Heterogeneous Selection in the Market for Private Supplemental Dental Insurance: Evidence from Germany*

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Abstract

This paper analyzes the German market for supplemental dental insurance (SuppDI) to identify individual selection behavior. The rather limited underwriting by German private health insurers makes the SuppDI market especially prone to selection effects, which can lead to inefficient insurance coverage. Although our OLS does not identify a significant correlation between SuppDI coverage and risk for acute treatments, we conjecture that this outcome may result from sample heterogeneity when adverse and advantageous selection occur simultaneously and offset each other. We therefore use an IV method to confirm the existence of advantageous selection in a distinct subsample. We find that individuals who purchase SuppDI because of high insurance affinity have significantly lower risk in terms of dental treatment. Our results thus suggest that even in the absence of a positive correlation between risk and insurance coverage, the German SuppDI market suffers from information asymmetry caused by multidimensional private information.

JEL Classification: D82, I11

Keywords: Asymmetric information; advantageous selection; adverse selection; dental insurance; German statutory health insurance; supplemental health insurance

* We wish to particularly thank Stefan Felder and Peter Zweifel, as well as all the participants at the 41st annual EGRIE seminar and the University of Ulm, for their helpful comments. We also thank the Bertelsmann Foundation for providing the Health Care Monitor Data in cooperation with the statutory health insurance fund Barmer GEK. We also gratefully acknowledge financial support from the Deutsche Verein für Versicherungswissenschaft e.V.
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1. Introduction

As health care expenditures have risen, coverage by public health care systems like the German statutory health insurance (SHI) has been incrementally reduced (Simon, 2013). Therefore, markets for supplemental health insurance (SuppHI) that enables individuals to close these widening coverage gaps have been and are likely to continue growing in many OECD countries (OECD, 2004; Paolucci et al., 2007; Grabka, 2014). Within such a context, increasing copayments or benefit exclusions in public health care systems not only reduce the financial burden on public insurance schemes but can also strengthen personal responsibility for health and raise individual cost consciousness (OECD, 2004; Müller & Böhm, 2009). Individuals are also more able to voluntarily choose their preferred insurance coverage. When the insurance market suffers from information asymmetry, however, shifting coverage to voluntary private health insurance carries a risk of inefficiency. That is, if insurers are not able, or not allowed, to fully adjust premiums for individual risk type, selection effects lead to nonoptimal insurance coverage of the population.

To improve understanding of selection within voluntary private health insurance, this paper analyzes information asymmetry in the market for private supplemental dental insurance (SuppDI) in Germany, a particularly appropriate context given that the rather limited underwriting by German private health insurers makes the SuppDI market particularly prone to selection effects. In particular, it tests a basic prediction of the standard adverse selection model (i.e., Rothschild & Stiglitz, 1976), the existence of a positive correlation between insurance coverage and individual risk once all the policyholder characteristics used by insurers for pricing are controlled for (Cohen & Siegelman, 2010). Despite empirical support for this positive correlation in various voluntary private health insurance markets (e.g., Wolfe & Goddeeris, 1991; Godfried et al., 2001), several recent studies find a nonsignificant or even

negative relation (e.g., Fang et al., 2008; Schmitz, 2011). This negative association, often referred to as advantageous selection, can be explained by multidimensional private information; that is, individual possession of private information about characteristics correlated with both higher insurance coverage and lower risk. De Meza and Webb (2001) suggest in their theoretical model that highly risk averse individuals are more likely to purchase insurance coverage and invest more in precaution, thereby lowering risk.

The absence of a coverage-risk correlation, however, which is also observed in our analysis despite the limited underwriting of German health insurers, could be explained by two alternatives: either the market does not suffer from empirically important information asymmetry, which suggests an efficient solution, or the adverse and advantageous selection offset each other in the aggregate, which may lead to an inefficient market outcome (Finkelstein & McGarry, 2006). Because both these explanations have different welfare implications, it is important to investigate the underlying cause of this nonsignificant correlation. Hence, we apply an instrumental variable (IV) approach that allows us to disentangle different subgroups within a heterogeneous sample. By instrumenting SuppDI, we identify the presence of information asymmetry in the German SuppDI market that is not evident when the coverage-risk correlation is estimated using standard regression.

By identifying heterogeneous selection behavior in the insurance market using a method different to that of previous studies (e.g. Fang et al., 2008; Finkelstein & McGarry, 2006, Lange et al., 2015), we make a valuable contribution to the literature. To the best of our knowledge, we are the first to use an IV approach to disentangle adverse and advantageous selection in the same insurance pool. Moreover, we base this approach on the assumption that, in line with de Meza and Webb (2001), individuals having many supplemental insurances are more likely to exert effort for prevention and purchase SuppDI because of an inner need for

security. Thus, our IV results complement the scarce and mixed evidence on risk preferences as a potential source of advantageous selection.

The remainder of the paper proceeds as follows. Section 2 gives an overview of the German health insurance system with a special focus on SuppDI. Section 3 then summarizes the basic theoretical effects of information asymmetry in insurance markets and reviews the most relevant empirical studies on such asymmetry as it pertains to voluntary private health insurance. Section 4 describes the data and empirical model, and Section 5 reports the results of both the main analysis and several robustness checks. Section 6 concludes the paper.

2. Institutional Background and Private Supplemental Dental Insurance in Germany

In Germany, nearly 90% of the population is covered by SHI, while about 10% has substitutive private health insurance (PHI). SHI members contribute in the form of a payroll tax with a uniform rate since 2009. Dependent workers whose income is below the so-called compulsory threshold cannot opt out of SHI,[1] but employees with an income above the threshold, as well as civil servants and the self-employed, can opt for PHI, which substitutes for SHI entirely. PHI premiums are generally risk adjusted based on age and health status at the date of contract signing, with benefits subject to individual contractual agreement between the health insurer and the insured. SHI, in contrast, has a highly uniform standard benefit package for all funds (Simon, 2013), one that is quite comprehensive compared to those in other industrialized countries (Beske et al., 2005). Nevertheless, because German health care expenditure as a proportion of GDP is only exceeded by that of the United States and a few other countries (OECD, 2013), out-of-pocket expenses from copayments and standard benefit exclusions have

[1] In the empirical analysis, we use data from 2011 when the threshold for compulsory health insurance was a pre-tax annual income of €49,500.

recently been increasing in an attempt to lower this share (Müller & Böhm, 2009; Farbmacher & Winter, 2013).

Individuals enrolled in SHI are however permitted to buy supplemental private coverage directly from private health insurers (rather than through their employers), which is guaranteed renewable (Pauly et al., 1995). Generally, SuppHI offers two types of benefits: entitlement to higher quality treatment (e.g., private hospital rooms or treatment by a chief physician) and reduced financial risk associated with services not or only partly covered by SHI. In case of SuppDI, the main purpose is to reduce or close the coverage gaps in the SHI benefit package.[2] According to data from the German Socio-Economic Panel (GSOEP), a representative survey for the German population, the proportion of SHI enrollees having at least one supplemental insurance increased from 9.6% in 2000 to 21.6% in 2012 (see Figure 1), meaning that more than one out of five SHI members have some type of additional health insurance coverage (Grabka, 2014).

[2] A minor purpose of SuppDI is to obtain higher quality by offering services such as professional tooth cleaning.

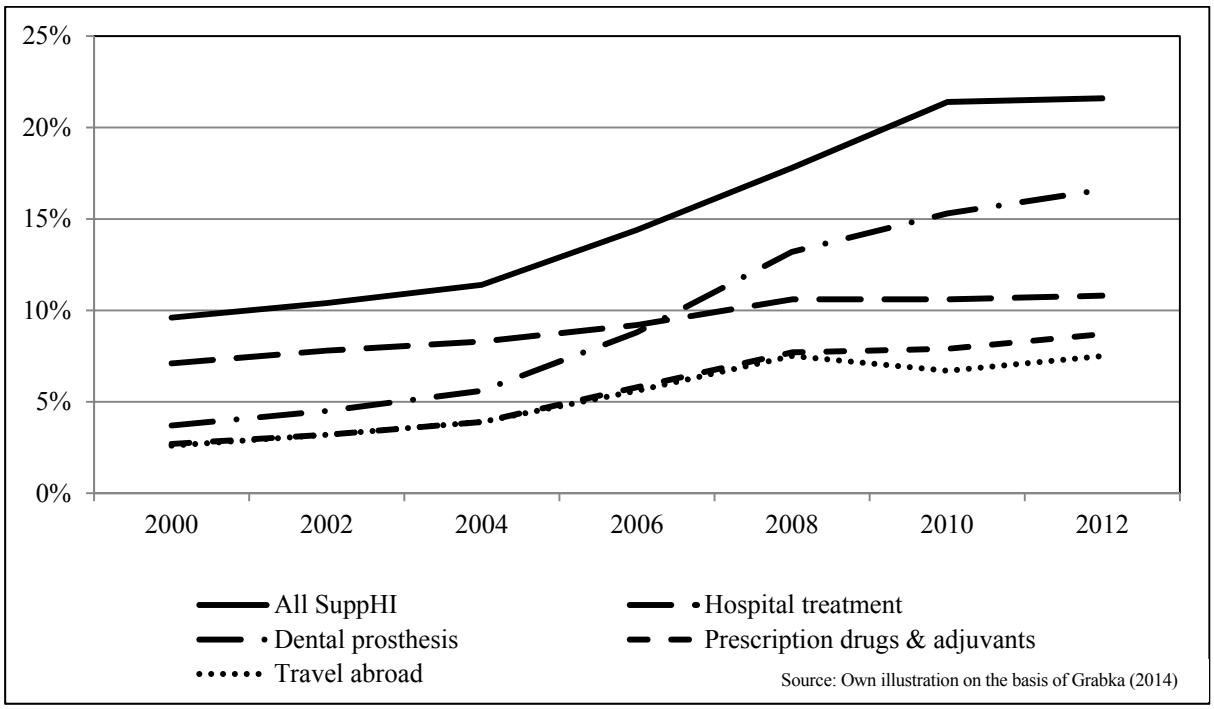

Figure 1: Share of SHI enrollees with SuppHI, 2000–2012

Among the various supplemental insurances available to SHI enrollees, SuppDI is the most prevalent and has the highest recent growth rate, probably because of the considerable cuts in SHI dental benefits over the past 20 years (Simon, 2013). In particular, these benefits have been subject to two major reforms. The first, in 1997, excluded dental prostheses from the standard benefit package for a subgroup of insured, although this exclusion was reversed only two years later for political reasons.[3] The second was a 2004 reform that changed the 35%–50% coinsurance rate for dental prostheses to diagnosis-based fixed benefits covering 50%[4] of the cost of standard treatment for all but low-income SHI enrollees, who are eligible to receive

[3] This reform, which was based on the law for contribution reduction (*Beitragsentlastungsgesetz*), only applied to those born after 1978. The fixed benefits for dental prostheses were introduced as part of the laws for SHI reorganization (*GKV-Neuordnungsgesetze*) but were replaced in 1999 by the principle of benefits in kind for dental prostheses.

[4] By law, the fixed benefits can rise by 20% (30%) if there is evidence that the insured performs regular prevention and can prove yearly dental check-ups during the last 5 (10) years before treatment.

the full cost of standard treatment.[5] Dental prostheses costs that exceed the fixed benefits, however, must be paid out of pocket (Klingenberger & Micheelis, 2005), subjecting SHI enrollees to an increased financial risk associated with dental care (Simon, 2013). In response, SHI enrollees have substantially stepped up their demand for SuppDI after the reform (Figure 1). Additionally, some funds started cooperating with private health insurers to offer SuppHI to their insured since 2005, possibly stimulating the demand for SuppDI policies (Grabka, 2014). According to the Association of German Private Healthcare Insurers (2006, 2013), the number of such policies rose nearly 75% between 2005 and 2012 to over 13 million, with 16.6% of statutorily insured individuals having a SuppDI in 2012 (see Figure 1). Hence, the proportion of SHI enrollees with SuppDI coverage tripled between 2004 and 2012.

The premiums for SuppDIs are generally risk adjusted based on individual age at date of contract signing[6] and sometimes based on a few questions about dental health for risk classification. Specifically, insurers may ask applicants about past dental prostheses or advised dental or orthodontic treatment and can also reject them based on risk-related responses. Nevertheless, the ex-ante premium differentiation for SuppDI is limited, which may lead to selection effects from information asymmetry. In addition, there is no consideration of past premium payment history, meaning that the information asymmetry from lack of ex-ante premium differentiation preserves over time.

[5] According to Barmer GEK, in 2012, about 9% of SHI enrollees received diagnosis-based fixed benefits covering 100% of the cost of standard treatment (Rädel et al., 2014).

[6] Conditional on the chosen coverage, the premium for an individual signing a SuppDI contract at age 43 is between 5 and 47 euros per month (Finanztest, 2014).

3. Theoretical Effects of Information Asymmetry in Insurance Markets

In the standard insurance model with adverse selection (Rothschild & Stiglitz, 1976), individual private information is one-dimensional because the individuals differ only with respect to policyholder risk. In this setting, insurers can only offer separating contracts, which induce self-selection. Hence, in equilibrium, high-risk individuals choose policies with full (more) coverage at higher unitary premiums, whereas low-risk individuals choose policies with partial (less) coverage at lower unitary premiums. According to this model, in the context of mandatorily insured SHI enrollees, only high-risk individuals purchase SuppDI, meaning that low-risk individuals are rationed with respect to the first-best market outcome. The result is an inefficient market outcome in the separating equilibrium.

The basic empirical prediction of adverse selection models is that in market equilibrium, the amount of insurance coverage is positively correlated with the risk of loss (Chiappori et al., 2006). In testing this assumption, however, it is very important to control for all relevant characteristics used by insurers for risk-based rate setting (Cohen & Siegelman, 2010) so that the impact of residual private information can be assessed (Finkelstein & McGarry, 2006). Nevertheless, once all known observables are controlled for, a positive correlation between coverage and risk is only a necessary and not a sufficient condition for the presence of adverse selection, as such a positive correlation may also arise from moral hazard. In the latter case, individuals with higher coverage take fewer preventive measures, which in turn leads to a higher probability of loss (ex-ante moral hazard), or demand more health services following illness when such demand is not perfectly inelastic (ex-post moral hazard) (Cutler & Zeckhauser, 2000; Einav & Finkelstein, 2011).

The absence of such a positive correlation can be explained either by negligible information asymmetries or, more important, by the introduction of unobservable risk

preference heterogeneity into the model. Hemenway (1990), who first applied the term "propitious selection" to this reversal of the standard adverse selection prediction, suggests that highly risk-averse individuals are more likely to buy insurance coverage and invest more in prevention so as to reduce their risk of loss. This mechanism can produce an advantageous selection leading to a negative correlation between actual risk and risk aversion. In line with this argument, de Meza and Webb (2001) develop a theoretical model that explicitly allows for multidimensional private information and assumes that individuals differ not only with respect to risk type but also to risk preferences. Based on this assumption, the authors show the existence of equilibria with advantageous selection in competitive insurance markets, which is crucially dependent on private information about characteristics that are positively correlated with insurance coverage and negatively correlated with individual risk. These characteristics, therefore, must not be used in insurers' premium calculations (Finkelstein & McGarry, 2006).

The evidence for such ex-ante hidden information in private SuppHI markets, however, is mixed. In an analysis somewhat similar to ours, Godfried et al. (2001) identify adverse selection among the effects of dental service exclusion from compulsory health insurance on the demand for SuppDI in the Netherlands. In doing so, they show that individuals with poorer dental health or more frequent past dentist visits (high risk) are more likely to purchase SuppDI than individuals with better dental health or fewer past visits (low risk). In contrast, Schmitz (2011), using GSOEP data, reports weak evidence for advantageous selection in the German supplemental hospital insurance market. He shows that males with higher risk aversion are more likely to purchase this insurance but have fewer hospital stays within a 6-year post-purchase period than males with lower risk aversion. In another study, Augurzky and Tauchmann (2011) find no significant effect of excluding and then re-including dental prostheses in SHI coverage on SuppDI demand in Germany. They conclude that either

individuals fail to make informed choices about the amount of dental insurance coverage needed or individual preferences are not subject to heterogeneity. However, their analysis, unlike ours, does not focus on information asymmetry.

Several recent studies do find evidence for the importance of multidimensional private information in different insurance markets (Cohen & Siegelman, 2010; Einav & Finkelstein, 2011). For example, Finkelstein and McGarry (2006), in a closely related analysis of the U.S. long-term care (LTC) insurance market, show that once insurer assessment of policyholder risk type is controlled for, individuals with a higher subjective expectation of entering a nursing home are more likely to buy LTC insurance coverage. On the other hand, they find no evidence from the same data of a positive correlation between LTC insurance coverage and admission to a nursing home. They explain this puzzle by suggesting that risk-based (adverse) selection is offset by preference-based (advantageous) selection in the aggregate. Using two separate regressions based on the approach proposed by Chiappori and Salanié (2000), they show that wealthier and more cautious individuals are more likely to hold an LTC insurance policy but less likely to enter a nursing home. They thus conclude that an insurance market may suffer from inefficiencies due to information asymmetry even in the absence of a positive correlation between insurance coverage and risk occurrence.

Combining the ideas of Hemenway (1990) with the theoretical model of de Meza and Webb (2001) highlights risk aversion as an important potential source of advantageous selection in voluntary health insurance markets. However, the empirical evidence on the role of risk preferences in SuppHI demand remains scarce and ambiguous (Kiil, 2012). Moreover, evidence for risk aversion as a significant determinant of insurance coverage is not a sufficient condition for risk aversion as a source of advantageous selection. For example, Fang et al. (2008) find evidence for advantageous selection in the U.S. market for Medigap (i.e. a

supplement for Medicare). Furthermore, they add some covariates into a regression of Medigap coverage on expected health care expenditure and pricing variables to identify the sources of advantageous selection.[7] Adding only proxies for risk preferences into this regression barely changes the coefficient on health care expenditure risk even though risk tolerance significantly decreases the purchase of Medigap. One possible explanation is that risk tolerance is not necessarily linked to bad health, meaning that risk preferences are not a source of advantageous selection. This is in line with Cutler et al. (2008) who find no systematic relationship between risky behavior and expected claims for Medigap and acute health insurance. Instead, Fang et al. (2008) identify cognitive ability as an important selection source in the Medigap market.

Buchmueller et al. (2013), using a similar approach with risk as the dependent variable,[8] find a significantly negative correlation between having a duplicate private health insurance in Australia and the number of nights spent in hospital (risk) indicating advantageous selection in this market. Furthermore, they show that risk preferences turn the relation between insurance coverage and risk from negatively significant to insignificant when proxies for risk preferences are added into the regression. They conclude, along with their additional finding that individuals with private health insurance are more likely to buy other types of insurance (e.g., life insurance), that risk aversion essentially influences the demand for private health insurance and modestly contributes to the observed advantageous selection in this market.

[7] In their study, variables that are correlated positively with coverage but negatively with risk change the magnitude of the risk coefficient and can thus be considered sources of advantageous selection.

[8] In contrast to Fang et al. (2008), Buchmueller et al. (2013), in studying advantageous selection sources, use a proxy for risk as the dependent variable and insurance coverage as the independent variable. However, their strategy of adding covariates into the regression to identify sources is similar to Fang et al. (2008).

4. Data and Methodology

Our analysis is based on the Healthcare Monitor,[9] a representative survey of a cross-section of the German population administered since 2001 by the Bertelsmann Foundation.[10] Comprising 21 biannual waves, this survey includes such detailed health information as general health status, health insurance coverage, different types of SuppHI coverage (including SuppDI), socioeconomic characteristics, number of physician visits, and relationship between patients and physicians. For the present analysis, we rely exclusively on wave 19 (from 2011) because it contains very detailed information about dental status and dentist visits. For this wave, a total of 2,200 individuals aged 18 to 79 were contacted by mail, of whom over 80% responded, producing a sample of 1,781 individuals (GfK Health Care, 2011).

Table 1 lists the characteristics of all individuals by insurance status. According to column 1, which shows the share of PHI enrollees (n = 285), these individuals tend to be older, have higher incomes, and be more predominantly male than SHI enrollees (column 2). These findings are in line with the fact that switching from SHI to PHI requires an income above the compulsory threshold, which is far above the German average income. With regard to dental health, however, we observe no major differences between the two groups. Given our focus on selection in the SuppDI market, however, we are particularly interested in differences between individuals with and without a SuppDI policy. Since the additional coverage offered by SuppDI is already included in most PHI plans, we exclude individuals with PHI and concentrate only on individuals with SHI, which reduces the final sample to 1,496. The comparison between SHI with (3) and without (4) SuppDI shows that, in line with most findings in the literature (e.g., Kiil, 2012), SuppDI enrollees are more likely to be married and have a higher income.

[9] The *Gesundheitsmonitor*.

[10] Since 2011, the statutory health insurance fund Barmer GEK has been cooperating with the Bertelsmann Foundation on the Healthcare Monitor.

Table 1: Descriptive Statistics by Insurance

	PHI (1) All	SHI (2) All	SHI (3) SuppDI Yes	(4) No
Male	0.687	0.454	0.429	0.464
Age	54.567	49.495	50.324	49.153
Married	0.690	0.576	0.637	0.550***
Income	3.690	2.782	2.993	2.695***
A-level	0.657	0.462	0.446	0.468
Employment				
Full time	0.422	0.389	0.407	0.381
Part time	0.052	0.123	0.115	0.127
Hourly	0.022	0.059	0.061	0.059
Unemployed	0.455	0.358	0.373	0.352
Job training	0.049	0.071	0.044	0.082**
Household size	2.291	2.315	2.341	2.304
Self-rated health	3.201	3.135	3.130	3.137
Never a smoker	0.545	0.561	0.532	0.572
BMI	26.500	26.428	26.543	26.381
Activity	4.134	3.940	4.034	3.901
Diet				
Fruits	3.179	3.218	3.267	3.198
Vegetables	3.157	3.075	3.137	3.050**
Fast food	1.825	1.822	1.824	1.822
Sweets	2.347	2.411	2.419	2.408
Dentist visits per year	1.817	1.761	2.049	1.641***
Number of other SuppHIs	1.160	0.506	1.179	0.228***
Usual preventive dentist visits per year				
Seldom/only in pain	0.108	0.054	0.022	0.068***
Once in 2 years	0.082	0.032	0.020	0.036
Once	0.354	0.375	0.353	0.384
Twice	0.384	0.490	0.551	0.464***
Three times or more	0.071	0.049	0.054	0.048
Dental issues				
Periodontitis	0.146	0.178	0.159	0.185
Filling	0.623	0.674	0.728	0.651***
Prosthesis	0.384	0.419	0.441	0.409
Implant	0.198	0.105	0.127	0.096*
Braces	0.022	0.021	0.017	0.022
Grind teeth	0.056	0.065	0.076	0.060
Missing teeth	0.078	0.095	0.098	0.093
Toothache	0.011	0.015	0.025	0.011*
Chewing/jaw	0.007	0.022	0.025	0.021
Caries	0.071	0.074	0.061	0.079
No issues	0.123	0.115	0.088	0.126**
Observations	285	1,496	429	1,067

Notes: Sample size can vary slightly within each variable. Income is measured in €1,000 intervals from < €1,000 up to > €5,000 monthly net household income. Self-rated health: bad = 1 to excellent = 5. Activity: never = 1 to daily = 6. Diet: never/seldom = 1 to daily = 4. The level of significance for the statistical differences in a two-sided *t*-test between the two groups (see columns 3 and 4) is designated as follows: *p<.10; **p<.05; ***p<.01.

More important in our context, the comparison reveals that policyholders have significantly more dental implants and fillings, as well as more acute dental pain, and show generally worse dental health, with a lower share of individuals without any dental issues. Individuals with SuppDI also go to the dentist more often than the noninsured comparison group, which would suggest adverse selection were it not that the overall number of dentist visits also includes check-ups and aesthetic procedures. In fact, Table 1 confirms this latter observation: SuppDI policyholders tend to have more preventive dentist visits than individuals without SuppDI.

To estimate the relation between SuppDI coverage and risk, we must find an appropriate measure for the financial risk associated with dental treatments. Because the Health Monitor data are cross-sectional only and based on patient surveys, they include no information on specific type of dental care or resulting expenditure for dental treatments, meaning that we cannot fully measure individual risk. Rather, we proxy risk by the number of dentist visits. Simply comparing the numbers for SuppDI enrollees and non-enrollees, however, is inadequate for risk assessment because the former may simply be more likely to have annual check-ups. Hence, to improve our dependent variable's risk measuring ability, we adjust our model in two ways: transforming the count variable to disentangle acute treatment visits from preventive check-ups and adding in more covariates to further reduce the nonacute treatment bias.

As regards the first adjustment, Figure 2 shows the distribution of dentist visits for the whole sample of individuals with SHI. As is evident, many individuals go to the dentist only once or twice a year, which indicates actual treatment or simply following dentist recommendations of two dental check-ups per year.[11] We thus transform the dependent variable *DentVisits* into a dummy equal to 1 if an individual went to the dentist more than twice in the

[11] SHI members have a financial incentive to go for regular dental check-ups because if they do so during the 5 or 10 years preceding treatment, they receive higher benefits for dental prostheses.

previous year, and 0 otherwise. This transformation of the count variable, also used by Godfried et al. (2001), should prevent incorrect measurement of preventive dentist visits as a proxy for risk. Because German insurers only cover two annual check-ups, we assume that three or more dentist visits a year clearly point to acute treatment.

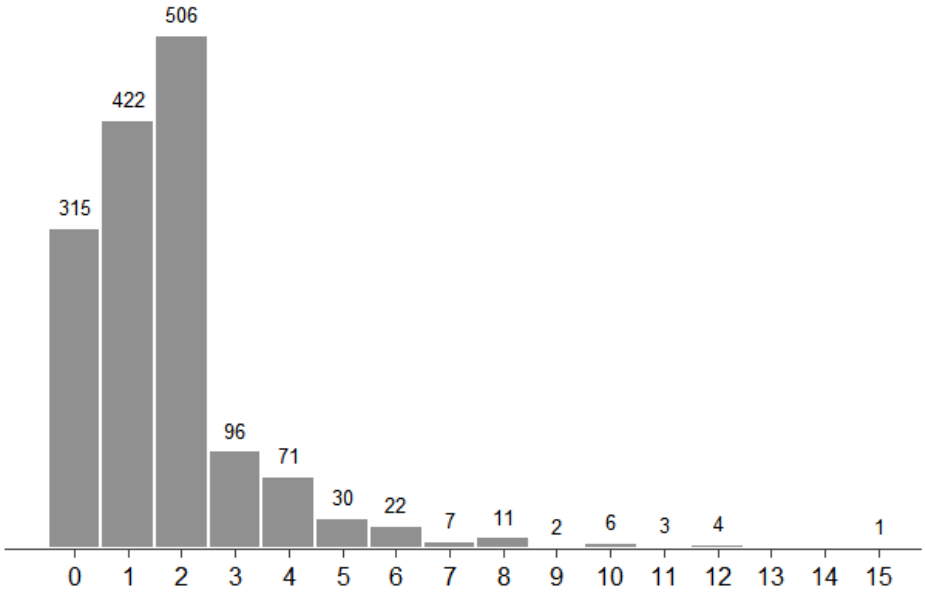

Figure 2: Number of dentist visits for all individuals with SHI

The other covariates introduced into the model to further reduce the nonacute treatment bias are based on responses to individual survey items. One assesses the usual number of annual dentist visits for patients without any major dental issues.[12] We add dummies for this variable into the controls represented by vector *C* with the aim of capturing overly cautious individuals (i.e., those getting more than the recommended two annual check-ups). *C* also

[12] Possible answers are three or more times a year," "about twice a year," "about once a year," "about once in two years," or "seldom, only in pain."

includes individuals' fear of the dentist, which might prompt them to skip annual check-ups or even avoid necessary treatments.[13]

Drawing on the above, we estimate the relation between SuppDI coverage and risk by specifying the following linear probability model[14] (LPM):

$$P(DentVisits=1|DIns, X, C) = \alpha_0 + \alpha_1 DIns + \alpha_2 X + \alpha_3 C \quad (1)$$

Here, the coefficient of interest, *DIns*, indicates insurance coverage (i.e., whether an individual has SuppDI (*DIns*=1) or not (*DIns*=0)), and X represents a vector of covariates to control for the risk classification in SuppDI policies. In line with the pricing of all German health insurers offering SuppDI, we use the insured's age[15] but also include whether or not the individual has dental prostheses or dental implants to reflect the more thorough risk classification used by some insurance companies. All these variables are included in nonparametric form, and results are robust against interaction between all characteristics. Because of space constraints, however, in Table 2, we use only the simplified version of the risk classification without interaction terms. It should also be noted that although insurers are allowed to reject applicants whose estimated risk is too high, the data do not allow us to control for rejected applications. Given that only a few insurance companies have explicit rejection rules (e.g., no contract finalization when tooth loss is greater than three), we expect this bias to be small. Moreover, rejections by German private health insurers because of bad dental health are rare (Finanztest, 2014).

[13] Measured by a 6-item scale from "no fear" to "panic."

[14] Because the dependent variable is dichotomous, we also estimate a probit model whose results are given in Table 2.

[15] As the data are only cross-sectional, we cannot include characteristics related to time of contract finalization. As a proxy, we use current information from the survey. In fact, age at contract entry is decisive for risk classification; however, since the survey does not report this datum, we control for the age of the insured at time of survey. We assume this bias to be relatively small since the majority of policies were finalized after the 2004 health care reform.

Assuming that model (1) adequately measures risk, three observations are possible in the interdependence between SuppDI coverage and dentist visits, two related to a positive correlation of $\alpha_1 > 0$ in (1) and one to a negative link ($\alpha_1 < 0$). The first, in line with classical adverse selection, is that $\alpha_1 > 0$ results from residual ex-ante private information about the expected use of dental services. Under this condition, individuals with private information about their high risk type would be more likely to buy the supplemental coverage. The second possibility is that individuals with SuppDI coverage take fewer precautions (e.g., everyday dental care) and are thus either at higher risk (ex-ante moral hazard) or demand more dental services because of lower marginal costs (ex-post moral hazard). A negative link ($\alpha_1 < 0$), in contrast, would indicate advantageous selection in the German SuppDI market, possibly caused by a higher likelihood that cautious individuals will purchase SuppDI and engage in more preventative behaviors, leading to fewer dentist visits for acute treatments. Nevertheless, it should also be noted that, despite doubts about a strong impact of moral hazard in the field of dentistry, we cannot reject a possible bias in the analysis of selection behavior. Because moral hazard can only explain an upward bias that overestimates possible adverse selection, it brings into question the interpretation of a positive correlation. In the case of a negative correlation, on the other hand, moral hazard would cause the model to underestimate the magnitude of the coefficient. Hence, $\alpha_1 < 0$ indicates advantageous selection irrespective of the presence of moral hazard.

When equation (1) is estimated by a simple OLS regression, the coefficient α_1 shows the aggregate relation of all these possibly overlapping effects. A significant correlation thus only refers to the dominant population. If the sample is heterogeneous, some high-risk individuals may adversely select into SuppDI, while others bring about advantageous selection by having characteristics that are positively correlated with buying SuppDI but negatively

correlated with dentist visits for acute treatments. If selection in the sample is heterogeneous, these effects may offset each other so that an insignificant correlation might wrongly suggest the absence of information asymmetry. Because such an equilibrium could be inefficient (Finkelstein & McGarry, 2006), it is useful to distinguish these groups in order to derive a clearer picture of the different selection effects.

To test for a heterogeneous sample, we employ an IV method that allows us to identify a set of advantageous selectors while disentangling any possible overlap with adverse selection. The arrows in Figure 3 illustrate the interdependence of insurance coverage and risk: (i) designates the potential link resulting from adverse selection, (ii) indicates moral hazard, and (iii) represents our assumption that SuppDI policyholders differ not only in risk type but also in motivation for purchasing SuppDI. From the previous literature, we know that high risk aversion may lead to simultaneous overcautiousness and purchase of health insurance; in other words, advantageous selection. In line with Buchmueller et al. (2013), we assume that this relation is not restricted to a specific risk and that cautious individuals generally have a higher affinity for buying insurance to reduce future risk. We then look at how many SuppHIs individuals have in addition to their SuppDI. Based on de Meza and Webb (2001), we argue that individuals holding many SuppHIs buy SuppDI because of their inner need for security (hereafter, insurance affinity) and are more likely to take precautions leading to lower risk.

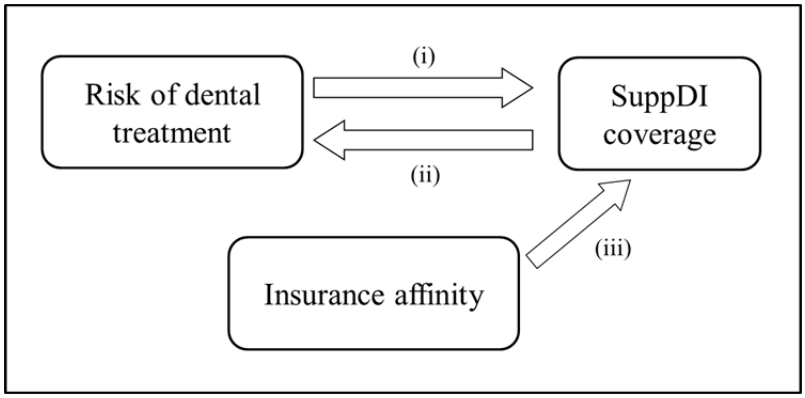

Figure 3: Relation between SuppDI coverage and individual risk of dental treatment

As our instrument for having a SuppDI, we use the number of other SuppHIs enrolled in. We avoid misspecifying our instrument's functional form by creating the dummy variable "insurance affinity," which equals 1 if an individual has more than two SuppHIs in addition to SuppDI ("high insurance affinity") and 0 otherwise ("low insurance affinity"). In equation (2), we model the linear projection fo*r DIns* with the same covariates as in model (1) but add in the dichotomous instrument Z, which is excluded from the second stage:

$$P(DIns=1|Z, X, C) = \beta_0 + \beta_1 Z + \beta_2 X + \beta_3 C \qquad (2)$$

SuppHIs will be a valid instrument (Z) for SuppDI as long as it satisfies two criteria: buying other SuppHIs must be a good predictor of purchasing a SuppDI and the correlation between dentist visits and having other SuppHIs must not be channeled through any other mechanism than that presented here. The first condition is shown to be met in our discussion of results; we find the second to be true for the following SuppHI components:

- additional daily hospital benefits;
- single or double hospital bed and treatment by chief physician;
- benefits for eyeglasses, drugs, and other medication;
- long-term care;

- alternative healing methods and naturopathy; and
- treatment by a private physician.

Admittedly, we doubt that worse dental health is likely to influence the decision to buy one of these insurance products. Moreover, dental care, being a very distinct field, may not be influenced by other health issues that increase the likelihood of buying supplemental hospital insurance. Nevertheless, if an individual's general health correlates negatively with overall insurance coverage and positively with dental health, any potential bias is likely to be positive.

This relation, however, is in no way straightforward. Rather, we are interested in identifying those who buy SuppDI because of their relatively high insurance affinity, a sample we explicitly assume to be heterogeneous in selection behavior. Yet the IV results, because they show only a local average selection for a specific subpopulation (the effect for so-called compliers), are not representative of the whole sample (Imbens & Angrist, 1994). Hence, for the results derived using our instrument, in contrast to those based on local average treatment effects, we claim no direct causality. Rather, we assert that individuals buying SuppDI because of high insurance affinity are better risks because of their preventive behavior, which is not necessarily observable.

5. Results

5.1 Evidence for heterogeneous selection

Table 2 shows the effects of the LPM (column 1) representing the aggregated correlation between risk and insurance coverage. In this model, the coefficient of SuppDI is not significantly different from zero. Hence, in the aggregate, we find no evidence of information asymmetry. Moreover, although the covariates indicate that the dummies for dental implants and prostheses are significant and positive, age seems not to affect the number of dentist visits.

Nevertheless, individuals reporting many preventive dentist visits are more likely to go to the dentist more than twice. One obvious explanation is the common practice of arranging further appointments if any need for acute treatments is noted during the regular check-up. Fear of the dentist, in contrast, seems to have only a minor impact. Estimating the aggregated coverage-risk correlation using a probit model (column 5) confirms these results. Such a nonsignificant risk-coverage relation in this market may, as already discussed, be attributable to one of two possible explanations: (i) the information asymmetry is empirically negligible or (ii) the risk- and preference-based selection offset each other in the aggregate (Finkelstein & McGarry 2006).[16]

We report the results of our tests for this heterogeneous selection in Table 2. Column 2 shows the results for our 2SLS estimations, while column 3 reports the first stage results, whose *F*-statistic of 220 indicates that the instrument is sufficiently strong and Z a good predictor for SuppDI in the model. We also obtain a mildly significant negative impact of having a SuppDI policy on dentist visits for acute treatments. This negative correlation points to the existence of multidimensional private information and advantageous selection within a subgroup of the sample, although we again cannot rule out a possible upward bias from moral hazard. The reduced form (column 4), which directly estimates the effect of the instrument on the dependent variable, also yields significant negative results, suggesting that the interpretation of our IV results in column 2 is valid: those having more than two additional health insurances tend to be low risk.[17]

[16] Another explanation may be that private health insurers often include an elimination period in the SuppDI contracts during which they do not pay for any dental treatment. Unfortunately, the Healthcare Monitor does not include information about the date of contract signing. Nevertheless, we expect any possible bias to be small because the elimination period is usually only eight months (Finanztest, 2014).

[17] The estimations reported in columns 3 and 4 of Table 2 are comparable to Finkelstein and McGarry's (2006) two separate regressions to identify advantageous selection.

Table 2: Aggregated and Instrumented Selection into Insurance

	(1) OLS	(2) 2SLS	(3) First stage	(4) Reduced form	(5) Probit	(6) IV probit
SuppDI	0.0321	-0.1056*			0.1392	-0.5075*
	(0.021)	(0.059)			(0.089)	(0.284)
Insurance affinity			0.6082***	-0.0642*		
			(0.041)	(0.036)		
Underwriting						
Dental prosthetics	0.0746***	0.0757***	-0.0018	0.0759***	0.3255***	0.3165***
	(0.021)	(0.021)	(0.026)	(0.021)	(0.089)	(0.088)
Dental implants	0.0723**	0.0794**	0.0194	0.0774**	0.2778**	0.3003**
	(0.035)	(0.036)	(0.040)	(0.035)	(0.125)	(0.124)
Age 20-24	0.0224	0.0235	-0.0353	0.0273	0.1139	0.1244
	(0.051)	(0.052)	(0.064)	(0.051)	(0.325)	(0.320)
Age 25-29	0.0454	0.0558	0.0537	0.0502	0.2645	0.3069
	(0.055)	(0.055)	(0.067)	(0.054)	(0.319)	(0.311)
Age 30-34	0.0295	0.0467	0.1105	0.0350	0.1733	0.2481
	(0.052)	(0.054)	(0.069)	(0.052)	(0.307)	(0.305)
Age 35-39	0.0708	0.0885*	0.0944	0.0785	0.3709	0.4427
	(0.052)	(0.053)	(0.066)	(0.052)	(0.295)	(0.290)
Age 40-44	0.0429	0.0623	0.1208*	0.0495	0.2607	0.3446
	(0.050)	(0.052)	(0.064)	(0.050)	(0.290)	(0.288)
Age 45-49	0.0097	0.0283	0.1202*	0.0156	0.1176	0.2002
	(0.049)	(0.051)	(0.063)	(0.050)	(0.293)	(0.291)
Age 50-54	0.0558	0.0708	0.1011	0.0601	0.2918	0.3565
	(0.052)	(0.053)	(0.067)	(0.052)	(0.292)	(0.288)
Age 55-59	0.0552	0.0687	0.0955	0.0586	0.3056	0.3604
	(0.052)	(0.052)	(0.064)	(0.052)	(0.288)	(0.284)
Age 60-64	0.0679	0.0819	0.0996	0.0714	0.3529	0.4085
	(0.058)	(0.059)	(0.069)	(0.058)	(0.304)	(0.300)
Age 65-69	0.0758	0.0878	0.0944	0.0778	0.3783	0.4226
	(0.054)	(0.055)	(0.066)	(0.054)	(0.290)	(0.285)
Age 70-79	0.0524	0.0685	0.1256**	0.0553	0.2888	0.3547
	(0.049)	(0.051)	(0.062)	(0.049)	(0.280)	(0.278)
Preventive visits						
Once in 2 years	0.0709	0.0850	0.1066	0.0738	0.3892	0.4343
	(0.061)	(0.064)	(0.071)	(0.062)	(0.316)	(0.315)
Once a year	0.0103	0.0304	0.1309***	0.0166	0.0857	0.1705
	(0.036)	(0.037)	(0.043)	(0.036)	(0.221)	(0.215)
Twice a year	0.0839**	0.1123***	0.1766***	0.0937**	0.4271**	0.5369**
	(0.037)	(0.039)	(0.043)	(0.037)	(0.217)	(0.210)
3+ a year	0.5942***	0.6207***	0.1387**	0.6060***	1.8687***	1.9099***
	(0.062)	(0.063)	(0.066)	(0.062)	(0.260)	(0.249)
Fear of dentist						
Very much	-0.0886	-0.0789	0.0760	-0.0869	-0.3322	-0.2733
	(0.070)	(0.070)	(0.074)	(0.070)	(0.290)	(0.283)
Rather more	-0.0985	-0.0868	0.0875	-0.0961	-0.4131	-0.3450
	(0.065)	(0.067)	(0.073)	(0.066)	(0.266)	(0.262)
Rather little	-0.0911	-0.0850	0.0570	-0.0910	-0.3710	-0.3264
	(0.065)	(0.066)	(0.070)	(0.065)	(0.254)	(0.250)
Very little	-0.0247	-0.0040	0.1629**	-0.0212	-0.1089	-0.0084
	(0.068)	(0.069)	(0.073)	(0.068)	(0.262)	(0.258)
None	-0.0967	-0.0927	0.0451	-0.0975	-0.3977	-0.3586
	(0.064)	(0.065)	(0.069)	(0.064)	(0.251)	(0.245)
Constant	0.0783	0.0707	-0.0564	0.0766	-1.5292***	-1.5022***
	(0.075)	(0.075)	(0.078)	(0.075)	(0.376)	(0.367)
Observations	1474	1474	1474	1474	1474	1474
Adj. R^2	0.134	0.107	0.100	0.134		

Notes: The dependent variable in column 3 equals 1 for individuals having a SuppDI; otherwise, the dependent variable equals 1 for individuals who had two or more dentist visits in the previous year. Instrument: more than two additional SuppHI = 1. Omitted reference categories: age = age< 20; preventive dentist visits = seldom/only in pain; fear of dentist = panic. Robust standard errors in parentheses. *p<.10, **p<.05, ***p<.01.

Additionally, using an endogeneity test for robust standard errors, we are also able to reject the hypothesis that the SuppDI coefficient does not differ from OLS at a 5% significance level (Wooldridge, 1995). This rejection supports our assumption that the identified sample of advantageous selectors differs significantly from the aggregate with respect to risk. It is also worth noting that the 2SLS model (column 2) explains less variation in the dependent variable because we are now targeting only a specific subgroup. The results of the additionally estimated IV probit model (column 6) support the findings from the LPM (column 2).

5.2 Robustness Checks

We test the robustness of our results using additional survey data not observable by the insurance company. Table 3 reports the share of individuals without any dental problems and the self-rated health for four separate subgroups, with the differences in means reported within the first and last two columns. The first row shows that the share of individuals without SuppDI coverage (12.6%) who are not suffering from any dental problems is significantly higher than the respective share of SuppDI policyholders (8.9%), indicating that in the aggregate, SuppDI policyholders are higher risk than individuals without SuppDI coverage. It should also be noted that this result cannot be interpreted as information asymmetry because we do not control for insurance company risk classification. It does, however, imply that the negative correlation is unlikely to be caused by these companies' successful engagement in active risk selection.[18] This minor importance of active risk selection on the part of German private health insurers is also supported by the fact that the commissions of insurance agents with respect to SuppDI is based on volume rather than profit. Thus, these agents are not incentivized to select and reveal information about individual risk types to their companies (Cummins & Doherty, 2006).

[18] Active risk selection means that insurers take measures to attract low-risk individuals and prevent high-risk individuals from enrolling (Nuscheler & Knaus, 2005).

Table 3: Differences by Insurance and Subgroup

Variable	(1) No SuppDI	(2) SuppDI	(3) ≤2 other SuppHIs	(4) >2 other SuppHIs
No dental issues	12.6%	8.9%**	7.2%	18.0%***
Self-rated health	3.14	3.13	3,10	3,30*
Observations	1,067	429	365	64

Notes: Measurements: no dental issues (1 = yes); self-related health from bad (1) to excellent (5). The level of significance for the statistical differences in means is designated as follows: *p<.10; **p<.05; ***p<.01.

Even more relevant, column 4 shows that 18.0% of SuppDI policyholders with more than two other SuppHIs have no dental issues versus only 7.2% of SuppDI policyholders with fewer additional SuppHIs. This significantly lower result is consistent with our earlier estimations showing that multidimensional private information leads to preference-based selection by some individuals. It should also be noted, however, that the group with more than two other types of insurance does not consist only of compliers. Hence, these differences must be interpreted with caution. Nevertheless, individuals with high insurance affinity do seem to have better dental health, an observation supported by the fact that their mean of self-rated overall health is slightly higher than that of the comparison group (for additional intergroup differences, see Appendix Table A1).

In general, the differences between these two groups show that SuppDI policyholders with a high insurance affinity have a higher income and are better educated than SuppDI policyholders with lower insurance affinity. Moreover, as shown in Table A1, including variables on smoking behavior, physical activity,[19] and diet as further proxies for risk preferences suggests that SuppDI policyholders with a high insurance affinity are more risk-averse than SuppDI policyholders with a lower insurance affinity. On the other hand, those with higher insurance affinity also seem to consume more fast food, which is usually a health risk but possibly explainable by their younger age. Admittedly, however, the differences

[19] Physical activities include sports, hiking, and gardening.

between both groups with respect to the potential sources of advantageous selection are mostly not statistically significant, which is at least partly attributable to the small sample size.

Table 4 reports the regression results for three models containing an increasing set of additional covariates. In column 2, the coefficient of the instrumented SuppDI (-0.1345) becomes slightly more negative than in Table 2 (-0.1056) once socioeconomic controls are added into the basic model. Whereas the results for most of the added covariates in column 2 are insignificant, overall self-assessed health shows a significant negative relation to the dependent variable, indicating that healthier individuals are generally lower risk with respect to dental treatments. This link might contribute to the increased negative coefficient of SuppDI when sick individuals purchase more insurance coverage and are a worse dental risk.

When health is not controlled for, this link affects the second stage error term, violating the exclusion restriction and producing an upwardly biased estimate. Therefore, even though we cannot directly test for this bias, we split the sample by health status and re-estimate the model. The results, shown in Appendix Table A2, suggest that instrumenting SuppDI does not work when individual health is bad: the coefficient shows a positive but insignificant correlation between coverage and risk. Moreover, although the SuppDI coefficient is negative and highly significant in the upper health distribution (from good to excellent), the impact of self-assessed health appears small and the coefficient decouples in the lower health distribution (from bad to less good). These findings support the hypothesis that cases of very bad health in combination with full insurance coverage can upwardly bias our 2SLS results and hamper our identification strategy. Nevertheless, not only are such cases rare, but we obtain a significant negative effect even without controlling for overall self-assessed health.

Table 4: Aggregated and Instrumented Selection with Additional Controls

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS
SuppDI	0.0264	-0.1345**	0.0275	-0.1172**	0.0252	-0.1171**
	(0.022)	(0.058)	(0.022)	(0.059)	(0.022)	(0.057)
Demographic controls						
Male	0.0088	0.0039	0.0161	0.0114	0.0184	0.0137
	(0.021)	(0.021)	(0.023)	(0.023)	(0.023)	(0.023)
Part time work	0.0495	0.0419	0.0493	0.0414	0.0480	0.0403
	(0.035)	(0.036)	(0.036)	(0.036)	(0.035)	(0.036)
Hourly based work	0.0367	0.0391	0.0159	0.0178	0.0214	0.0239
	(0.046)	(0.046)	(0.044)	(0.044)	(0.044)	(0.044)
Unemployed	-0.0303	-0.0247	-0.0343	-0.0291	-0.0337	-0.0286
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Trainee position	-0.0013	-0.0038	0.0009	-0.0029	0.0066	0.0026
	(0.051)	(0.051)	(0.054)	(0.053)	(0.055)	(0.054)
A-level	0.0068	0.0003	0.0058	0.0015	0.0037	-0.0003
	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
Married	0.0176	0.0317	0.0163	0.0285	0.0169	0.0283
	(0.028)	(0.029)	(0.028)	(0.029)	(0.028)	(0.028)
Widowed	0.0668	0.0835	0.0615	0.0783	0.0735	0.0898
	(0.054)	(0.056)	(0.055)	(0.056)	(0.054)	(0.055)
Divorced	-0.0065	0.0100	-0.0098	0.0045	-0.0053	0.0085
	(0.038)	(0.038)	(0.040)	(0.040)	(0.040)	(0.040)
Income	0.0151	0.0262**	0.0140	0.0234**	0.0147	0.0239**
	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)
HH size	-0.0143	-0.0193*	-0.0126	-0.0164	-0.0121	-0.0156
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Self-rated health	-0.0341**	-0.0349**	-0.0379**	-0.0384***	-0.0301**	-0.0306**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Risk measures						
Care about health			-0.0073	-0.0095	-0.0079	-0.0099
			(0.014)	(0.014)	(0.014)	(0.014)
Never smoker			-0.0021	-0.0063	-0.0005	-0.0040
			(0.021)	(0.021)	(0.021)	(0.021)
BMI			-0.0040*	-0.0039*	-0.0043**	-0.0041*
			(0.002)	(0.002)	(0.002)	(0.002)
Physical activity			-0.0117*	-0.0112*	-0.0121*	-0.0116*
			(0.006)	(0.006)	(0.006)	(0.006)
Consumption						
Fruits			0.0040	0.0035	0.0055	0.0052
			(0.013)	(0.013)	(0.013)	(0.013)
Vegetables			0.0104	0.0132	0.0089	0.0113
			(0.016)	(0.016)	(0.016)	(0.016)
Fast food			-0.0111	-0.0099	-0.0142	-0.0123
			(0.017)	(0.017)	(0.016)	(0.017)
Sweets			0.0158	0.0161	0.0099	0.0095
			(0.013)	(0.013)	(0.013)	(0.013)
Dental issues						
Periodontitis					0.0784***	0.0706**
					(0.029)	(0.029)
Filling					0.0318	0.0381*
					(0.022)	(0.022)
Braces					-0.0196	-0.0260
					(0.056)	(0.057)
Grind teeth					0.0561	0.0625
					(0.040)	(0.040)
Missing teeth					0.0334	0.0373
					(0.036)	(0.036)
Toothache					0.1406	0.1707*
					(0.094)	(0.094)
Chewing/jaw					0.1357*	0.1356*
					(0.080)	(0.075)

Table 4 (continued)

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS
Caries					0.0467	0.0429
					(0.043)	(0.043)
Constant	0.2057**	0.1967**	0.3121**	0.3004**	0.2724**	0.2565*
	(0.097)	(0.097)	(0.137)	(0.137)	(0.139)	(0.138)
Fear dummies	Yes	Yes	Yes	Yes	Yes	Yes
Underwriting	Yes	Yes	Yes	Yes	Yes	Yes
Preventive visits	Yes	Yes	Yes	Yes	Yes	Yes
N	1448	1448	1382	1382	1382	1382
Adj. R^2	0.136	0.100	0.141	0.111	0.157	0.128

Notes: The dependent variable equals 1 for individuals who had two or more dentist visits in the previous year. Income is measured in €1,000 intervals from < € 1,000 up to > €5,000 monthly net household income. Self-rated health: bad=1 to excellent=5. Care about health: not at all = 1 to very strongly = 5. Activity: never = 1 to daily = 6. Diet: never/seldom = 1 to daily = 4. Omitted reference categories: full time employment, marital status = single. Robust standard errors in parentheses. *p<.10, **p<.05, ***p<.01.

In columns 3 and 4 of Table 4, we include additional proxies for possible risk tolerance, including BMI, physical activity, and diet. The observed decrease in magnitude of the SuppDI coefficient suggests that we are capturing some of the linkage between insurance affinity and risk. Adding further information about current dental health into columns 5 and 6 slightly reduces the coefficient size; however, in column 5, the coefficient remains positive and insignificant, while in column 6 (the 2SLS results), the correlation remains significantly negative.

6. Conclusions

In this paper, we analyze information asymmetry in the German SuppDI market using a representative sample from the Healthcare Monitor patient survey. Our results provide no evidence that individuals with SuppDI visit the dentist for acute treatments more frequently than individuals without SuppDI, meaning that like many other recent studies on SuppHI in other countries, we find no support in the aggregate for the positive coverage-risk correlation predicted by classic adverse selection models. Although this lack of evidence could be attributed to information asymmetry not being empirically important in this market, we suggest it could be better explained by multiple forms of private information offsetting each other. We

therefore apply an IV method to disentangle any overlap between adverse and advantageous selection. Using possession of a SuppHI in addition to a SuppDI as our instrument, we show that SuppDI policyholders with a high insurance affinity go to the dentist for acute treatments significantly less frequently than those without SuppDI coverage, which supports the multiple information offset assumption. These results remain robust even after we control for a comprehensive set of covariates, which suggests that demographic characteristics alone, even when used for a more thorough underwriting, are insufficient to account for such selection behavior.

Nevertheless, even though these results are consistent with our findings that SuppDI policyholders with a high insurance affinity have better dental health than other SuppDI policyholders, we are unable to fully identify the causal mechanics by controlling for further covariates. That is, because the survey items gather only dichotomous information on dental health (e.g. “Do you have a least one dental filling?”), we cannot control for the intensive margin of dental health (i.e., whether an individual has 1 or 10 dental fillings), which might explain the remaining information asymmetry in our model and provide a possible cause for the remaining lower dental risk of the instrumented SuppDI policyholders.

Our findings do, however, provide solid evidence of information asymmetry in the German SuppDI market, an imbalance disguised by heterogeneous selection behavior. We thus argue that more than one type of individual is buying insurance coverage: on the one hand, individuals with private information about their own high risk lead to adverse selection; on the other, low risk individuals who purchase because of higher risk aversion lead to advantageous selection. Although these different selection effects can offset each other in the aggregate, they lead to a market equilibrium that is unlikely to be efficient compared to the first-best solution of symmetric information (de Meza & Webb, 2001; Finkelstein & McGarry, 2006). Further

research is thus needed that extends our insights about heterogeneous selection and tests our findings using longitudinal data with better risk measures. Such investigation might reveal the causal channels for the negative coverage-risk correlation and yield robust results for practical application.

In the meantime, the selection effects identified here might be gainfully used by the German SuppDI market for a more thorough underwriting, which could decrease inefficiencies from information asymmetry. In particular, given the lack of perfect competition between insurance companies, private health insurers in the German SuppDI market might profit not only from more thorough premium differentiation but from selecting individuals with a high insurance affinity.[20]

[20] Under the opposite assumption of perfect competition in the insurance market (cf. the model proposed by Rothschild & Stiglitz, 1976), health insurers can earn no positive profits.

Appendix

Table A 1: SuppDI Policyholders: Low versus High Insurance Affinity

	Low insurance affinity	High insurance affinity
Characteristics	(1)	(2)
Male	0,435	0,393
Age	51,418	44,098***
Married	0,648	0,574
Income	2,960	3,180
A-level	0,438	0,492
Employment		
Full time	0,392	0,492
Part time	0,121	0,082
Hourly	0,066	0,033
Unemployed	0,378	0,344
Job training	0,043	0,049
Household size	2,346	2,311
Self-rated health	3,101	3,295*
Never smoker	0,524	0,574
BMI	26,427	27,202
Activity	3,983	4,328
Diet		
Fruits	3,271	3,246
Vegetables	3,135	3,148
Fast food	1,801	1,951*
Sweets	2,415	2,443
Dentist visits per year	2,081	1,869
Number of other SuppHIs	0.726	3.754***
Usual preventive dentist visits per year		
Seldom/only in pain	0,023	0,016
Once in 2 years	0,023	0,000
Once	0,363	0,295
Twice	0,539	0,623
Three times or more	0,052	0,066
Dental issues		
Periodontitis	0,167	0,115
Filling	0,720	0,770
Prosthesis	0,441	0,443
Implant	0,124	0,148
Braces	0,017	0,016
Grind teeth	0,075	0,082
Missing teeth	0,098	0,098
Toothache	0,023	0,033
Chewing/jaw	0,026	0,016
Caries	0,061	0,066
No issues	0,072	0,180***
Observations	365	64

Notes: Sample size can slightly vary within each variable. Income is measured in €1,000 intervals from < €1,000 up to > €5,000 monthly net household income. Self-rated health: bad = 1 to excellent = 5. Activity: never = 1 to daily = 6. Diet: never/seldom = 1 to daily = 4. The level of significance for the statistical differences in a two-sided *t*-test between the two groups is designated as follows: *p<.10; **p<.05; ***p<.01.

Table A 2: Individual Health Status: Good versus Bad

	Good Health		Bad Health	
	(1)	(2)	(3)	(4)
	OLS	2SLS	OLS	2SLS
SuppDI	0.0263	-0.1567***	0.0009	0.2482
	(0.024)	(0.057)	(0.055)	(0.375)
Self-rated health	-0.0307*	-0.0325*	-0.3764***	-0.3545***
	(0.018)	(0.019)	(0.107)	(0.107)
Constant	0.2650**	0.2570**	0.5161*	0.3381
	(0.119)	(0.119)	(0.262)	(0.376)
Fear dummies	Yes	Yes	Yes	Yes
Underwriting	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
N	1,166	1,166	282	282
Adj. R^2	0.109	0.059	0.254	0.185

Notes: The dependent variable equals 1 for individuals who had two or more dentist visits in the previous year. Good health includes good, very good, and excellent health; bad health includes less good and bad health. The variable self-rated health contains the corresponding within-group variation. Robust standard errors in parentheses. *p<.10, **p<.05, ***p<.01.

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