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ECONOMIC INCENTIVES AND HOSPITALIZATION IN GERMANY

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SUMMARY

The dramatically rising health expenditures have become a matter of prime concern. Using a rich panel dataset this paper contributes to this debate by investigating factors determining the demand for hospitalization in Germany. While most previous studies have found a significant impact of social insurance on the demand for hospital trips, the empirical results presented here cast doubts on the role of those economic incentives. There are also important differences in the hospitalization behaviour of men and women, and between the full sample and those with chronic conditions, which have been neglected by the literature. © 1997 by John Wiley & Sons, Ltd.

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1. INTRODUCTION

Expenditures for health-care services have soared in virtually all industrialized countries in recent years (Cutler, 1994). In the case of Germany, the percentage of GNP spent on health through public or private insurance has risen from 4·2% in 1970 and 6·5% in 1990 to (after unification) 8·5% in 1994 (IDW, 1996). During the same period, average contributions to the public health insurance scheme have increased from 8·2% of gross income (1970) to 12·5% (1990) and 13·2% (1994). Alternative policy reform concepts discussed are price and quantity controls and the introduction of better economic incentive schemes.

The relatively low number of people who are already fully privately insured in Germany (7·0 million compared to 50·7 million in the public system in 1994) seems to confirm the need to strengthen the role of economic incentives. Average per capita expenditures on hospital services for the privately insured amount for only two thirds of those for members of the public insurance scheme (1994). Moreover, this ratio has been decreasing steadily from 87% in 1970 to 68% in 1990 (IDW, 1996). Since hospital costs clearly form the largest, and still increasing, part of insurance outlays (about 32% for the public and 34% for the private insurance in 1994), these numbers seem to indicate that privatization, at least partly could help to overcome the present crisis of health insurance. However, individuals need to respond to economic incentives to make such reforms work, and we want this to be confirmed in an empirical analysis.[1] Since so far there

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[1] The privately organized health care system in the USA seems to be much more expensive than the German system. In 1994, the health spending per person in dollars at purchasing-power parity was less than 2000 in Germany while about 3500 in the USA. (*The Economist*, 3 August 1996, p. 98).

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is no econometric evidence for hospital service use in Germany, a more thorough study of the factors that drive hospital demand is clearly needed.

Hence, this paper will empirically investigate the relevant individual factors of hospitalization for Germany. The major objective is to examine to what extent the rich structure in the German health-care system affects behaviour, and whether a change in the incentive schemes would be a reasonable option for reform. The demand for hospitalization will be measured by the frequency of hospital trips within a year. Due to the special nature of this data, count data models are applied to the field of health economics. Our research thus follows previous work by Cameron *et al.* (1988), among others.

The paper is organized as follows. Section 2 outlines the theoretical framework and previous findings. Section 3 details the characteristics of the German health insurance system that provides a number of important restrictions on individual demand for hospital care, and explains the sample used from the German Socio-Economic Panel (GSOEP). Section 4 explains the employed estimation techniques. Section 5 contains the empirical results and evaluates their implications. Section 6 concludes.

2. THEORY AND PREVIOUS EMPIRICAL RESULTS

2.1. Theoretical Background and Empirical Findings

A review of the literature[2] suggests that insurance schemes and their consequences for hospital demand have been the crucial part in economic theories about the costs of health care. The basic problem of moral hazard in the framework of health insurance has been summarized by Arrow (1963). Health insurance may have an incentive effect on the demand for health services since the event against which insurance is taken is not totally out of the control of the individual. In principle, one is able to influence the risk of needing medical care, i.e. in our case going to a hospital, to a certain degree by avoiding risky activities and an unhealthy environment. According to economic theory, the incentive to behave this way will be weaker if one is covered by health insurance bearing the costs for a cure. As a result, the mere fact of being insured will lead to a higher demand for hospital trips since carelessness is fostered.

This moral hazard problem is aggravated if contributions and performance or coverage of the insurance do not correspond in the individual case. In particular, this will hold when insurance is provided through a public scheme financed on the social insurance principle of solidarity. Whereas private health insurance providers may adjust contribution rates to individual circumstances (e.g. gender or age) and require health checks before insuring a new customer, the individual risk is typically not reflected in the contributions to the social insurance system since in Germany everyone pays the same fraction of his or her income. In return one receives the right to claim all services one may need whatever their actual costs. Furthermore, while private insurance companies offer a repayment of contributions in the case of no claims, such an incentive scheme is not used in public insurance. Hence, the moral hazard problem should be clearly more serious in public than in private health insurance. If this is confirmed by empirical analysis, it suggests that the introduction of more private elements into existing health insurance systems could reduce demand and thus expenditures for hospital care.

While previous empirical studies (e.g. Feldstein, 1971; Hunt-McCool *et al.*, 1994) have concentrated on the effects of the introduction of social insurance coverage and of the existence of

[2] Reviews are provided by Weisbrod (1991), Cutler (1995), and Feldstein (1995).

insurance *per se*, differences in the health demand of publicly and privately insured people have hardly been studied so far. For Australia, Cameron *et al.* (1988) find that for a broad range of health services, including hospital care, there is a higher usage of services by people with insurance policies with more generous coverage, which includes private insurance schemes. This is, however, conditional on the preceding choice of insurance and thus a problem of self-selection as well as of moral hazard. For Germany, Pohlmeier and Ulrich (1995) conclude that private insurance has a negative effect on the number of trips to a general practitioner, but they do not discuss hospitalization.

Besides insurance, a number of additional factors of significant relevance for the demand for health and hospital care have been identified in the empirical literature. Contrary to van Vliet and van Doorslaer (1988), Acton (1975) and Bikker and de Vos (1992) have found a considerable impact of spatial factors in allocation of hospital care for New York and the Netherlands, respectively. This can be seen as a consequence of travel-time costs linked to distance changing optimal demand. Interpreted in a supply-side way, one could argue that availability of hospital services in the neighbourhood may increase demand. Gender differences also play a role. According to Acton (1975), Wagstaff (1986) and Cameron *et al.* (1988), males are more likely to go to hospital than females. A poor health status, e.g. due to chronic conditions, is found to have a positive effect on demand for hospitalization throughout the literature (Acton, 1975; Wagstaff, 1986; Cameron *et al.*, 1988; Hunt-McCool *et al.*, 1994).

Education is found to be ambiguous. Rosett and Huang (1972), and Acton (1975) obtained a negative effect on demand, while Wagstaff (1986) found a positive impact, and Cameron *et al.* (1988) and Hunt-McCool *et al.* (1994) received inconsistent or no significant effects at all. Similar findings have been obtained for income having positive, negative or no significance in Rosett and Huang (1972) and Cameron *et al.* (1988), Acton (1975), and Atri and Lahiri (1986), and Feldstein (1977) and Hunt-McCool *et al.* (1994), respectively. Inconclusive results were also obtained for age, with Acton (1975) finding a slightly negative and Hunt-McCool *et al.* (1994) a positive effect. The results of Wagstaff (1986) and Cameron *et al.* (1988) indicate no significant impact of age on hospitalization.

2.2. Modelling Hospitalization

To model hospitalization we follow Grossman's (1972) seminal work which has become the benchmark approach to medical care demand (Grossman, 1982; Muurinen, 1982; Wagstaff, 1986). Health demand is seen as an individual investment decision similar to standard human capital theory. The individual inherits an initial stock of health capital which depreciates over time. This depreciation can be slowed down or even reversed by health investments. The literature generally associates health investments with the demand for medical care. Individual utility from health may be derived either directly (feeling good) or indirectly from respective rewards in the labour market. The individual maximizes utility from health given the production function of health and a budget constraint. Typically, the demand for health care then depends on the existing stock of health capital, the wage rate, the price of medical care, age, a vector of environmental variables (e.g. working conditions), and education (Wagstaff, 1986).

However, if investments in health are expected to decrease the probability of illness (Cropper, 1977), identifying these investments with demand for medical care including hospital trips, as it is often done in the literature, is rather problematic. Instead, one may view hospital trips as a consequence of neglected investments in health, since hospitalization may simply be the consequence of neglected prophylactic efforts. Thus, the higher the individual investments in health,

the lower the actual demand for hospitalization will be. Contrary to conventional approaches developed from the Grossman model, this suggests that determinants promoting individual (i.e. private) health expenditures will result in lower numbers of hospital trips and in lower expenditures for public health care. This interpretation may resolve the puzzle of several empirical results showing 'the wrong sign' of coefficients, as Wagstaff (1986), Pohlmeier and Ulrich (1995), or Grossman (1972) have reported.

The investment interpretation of the demand for medical care only holds if there are no additional direct or indirect effects of the variables on health determining the risk of illness. This is likely not to be the case with age, education and environmental factors. For instance, health risks of working conditions may foster health investments, but the direct (and negative) effects on health may still dominate. With increasing age, health investments may rise due to greater life experience and rationality, e.g. by changing risky behaviour in traffic or consumption of drugs, but health risks are also higher due to a natural decline in physical fitness. If education affects health productivity positively, there will be a negative effect on hospitalization. Moreover, the moral hazard problem certainly still prevails in the demand for hospital trips, and may be even higher than for ambulatory or prophylactic services. The differences between individual prices (insurance contributions) and actual costs is higher in hospital care, especially in social insurance schemes, which increases the individual's potential rent.

Hence, hospitalization is an ambiguous measure of health investments. Certainly, a hospital trip is likely to improve health conditions. But hospitalization is also the consequence of neglected other investments in health. Many variables that affect the demand for medical care have also a direct (and often reversed) effect on health itself.

The structural demand for hospital trips T (with realizations $0, 1, 2, \ldots$) can then be modelled by

$$T(t) = \beta_0 + \beta_1 H(t) + \beta_2 y(t) + \beta_3 I(t) + \beta_4 t + \beta_5 X + \beta_6 E + \beta_7 Z + u(t) \qquad (1)$$

where H is health capital, y is income, I represents insurance coverage, t covers the effect of age, X are environmental controls, E is education, Z is an additional vector of common human capital control variables, and u is a stochastic error term. After all, health should result in a negative effect on hospital trips ($\beta_1 < 0$). We expect β_2 to be negative. Higher income leads to increased returns from work and thus from health. Hence, this should result in higher previous health investments and less need for hospital care. The impact of more generous insurance coverage based on the relation of individual costs and benefits should result in a positive β_3. As discussed above, the effects of t, X, and E are expected to be more ambiguous than in the simple investment model.

Finally, there has been some recent literature on the hospitalization of individuals with chronic conditions (Dowd *et al.*, 1991; Krupnick and Cropper, 1992; Newhouse *et al.*, 1993; Fox, 1993; Tolley *et al.*, 1994), suggesting that this is a very important area of research. These patients are considered to be the most expensive group due to their high frequency of hospital trips. In our sample, for example, their average number of overnight stays in hospital is about twice the number of the average of all individuals. Individuals with chronic conditions may also face a specific incentive structure which demands a separate investigation.

3. INSTITUTIONS AND DATA

3.1. The German Health Insurance System

In order to understand the particular incentives set by insurance schemes which may be the driving force of the demand for hospital care in Germany, one has to examine the institutional

peculiarities of the German health insurance system.[3] One basic characteristic is the legal obligation for individual health insurance. In principle, everybody has to be insured through a public or a private scheme. Public health insurance is provided by about 1000 autonomous, i.e. self-administering public corporations (*Krankenkassen*). Despite the principle of free choice of one's *Krankenkasse*, until recently, there were actually some restrictions of choice according to one's job status (mainly blue versus white collar workers). Two exemptions from the public insurance scheme are important. First, self-employed (except for small groups like farmers, artists, or freelance journalists) are not obliged to be health insured. They have, however, the option to join the public or a private insurance scheme. Second, employees whose monthly gross earnings exceed a certain amount (currently DM 6000 per month) and civil servants can opt out of public health insurance to choose a private alternative from the market.

Public insurance is based on the principle of solidarity among its members, and is financed by contributions which are a fixed percentage of income without any direct connection to the amount of services used. The insured employee and his or her firm each pay 50% of the contribution. Contributions do not vary much among public insurance corporations, since they are linked through a joint redistribution fund covering losses of corporations with financial problems by contributions of the others. There is no reimbursement of contributions, and copayments for inpatient hospital care are very low (currently DM 12 per day). Private insurance contributions depend on individual risk and actual coverage requested. Common reimbursement and copayment schemes in private health insurance increase incentives to minimize the use of services.

In general, public health insurance covers all necessary medical services independent of their costs. Services are paid for by the *Krankenkassen* according to fixed prices resulting from previous bargaining with the doctors' associations and hospitals. Services for the privately insured are not restricted to those rates and can depart significantly from them.

There are three important features of the public insurance system which one has to be aware of. First, compulsory public insurance automatically covers non-employed family members like spouse and children. They receive the same services as paying members. Second, the largest group of public insurance corporations, which are organized on the local level, the *Allgemeine Ortskrankenkassen* (AOKs) play a special role. While all other corporations have been able to introduce some kind of basic restrictions for eligibility, they have to provide services for anyone who needs to be insured and is not a member of another corporation. Traditionally, the AOKs mainly insure blue collar workers who tend to bear a higher health risk anyway. Hence, there tends to be a special problem of adverse selection for them which has to be controlled for. Third, membership in the public health insurance scheme does not pre-empt the possibility of additional private insurance coverage for special services, e.g. single-room care in hospitals. In 1994, about 5·8 million Germans had some kind of additional private coverage (IDW, 1996).

The particularities of the German health care system thus result in specific adverse selection problems for three groups: AOK members, insured self-employed, and voluntary participants in the public insurance scheme. The latter two groups have the alternative to insure themselves not at all or in a private scheme, both choices being very costly if individual risks are high. This adds to the problem of moral hazard which, due to the missing link between contribution and services, should be especially large for all members of public insurance companies.

[3] An introduction to the German system is provided by Holtz-Eakin (1993).

3.2. The Data

Our data source is the German Socio-Economic Panel (GSOEP), a representative sample for western Germany that is collected yearly since 1984 (Wagner *et al.*, 1993). Our sample contains 30,590 observations on 5180 individuals from the (8) 1984 to 1989, 1992 and 1994 waves. The 1990, 1991 and 1993 waves had to be omitted because they concentrate on different topics and do not provide information on all relevant questions, especially on hospitalization. Our sample contains adults (females and males) aged 25 to 64, thus excluding children, students and retired people. We also study the subsample of 1480 persons with chronic conditions. The panel is unbalanced due to missing data, but all individuals have to be observed for at least two waves. The total sample of 30,590 observations will be studied for the subsamples of 14,890 males and 15,700 females. Individuals with chronic conditions provide 5506 observations, 2944 are females and 2562 are males. Table I explains in detail all variables used, and Table II contains means and standard deviations for selected variables from the pooled sample.

The individual demand for hospitalization is measured by a person's yearly number of hospital trips. A hospital trip is defined as accession to a hospital for at least one overnight stay. Table II

Table I. Variables in the dataset

Variable	Description
Hospital trips	Number of yearly inpatient stays in hospital
Age	Age of the individual in years
Gender	1 = male
Private	1 = full coverage by private health insurance
Copayment	1 = full coverage by private health insurance with copayment obligation
Public	1 = public, i.e. non-private insurance scheme including those insured voluntarily and as family members
Voluntary	1 = voluntarily in public insurance scheme
Family	1 = public insurance scheme for non-working spouse and children of paying members of public insurances
AOK	1 = public insurance in *Allgemeine Ortskrankenkasse*, the insurance company legally obliged to accept all risks
Additional	1 = public insurance with voluntary additional coverage through a private scheme
Chronic	1 = chronic conditions
Handicap	1 = handicapped
Income	Monthly net income of the household (DM)
Distance	1 = place of living is outside of a city centre
Married	1 = married
Secondary	1 = educational level at least secondary school (*Realschule*)
University	1 = degree from a university or technical college
Apprenticeship	1 = passed vocational training
Health job	1 = working in a health related field
In labour	1 = in the labour force, i.e. working or unemployed
Blue collar	1 = blue collar worker
White collar	1 = white collar worker
Civil servant	1 = civil servant
Self-employed	1 = self-employed
Part-time	1 = part-time job
Western	1 = EU, US, Canadian, or Swiss national
Nation else	1 = other non-German nationals
Children	1 = children below age 16 in the household

conveys two major results. First, the structural differences between the total sample and the subsample of individuals with chronic conditions are small. Therefore, any important differences in their demand for hospital care should be caused by the fact of chronic disease. Second, there are some major differences for men and women. The average number of hospital trips is higher for women (0·17) than for men (0·10). Moreover, the continuance of some special status of women in the labour market is documented by the job status variables (not reported in Table II). Females are more frequently out of the labour force than males (38% against 2%), they tend to work less often in blue collar jobs (24% against 57%), in the civil service (3% against 9%) or as self-employed entrepreneurs (4% against 8%), and they dominate in part-time jobs (20% against 1%). They are also less likely to be insured in a private scheme, be it with or without copayment, or voluntarily in the public system. (See Table II for specific details.) The important role of housewives in the German insurance system is shown by the large share of females being insured as family members in the public scheme (42% in comparison to 1% for males only), although participation in the public system in general is very similar among both males (90%) and females (95%).

Table II. Means of selected variables (standard deviations in parentheses)

	Males		Females	
	Total	Chronic conditions	Total	Chronic conditions
Age (years)	49·77	53·06	47·37	50·41
	(8·76)	(8·01)	(8·61)	(7·85)
Hospital trips	0·10	0·19	0·17	0·23
	(0·66)	(0·74)	(0·68)	(0·86)
Private	0·12	0·13	0·06	0·07
	(0·33)	(0·34)	(0·24)	(0·27)
Copayment	0·10	0·11	0·05	0·07
	(0·30)	(0·31)	(0·23)	(0·25)
Public	0·90	0·89	0·95	0·94
	(0·30)	(0·31)	(0·21)	(0·24)
Voluntary	0·16	0·16	0·05	0·04
	(0·37)	(0·37)	(0·21)	(0·20)
Family	0·01	0·02	0·42	0·43
	(0·10)	(0·13)	(0·49)	(0·49)
AOK	0·46	0·42	0·44	0·39
	(0·50)	(0·49)	(0·50)	(0·49)
Additional	0·05	0·07	0·05	0·06
	(0·22)	(0·25)	(0·21)	(0·25)
Chronic	0·19	—	0·21	—
	(0·40)		(0·41)	
Handicap	0·17	0·26	0·16	0·22
	(0·38)	(0·44)	(0·37)	(0·41)
Income (DM per month)	3659·18	3727·76	3575·54	3634·80
	(2030·12)	(2250·48)	(1994·54)	(1965·60)
Distance	0·87	0·87	0·87	0·86
	(0·33)	(0·33)	(0·33)	(0·34)
Married	0·80	0·86	0·84	0·85
	(0·40)	(0·35)	(0·37)	(0·36)
Children	0·58	0·53	0·62	0·54
	(0·49)	(0·50)	(0·49)	(0·50)

To take proper account of the insurance problem we distinguish seven forms of contract. There is private insurance in general, private insurance with copayment obligations, and additional private insurance as a complement to public insurance. As far as the public insurance status is concerned, there is additional information whether an individual is insured as a family member, a paying voluntary member, or a member of an AOK.

Specific information on health status is provided by two dummies for individuals with chronic conditions or being handicapped. The environmental factors of the Grossman model are represented by five job status variables (working or unemployed, blue collar worker, white collar worker, civil servant, self-employed) and by two dummies for part-time employment and distance to a city centre. Employment status should capture opportunity costs of hospital trips, but could also measure differences in preferences. This also holds for part-time employment. Distance provides information on how close an individual lives to a city centre. According to the literature, low distance to a hospital (i.e. good supply and low transportation costs) should increase demand for hospital care. Since city centres generally provide the broadest range of hospital services and the largest amount of hospital beds, we took 'living outside a city centre' as a simple proxy for distance to a hospital.

Education plays a major role in the Grossman model as an indicator for health productivity. It is covered by two variables indicating the level of formal education a person has received. The two criteria here were graduation from a secondary school and holding a degree from a technical college or university. Additionally, we use a dummy for having passed an apprenticeship training. It is hardly possible to correlate quality with the duration of education in a system with vast differences in the average length of university education in different subjects leading to the same formal degree. Therefore, this specification seems more adequate than the standard 'years of schooling' approach in the conventional specification of wage equations. Moreover, since better information and awareness of health risks and cure may be a comparative advantage of medical jobs independent of their formal qualification requirements, we also use a dummy capturing whether a person is working in a health-related job.

Finally, there are the standard variables age, a dummy for children below 16 in the household, household net income and dummies for male and married. We use also dummies for non-German residents because there may be some basic differences in behaviour due to different socialization and experience. In order to cover potential cultural differences, we distinguish between foreigners from Western countries and from the rest of the world.

4. COUNT DATA ESTIMATION

4.1. Count Data Models

Our endogenous variable, the number of hospital trips in each year, is discrete and non-negative, which suggests the use of count data estimation methods.[4] In this section we briefly outline the approaches used for better reference to the reader, and explain the modelling strategy. We start our analysis with the benchmark standard cross-section model for count data, the Poisson and the negative-binomial (NEGBIN) models, which we apply to the pooled data set to obtain first insights in the data structure. To exploit the data structure fully, we then estimate random effects NEGBIN panel models and examine their relative performance in explaining determinants of hospital trips in Germany.

[4] An overview of recent developments in count data modelling is given by Winkelmann and Zimmermann (1995).

In order to overcome weaknesses of the Poisson model (e.g. Cameron and Trivedi, 1986; Winkelmann and Zimmermann, 1995), compound Poisson models have been developed which introduce an additional error (ε) into the simple Poisson framework. Let

$$\tilde{\lambda}_i = \exp(x_i\beta + \varepsilon_i) = \exp(x_i\beta)u_i \tag{2}$$

where ε_i (u_i) captures unobserved heterogeneity and is uncorrelated with the explanatory variables. The distribution of the counts y is then a mixture distribution. If u_i is distributed with $\Gamma(\alpha, \alpha)$ then y_i follows a negative binomial distribution with

$$f(y_i|\alpha, \lambda_i) = \frac{\Gamma(\alpha + y_i)}{\Gamma(\alpha)\Gamma(y_i + 1)}\left(\frac{\alpha}{\lambda_i + \alpha}\right)^{\alpha}\left(\frac{\lambda_i}{\lambda_i + \alpha}\right)^{y_i} \tag{3}$$

and

$$\mathrm{Var}(Y_i|x_i) = E(Y_i|x_i) + \sigma^2[E(Y_i|x_i)]^2 \tag{4}$$

Assuming that the dispersion-parameter $\sigma^2 = \alpha^{-1}$, Cameron and Trivedi (1986) denote this special negative binomial model as NEGBIN II which nests the standard Poisson model. (In this paper, we refer to this as the NEGBIN model.)

We further follow Hausman *et al.* (1984) who have developed panel models for count data. We use their NEGBIN random effects panel model here. Similarly to the ordinary NEGBIN model an additional stochastic parameter δ is introduced which varies across individuals:

$$\tilde{\lambda}_{it} = \exp(x_{it}\beta + \delta_i) \tag{5}$$

Contrary to NEGBIN which, as a cross-section model, implicitly assumes that ε follows a constant distribution, the parameter of δ remains the same only for each single individual. Following Hausman *et al.* (1984), the panel NEGBIN model starts from a basic random effects Poisson framework with

$$P(Y_{it} = y) = \frac{\exp(-\lambda_{it}\,e^{\delta_i})(\lambda_{it}\,e^{\delta_i})^y}{y!} \quad y = 0, 1, 2, \ldots \tag{6}$$

which is identical to a NEGBIN model with a parameter varying across groups (represented by each individual person here). δ_i follows another probability function. In our case, a gamma distribution for δ_i with $\Gamma(\alpha_i, \alpha_i)$ is assumed. In order to incorporate the random effects into this model, $\alpha_i/(1 + \alpha_i)$ is then assumed to be beta distributed with $B(a, b)$. Hence, the random effects NEGBIN panel model allows σ^2 in equation (4) to vary randomly across groups.

4.2. Model Specification

Our major interest is the impact of insurance on the number of hospital trips. The effects are measured by a set of dummy variables. Choosing private insurance as reference, there is first a dummy measuring the relative effect of public insurance (compulsory, voluntary, or as a family member). Further dummies (*Voluntary*, *Family*) capture the difference from this overall effect for the two subcases (leaving the compulsory membership as reference). We further investigate two different groups in public insurance who typically are expected to behave differently. First, this is

the group of *AOK* members, the insurance companies that are legally obliged to insure all risks. Second, there are those with voluntary additional coverage through a private scheme (*Additional*). We interact these two dummies (*AOK*, *Additional*) with dummies *Public*, *Voluntary*, and *Family* to study group effects. Since our dataset includes only very few male family members in the public insurance scheme who at the same time were *AOK* members or had an additional private coverage, we set the interaction effects of family insurance in the male sample to zero. Similarly, these interactions were also excluded in both equations for male and female individuals with chronic conditions. Here, it was further impossible to estimate the parameters of *Voluntary* interacted with *Additional* and *AOK*, again due to insufficient variation of the regressors.

The count data regressions will also contain information on age (in a cubic form to investigate non-linearities), net household income, distance, marriage status, education (secondary school, apprenticeship training, university), working in a health job, being in the labour force, job status variables (blue collar, white collar, civil servant, self-employed), working part-time, the presence of children below age 16, and foreign nationality (Western or nation else).

We examined the issue that chronic conditions could be a result of previous behaviour in health investment and thus a consequence of the insurance scheme chosen, which does not seem to be a problem here. Neither was there high correlation between the insurance variables and *Chronic*, nor did an exclusion of this variable change the estimated parameters in any relevant way.

Since women and men are known to respond differently to economic incentives (e.g. for labour supply see Zimmermann, 1993), we split the sample into males and females, and compared the findings with the joint estimations. Simple likelihood-ratio tests (not reported here) suggest that a sample split is appropriate. Hence, we report only the findings for the separate samples for males and females.

5. RESULTS

The findings for the total sample for males and females are given in Table III; results for the subsets of individuals with chronic conditions are reported in Table IV. Model evaluations are provided in both tables, but also in Table V. Table V reveals that there is overdispersion at the level of the raw data. The estimates of the dispersion parameter σ^2 of the simple cross-section NEGBIN models are rather large in all cases and clearly indicate that a Poisson specification would not be appropriate, which is also supported by likelihood-ratio tests (not reported here). The dispersion parameters are much larger in case of the full sample when compared with the respective estimates for the samples of the individuals with chronic conditions. Similarly, the stochastic specification of the random effects panel NEGBIN model is clearly supported by the data. Since both models are not nested, Tables III and IV provide the values for the AIC (Akaike) and SC (Schwarz) information criteria. These numbers prefer the random effects NEGBIN panel specification in all cases. This finding is supported by a comparison of the aggregated actual and predicted frequencies of the models as given in Table V. It is also shown in the summary statistic S that compares the sum of squared prediction errors of the cross-section and the random effects panel NEGBIN models with the sum of the squared prediction errors of the cross-section NEGBIN model with a constant and the dispersion parameter only. Panel NEGBIN clearly performs much better. However, the findings also demonstrate that the explanatory variables substantially improve predictions.

These results suggest to rely the interpretation on the parameter estimates of the variables on the panel estimates. The picture provided by the cross-section NEGBIN model is not really

Table III. Estimation results for males and females, total sample

	NEGBIN		NEGBIN Panel	
	Males	Females	Males	Females
Constant	−9·535*	−8·949*	−5·798	−9·068**
	(−1·79)	(−1·69)	(−1·16)	(−2·55)
Age	0·475	0·607*	0·361	0·722**
	(1·40)	(1·72)	(1·12)	(3·02)
	[−1·5][a]	[−6·7][a]	[0·4][a]	[−4·5][a]
Age$^2 \cdot 10^{-3}$	−9·854	−15·678**	−8·341	−18·286**
	(−1·38)	(−2·04)	(−1·23)	(−3·47)
Age$^3 \cdot 10^{-4}$	0·673	1·241**	0·633	1·430**
	(1·36)	(2·26)	(1·36)	(3·77)
Copayment	0·236	0·116	0·186	−0·105
	(1·07)	(0·47)	(0·99)	(−0·53)
	[−6·2][b]	[−18·3][b]	[−4·0][b]	[−25·3][b]
Public	0·292	0·570**	0·199	0·447**
	(1·17)	(2·01)	(0·94)	(1·99)
	[−26·2][c]	[−26·7][c]	[−20·6][c]	[−17·0][c]
Voluntary	0·133	−0·349	0·148	−0·292*
	(0·95)	(−1·60)	(0·98)	(−1·95)
	[13·8]	[−30·0]	[16·1]	[−25·3]
Family	−0·421	−0·857**	−0·349	−0·865**
	(−0·95)	(−6·04)	(−0·94)	(−9·26)
	[−33·8]	[−58·3]	[−29·4]	[−58·0]
Public · Additional	−0·303	−0·581	0·094	−0·278
	(−0·41)	(−1·10)	(0·17)	(−0·80)
	[−26·2]	[−43·3]	[10·1]	[−24·2]
Public · AOK	0·011	−0·246**	0·030	−0·259**
	(0·14)	(−2·12)	(0·34)	(−2·94)
	[0·0]	[28·3]	[−2·8]	[29·6]
Voluntary · Additional	0·559	0·433	−0·078	0·315
	(0·71)	(0·59)	(−0·12)	(0·64)
	[200·0][d]	[8·3][d]	[7·3][d]	[2·5][d]
Voluntary · AOK	0·261	0·104	0·237	0·142
	(1·26)	(0·27)	(1·12)	(0·60)
	[49·2][e]	[−21·7][e]	[47·2][e]	[−13·8][e]
Family · Additional	—	0·654	—	0·350
		(1·16)		(0·85)
		[−18·3][f]		[−40·3][f]
Family · AOK	—	0·218	—	0·159
		(1·46)		(1·35)
		[−46·7][g]		[−50·7][g]
Chronic	0·799**	0·576**	0·690**	0·467**
	(10·11)	(7·68)	(9·43)	(8·03)
	[123·1]	[78·3]	[99·1]	[59·7]
Handicap	0·191**	0·224**	0·190	0·157**
	(2·24)	(2·47)	(0·81)	(2·66)
	[21·5]	[25·0]	[21·0]	[17·2]
Income $\cdot 10^{-5}$	−0·880	−0·962	0·112	−0·403
	(−0·35)	(−0·47)	(0·05)	(−0·32)
	[−1·5]	[−1·7]	[0·4]	[−0·7]

Table III continued over page

Table III. Continued

	NEGBIN		NEGBIN Panel	
	Males	Females	Males	Females
Distance	−0·011	−0·201*	−0·195*	−0·157**
	(−0·09)	(−1·83)	(−1·95)	[−2·05)
	[1·5]	[21·7]	[21·8]	[17·2]
Married	−0·069	0·338**	−0·200*	0·312**
	(−0·57)	(2·89)	(−1·88)	(3·91)
	[7·7]	[−28·3]	[22·2]	[−26·7]
Children	0·329**	0·550**	0·154*	0·471**
	(2·72)	(6·52)	(1·92)	(7·26)
	[−27·7]	[−41·7]	[−14·1]	[−37·6]
σ^2	6·712**	6·823**	—	—
	(18·36)	(26·56)		
a	—	—	5·160**	9·006**
			(12·74)	(13·86)
b	—	—	1·160**	2·104**
			(6·83)	(8·26)
lnL	−4495·3	−7365·6	−4342·0	−7028·0
N	14890	15700	14890	15700
AIC	9056·6	14797·2	8752·0	14124·2
SC	9307·7	15050·0	9010·7	14384·5

Notes:
Estimations also included *Secondary*, *Apprenticeship*, *University*, *Health job*, *In labour*, *Blue collar*, *White collar*, *Civil servant*, *Self-employed*, *Part-time*, *Western*, and *National else*.
t-ratios are given in parentheses (two-tailed significance: * 10%, ** 5%).
σ^2 is the estimated dispersion parameter in the NEGBIN model. *a* and *b* are the estimated parameters of the beta-distribution for α in the NEGBIN random effects panel model.
lnL: log-likelihood value of the model. Akaike Information Criterion and Schwarz Criterion are calculated as AIC $= -2\ \text{lnL} + 2\ K$, and SC $= -2\ \text{lnL} + K\ \text{ln}N$, respectively, with K = number of parameters estimated and N = number of observations.
In square brackets there are percentage changes in expected frequencies due to changes in the characteristics of a reference individual defined by: *Age* = 50 for men and 47 for women, *Public* = 1, *AOK* = 1, *Income* = DM3659 for men and DM3576 for women, *Children* = 1, *Distance* = 1, *Married* = 1, *Blue collar* = 1 for men and *White collar* = 1 for women, all other variables = 0. Simulated changes are the switch of variable to the opposite state for a dummy, and addition of 1 year of *Age* and of one standard deviation for *Income*, respectively. Reported simulated effects for the insurance dummies incorporate the simultaneous impact of a switch on corresponding insurance variables as indicated.
[a] Total age effect.
[b] *Public* = 0 and *AOK* = 0.
[c] *AOK* = 0.
[d] *Voluntary* = 1 and *Additional* = 1.
[e] *Voluntary* = 1.
[f] *Family* = 1 and *Additional* = 1.
[g] *Family* = 1.

different, however.[5] This contrasts the typical findings in the patents–R&D literature (see Hausman *et al.*, 1984) that obtains larger differences between cross-section and panel models. An explanation might be that there is greater unobserved firm-specific heterogeneity in the patents case than individual-specific heterogeneity in the hospital visits case.

[5] Geil *et al.* (1996) have investigated a larger number of more sophisticated cross-section count data models with no important economic differences. Hence, the results summarized in this paper seem to be stable within a wide class of models.

Table IV. Estimation results for males and females with chronic conditions

	NEGBIN		NEGBIN Panel	
	Males	Females	Males	Females
Constant	9·305	−1·977	10·151	−8·856
	(0·61)	(−0·22)	(0·77)	(−0·89)
Age	−0·592	0·128	−0·574	0·708
	(−0·63)	(0·21)	(−0·70)	(1·10)
	[1·4][a]	[−0·9][a]	[1·7][a]	[−2·6][a]
$Age^2 \cdot 10^{-3}$	11·985	−4·740	10·589	−18·137
	(0·62)	(−0·37)	(0·63)	(−1·33)
$Age^3 \cdot 10^{-4}$	−0·790	0·449	−0·630	1·435
	(−0·61)	(0·50)	(−0·56)	(1·51)
Copayment	0·265	0·629*	0·050	0·051
	(0·70)	(1·88)	(0·13)	(0·12)
	[95·8][b]	[23·1][b]	[−1·7][b]	[−17·7][b]
Public	−0·026	0·561	0·159	0·469
	(−0·06)	(1·57)	(0·40)	(1·04)
	[50·7][c]	[−34·3][c]	[−6·7][c]	[−21·8][c]
Voluntary	0·578**	−0·447	0·311	−0·284
	(1·99)	(−1·49)	(1·13)	(−0·94)
	[77·5]	[−36·1]	[36·3]	[−24·7]
Family	−1·636**	−0·579**	−0·877	−0·626**
	(−2·01)	(−3·06)	(−1·15)	(−3·38)
	[−80·3]	[−44·0]	[−58·5]	[−46·5]
Public · Additional	0·033	−0·132	−0·499	−0·107
	(0·06)	(−0·35)	(−0·91)	(−0·26)
	[38·0]	[−12·5]	[−39·3]	[−10·3]
Public · AOK	−0·015	−0·141	−0·091	−0·233
	(−0·11)	(−1·04)	(−0·56)	(−1·51)
	[15·5]	[14·8]	[9·5]	[24·9]
Handicap	0·297*	0·143	0·230	0·130
	(1·89)	(1·03)	(1·55)	(1·04)
	[33·8]	[15·3]	[28·9]	[13·8]
$Income \cdot 10^{-5}$	−1·005	0·711	−2·062	1·701
	(−0·20)	(0·19)	(−0·45)	(0·47)
	[−2·8]	[1·4]	[−4·5]	[3·5]
Distance	−0·154	−0·315*	−0·079	−0·050
	(−0·73)	(−1·94)	(−0·44)	(−0·28)
	[15·5]	[37·0]	[8·2]	[5·0]
Married	−0·337	0·252	−0·402*	0·259
	(−1·36)	(1·37)	(−1·87)	(1·34)
	[39·4]	[−22·2]	[49·5]	[−22·9]
Children	0·475**	0·491**	0·312**	0·308**
	(2·80)	(3·62)	(2·01)	(2·34)
	[−38·0]	[−38·9]	[−26·9]	[−26·4]
σ^2	4·032**	3·610**	—	—
	(8·71)	(11·19)		
a	—	—	4·619**	4·660**
			(6·13)	(7·37)
b	—	—	1·247**	1·352**
			(3·43)	(4·27)

Table IV continued over page

Table IV. Continued

	NEGBIN		NEGBIN Panel	
	Males	Females	Males	Females
lnL	−1229·8	−1646·6	−1198·9	−1602·2
N	2562	2944	2562	2944
AIC	2511·6	3345·2	2451·8	3258·4
SC	2663·7	3500·9	2609·7	3420·1

Notes:
Estimations also included *Secondary*, *Apprenticeship*, *University*, *In labour*, *Blue collar*, *White collar*, *Civil servant*, *Self-employed*, *Western* and *Nation else*.
t-ratios are given in parentheses (two-tailed significance: * 10%, ** 5%).
σ^2 is the estimated parameter of the gamma-distribution in the NEGBIN model. *a* and *b* are the estimated parameters of the beta-distribution for α in the NEGBIN random effects panel model.
lnL: log-likelihood value of the model. Akaike Information Criterion and Schwarz Criterion are calculated as AIC = -2 lnL + 2 *K*, and SC = -2 lnL + *K* lnN, respectively, with *K* = number of parameters estimated and *N* = number of observations.
In square brackets there are percentage changes in expected frequencies due to changes in the characteristics of a reference individual defined by: *Age* = 53 for men and 50 for women, *Public* = *1*, *AOK* = 1, *Income* = DM3728 for men and DM3576 for women, *Children* = 1, *Distance* = 1, *Married* = 1, *Blue collar* = 1 for men and *White collar* = 1 for women, all other variables = 0. Simulated changes are the switch of variable to the opposite state for a dummy, and addition of 1 year of *Age* and of one standard deviation for *Income*, respectively. Reported simulated effects for the insurance dummies incorporate the simultaneous impact of a switch on corresponding insurance variables as indicated.
[a] Total age effect.
[b] *Public* = 0 and *AOK* = 0.
[c] *AOK* = 0.

Table V. Actual and predicted frequencies

	Category							
	0	1	2	3	4	5	>5	S
Males, all: mean 0·10; variance 0·44								
Actual	13840	898	98	23	5	6	20	
NEGBIN	13855	765	178	56	20	8	8	0·19
Panel NEGBIN	13877	782	152	44	16	7	12	0·42
Females, all: mean 0·17; variance 0·47								
Actual	13686	1710	217	38	8	8	33	
NEGBIN	13723	1506	329	92	30	11	9	0·24
Panel NEGBIN	13684	1533	332	94	32	12	13	0·38
Males, chronic conditions: mean 0·19; variance 0·54								
Actual	2239	253	45	12	4	2	7	
NEGBIN	2244	222	60	20	8	4	4	0·24
Panel NEGBIN	2249	224	54	18	7	3	7	0·38
Females, chronic conditions: mean 0·23; variance 0·73								
Actual	2493	351	63	19	3	3	12	
NAGBIN	2503	299	87	31	13	6	5	0·10
Panel NEGBIN	2506	306	78	27	11	5	11	0·37

Note:
$S = 1 - S_\beta^M / S_0^{NEGBIN}$ where S_0^{NEGBIN} is the sum of squared differences between the actual and the predicted frequencies of the NEGBIN model with constant and dispersion parameter only, and S_β^M is the respective value for the fully specified NEGBIN and random effects panel NEGBIN models.

Since most of the regressors are dummies, and some of the variables are related, it is difficult to interpret the coefficients directly. Hence, we calculate the expected number of hospital trips for a reference group in each sample (explained in detail in the notes to Tables III and IV) and evaluate its percentage change for changes in the exogenous variables (or group of variables) as defined in the tables. Dummies are switched to the opposite state, age is increased by one year, and income is increased by one standard deviation. The tables provide these percentage changes in square brackets, while t-ratios are given in parentheses.

Because of their relevance for economic policy the estimates for the insurance variables are of major interest. For both male regressions (total sample and chronic conditions) insurance variables show no statistically significant role, and this is largely true also for females with chronic conditions. For the female total sample, membership in a private insurance is associated with a statistically significant reduction in hospital trips, which supports economic theory. However, the kind of private insurance plays no role. Also, the pattern is markedly different between alternative public insurance schemes. *Voluntary* and *AOK* membership moderates the increase in hospital trips due to public insurance; for non-working spouses and children (*Family*), this effect is even overcompensated. These latter more detailed results are not consistent with the theoretical considerations.

A clearer picture is given by the simulations which are detailed in Tables III and IV. For example, we consider a reference individual (as defined in the tables) that is a member of the public insurance scheme provided by *AOK*. A change to private insurance (without copayment obligation) would decrease hospital trips by 17% for females and 20% for males (Table III). Although the coefficient for public insurance for women is clearly larger than for men, the respective elasticities are of similar size due to moderating effects of *AOK* membership.

Contrary to the implications of the Grossman investment model, but consistent with previous empirical results, age does not seem to have a significant impact on the decision about hospitalization of men. There are significant effects for women in the total sample, although not for females with chronic conditions. However, the simulation results reveal that an age increase of one year for an average women (age 47 for the total sample and age 50 for those with chronic conditions) causes a small but negative percentage change in hospitalization. This result is not in accordance with theory.

This has to be qualified by the strong effects of health variables which may be correlated with age. Not surprisingly, chronic conditions increase the number of hospital trips massively, for men as well as for women. This finding from the total sample also serves as an additional empirical justification for our separate investigation of the subsample of those with chronic conditions. The same expected positive effect, though clearly lower in magnitude and often not statistically significant, shows up for handicapped persons. The simulations exhibit an about 100% increase in hospital trips for men with chronic conditions in the total sample, while the effect of becoming handicapped is 21%. These health effects are substantially smaller for females.

Distance is a statistically significant element of hospitalization demand, which supports the theoretical considerations, but only for the total sample. Chronic conditions seem to overcompensate travel cost considerations. One robust finding is the insignificance of income throughout the samples. This is contrary to economic expectations according to the Grossman model. The presence of children has a positive and statistically significant effect on the number of hospital trips of men and women in all samples. An interesting feature provided by our data is the different impact of marriage on men and women. While for females being married implies a

significant rise in hospitalization, the effect on men's behaviour is reversed. For females with chronic conditions, this is no longer statistically significant.

The control variables (not reported in the tables) convey the following message. All education variables are insignificant throughout the estimations. While being in the labour force *per se* does not affect hospitalization, occupational status clearly matters. Blue and white collar workers as well as self-employed show significantly negative effects. Part-time work has a negative effect for women, while having a health-related job has a positive one. Finally, there was a significantly higher number of hospital trips of non-western male foreigners in the total sample only.

6. CONCLUSIONS

Based on theoretical implications of the Grossman investment model, we investigated the driving factors of the individual demand for hospitalization in Germany. One major finding is that the kind of individual insurance coverage does not play an important role for the hospitalization decision. Females seem to be more likely to react to economic incentives than males. The impact of insurance decreases further for persons with chronic conditions.

Crucial elements of the Grossman model, like age, income and education have no or only limited impact. Family structure and position in the labour market seem much more important for the individual decision than insurance. Especially being married and having children affect men's and women's behaviour significantly.

Our results thus show that a differentiated view of the demand for health care is necessary. In the German case, institutional settings do not foster 'overconsumption' of hospital care services, which contradicts experiences in the USA or Australia. We conclude that a change in the German health insurance system, aiming at a higher level of private coverage, is not sufficient to curb the demand for hospital trips.

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