

Physician-induced demand for medical services in Germany: new evidence from combined district and individual level data

Hendrik Jürges

This version: February 2007

MEA-Universität Mannheim
L13,17
68131 Mannheim
Germany
Email: juerges@mea.uni-mannheim.de
Fax: +49-621-181-1863

Abstract: Using German SOEP 2002 data, I estimate a hurdle model for the effect of district (*Kreis*-) level physician density on the individual number of doctor visits – accounting for the possibility of simultaneously determined physician density. The paper has four main findings. First, I find no evidence that physician density might be endogenous. Second, conditional on health, privately insured patients are less likely to contact a physician but more frequently visit a doctor following a first contact. Third, physician density has a significant positive effect on the decision to contact a physician and on the frequency of doctor visits of patients insured in the statutory health care system, whereas, fourth, physician density has no effect on privately insured patients' decisions to contact a physician but an even stronger positive effect on the frequency of doctor visits than for the statutorily insured. These findings give indirect evidence for the hypothesis that in Germany, physicians induce demand for medical services among privately insured patients but not among statutorily insured.

Keywords: supplier-induced demand, health care utilisation

JEL-Classification: I11

Acknowledgements: I am greatly indebted to Dr. K.H. Wacker, Gummersbach, for raising my interest in this topic and providing anecdotal evidence.

1. Introduction

This paper analyses the effects of physician density (the number of physicians per 100,000 inhabitants) on the individual number of doctor visits in Germany, using data from the 2002 German Socio-economic Panel (SOEP). The paper contains three innovations compared to earlier analyses based on the same data set: first and foremost, I use district level (*Kreise*) information on physician density (today, Germany is divided into 439 districts). The information used in earlier studies was much coarser, and thus less likely to capture the physician density that is relevant for the demand for doctor's services.¹ The second innovation is the use of an instrumental variable approach to account for the potential simultaneity of physician density. In principle, the first stage of the IV-approach models physician's location decisions and thus the aggregate supply of ambulatory health care services. The third innovation is the separate treatment of respondents insured in the German statutory health insurance system and privately insured respondents. This is important because physicians' incentives to induce demand are much higher for the latter patient type.

In empirical studies of physician-induced demand for health care services, physician density is probably the most commonly used variable. Given the number and the average health level of patients in a specific region, a higher physician density implies a shift of the aggregate supply curve. Demand for medical services per physician decreases. If physicians respond by lowering their fees, the quantity of health services demanded will rise until a new equilibrium is reached. Thus a positive correlation between physician density and health care utilisation does not necessarily mean that the market for medical services fails. Physicians can also respond to reduced demand per capita by raising their fees (in order to reach some income target). This is only possible if they are able to shift (i.e. induce) demand.² A positive correlation between physician density and physician fees thus indicates that there might be some market problem. However, an alternative explanation for a positive correlation between physician density and doctor visits is that a higher physician density entails lower patients' opportunity costs of doctor visits, both in terms of travel costs and shortened queues in the physician's offices.

Physicians have the opportunity to induce demand because – as in other markets for credence goods such as car repairs or home maintenance – there are significant information

¹ For instance, Pohlmeier & Ulrich (1995) and Cassel & Wilke (2002) use physician density on the federal state level. West Germany (data until 1990) had 11 federal states. Post-unification Germany has 16 federal states.

² In Germany, however, fees for health care services are fixed, and physicians can respond to an increase in physician density only by trying to increase the demand for their services, both in terms of quality and quantity.

asymmetries in the medical market.³ Doctors are generally better informed about necessary and appropriate diagnoses and treatments than their patients. After all, this is the very reason why patients visit doctors, and exactly because doctors are better informed, it is their duty to induce demand by informing patients about necessary and appropriate next steps in the treatment of some disease. Hence it is not the fair-minded attempt by the physician to convince a patient of the necessity of some particular diagnostic test or treatment that health economists have in mind when they talk of demand inducement. Rather, to talk of physician induced demand, tests and treatments must not be medically indicated (including flat-of-the-curve medicine) and doctors must suggest them only for profit and not for medical reasons.

The question whether physicians *systematically* induce demand is contentious. Probably there is no health care system without incentives for demand inducement, and many people may once or twice have had the odd feeling that some diagnostic test or treatment was not strictly necessary, but the important question is whether physician demand inducement is a such a widespread and significant phenomenon that it should instigate public intervention.

The empirical evidence on demand inducement is ambiguous. Early studies that find positive effects of physician density on health care utilisation in an instrumental variables approach (simultaneity of physician density arises if one assumes that doctors tend to locate where demand is high) are for example Fuchs (1978), Wilensky & Rossiter (1981), and Cromwell & Mitchell (1986). In his classical article, Fuchs (1978) showed that a 10 percent increase in the surgeon/population ratio results in a three percent increase in the number of operations. Wilensky & Rossiter find an elasticity of 0.1 between physician density and the frequency of follow-up visits to doctor's offices, and Cromwell & Mitchell find a surgery rate elasticity with respect to surgeon concentration of 0.09. However, evidence against the inducement hypothesis was also found e.g. by Sweeney (1982), McCarthy (1985), and Stano (1985) for the US, or Carlsen & Grytten (1998) for Norway.

The early studies have been criticised because they provide at most indirect evidence (Dranove & Wehner, 1994) or because the particular identification strategy was considered inappropriate or flawed (e.g. Auster & Oaxaca 1981, Dranove & Wehner, 1994). A few recent studies provide more direct evidence that corroborates the demand inducement hypothesis. For instance, Gruber & Owins (1996) use an exogenous decline in birth rates and hence decline in the income of obstetricians and gynaecologists to explain a substantial increase in the proportion of caesarean deliveries. Other studies show that physicians react to exogenous

³ See Dullek and Kerschbamer (2006) for a unifying review of the economic theory of credence goods.

changes in reimbursement rates (and hence exogenous changes in income) in a way that is consistent with demand inducement: output (the number of visits) increases when reimbursement is reduced, and vice versa (Rice 1983, Yip 1998)

Empirical studies of demand inducement in Germany using a variety of data sources include Krämer (1981), Breyer (1984), Pohlmeier & Ulrich (1995), Cassel & Wilke (2002), Thode et al. (2004), and Kopetsch (2007). Here the evidence is also mixed. Krämer (1981) uses regional-level administrative data of statutory health insurances from the early 1970s and finds that the number of doctors in region has a twice as large effect on aggregate health care expenditures than the number of patients. This finding is consistent with demand inducement. Breyer (1984) uses administrative data provided by the largest German statutory health insurance (AOK) and estimates separate single-equation models for regions with a low and high physician density. Although he finds a positive relationship between local physician density and health care expenditures in both regressions, the gradient is steeper at low initial levels of physician density than at high initial levels, which (in the light of a specific theoretical model), is interpreted as evidence for an availability effect rather than an inducement effect. Kopetsch (2007) uses detailed physician claims data and finds negative effects of physician density on the average number of patients but positive effects on average treatment intensity.

Pohlmeier & Ulrich, Cassel & Wilke, and Thode et al. combine survey data on individual health care utilisation with regional information on physician density. Pohlmeier & Ulrich use 1985 SOEP data to estimate hurdle models, which separate the individuals' contact from their frequency of contact decisions. They find no effect of physician density on the probability of contacting a GP but significant positive effects on the number of GP visits. Since the former decision can be viewed as purely demand driven but the second combines demand and supply evidence, this finding is interpreted as evidence for demand inducement and against the availability hypothesis. Cassel & Wilke use ECHP and SOEP data for several years in the 1980s and 1990 and find no effects of physician density on the probability and frequency of doctor visits. The same holds for Thode et al who use data from the German health interview surveys (*Gesundheitssurveys*).

The major drawback of the first set of studies is that they provide evidence only on patients insured in the statutory health care system while those who are privately insured are ignored due to data limitations. However, as is shown below, the distinction is important. One shortcoming of the latter set of studies is that physician density is measured on the federal

state (*Bundesland*) level. Estimates could be biased downwards because this information is too coarse to reflect the relevant regional market for health care services. In particular for GPs, the relevant market is likely to be much smaller, probably on the town or in the case of larger cities even on the quarter level. Non-findings can thus be explained by measurement error in the main explanatory variable. Moreover, none of the above studies for Germany accounts simultaneously for both alternative explanations for the positive physician density-health care utilisation: reverse causation and availability effects.

This paper is an attempt to remedy the above shortcomings by using data on physician density on the district level, by explicitly modelling supply or doctors' location decisions, by estimating negative binomial hurdle models and thus analytically separating contact and frequency decisions, and by providing separate analyses for respondents with different insurance status (statutory vs. private). The paper is organised as follows. Section 2 gives the institutional background by briefly describing some salient features of the German health care system. In section 3, I describe the data. After motivating the identification strategy chosen in this paper, Section 4 contains the regression results. Section 5 gives a summary and conclusion.

2. Institutional background: fees, insurance and incentives

About 90 percent of the German population are insured in the German statutory health insurance system (GKV). The GKV is financed by payroll taxes or contributions. Contribution rates are independent of individual health risks and provide coverage not only for the insured but also for spouses and children. Although the GKV system consists of 350 (in 2002) different insurers or sickness funds, there is no competition between sickness funds, and each of them offers more or less the same services. The GKV provides free ambulatory care from GPs and specialists (only recently a lump-sum fee of 10€ per quarter has been introduced).

In Germany, 95 percent of the physicians who provide ambulatory care are self-employed. They receive a fixed fee for each service – as negotiated between GKV and doctors' organisations. One important feature of the GKV system is that doctors are paid directly by the insurers. Patients never see the bill, i.e. they never learn how much doctors actually charge for their services and thus have no idea about the (marginal) costs of treatment, which might create the illusion of zero marginal costs. Willingness to pay is thus no barrier to "unproductive" treatments. Overall, the GKV system provides no incentives to

physicians and patients to restrict the treatment to the medically necessary and to contain costs.

Civil servants, the self-employed, and employees above a certain gross annual income threshold (40,500 € in 2002) are allowed to opt out of the GKV and get insurance in the private health insurance system (PKV). Overall, the PKV has a much better risk pool than the GKV. This is not only due to the legal access constraints that effectively allow only better average health risks to join the PKV. In contrast to GKV, private health insurers are allowed to take individual risk premia and to reject applicants with high health risks. Moreover, the PKV charges insurance premia that are independent of income, and health insurance for dependants is not free. Patients can usually choose between different contracts with different deductible (although there are exceptions, see footnote 3 below). Another difference to GKV patients is that Physicians are paid directly by the patient who later gets reimbursed by the insurance.

Whether someone has a private health insurance in Germany might have an effect on the demand for and supply of health care services. Privately insured patients get preferential treatment at some doctors' offices, for instance by getting appointments much quicker than others. Physicians do this because patients with a private health insurance are attractive from the doctors' viewpoint: they can be charged much higher fees for the same services than GKV patients. Usually, private health insurers pay up to a fixed multiple of the standard fee (the upper limit paid by most insurers is currently at 2.3). If physicians induce patients to demand services beyond what is strictly necessary, they behave rationally if they do so in particular for the privately insured. Individual doctors can thus raise their income by generating more patient visits, by supplying on average more expensive treatments, or by increasing services to the privately insured (if necessary at the expense of patients in the statutory health insurance).

3. Data description

The data used in this study combine survey data on individual health care utilisation drawn from the 2002 wave of the German Socio-Economic Panel (SOEP) with indicators on the regional level, specifically on the *Kreis* (district) level, which were mainly drawn from the 2004 regional database (INKAR) of the Federal Office for Building and Regional Planning (BBR). In the following, I describe each data in turn.

3.1. Individual level data

SOEP respondents are asked to report the number of doctor visits during the last three months. The 2002 wave does not discriminate between GP and specialist visits. 31 percent of all GKV patients and 37 percent of the PKV patients have not seen a doctor at all during these three months (see Figure 1). Conditional on visiting a doctor at least once, the average number of doctor visits was about 3.7 in both subsamples (only marginally larger for GKV patients). The number of visits is highly skewed. Nearly 80 percent of the sample visited a doctor three times or less. Only 3.5 percent of the sample reported more than 10 visits.

--- about here Table 1 ---

The explanatory variables in the working sample are described in Table 1, separately for GKV and PKV respondents. The full sample has 22,417 observations, of which 3,245 (14.5 percent) say they are privately insured. 40 percent of the privately insured have a deductible.⁴ The two subsamples differ in a number of important respects. In particular, privately insured respondents are in better self-rated health. 49 percent of the GKV sample compared to 60 percent of the PKV sample say they are in good or very good health, and 12 percent versus 10 percent have been in a hospital in the preceding year. Note that the health difference can be found despite the fact that the privately insured are on average nearly one year older. Still, as explained above, it is not surprising to find the privately insured sample in better health. In addition to the fact that they have most likely passed a health screening before buying private health insurance, they are predominantly male, have nearly three years more formal education and much higher income. The median equivalent income in the GKV sample was 17,747€ compared to 30,282€ in the PKV sample.⁵ Among the privately insured, more people work full-time, and less people work part-time or do not work. Considering how selection into private health insurance works (see the minimum income threshold), this is not surprising either.

It should be noted that despite the fact that privately insured respondents are so much healthier and wealthier, they visit doctors only slightly less often than respondents insured in the statutory health insurance. In fact the difference in the number of doctors visits is not

⁴ Privately insured respondents without deductible are found predominantly among civil servants. In their case, the employer pays at least 50 percent of the sickness costs, and only the rest needs to be covered by a private insurance. To the best of my knowledge, private insurers do not offer contracts with deductibles to civil servants. Interestingly, the employer's part of the insurance has a deductible, but it does come by a completely different name (*Kostendämpfungspauschale*), so that many civil servants may actually not be aware of the fact that they have a deductible indeed.

⁵ Individuals living in households with implausibly low income (<3600 Euro per year; 111 households) have been excluded from the sample.

statistically significant. Thus conditional on health, it appears as if physicians treat the privately insured more intensely. This issue will be analysed in greater detail in Section 4.

3.2. District level data

The bottom of Table 1 contains information on the district level. Of the 439 districts in Germany, the SOEP data covers 434. The INKAR 2004 database is a rich source of statistical information on the district level in Germany (for the year 2002). Physician density, measured as the number of physicians per 100,000 inhabitants, is the most interesting variable in the context of this study.⁶ It ranges from 70 (Saalkreis) to 383 (Heidelberg) with a mean of 150 and a standard deviation of 51. We have thus sufficient regional variation in this variable for an informative empirical analysis.

As mentioned before, I use an instrumental variable approach to account for the potential simultaneity of physician density. Suitable instruments are variables that affect the location decision of physicians but have no direct effect on the number of doctor visits of individuals observed in the SOEP. The instruments used here are log income per capita in the district, the percentage of inhabitants aged 65 and over living in the district and whether the district has a university with a medical department.

Data on the first two instruments are drawn from the INKAR database. Gross income per capita serves as a proxy for a whole host of amenities that make a particular region attractive in individual location decisions. Per capita gross income ranges from 11,300€ (Südwestpfalz, Zwickauer Land) to 80,600€ (München). Doctor density is expected to be higher in high income regions, for instance because high income regions might provide better employment opportunities for physicians' spouses, or better schools for physicians' children. The number of privately insured patients might also be higher, which offers better earning opportunities for physicians.

Since older individuals are on average less healthy and need doctors services more often, this variable indicates the aggregate demand for medical services in the population. It is assumed that doctors tend to locate where demand is relatively high. The average percentage of inhabitants aged 65 and over is 17.7. It has standard deviation 1.9 and it ranges from 12.4 (Freising) to 23 (Pirmasens). One argument that could be brought forward against this

⁶ The number of physicians includes those providing ambulatory services under contract of the regional doctors' association (*Kassenärztliche Vereinigung*). Such a contract is a necessary condition to treat patients insured in

instrument is that the direction of causality might also go in the opposite direction: less healthy people tend to locate in regions where there is a large supply of medical services. However, given the low geographical mobility of older people, it seems unlikely that this is an important causal pathway.

The third instrument is a dummy variable that captures whether a university with a medical department is located in the district. There are 43 such districts in Germany. The argument behind this instrument is that people are to some extent regionally immobile. Physicians in Germany who start practising on their own are typically between 35 and 40 years old (cf. Kassenärztliche Bundesvereinigung 2003, Table I.21), i.e. at an age where regional mobility might be reduced by family and children. Moreover, starting physicians will often have lived for a substantial number of years in or close to a city where a university with a medical department is located and have built up location-specific capital.

4. Model estimation and results

Following Pohlmeier & Ulrich (1995), the econometric approach to analyse health care demand used in this paper is the negative binomial hurdle model. The model consists of two parts, which can be estimated by separate maximizations of the likelihood functions. The idea behind the two-part model is that the decision to contact a physician at all and the decision how often to visit the physician frequency can be treated as different stochastic processes. In case of some ailment, the decision to contact a doctor is made by the patient. In the first part of the model, our key variable physician density reflects the regional availability of doctors to the patients. The second part of the model analyses the individual number of doctor visits only for those who visited a doctor at least once in the reference period. Only in this second part, a positive coefficient of physician density on the number of doctor visits is interpreted as evidence for physician induced demand. One advantage of hurdle model is that it allows the same variables to have effects of different signs on the contact decision and the frequency decision.⁷

The meaningful distinction between contact and frequency of contact decision in a hurdle model entails two assumptions. First, there must not be more than one sickness spell

the German statutory health care system. Physicians who exclusively treat privately insured patients (less than 5% of all physicians providing ambulatory services) are thus not included here.

⁷ This assumption can be tested statistically by comparing the log likelihood of the hurdle model (which is the sum of the two parts' log-likelihoods) with the log likelihood of a (single equation) negative binomial model. With the data used in this paper, the single equation model is clearly rejected.

within the reference period. Second, the first count in the reference period actually constitutes a first contact related to a sickness spell and not a follow-up visit belonging to sickness spell that started before the reference period. Of course, either assumption will almost certainly be violated in a few cases. How many cases are concerned obviously depends on the length of the reference period. The longer the reference period, the larger the number of multiple sickness spells but the smaller the probability that the first registered contact belongs to sickness spell from a preceding period, and vice versa. The optimal length of the reference period is a priori unclear, but the three months used in the SOEP appear to be fairly good compromise (cf. Pohlmeier & Ulrich 1995).

4.1. Instrumenting physician density

To account for the potential simultaneity of physician density, I follow a two-step IV-type procedure (cf. Mullahy 1997, Winkelmann 2000). In the first step I predict physician density by OLS, using the three instruments described above: the average gross income in the district, the proportion of people older than 65 living in the district, and a dummy variable that indicates whether the district has a university with a medical department. The predicted values are then used in the second step two-part model instead of the original value of physician density. Standard errors that account for the inclusion of estimated variables in the second step are computed by bootstrapping (repeating the full estimation procedure including first and second estimation steps 200 times).

Instrumental variables are always subject to close scrutiny. First, the instruments must not be weak, i.e. they must be sufficiently correlated with the endogenous regressor. A recently established rule-of-thumb criterion for good instruments is an F-statistic larger than 10 in a test of joint significance in the first stage regressions (cf. Staiger & Stock, 1997, but note that the rule-of-thumb was developed for the linear 2SLS model). On that account, my instruments perform quite well. Table 2 shows the parameter estimates and test results for the first step regressions, i.e. for the full sample and for the separate samples. Note that standard errors are cluster adjusted, i.e. they are computed as if the full sample regression contained only 434 observations (of districts). The F-statistics are larger than 55 and thus well above the threshold of 10 in all three models. Including the instruments in the first step raises the R-squared by more than 60 percentage points, i.e. the instruments have substantial explanatory power.

--- about here Table 2 ---

In terms of their signs, the instrumental variables have the expected effects on physician density. Districts with higher per capita income, districts with a large proportion of older inhabitants, and districts with a university with a medical department have a higher physician density than others. Only few of the individual level variables are significantly related with doctor density. Districts with a higher physician density are characterised by a lower proportion of married individuals, and a higher proportion of better educated, two variables that possibly reflect the degree of urbanisation.

Another concern about instrumental variables is that the identifying (exclusion) restrictions may not hold. In the context of this paper, the exclusion restrictions hold if average district income, the percentage of individuals aged 65 and over living in a district, and the presence of a university with medical department do not directly affect the likelihood and frequency of doctor visits of an individual living in the district. If there is an effect, it must be only indirect, i.e. through the correlation of the instruments with physician density. This assumption sounds plausible, and although exclusion restrictions cannot be tested formally, one can at least check whether the instruments have an independent effect on the outcome variables by including them in the outcome regression along with the variable that is to be instrumented. The Chi-squared statistics for the joint significance of the instruments in the two outcome equations are 3.40 and 3.53 (with 3 degrees of freedom), respectively, in the full sample, 3.17 and 3.04 in the GKV subsample, and 3.13 and 0.26 in the PKV subsample (detailed regression results not shown). The corresponding P-values are .33 and .32, .37 and .36, and .38 and .97. In other words, the instruments appear to have no independent effect on the probability of visiting a doctor and the number of doctor visits.

4.2. The probability of physician visits

The first part of the hurdle model used to analyse the probability of contact is a logistic regression model. Results without and with correction for possible simultaneity of physician density are shown in Table 3. Let us begin with a discussion of the full sample results (column 1 and 2). A positive effect of physician density on the probability of contact is found regardless of whether physician density is instrumented. Assuming that the first contact is solely demand driven, the positive effect of physician density can be interpreted as the effects of reduced opportunity costs or increased availability. Without taking into account potential simultaneity, the logit coefficient of log physician density is about .15 and significant at the 1 percent level. The coefficient can be roughly interpreted as an elasticity, i.e. when physician

density rises by 1 percent, the probability that a physician is contacted (conditional on health and other covariates) rises by 0.15 percent. When simultaneity is taken into account, the effect size is only slightly smaller, but standard errors increase so much that the effect is no longer statistically significant even at the 5 percent level. However, the difference between both estimates is statistically insignificant, so that one cannot reject the null hypothesis that physician density is in fact exogenous. This holds not only for the logit model in the full sample but for all estimation parts in all samples. For this reason, I will restrict the following discussion to the standard regression results (but all IV-estimates are still shown for interested readers).

--- about here Table 3 ---

Privately insured respondents are less likely to have seen a doctor at all in the preceding three months. Note that this is conditional on *observed health*. Plausible explanations for this finding have been mentioned before. First, insurance status might reflect unobserved health status since private insurance companies are allowed to screen applicants and to reject bad risks. Second, in contrast to patients covered by the statutory health system, privately insured patients first pay the doctors bill and get reimbursed later (even if they have full coverage), i.e. they do not have the illusion of zero marginal costs. Deductibles should further discourage doctor visits for minor ailments. In fact, for patients with deductibles, the estimated probability of visiting a doctor is further reduced, but the difference to privately insured without deductible is statistically insignificant.

When the sample is split into statutorily and privately insured individuals (see columns 3 to 6), an interesting picture emerges. Whereas the effect of physician density is still positive and significant in the GKV sample (with an elasticity of about 18 percent), it vanishes for privately insured patients. This means that demand for health care services of statutorily insured respondents is affected by changes in opportunity costs related to physician density but that the demand of the privately insured is not. This result is plausible because the privately insured can jump queues formed by the statutorily insured patients at some doctors' offices, an issue that often gives rise to health care equity debates in the German public. Again, the effect of deductibles on contact is negative but insignificant.

Let us also briefly discuss the effects of the other covariates. First note that with one exception (part-time employment), the estimated coefficients are very similar across samples and estimation methods. Moreover, they are mostly according to expectations and in line with earlier studies for Germany (e.g. Pohlmeier & Ulrich, 1995). Expectedly, the largest effects

on the decision to contact a physician can be found for self-rated general health and for hospital stays in the preceding year (as a more objective health indicator). The odds of visiting a doctor at least once are about 4.5 times larger for respondents in very poor self-rated health than for those in fair health (the reference category). Likewise, those in very good health have odds that are about one third as large as those of the reference category.⁸ Hospital stays in the preceding year lead to about 2.5 higher odds of physician contacts.

Conditional on all covariates, the probability of having visited a doctor in the last three months first decreases in age and then increases in age. The minimum is reached at about age 40. Women are substantially more likely to visit doctors even if self-rated health status is controlled for, and married individuals are more likely to contact doctors than others. This holds particularly for men, as the large interaction effect of marital status with sex reveals. Better educated and higher income individuals also show a higher likelihood of visiting a doctor. Since this effect is measured conditional on health, it might reflect the tendency of better educated and higher income individuals to care more for their health (higher allocative efficiency or stronger preferences for the future, cf. Grossman 2005). Full-time employed respondents are significantly less likely to contact a physician, which is probably largely a matter of opportunity costs. Part-time employees in the statutory health care system are also less likely to contact a physician than the reference group, whereas privately insured part-time employees are more likely, but the difference to respondents who are not working is not significant.

4.3. The frequency of doctor visits

The frequency of doctor visits is analysed conditional on visiting a physician at least once in the last three months using the zero-truncated negative binomial model. Results for the different samples without and with correction for possible simultaneity of physician density are shown in Table 4.

Physician density has a significant positive relationship with the number of doctor visits. This holds in the full sample and in the two subsamples, independent of whether potential simultaneity is dealt with. Instrumenting physician density actually increases the point estimates, but as was mentioned above, the Hausman-test never rejects the null hypothesis. Since physician density enters the regression equation in logarithms, its

⁸ Odds ratios are obtained by exponentiating the logit coefficients. In contrast to marginal effects obtained from probit regressions they are constant across different values of the other explanatory variables.

coefficient can be interpreted as an elasticity. Thus a one percent increase in physician density raises the number of doctor visits among all respondents by 0.17 percent. Overall, the effect size is in the range of findings found in the US (e.g. Stano 1985, Cromwell & Mitchell 1986).

Note that insurance status has a fundamentally different effect on the frequency of doctor visits than on the contact decision. While the privately insured are less likely to contact a doctor, their number of doctor visits is significantly larger than that of patients covered by statutory health insurance. If the privately insured are on average healthier, one can expect them also to visit their doctor less often. One possible explanation for this seemingly contradictory finding is that physicians treat privately insured patients differently. Just because the health services rendered to a privately insured individual pay so much better than the same services rendered to individuals insured in the statutory health insurance, physicians have an incentive to sell unnecessary diagnoses and ineffective treatments to the privately insured. Separating the sample by insurance status corroborates this interpretation. It reveals that the estimated effect among privately insured is about 1.6 times as large as among statutorily insured (with an. the elasticity of 27 versus 16 percent). The difference is not statistically significant, however, due to the large standard errors estimated for the privately insured.

The frequency of physician visits given contact is assumed to be determined by demand as well as supply factors. Viewed in conjunction with the earlier results on contacts, which are assumed to be determined only by demand, I hence find indirect evidence *against demand inducement among statutorily insured but for demand inducement among the privately insured*. This is because (1) among statutorily insured patients the elasticity of the contact and the elasticity of the number of doctor visits with respect to physician density are of the same size, (2) the frequency elasticity is (statistically) larger than the contact elasticity among privately insured (at $p < 0.10$)

--- about here Table 4 ---

Let us also look at the effects of the covariates. Again, the estimates are fairly similar across samples and specifications. Health itself has the expected strong impact on the frequency of doctor visits. Conditional on covariates, the estimated number of visits of respondents in the full sample who are in very poor health is about 5.8 times as large as the

number of visits of those in fair health.⁹ Respondents with hospital stays in the preceding year go to the doctor 1.6 times as often as those without hospital stays.

Age plays an ambiguous role. In the full sample and among GKV patients, the effect is U-shaped but hardly significant, among PKV patients is highly significant and hump-shaped with a maximum at about age 50. Conditional on a visiting a doctor at all, education, income and marital status (in the case of men) have no effect on the frequency of visits. Thus married men contact a doctor more often than unmarried men but conditional on contact they do not visit a doctor significantly more often. Conditional on health, women visit doctors 1.2 times as often as men. Finally, being employed, full-time or part-time, reduces the frequency of doctor visits by about 10 and 7 percent respectively.

5. Summary and Conclusion

In this paper I have analysed the relationship between regional physician density (number of physicians per 100,000 inhabitants) and the frequency of individual doctor visits in Germany in a negative binomial hurdle model. The hurdle model statistically distinguishes between the decision to contact a physician (which is purely demand driven) and the frequency of contact decision (which combines demand and supply aspects). The paper added to earlier evidence from Germany in three respects: first, the analysis combined detailed regional data on physician density with individual survey data on the frequency of doctor visits. Data on doctor visits of some 20,000 individuals aged 17 to 99 were drawn from the German Socio-economic panel 2002. Regional physician density was measured on the level of districts (*Kreise*), of which Germany currently has 439 (the SOEP data used in this study contains information on individuals from 434 of these districts). Similar studies with SOEP data have used regional information on the state (Bundesland) level, which – due to measurement error – was probably too coarse and resulted in downward biased estimates of the effect of physician density.

The second innovation in this paper in comparison to earlier studies using SOEP data is that it uses an instrumental variable approach to account for the potential simultaneity of physician density. I have chosen average district gross income, the percentage of inhabitants aged 65 and over living in the district, and whether the district has a university with a medical department as instruments. The analysis shows that these instruments perform well in explaining physician density and that they are conditionally unrelated to the main outcome

⁹ This ratio is computed as $\exp[\beta(\text{very poor health}) - \beta(\text{very good health})]$.

variables, the probability and frequency of individual doctor visits. However, it was also shown that an instrumental variable approach is not necessary because the parameters of the instrumented variable "physician density" do not differ significantly between the ordinary hurdle model and the IV model.

The third innovation is the explicit distinction between privately and statutorily insured patients. This distinction has proved crucial to arrive at the main finding of the paper. Conditional on health, privately insured patients are less likely to contact a physician but more frequently visit a doctor following a first contact. This finding is consistent with the idea that – if at all – physicians in Germany induce privately insured patients to demand services beyond what is strictly necessary. Physicians have an incentive to do this because patients with a private health insurance are more attractive as they can be charged higher fees for the same services.

Physician density has a significant positive effect on the doctor *contact probability* of patients insured in the statutory health care system, whereas it has no effect on privately insured patients' contact probability. This finding can be interpreted as evidence for the idea that an increase in the number of doctors per inhabitant reduces the opportunity costs of doctor visits for statutorily insured but not for privately insured. However, the effect of physician density on the *frequency* of doctor visits is 1.6 times as large among privately than among statutorily insured. In fact, I find an elasticity of 27 percent that is not only statistically different from zero but also different from the contact probability elasticity.

Reverse causation and smaller opportunity costs can thus be excluded as explanations for the rising number of doctor visits of privately insured patients as physician density increases. Therefore, the findings presented in this paper give plausible albeit indirect evidence for the hypothesis that in Germany, physicians tend to induce demand for medical services among privately insured patients.

References

- Auster, R.D. & Oaxaca, R.L. (1981): Identification of supplier induced demand in the health care sector. *The Journal of Human Resources*: 327–343.
- Breyer, F. (1984): *Die Nachfrage nach medizinischen Leistungen: Eine empirische Analyse von Daten aus der Gesetzlichen Krankenversicherung*, Berlin.
- Cameron, A.C. & Trivedi, P.K. (1998): *Regression Analysis of Count Data*. Cambridge: Cambridge University Press.
- Carlsen, F.& Grytten, J. (1998): More Physicians: Improved Availability or Induced Demand? *Health Economics* 7, 495-508.
- Cassel, D. & Wilke T.. (2001): Das Saysche Gesetz im Gesundheitswesen: Schafft sich das ärztliche Leistungsangebot seine eigene Nachfrage? *Zeitschrift für Gesundheitswissenschaften* 9, 331-348
- Cromwell, J & Mitchell, J.B. (1986): Physician-Induced Demand for Surgery. *Journal of Health Economics* 5, 293-313.
- Dranove, D. & Wehner, P. (1994): Physician-induced demand for childbirths. *Journal of Health Economics* 13: 61–73.
- Dullek, U & Kerschbamer, R. (2006): On Doctors, Mechanics, and Computer Specialists: The Economics of Credence Goods. *Journal of Economic Literature* 44, 5-42.
- Evans, R.G. (1974): Supplier Induced Demand: Some Empirical Evidence and Implications, In: Perlman, M (ed.), *The Economics of Health and Medical Care*, Mac Millan.
- Federal Office for Building and Regional Planning (BBR) (2004): *Indikatoren und Karten zur Raumentwicklung 2002*. CD-ROM.
- Fuchs, V. (1978): The Supply of Surgeons and the Demand for Operations. *Journal of Human Resources* 13, 35-56
- Grossman, M. (2005): *Education and Nonmarket Outcomes*. NBER Working Paper 11582.
- Kassenärztliche Bundesvereinigung (2003): Grunddaten zur vertragsärztlichen Versorgung in Deutschland 2003. Downloaded Feb 12th 2007 from www.kbv.de.
- Kopetsch, Thomas (2007): Arztdichte und Inanspruchnahme ärztlicher Leistungen in Deutschland: Eine empirische Untersuchung der These von der angebotsinduzierten Nachfrage nach ambulanten Arztleistungen. *Schmollers Jahrbuch* (forthcoming).
- Krämer, W. (1981):, Eine ökonometrische Untersuchung des Marktes für ambulante kassenärztliche Leistungen. *Zeitschrift für die gesamte Staatswissenschaft* 1, 45-61.
- McCarthy, T. (1985): The Competitive Nature of the Primary-Care Physician Services Market. *Journal of Health Economics* 4, 93-117.
- Mullahy, J. (1997): Instrumental-Variable Estimation of Count Data Models: Applications to Models of Cigarette Smoking Behavior. *Review of Economics and Statistics* 79: 586-593.
- Pauly, M.V. (1994): Editorial: A Re-examination of the Meaning and Importance of Supplier-induced Demand. *Journal of Health Economics* 13, 369-372.
- Pohlmeier, W. & Ulrich, V. (1995): An Econometric Model of the Two-Part Decision Making Process in the Demand for Health Care. *Journal of Human Resources* 30, 339-361.

- Rice, T.D. (1983): The impact of changing Medicare reimbursement rates on physician-induced demand. *Medical Care* 21, 803-815.
- Staiger, D. & Stock, J.H. (1997): Instrumental Variables Regression with Weak Instruments. *Econometrica* 65: 557-586.
- Stano, M. (1985): An analysis of the evidence on competition in the physician services markets. *Journal of Health Economics* 4, 197-211.
- Sweeney, G.H. (1982): The Market for Physician's Services: Theoretical Implications and an Empirical Test of the Target Income Hypothesis. *Southern Economic Journal* 48, 594-613
- Thode, N., Bergmann, E., Kamtsiuris, P. & Kurth, B.M. (2004): *Einflussfaktoren auf die Inanspruchnahme des deutschen Gesundheitswesens und mögliche Steuerungsmechanismen*. Robert-Koch Institut Berlin.
- Wilensky, G.R. and Rossiter, L.R. The relative importance of physician-induced demand in the demand for medical care. *Milbank Memorial Fund Quarterly / Health and Society* 61, 252-277.
- Winkelmann, R. (2000): *Econometric Analysis of Count Data*, 3rd. ed. Berlin: Springer.
- Yip, W. (1998): Physician response to Medicare fee reductions: changes in the volume of coronary artery bypass graft (CABG) surgeries in the Medicare and private sectors. *Journal of Health Economics* 17, 675-699.

Table 1: Sample description

Variable	Mean	StdDev	Min	Max
<i>Individual level GKV patients (N=19,172)</i>				
Visited doctor	0.69	0.46	0	1
# of doctor visits*	3.75	4.67	1	90
Self-rated health: very good	0.09	0.28	0	1
Self-rated health: good	0.40	0.49	0	1
Self-rated health: fair	0.34	0.47	0	1
Self-rated health: poor	0.14	0.34	0	1
Self-rated health: very poor	0.04	0.19	0	1
Hospital stay in 2001	0.12		0	1
Age	47.42	16.91	17	99
Female	0.53		0	1
Married	0.64		0	1
Years of education	11.70	2.42	7	18
Log equivalent household income	9.79	0.52	7.53	13.14
Working full-time	0.41		0	1
Working part-time	0.23		0	1
Not working	0.36		0	1
<i>Individual level PKV patients (N=3,245)</i>				
Visited doctor	0.63	0.48	0	1
# of doctor visits*	3.67	4.50	1	50
Deductible	0.40		0	1
Self-rated health: very good	0.13		0	1
Self-rated health: good	0.47		0	1
Self-rated health: fair	0.29		0	1
Self-rated health: poor	0.09		0	1
Self-rated health: very poor	0.01		0	1
Hospital stay in 2001	0.10		0	1
Age	48.29	13.62	17	93
Female	0.39		0	1
Married	0.72		0	1
Years of education	14.48	3.03	7	18
Log equivalent household income	10.32	0.55	7.68	13.37
Working full-time	0.61		0	1
Working part-time	0.18		0	1
Not working	0.21		0	1
<i>District level (N=434)</i>				
Physicians / 100,000 inhabitants	150.4	51.3	70	383
Per capita income in €10,000	23.3	9.9	11.3	80.6
Percentage inhabitants aged 65+	17.8	1.9	12.4	23.0
University with medical department	0.1		0	1
Number of individual observations	51.7	55.8	1	782

* conditional on visiting; N=13,173 (GKV), N=2,044 (PKV)

Table 2: First stage regression, OLS; dependent variable: log (physician density)

Variable	Full sample	GKV	PKV
<i>Instruments (regional level variables)</i>			
Medical department	0.2527** (0.0531)	0.2532** (0.0529)	0.2479** (0.0555)
Percentage of inhabitants age 65+	0.0207** (0.0075)	0.0208** (0.0073)	0.0202* (0.0095)
Log income per capita	0.4575** (0.0470)	0.4573** (0.0461)	0.4612** (0.0555)
<i>Individual level variables</i>			
Privately insured	0.0075 (0.0071)		
Deductible	-0.0025 (0.0068)		-0.0020 (0.0071)
Very good health	0.0030 (0.0083)	0.0009 (0.0078)	0.0125 (0.0156)
Good health	0.0007 (0.0044)	-0.0018 (0.0045)	0.0143 (0.0077)
Poor health	0.0017 (0.0036)	0.0019 (0.0039)	-0.0021 (0.0135)
Very poor health	0.0027 (0.0076)	-0.0003 (0.0080)	0.0367 (0.0278)
Hospital stay in 2001	0.0064 (0.0041)	0.0078 (0.0040)	-0.0019 (0.0130)
Age	0.0007 (0.0006)	0.0008 (0.0007)	0.0001 (0.0016)
(Age/10)^2	-0.0004 (0.0006)	-0.0003 (0.0007)	0.0001 (0.0016)
Female	0.0020 (0.0033)	0.0032 (0.0036)	-0.0129 (0.0141)
Married	-0.0220** (0.0061)	-0.0235** (0.0068)	-0.0151 (0.0087)
Married*Female	0.0041 (0.0036)	0.0035 (0.0043)	0.0209 (0.0170)
Years of Education	0.0061** (0.0011)	0.0072** (0.0012)	0.0025 (0.0013)
Log equivalent hh income	-0.0152** (0.0058)	-0.0165** (0.0059)	-0.0106 (0.0109)
Full Time Employed	0.0048 (0.0037)	0.0056 (0.0039)	0.0054 (0.0100)
Part Time Employed	0.0014 (0.0037)	0.0008 (0.0041)	0.0098 (0.0098)
Constant	3.2074** (0.2383)	3.2060** (0.2339)	3.2261** (0.2856)
N	22,417	19,172	3,245
Clusters	434	433	394
F statistic instruments	70.37	73.31	55.40
ΔR^2 from including instruments	0.62	0.62	0.62

Note: * p<0.05; ** p<0.01

Table 3. Logit regressions explaining whether a doctor was visited at all in last three months

	Full sample		GKV sample		PKV sample	
	Logit (1)	IV-Logit ^{a)} (2)	Logit (3)	IV-Logit ^{a)} (4)	Logit (5)	IV-Logit ^{a)} (6)
Log (Physician Density)	0.1488** (0.0537)	0.1297 (0.0685)	0.1769** (0.0595)	0.1661* (0.0749)	-0.0045 (0.1258)	-0.0357 (0.1620)
Privately insured	-0.1824** (0.0568)	-0.1812** (0.0558)				
Deductible	-0.0704 (0.0797)	-0.0706 (0.0814)			-0.0618 (0.0818)	-0.0615 (0.0877)
Very good health	-1.2303** (0.0556)	-1.2292** (0.0568)	-1.2650** (0.0618)	-1.2642** (0.0595)	-1.0799** (0.1281)	-1.0781** (0.1282)
Good health	-0.6696** (0.0364)	-0.6693** (0.0372)	-0.6755** (0.0397)	-0.6753** (0.0391)	-0.6266** (0.0924)	-0.6258** (0.0986)
Fair health (reference category)	0.0000	0.0000			0.0000	0.0000
Poor health	0.9555** (0.0699)	0.9554** (0.0756)	0.9560** (0.0744)	0.9558** (0.0751)	0.9661** (0.2052)	0.9669** (0.2208)
Very poor health	1.5025** (0.1742)	1.5016** (0.1727)	1.5102** (0.1818)	1.5088** (0.1730)	1.3561* (0.6139)	1.3584* (0.6338)
Hospital stay in 2001	0.9364** (0.0640)	0.9364** (0.0612)	0.9225** (0.0692)	0.9226** (0.0639)	1.0479** (0.1699)	1.0479** (0.1736)
Age	-0.0589** (0.0069)	-0.0588** (0.0067)	-0.0630** (0.0074)	-0.0629** (0.0070)	-0.0428* (0.0211)	-0.0428 (0.0224)
(Age/10) ²	0.0769** (0.0074)	0.0768** (0.0075)	0.0829** (0.0079)	0.0829** (0.0077)	0.0495* (0.0219)	0.0495* (0.0238)
Female	0.6515** (0.0523)	0.6520** (0.0533)	0.6606** (0.0561)	0.6612** (0.0534)	0.5684** (0.1501)	0.5687** (0.1557)
Married	0.1661** (0.0492)	0.1649** (0.0497)	0.1540** (0.0546)	0.1531** (0.0495)	0.2285* (0.1140)	0.2265 (0.1171)
Married*Female	-0.1315* (0.0671)	-0.1321* (0.0668)	-0.1265 (0.0727)	-0.1271 (0.0686)	-0.0907 (0.1832)	-0.0901 (0.1878)
Years of Education	0.0493** (0.0066)	0.0495** (0.0070)	0.0575** (0.0076)	0.0576** (0.0079)	0.0291* (0.0139)	0.0294* (0.0140)
Log equivalent hh income	0.1829** (0.0332)	0.1832** (0.0354)	0.1866** (0.0368)	0.1867** (0.0390)	0.1676* (0.0779)	0.1686* (0.0820)
Full Time Employed	-0.1305** (0.0486)	-0.1308** (0.0499)	-0.1187* (0.0523)	-0.1188* (0.0536)	-0.1283 (0.1371)	-0.1286 (0.1417)
Part Time Employed	-0.0514 (0.0491)	-0.0514 (0.0506)	-0.0697 (0.0524)	-0.0696 (0.0545)	0.1671 (0.1435)	0.1671 (0.1406)
Constant	-1.5429** (0.4146)	-1.4550** (0.4885)	-1.7592** (0.4579)	-1.7087** (0.5282)	-0.7254 (1.0202)	-0.5830 (1.2509)
N	22,417	22,417	19,172	19,172	3,245	3,245
Model Chi-Squared	3448.43	3444.48	3057.30	3053.42	380.94	380.99
Pseudo-R2	0.1225	0.1224	0.1283	0.1282	0.0891	0.0891
P-value of Hausman endogeneity test	.83		.91		.88	

Note: a) Standard errors are bootstrapped (200 reps), * p<0.05, ** p<0.01

Table 4: Zero-truncated negative binomial regressions explaining the number of doctor visits in last three months

	Full sample		GKV sample		PKV sample	
	Zero-Truncated Negbin (1)	IV-Zero Truncated Negbin ^{a)} (2)	Zero-Truncated Negbin (3)	IV-Zero Truncated Negbin ^{a)} (4)	Zero-Truncated Negbin (5)	IV-Zero Truncated Negbin ^{a)} (6)
Log (Physician Density)	0.1719** (0.0344)	0.2112** (0.0532)	0.1647** (0.0367)	0.2047** (0.0572)	0.2702** (0.0993)	0.3049* (0.1449)
Privately insured	0.1816** (0.0384)	0.1787** (0.0437)				
Deductible	-0.0800 (0.0564)	-0.0798 (0.0746)			-0.0959 (0.0639)	-0.0956 (0.0781)
Very good health	-0.7109** (0.0495)	-0.7110** (0.0662)	-0.6633** (0.0546)	-0.6636** (0.0821)	-0.8792** (0.1199)	-0.8777** (0.1295)
Good health	-0.5237** (0.0252)	-0.5232** (0.0310)	-0.5225** (0.0271)	-0.5216** (0.0340)	-0.5289** (0.0694)	-0.5311** (0.0844)
Fair health (reference category)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Poor health	0.6070** (0.0277)	0.6076** (0.0305)	0.5874** (0.0289)	0.5883** (0.0327)	0.7961** (0.0934)	0.7935** (0.1031)
Very poor health	1.0452** (0.0449)	1.0395** (0.0484)	1.0486** (0.0456)	1.0432** (0.0579)	0.9573** (0.2021)	0.9518** (0.2324)
Hospital stay in 2001	0.5093** (0.0266)	0.5098** (0.0301)	0.5045** (0.0279)	0.5047** (0.0334)	0.5404** (0.0835)	0.5435** (0.0946)
Age	-0.0053 (0.0039)	-0.0053 (0.0048)	-0.0098* (0.0040)	-0.0098 (0.0052)	0.0499** (0.0139)	0.0492** (0.0159)
(Age/10) ²	0.0033 (0.0038)	0.0034 (0.0047)	0.0075 (0.0039)	0.0075 (0.0051)	-0.0490** (0.0137)	-0.0482** (0.0155)
Female	0.1986** (0.0362)	0.1945** (0.0445)	0.1966** (0.0381)	0.1919** (0.0516)	0.2630* (0.1185)	0.2642* (0.1298)
Married	0.0473 (0.0358)	0.0479 (0.0421)	0.0618 (0.0386)	0.0622 (0.0477)	-0.0292 (0.0969)	-0.0280 (0.1183)
Married*Female	-0.0996* (0.0448)	-0.0963 (0.0519)	-0.1087* (0.0476)	-0.1048 (0.0612)	-0.1319 (0.1388)	-0.1337 (0.1542)
Years of Education	0.0025 (0.0043)	0.0022 (0.0051)	0.0023 (0.0048)	0.0019 (0.0062)	0.0003 (0.0106)	0.0004 (0.0131)
Log equivalent hh income	0.0022 (0.0215)	0.0016 (0.0256)	0.0169 (0.0227)	0.0163 (0.0266)	-0.1076 (0.0637)	-0.1063 (0.0733)
Full Time Employed	-0.1055** (0.0306)	-0.1049** (0.0379)	-0.1056** (0.0323)	-0.1048* (0.0419)	-0.1858 (0.0957)	-0.1851 (0.1135)
Part Time Employed	-0.0725* (0.0307)	-0.0725 (0.0380)	-0.0784* (0.0322)	-0.0784* (0.0395)	-0.0742 (0.1006)	-0.0754 (0.1106)
Constant	-0.0021 (0.2646)	-0.1872 (0.3706)	0.0117 (0.2813)	-0.1765 (0.3825)	-0.5345 (0.8067)	-0.7117 (0.9403)
Ln(alpha)	0.0550 (0.0336)	0.0537 (0.0497)	0.0098 (0.0355)	0.0083 (0.0552)	0.3206** (0.1042)	0.3217** (0.1215)
N	15,219	15,219	13,175	13,175	2,044	2,044
Model Chi-Squared	3190.92	3190.40	2810.94	2810.69	413.75	412.30
Pseudo-R2	0.0488	0.0488	0.0495	0.0495	0.0488	0.0477
P-value of Hausman endogeneity test	.54		.56		.84	

Note: a) Standard errors are bootstrapped (200 reps), * p<0.05, ** p<0.01

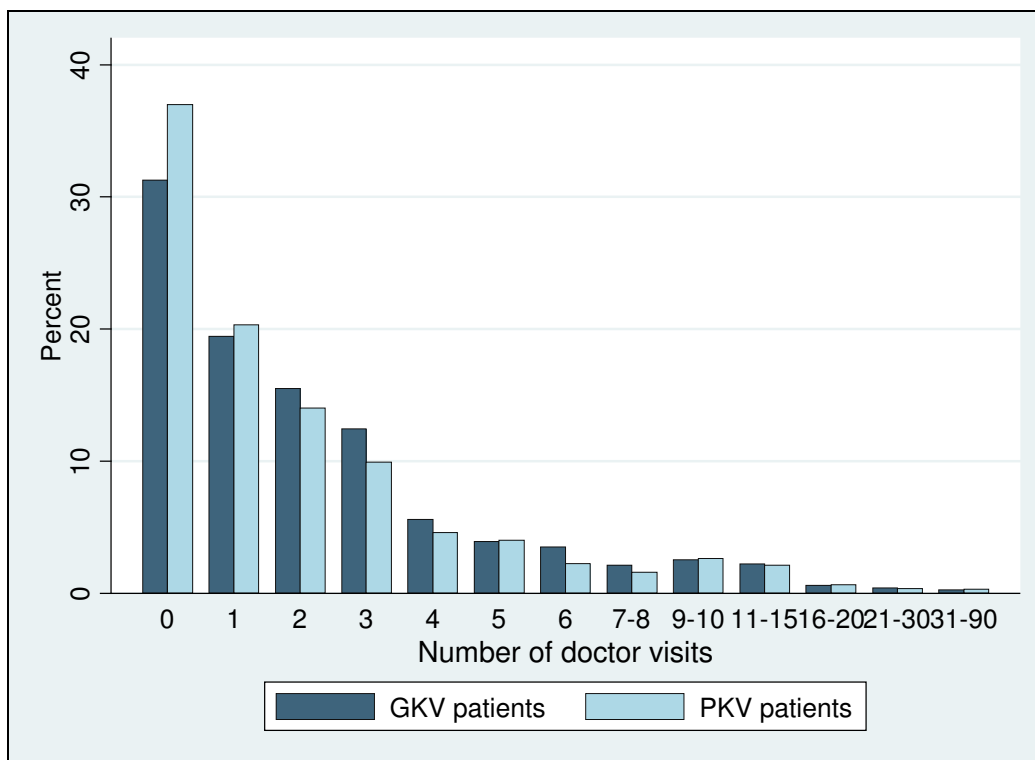


Figure1: Individual number of doctor visits in the last three months (SOEP 2002), by insurance status