Title: Regional Distribution of Physicians: the Role of Comprehensive Private Health Insurance in Germany

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Abstract

Objective In recent years, the co-existence in Germany of two parallel comprehensive insurance systems – Statutory Health Insurance (SHI) and Private Health Insurance (PHI) – has been posited as a possible cause of a persistent unequal regional distribution of physicians. The present study investigates the effect of the proportion of privately insured patients on the density of SHI-licensed physicians, while controlling for regional variations in the average income from SHI patients.

Methods The proportion of residents in a district with private health insurance is estimated using complete administrative data from the SHI system and the German population census. Missing values are estimated using multiple imputation techniques. All models control for the estimated average income ambulatory physicians generate from treating SHI insured patients and a well-defined set of covariates on the level of districts in Germany in 2010.

Results Our results show that every percentage change in the proportion of residents with private health insurance is associated with increases of 2.2 and 1.2 percent in the density of specialists and GPs respectively. Higher SHI income in rural areas does not compensate for this effect.

Conclusion From a financial perspective, it is rational for a physician to locate a new practice in a district with a high proportion of privately insured patients. From the perspective of patients in the SHI system, the incentive effects of PHI presumably contribute to a concentration of health care services in wealthy and urban areas. To date, the needs-based planning mechanism has been unable to address this imbalance.

Keywords: Germany; Private Health Insurance; Statutory Health Insurance; physician density; regional variation; needs-based planning; physician income

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Introduction

Many OECD countries have a high overall physician density as measured in terms of the number of physicians per 100,000 inhabitants. However, this does not always mean that the geographical distribution of the physicians is in accordance with the health care needs of the population. Considerable shortages often occur in rural and/or in economically deprived areas, with Germany being no exception [1]. In 2010 in the city of Kaufbeuren, Bavaria, there were almost twice as many general practitioners (GPs) per 100,000 inhabitants as in the former East-German district of Saalekreis, Saxony-Anhalt. The unequal distribution is even more apparent among specialists in ambulatory practice: in the district of Nordvorpommern, an orthopaedic specialist was responsible for five times as many inhabitants as a colleague in the city of Wiesbaden, Hesse. This pattern of distribution among regions contributes to inequity in health care, with residents of urban areas having easier access to ambulatory care than those living in rural areas.

Twenty years of physician capacity planning in the German Statutory Health Insurance have not been able to rectify this unequal distribution. Once a region's quota of medical practitioners is reached, additional physicians are not, in principle, permitted to set up practice there. The quota-based allocation of medical practice licenses per region is however calculated using physician/population ratios dating from 1990. The unequal distribution of medical practitioners existing at that time has therefore been carried forward over the past two decades into the current "Needs-based Planning Mechanism" [2]. In his role as the responsible planning body in Germany, the Federal Joint Committee (GBA) has recently revised its directive governing the Needs-based Planning Mechanism. It introduced a more differentiated approach to regulating how many ambulatory physicians of each specialization are permitted to set up medical practice in each planning area, but the underlying physician/population ratios from 1990 remain in force. Moreover, in common with many other health care systems around the world, the Germa23-6]n planning system does not incentivize physicians to work in rural or remote areas.

Against this background, there is a considerable literature studying the factors motivating a physicians' choice of practice location. In summary, the literature finds that this decision is influenced by personal characteristics such as age, sex, marital status, and upbringing [3-8], as well as regional context factors, conditions of employment, economic incentives and the design of the health care system. Studies with a more econometrical approach usually

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analyze regional factors associated with physician density using aggregated area level data. They find that job opportunities for spouses, quality of school education, cultural factors, proximity to a teaching hospital and the patient structure play a major role in explaining physician density [6, 9-13]. In addition, conditions of employment including workload, call schedules [14] and the financial stability of the practice [15] are found to impact upon location choice. Most health economics studies are concerned either with the impact of marginal changes in income and/or the level of income on location choice [16], or with eliciting preferences regarding financial compensation for practicing in a rural setting [17-21]. A small number of studies have investigated the role of the private sector in the regional variation of physicians: Gächter et al. [22] analyzed how the co-existence of public and private health care providers impacts upon regional densities in Austria. Meliala et al. [23] explored the impact of private income and engagement in private practices on the regional distribution of physicians in Indonesia. They found that a growing private sector contributes to a concentration of physicians in urban regions.

In Germany, the co-existence of two separate comprehensive insurance systems – Statutory Health Insurance (SHI) and Private Health Insurance (PHI) – has in recent years been posited as a contributing factor in the unequal regional distribution of SHI licensed physicians. It is estimated that 97% of all ambulatory physicians registered with the German Medical Association (GMA) are licensed to treat SHI patients. Generally speaking, all GMA-registered physicians are permitted to treat PHI patients [24]. The SHI and PHI systems differ not only in relation to the insurance coverage and price calculation of the premiums charged but also in the nature of their contractual relationship with health care service providers. These differences are particularly apparent in the ambulatory sector, where the mechanisms for remuneration of medical practitioners under the SHI and PHI systems are fundamentally distinct.

Separate medical fee schedules exist for ambulatory health care services provided to patients under the SHI and PHI systems. Under the SHI system, services are restricted to those listed in the fee schedule. Remuneration is largely capitation-based with additional fees for particular services most relevant to specialist physicians. A quarterly standard volume of services is allocated to every licensed ambulatory physician based on his or her specialization and number of patients in the last year. Once this quota is exhausted, additional ambulatory services performed are only partially reimbursed, with the exemption of some extra-budgetary services. In contrast, a medical practitioner's provision of health care

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services to privately insured patients entails higher levels of remuneration on a purely fee-for-service basis [25]. Consequently, a physician in ambulatory practice can, in general, provide more health care services to privately insured patients (as there is no cap on service volume) at a higher level of remuneration. Consequently, SHI-licensed physicians in the ambulatory sector generate on average 27 % of their income from privately insured patients, who make up less than 15 % of the population [26]. SHI-licensed physician's income from PHI patients is, however, restricted indirectly by the Social Code Book V, the legal framework for the German SHI, which, in principle, requires SHI-licensed physicians to set aside at least 20 consultation-hours for SHI insured patients per week.

The hypothesis that the existence of dual comprehensive insurance systems may result in an unequal regional distribution of SHI licensed ambulatory physicians in Germany is based on the very narrow eligibility requirements for private health insurance: only employees with an income above the SHI threshold (2013: 52,200.00 Euro per year; 4,350.00 Euro per month), self-employed persons, and civil servants (German: *Beamte*) are exempt from compulsory insurance in the SHI system and are therefore eligible for PHI. This group of individuals with above-average incomes and typically good health risks are, however, unequally distributed among the regions. For example, cities have a larger proportion of civil servants and self-employed workers than rural areas, and areas with good public infrastructure generally have more high-income earners than areas with poor infrastructure [27, 28].

Based on the assumption that a physician seeking to establish a medical practice is to some extent influenced by financial incentives, the percentage of the population with private health insurance in an area could be a factor in his or her choice of location. The present study therefore estimates the number of privately insured residents in each German district and then investigates the impact of this statistic on the density of SHI-licensed physicians. All models control for the estimated average income ambulatory physicians generate from treating SHI insured patients and a well-defined set of covariates on the level of districts in Germany in 2010.

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Methodology

As there is no data available on the proportion of privately insured residents per region, we chose an indirect method for its estimation. Given that almost the entire German population has had health insurance since the introduction of compulsory health insurance in 2009, the number of privately insured residents may be calculated as the difference between the total population per district and the number covered by the SHI system. This leads to a slight overestimation of the actual number of privately insured people because those without insurance and those for whom neither the SHI nor PHI systems apply (e.g. civil servants working in courts and prisons, prisoners, and members of the German armed forces) cannot be excluded from the calculation due to a lack of data. According to data from the 2011 German micro-census, this group is composed of approximately 350,000 people and therefore represents less than one percent of the total population.

The number of statutorily insured persons in the various regions was determined using data held by the Federal Insurance Authority (BVA) for the purposes of calculating the morbidity-oriented risk structure compensation for individual health insurance funds. The data for the 2010 end-of-year adjustment included 68.8 million people and included the 5-digit district code of their last place of residence. The difference between the total district population numbers and the number within a district covered by the SHI scheme was then calculated using population data from the May 2011 census. A subsequent plausibility check of the district-specific differences suggested that the health insurance data contained some erroneously recorded district codes. There are two main reasons for this. Firstly, many health insurance funds presumably record district codes on the basis of the postcode of the patient's place of residence. There are, however, many postcode regions that extend over more than one district. Patients living in these postcode regions may, under certain circumstances, have been assigned the wrong district code by the health insurance fund. Secondly, there have been many reforms to district boundaries in the last twenty years which have, in part, resulted in some districts being broken up and some municipalities being reassigned to neighbouring districts. On assigning the district codes, it is possible that some health insurance funds wrongly recorded patients as living in newly amalgamated districts. In view of the above, we excluded 94 districts from our analysis where the following criteria were met:

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- Districts that share one or more postcodes with at least one other district.
- Districts that showed conspicuously large or small proportions of privately insured. Districts were considered to be conspicuous if they showed a proportion of privately insured greater than 40 percent in districts with a lower than average household income or less than 2 percent in districts with an average or higher than average household income.

These relatively rigid criteria sought to exclude erroneously recorded district codes from the analysis. As a result, acceptable data was available for 318 of 412 districts, of which 168 were urban areas and 150 rural. The proportion with private health insurance in the remaining 94 districts, of which 58 were rural areas, was regarded as missing data.

Multiple imputation

Broadly speaking, there are three alternative techniques for handling missing data: Listwise deletion, single imputation and multiple imputation. Listwise deletion discards all observations with missing values and all information contained in the non-missing values of these observations. With information on 94 districts missing, this may lead to less efficient results with wider confidence intervals and lower power. Single imputation does not discard records but replaces the missing values with estimates obtained using the available data. This in contrast underestimates the variance of the estimates and can lead to confidence intervals that are too narrow [29]. Multiple imputation addresses this problem by generating several estimates to create a number of possible data sets. The results are then combined in an appropriate manner to account for the uncertainty of the imputation procedure, thus leading to more realistic confidence intervals [29, 30]. In the present study the missing values for the 94 districts are multiply imputed using a well-defined truncated model with a threshold of zero in order to account for the natural lower level of the private insurance variable. The proportion with PHI was modelled with adjustment for the density of SHI-licensed physicians (i.e. the primary outcome) and for household income, the standardized number of civil servants and self-employed persons and a dummy variable for Eastern Germany. 100 imputations were performed using the software package STATA 13 [31].

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Regression analyses

The dependent variable, SHI physician density within a district, is a non-negative count that is divided by the number of residents in 2010. In order to investigate the relationship between the proportion with private health insurance and the density of SHI-licensed physicians in ambulatory practice, a Poisson regression was performed on each of the 100 completed datasets. Estimates and standard errors were collected and Rubin's rule applied to form a single set of statistically valid coefficients. The overall estimate of the proportion with private health insurance $\hat{z}_j$ in districts j ($j = 1,2 \dots m$) with standard errors u_j is the average of the individual estimates $\bar{z} = \frac{1}{m}\sum_{j=1}^{m} \hat{z}_j$. To obtain the overall standard error, the within-imputation variance $\bar{u} = \frac{1}{m}\sum_{j=1}^{m} u_j$ and the between-imputation variance $b = \frac{1}{m-1}\sum_{j=1}^{m}(\hat{z}_j - \bar{z})^2$ were calculated. Subsequently, the overall standard error was calculated by taking the square root of the total variance $\sqrt{t = \bar{u} + \left|1 + \frac{1}{m}\right| b}$. A significance test of the null hypothesis $\bar{z} = 0$ was performed by comparing the ratios $t = \frac{\bar{z}}{\sqrt{t}}$ to the same t-distribution [32].

The probability of a SHI physician y having chosen the location in district j was modelled by the Poisson distribution $\Pr(Y = y|\mu) = \frac{e^{-\mu}\mu^y}{y!}$ where the incidence rate μ is determined by $\bar{z}$. A set of additional factors that motivate the physicians' choice of location j is coded by a matrix X. The relationship between these quantities can then be expressed as $\mu = \exp(\alpha\bar{z} + X\beta)$, where are α and β coefficients to be estimated.

The factors in X motivating SHI-licensed physicians to choose a practice location (in addition to the factor of interest $\bar{z}$) were selected following a broad literature search. The estimated average income ambulatory physicians generate from treating SHI insured patients in a district j was included to approximate the economic return of working for the SHI. Regional variation in income may occur due to differences in the number of patients per SHI physician, the composition of SHI and PHI patients, the regional distribution of medical disciplines and, to some extent, the size of the budgets negotiated by the 17 regional associations of SHI physicians.

In addition to returns from labour for the SHI, physicians seek long-term financial stability through ownership of a practice [15] which can only be achieved if the number of patients is stable or increasing. We therefore included two dummy variables indicating an above average and a very high rate of population decline in a district within the last five years.

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Furthermore, physicians tend to practice in areas where they received their medical training and/or settled down for family life [10, 33]. An indicator variable for the existence of a university hospital was included to capture areas close to a place of specialist medical training. To control for the fact that patients use health care across district borders, with some districts providing health care services to patients in surrounding rural areas, we included a dummy variable indicating whether a substantial number of patients come from neighbouring districts ("provision for other areas"). The quality of life, including job opportunities for spouses, quality of school education, attractiveness of the area and cultural life, was captured using a regional quality of life index [34]. In addition, a dummy variable indicating urbanity of a region was included because some physicians prefer to live in densely populated areas irrespective of the average quality of life. Finally, the differing medical care needs of regions and cities should be taken into account, as a central requirement of the needs-based planning is to secure uniform and needs-based ambulatory health care. The GBA's recently revised needs-based planning mechanism however only takes into account the differing age structures in a population[1]. In this way, it aims to account for expected differences in the utilisation of medical services by patients above and below the age of 65 years (demographic factor). We therefore included the proportion of the population older than 64 years as an additional regressor.

Separate models were estimated for GPs and specialists. This stratification is based on the assumption that these groups differ in relation to their choice of practice location. GPs have historically demonstrated a greater willingness to set up practice in rural areas. They are also confronted with lower capital set-up costs, such as procurement costs of medical equipment and devices.

Data sources

The distinction between urban and rural areas used a classification developed by the Federal Institute for Building, Urban Affairs and Spatial Research (BBSR). Statistics on the share of population of age 65 and older and the rate of population decline were also taken from the BBSR database. Data on physician density and on the provision for other areas was provided by the National Association of SHI Physicians (NASHIP). The quality of life index

[1] In addition, the regional ASHIPs may deviate from the federal guidelines if this can be justified by, for example, special social or health care population needs or geographical accessibility. However, to date this exemption clause has not been used extensively. Thus, we do not include it in the analysis.

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was compiled by Kluge [34]. Estimates of physician income were taken from a 7% representative sample of SHI physicians in ambulatory practice. The income was weighted by the proportion of patients in a district who resided in other areas, thus taking cross-unit flows into account. The estimation was validated by comparing the estimated SHI income to the overall SHI budget in 2010 (€28 billion) and by comparison with the complete administrative data on SHI income from one regional association of SHI physicians.

Both the proportion with private health insurance and SHI physician income was estimated using data held by the Federal Insurance Authority (BVA). This data is collected from health insurance funds for the purpose of calculating the morbidity-oriented risk structure compensation between the individual funds.

Results

In 2010, there were on average 162 SHI licensed physicians in ambulatory practice per 100,000 inhabitants of the 412 German districts and cities. Each region had on average 64 GPs and 98 specialist medical practitioners per 100,000 inhabitants. The SHI physician density is particularly high in Hamburg, Berlin, the south of Baden-Württemberg and Bavaria. There were at least 250 physicians per 100,000 inhabitants in these areas. Figure 1 illustrates the regional concentration of specialist medical practitioners. High rates of specialists prevail in urban areas (e.g. 320 specialists per 100,000 in Heidelberg), which provide health services to patients in surrounding rural areas where the specialist density is generally lower (e.g. 21 specialists per 100 000 in Südwestpfalz). Although GPs are more evenly distributed among rural and urban areas, there are some rural areas with very low GP densities in North Germany.

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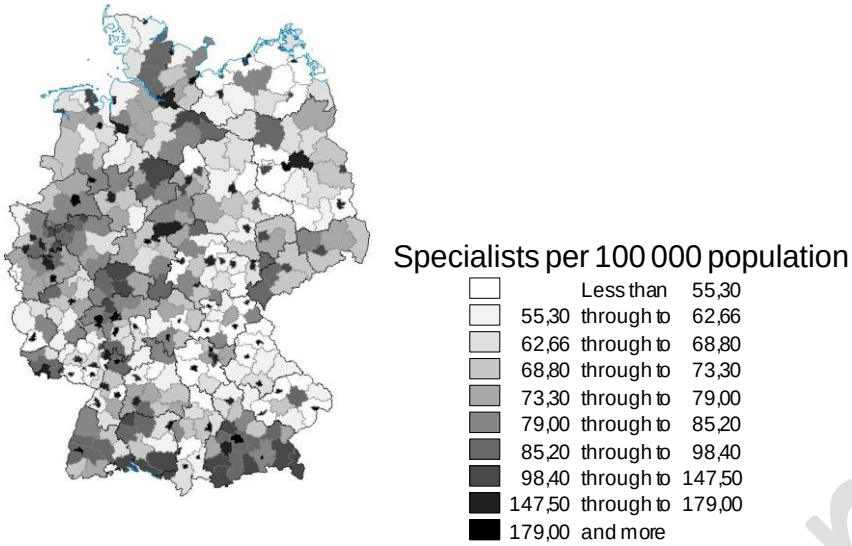

Figure 1: Ambulatory specialists per 100,000 population

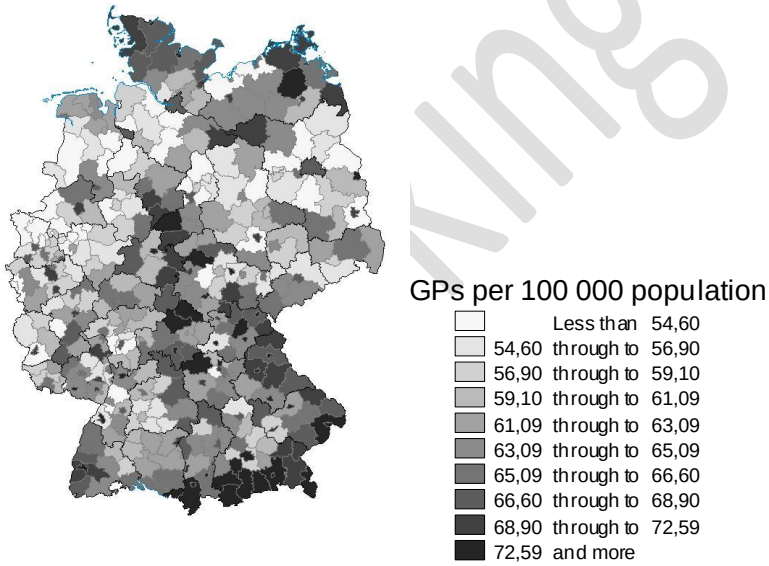

Figure 2: GPs per 100,000 population

The average proportion of privately insured residents in the 318 districts with reliable data is 13.48 percent. Multiple imputation for the remaining districts results in an average proportion of 13.5 percent for all 412 districts, ranging from a minimum of 3.53 percent with private health insurance in Ludwigslust to a maximum of 27 percent in Freiburg.

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Figure 3 illustrates the regional distribution of the proportion of privately insured (including the imputed values) using choropleth maps. The proportion of privately insured residents in the former East Germany and in Westphalia, lower Franconia and the northern part of Hesse is relatively small. The low proportion of residents with PHI in the former East Germany can be explained by low average household incomes and historically by the low number of public servants who were given the status of civil servant following reunification in 1990. In contrast, there are large numbers of privately insured residents in southern Bavaria, southern Baden-Württemberg and in the Rhein-Main area. Up to 27 percent of the population in these areas is privately insured.

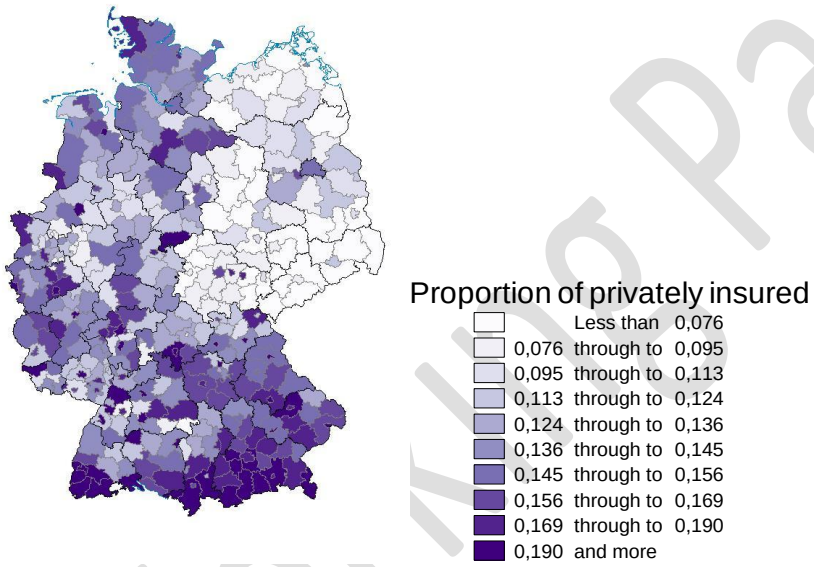

Figure 3: Proportion of privately insured residents

Table 1 displays the results of the final regression models. With the number of specialists as the dependent variable, taking exponentials of the regression coefficients reveals that, all else equal, the density of SHI specialists in ambulatory practice increases by 2.2 percent for every percentage increase in the number of residents with private insurance. Physician SHI income elasticity is -0.17, implying that a one percent increase in SHI income is associated with 0.17 percent decrease in the density of ambulatory SHI specialists. Interestingly, SHI-licensed physicians generate on average (before taxes and coverage of fixed costs) € 227 486 in rural areas but only € 207 728 in urban areas. Districts that provide health care

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services for their surrounding districts have, on average, a physician density 1.57 times higher than other districts. Similarly, the physician density in urban districts is 1.47 times higher than in rural districts. The presence of a university hospital is correlated with a higher specialist density but the effect is comparably small. Districts with declining populations have a significantly lower physician density. In districts with a population loss of 3 percent or more over the previous five years, the physician density is reduced by factor 0.85. A higher proportion of residents aged 65 and older is associated with a higher physician density. All coefficients except the indicators for regional quality of life are highly significant.

Multiple imputation estimates using Poisson regressions

Dependent variable	Specialists			GPs		
	Coefficients		Standard errors	Coefficients		Standard errors
Proportion privately insured	0,021	***	0,002	0,013	***	0,002
Log Income from SHI patients	-0,180	***	0,033	-0,011		0,040
Provision for other areas	0,452	***	0,015	0,083	***	0,018
Presence of university hospital	0,088	***	0,018	0,019		0,027
Population decline of up to 3%	-0,091	***	0,014	0,020		0,017
Population decline greater than 3%	-0,164	***	0,022	0,039		0,025
Regional quality of life: medium	0,020		0,015	-0,005		0,019
Regional quality of life: high	-0,023		0,021	-0,016		0,024
Urbanity indicator	0,353	***	0,015	-0,025		0,018
Population aged 65 years or more	0,034	***	0,003	0,014	***	0,004
Constant term	3,793	***	0,130	3,680	***	0,146
Number of districts	412			412		
Number of imputations	100			100		
Average RVI	0,253			0,042		
Average FMI	0,531			0,137		

Table 1: Results of final regression models

In the second model, a percent change in the proportion with private health insurance is associated with a significant 1.2 percent change in GP density. With respect to the control variables, however, a different picture arises when comparing specialist and GP medical practitioners. Supply of surrounding districts and a higher share of elderly population correlates highly significantly with GP density but there is no statistical evidence that the presence of a university hospital, declining population, physician income and urbanity is associated with GP density.

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Discussion

The present study gives a detailed overview of regional differences in the proportion of the population with private health insurance. Poisson models are used to analyse the impact of this measure on the density of specialists and GPs respectively. The proportion of residents with private insurance is estimated using complete administrative data from the SHI system and the May 2011 German census. Implausible values are estimated using multiple imputation techniques. The aim of the study was to investigate the effect in Germany of the co-existence of dual comprehensive insurance systems on the regional distribution of GPs and specialists in ambulatory care.

Our results show that every percentage increase in the proportion of residents with PHI is associated with increases of 2.2 and 1.2 percent in the density of specialists and GPs respectively. Although it is difficult to separate the effects of regional factors using aggregated data, the finding supports the hypothesis that the proportion or residents with PHI impacts upon the regional variation in physician density while controlling for a comprehensive set of covariates. Considering that the proportion of the population with PHI ranges from 3.53 to 27 percent among districts, a change by factor 1.022 for every percentage increase implies considerable distribution effects.

The German insurance system, with its co-existing statutory and private insurance schemes, where only selected subgroups may opt-out of SHI insurance, is unique in the OECD. For this reason there are, to our knowledge, no other studies with which the effect size may be compared. Most studies exploring the impact of private income and engagement in private practices on the regional distribution of physicians are, however, consistent with the finding that a strong or growing private sector contributes to the concentration of physicians in urban regions [23].

The difference in the strength of association found for GP density as opposed to ambulatory specialists seems reasonable. It is well known that GPs are more equally distributed among districts, with comparably higher densities in regions with higher health care need [2]. However, as GPs practicing in rural areas tend to be of above-average age and often struggle to find a successor for their practice, the influence of PHI on GP practices could increase in the future.

From a financial perspective, it is rational for an SHI-licensed physician to practice in districts

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with a high proportion of privately insured residents since the additional income generated may stabilize or increase practice income and/ or substitute physicians' SHI-income for a comparably low labour investment.

This substitution effect may also explain the unexpected negative income elasticity with respect to specialist physician density. SHI-licensed physicians generated on average (before taxes and coverage of costs for the practice) € 227 486 in rural areas but only € 207 728 in urban areas, where a large number of physicians compete for a limited number of SHI patients. Specialists are able to compensate this lack of income from SHI patients in oversupplied areas with income from PHI patients. This is why higher SHI income in rural areas does not incentivise SHI-licensed physicians to switch location. An interrelated possible cause of the negative income elasticity is that higher SHI income outside urban centres is not able to offset the disutility of leaving the city. This explanation is to some extent supported by Günther et al. [21], who found that the additional net income required to compensate the disutility of a rural compared to a urban practice is € 9,044 per month (€ 108,528 per year) for young German physicians.

From the perspective of the statutorily insured population, the incentive effects of PHI presumably contribute to a concentration of health care services in wealthy and urban areas, where civil servants and employees with incomes above the SHI threshold tend to live. Additionally, income from privately insured patients may compensate for lower SHI incomes so that an increase in SHI income does not incentivise physicians to choose a location in undersupplied districts. The co-existence of two distinct health insurance systems (statutory and private health insurance) with different remuneration systems may therefore make it more difficult to provide uniform, needs-based ambulatory health care services to all patients. A review of the different fee schedules for the provision of health care services by ambulatory physicians to SHI patients and PHI patients, with the goal of balancing out different levels of remuneration, would be a first step towards harmonising the incentives of the two insurance schemes [35]. Furthermore, governing bodies of the SHI could actively require SHI-licensed physicians to set aside at least 20 consultation hours for SHI patients per week, an agreement that is usually not implemented. The enforcement of this agreement would perhaps also restrict the SHI-PHI income substitution effect in oversupplied areas.

In the present study we have modelled the correlation between the proportion of the population with private health insurance and the regional physician density. Although this has been achieved to the best degree possible, the process is subject to certain limitations.

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Firstly, data on the proportion with private insurance is lacking and an indirect method to measure the variable of interest was required. While we believe the estimation to be reasonable, the rates in some districts may still be distorted. Large PHI proportions are, for instance, found in the districts of Schleswig-Holstein, which borders onto Denmark. This is may be a distortion caused by employees who live in Germany but work and are insured in Denmark. Secondly, in the absence of representative data, we have not been able to control for work schedules and working hours of SHI-licensed physicians on a regional level. Both factors were found to impact upon physician density in earlier studies [14]. Last, nationwide data on the share of SHI insured was only available at the level of districts. It may however be insightful to estimate the share if privately insured on smaller post code levels in order to gain a better understanding of its small area variation.

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