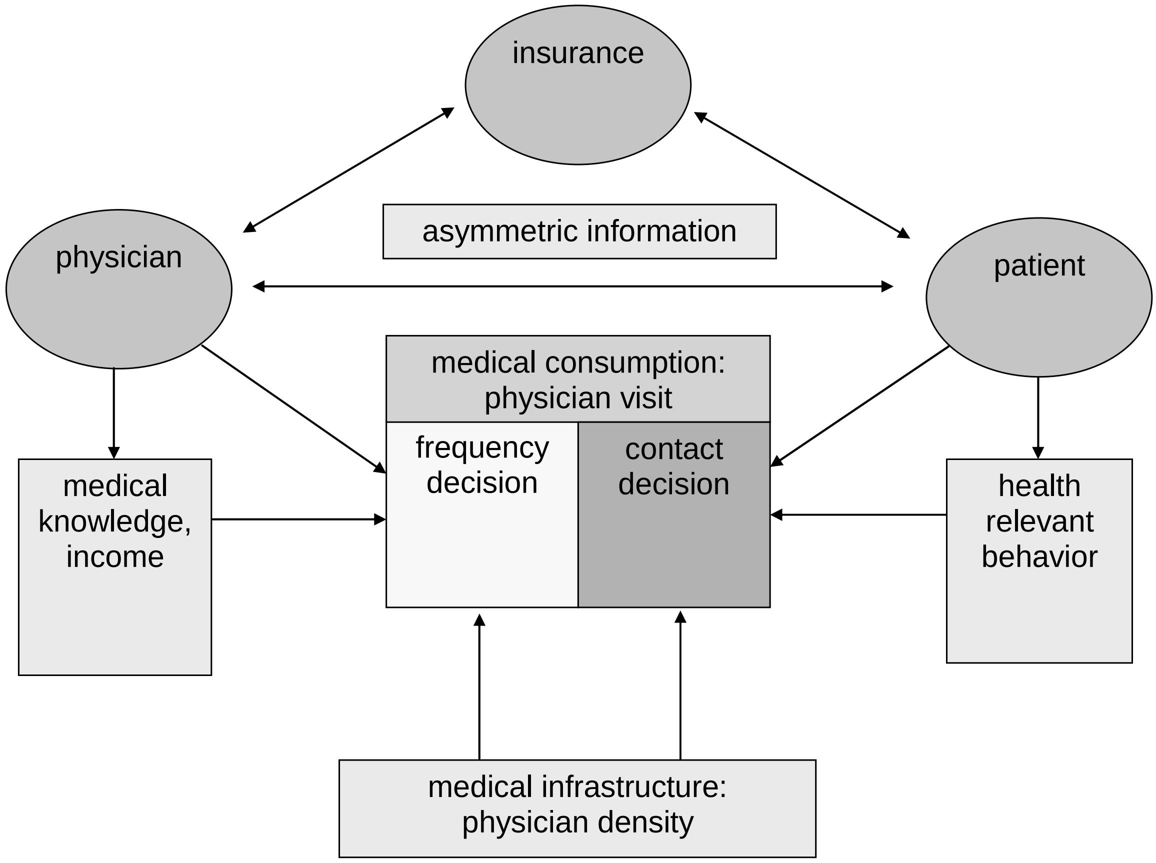

Figure 3: Indicators of health relevant behavior

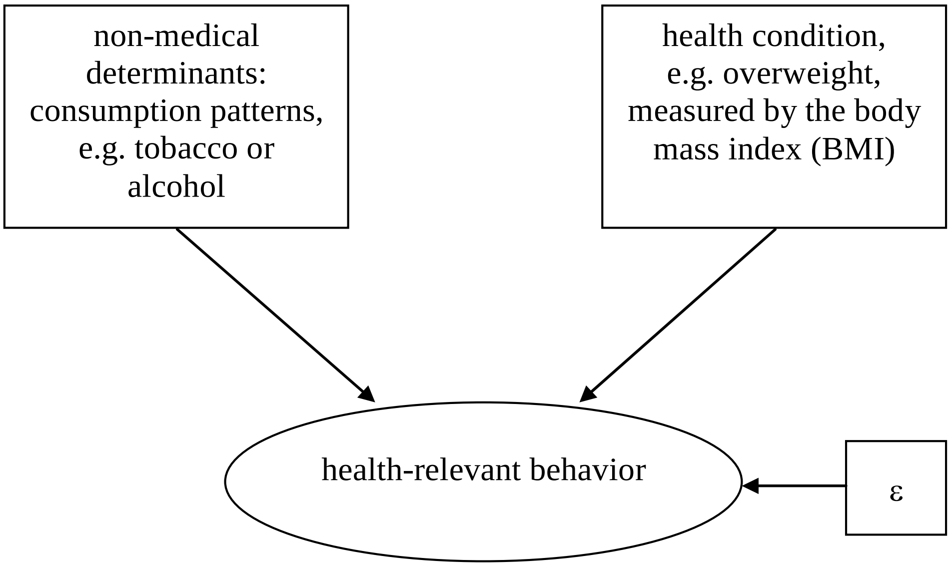

Table 1: Description of variables in the dataset

dependent variables	
physician	physician visit in the last quarter yes/no
adverse health behavior	smoker and age-adjusted overweight yes/no
predisposing variables	
age	age in years
$age^2/100$	age squared/100
$age^3/1000$	age cubic/1000
female	1 = female, 0 = male
female*age	interaction gender and age
single	not living together with a partner yes/no
foreign	nationality not German yes/no
socioeconomic variables	
unemployed	unemployed yes/no
employment	regular employment yes/no
pension	retired yes/no
income	Log equivalent household net income in 1000 €
unempl.*income	interaction unemployment and income
working*income	interaction regular employment and income
pension*income	interaction retired and income
university	university degree yes/no
high school	general qualification for university entrance yes/no
O-level	first public examination in secondary school yes/no
economic worries	strong worries about own economic situation yes/no
east	living in Eastern Germany
health and insurance variables	
stress	always stress or hurries in the last 4 weeks yes/no
handicap	handicap / physically challenged yes/no
hospital	hospital stay in last year yes/no
health very good	health status very good yes/no
good	health status good yes/no
satisfactory	health status satisfactory yes/no
poor	health status poor yes/no
bad	health status bad yes/no
health worries	strong worries about own health status
physician density	physicians per 10.000 inhabitants per state
supplemental insurance	private supplemental insurance yes/no
private health insurance	fully private insured yes/no
no insurance	no health insurance yes/no

Table 2: Descriptive statistics (n=8153, T=2, N=16306)

dependent variables	mean	standard deviation	min	max
physician	0.618	0.486	0	1
adverse health behavior	0.109	0.311	0	1
predisposing variables				
age	46.891	16.561	17	99
age²/100	24.310	16.627	2	98
age³/1000	142.548	138.821	4	970
female	0.517	0.500	0	1
female*age	24.386	26.531	0	99
single	0.271	0.445	0	1
foreign	0.109	0.311	0	1
socioeconomic variable				
unemployed	0.061	0.240	0	1
employment	0.588	0.492	0	1
pension	0.109	0.311	0	1
income	7.322	0.428	4.749	9.314
unempl.*income	0.427	1.673	0	8.353
working*income	4.367	3.667	0	9.314
pension*income	0.784	2.248	0	9.311
economic worries	0.234	0.423	0	1
university	0.174	0.379	0	1
high school	0.102	0.303	0	1
O-level	0.324	0.468	0	1
east	0.316	0.465	0	1
health and insurance variables				
stress	0.046	0.209	0	1
handicap	0.124	0.330	0	1
hospital	0.119	0.324	0	1
health very good	0.071	0.257	0	1
good	0.408	0.492	0	1
satisfactory	0.344	0.475	0	1
poor	0.142	0.349	0	1
bad	0.033	0.180	0	1
health worries	0.178	0.383	0	1
physician density	35.570	4.782	28.409	54.945
supplemental insurance	0.090	0.286	0	1
private health insurance	0.098	0.297	0	1
no insurance	0.005	0.074	0	1

Table 3: Comparison of different exclusion restrictions

Exclusion	I. stress	II. stress, economic worries	III. stress, economic worries, east	IV. none
AIC	1.442165	1.442076	1.442010	1.442228
BIC	24016.41	24007.25	23998.47	24025.97
LR test	I.-IV.: 0.14 $\chi^2(1)$= 3.84	II.-IV.: 0.88 $\chi^2(2)$= 5.99	III.-IV.: 2.48 $\chi^2(3)$= 7.81	

Table 4: Estimation results recursive bivariate probit model

	adverse health behavior		physician visit	
	coefficient	z-value	coefficient	z-value
adverse health behavior			0.2143	4.40***
predisposing variables				
2004	0.0203	0.76***	-2.0421	-50.80***
age	0.1553	11.21***	-0.0919	-6.07***
age²/100	-0.2466	-8.77***	0.2201	7.44***
age³/1000	0.0064	3.43***	-0.0078	-4.25***
female	-0.7401	9.95***	2.7127	29.89***
female*age	-0.0002	0.13***	-0.0321	-17.66***
single	-0.0055	-0.19***	-0.0571	-1.65***
foreign	0.1316	3.59***	-0.2089	-4.80***
socioeconomic variables				
unemployed	-0.7460	-0.863***	-2.0714	-1.99***
employment	1.2008	2.00***	-2.2386	-3.57***
pension	1.4368	1.68***	0.3652	0.42***
income	-0.3139	-4.30***	0.1746	2.31***
unempl.*income	0.1451	1.18***	0.2046	1.38***
working*income	-0.1326	-1.60***	0.2305	2.68***
pension*income	-0.1846	-1.54***	-0.1000	-0.82***
economic worries	0.1578	5.35***	-	-
university	-0.6163	-16.54***	0.4769	11.13***
high school	-0.3503	-8.33***	0.4320	8.72***
O-level	-0.2459	-8.68***	0.1708	4.98***
east	-0.0487	-1.79***	-	-
health and insurance variables				
stress	0.0264	0.50***	-	-
handicap	-0.2720	-6.08***	1.2265	22.43***
hospital	0.1277	3.24***	0.6856	14.52***
health very good	-0.8632	-8.66***	-3.0923	-22.30***
good	-0.1601	-1.85***	-2.2795	-17.78***
satisfactory	-0.1599	-1.89***	-1.3900	-11.15***
poor	-0.0428	-0.50***	-0.3739	-3.00***
health worries	-0.0059	-0.15***	0.6392	13.91***
physician density	-	-	0.1441	4.92***
suppl. insurance	-0.0282	-0.66***	0.2327	4.88***
private insured	-0.0845	-2.03***	-0.3038	-6.24***
no insurance	0.2772	1.94***	-1.1356	-5.82***
mean for random parameter	-1.9648	-3.30***	1.7131	2.68***
ρ	-0.1355		Wald test ρ = 0 (χ²) 40.67***	
Log-Likelihood	-11693.71			
McFadden R²	0.173		AIC	1.442010
McFadden R² adj	0.168		BIC	23998.47
N	16306	n = 8153	T = 2	

*** significant at the 1-%-level
** significant at the 5-%-level
* significant at the 10-%-level