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December 2018

Economics Group

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Working Paper 18/06  
December 2018

ISSN 2511-1159

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## Abstract

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At the beginning of their career civil servants in Germany can choose between the social health insurance (SHI) system and a private plan combined with a direct reimbursement of the government of up to 70 percent. Most civil servants chose the latter, not only but also because they have to cover all contribution payments in the social system themselves, while normal employees get nearly 50 percent from their employers. The city state of Hamburg decided to change the system by paying a share of the contributions if civil servants choose the social plan. We use a stochastic microsimulation model to analyse which socio-economic types of civil servants could benefit from the Hamburg plan and if this changes the mix of insured persons in the SHI system. Our results show that low income and high morbidity types as well as families have a substantially higher incentive to choose SHI. This reform might thereby increase the adverse selection of high risk cases towards SHI

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H55, I18, I13

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## Abstract

At the beginning of their career civil servants in Germany can choose between the social health insurance (SHI) system and a private plan combined with a direct reimbursement of the government of up to 70 percent. Most civil servants chose the latter, not only but also because they have to cover all contribution payments in the social system themselves, while normal employees get nearly 50 percent from their employers. The city state of Hamburg decided to change the system by paying a share of the contributions if civil servants choose the social plan. We use a stochastic microsimulation model to analyse which socio-economic types of civil servants could benefit from the Hamburg plan and if this changes the mix of insured persons in the SHI system. Our results show that low income and high morbidity types as well as families have a substantially higher incentive to choose SHI. This reform might thereby increase the adverse selection of high risk cases towards SHI.<sup>2</sup>

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<sup>2</sup> We thank Fabian Franke for comments and suggestions. The authors are responsible for all remaining errors.

# 1. Introduction

One of the most unique characteristics of the German health insurance system is, on principal, the access for the whole population to social health insurance (SHI) and an opt-out option for (substitutive) private health insurance (PHI) by the same time. Furthermore, the opt-out option is restricted to income thresholds and occupational status. The differentiation of the system in SHI, which is financed via (labour) income-related contributions, and PHI, which is financed via morbidity-related premiums, is essentially a historical relict. As SHI was originally designed with sickness allowances being one major type of benefit, it followed a logic to use income-related contributions, as insurance payments were based on wage losses to a high degree. Today, sickness benefits play only a minor role in total expenditure of SHI (6 percent). The majority of services are provided in accordance with the benefits in kind principle.

With respect to PHI the German civil servants (and their family members) play an essential and special role as they represent about half of the entire population of privately insured or 4.3 million people.<sup>3</sup> Furthermore the government pays up to 70 percent of the incurred health care costs directly if individuals decide for PHI. Thus, PHI must only cover the remaining costs, which results in comparatively low premiums. In contrast to this governmental subsidization, civil servants generally have to pay the full income-related contribution if they decide for SHI.

In January 2018, the city state of Hamburg initiated a reform granting for the first time a financial participation in SHI by paying half of the contribution payment (as private employers do in general). To date, almost all civil servants are privately insured.<sup>4</sup> However, this reform is expected to change the relative price between both systems and alter the mix and magnitude of insured between both schemes [1]. Even though currently limited to Hamburg, the media reports that there are already signs of imitation effects for other federal states. If this development proceeds, the reform could involve a significant change in the overall German health insurance market and unfold unintended consequences in the form of incentives for adverse selection. Our approach is to develop a stochastic microsimulation model to analyse these effects for the decision-making of civil servants on a household level.

Besides strands to the general literature about adverse selection in health insurance that is theoretically based on the work by Rothschild and Stiglitz [2] and discussed by Cutler and Zeckhauser [3], this paper is first, closely related to the branch of literature dealing with risk selection in the German health insurance system. In this scope, there has been a debate on the presence of demand and supply side induced risk selection and their consequences within the PHI [4] and SHI market [5, 6, 7, 8]. More specifically, our paper is relating to risk selection

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<sup>3</sup> Not counting supplementary insurance products like travel health insurance etc.

<sup>4</sup> An estimated 8 percent are insured in SHI according to the German Bundestag (lower house of German parliament).

between SHI and PHI as differences in premium calculation and consequently relative prices make it somehow reasonable that an adverse selection might take place to the detriment of SHI. This finding is substantiated by recent literature as e.g. Bünnings and Tauchmann [9] provide evidence, that especially young and healthy individuals disproportionately often choose the opt-out option and obtain PHI. Following Panthöfer [10], this selection can be attributed largely to the individual comparison of morbidity-adjusted premiums (PHI) and income-related contributions (SHI) as well as the degree of risk aversion. The selection process is also driven by dynamic information revelation about the risk type of the insured influencing the point in time when selection effects take place [11]. Adding to this finding, Grunow and Nuscheler [12] show that the tendency to switch from private to public health insurance increases if individuals were exposed to a health shock. Our main contribution to this branch of literature is that the group of civil servants has not been considered specifically yet, even though it faces a significantly unique set of choices.

Secondly, our paper contributes to the idea that preferences unrelated to health risks, so called “heterogeneous preferences” are influencing the choice of health and long-term care insurance [13, 14, 15]. We are specifically referring to the findings of Polyakova [16], who highlights that preferences for non-health related attributes of PHI such as the more generous health basket, the treatment by presumably “5-star” physicians or a higher convenience due to shorter waiting times [17, 18, 19] could mute health-related risk selection. Pendzialek et al. [20] are using a discrete choice experiment to illustrate in a German setting that additional benefits besides prices have a significant influence as well. Likewise, they are pointing out that health status plays a role in the relative importance of prices and is more important to the healthier. To model these effects, we use three scenarios regarding the difference in benefit levels between PHI and SHI to show the impact of heterogeneous preferences of this kind.

Furthermore, as pointed out by Polyakova [16], the long-term structure of PHI contracts incentivises early contracting as individual risk assessment is only done once at the time of enrolment. Our paper shows that the profitability of the overall outcome and therefore selection effects are heavily influenced by elements like family foundation that have to be extrapolated as they are typically unknown at the time of enrolment. This argument is in line with the findings of Grunow and Nuscheler [12], who propose that high morbidity risks are rather sorted out after being insured than before enrolment.

The individual advantageousness of the health insurance scheme in the German setting does not only depend on financial effects relating to morbidity and individual income, but also on non-pecuniary preferences and the presence of family members. Our contribution is that we integrate all three elements into a stochastic microsimulation model to analyse the effect of the

Hamburg reform and its magnitude, thereby taking into account the long-term structure of contracts in PHI, which essentially turns this task into a once-in-a-lifetime decision.

In the second section, we illustrate our simulation model against the institutional background that is determining the decision of a civil servant to opt for SHI or PHI respectively. The underlying long-term forecast highlights the evolution of individual-level health and family trajectories instead of aggregated health outcomes following the idea by Michaud et al. [21]. Our model is static in the behavioral dimension as the decision for one insurance scheme is essentially for life and switching is seldom and limited. Zabinski et al. [22] are assessing adverse selection effects if medical savings accounts are offered alongside comprehensive plans in a similar framework. More recently, Eggink et al. [23] are following a comparable approach to forecast the use of elderly care in the Netherlands. In addition, Di Novi et al. [24] are using a static tax-benefit-model to analyze the distributional effects of tax breaks for out-of-pocket payments. The third section presents the results of our stochastic microsimulation model and further data analysis showing the contributing factors. The paper concludes in the fourth section with a discussion of the results in light of the institutional environment.

## 2. Methodology of the Microsimulation Model

Switching opportunities between the SHI and PHI scheme are heavily restricted by law and economic feasibility. Once the decision has been made in favour of a PHI coverage, a change to the social system is only possible under certain legal conditions. Conversely, a switch from social to private health insurance is formally possible at any time. However, the incentives decrease with increasing age as the latter goes hand in hand with higher premiums.<sup>5</sup> Therefore, the choice of the insurance scheme can essentially be seen as a once-in-a-lifetime decision a rational civil servant would make at the beginning of the employment relationship based on the expected outcome. Following that idea, we build a stochastic life-cycle microsimulation model starting at the age of 25 to mimic that decision criterion at the career launch.

The model takes into account individual characteristics of the civil servant and household structures, as payments and benefits in the respective scheme are determined by both. Partner and children are provided free of charge in SHI but have to pay premiums in the PHI system.<sup>6</sup> However, the state bears up to 80 percent of health care costs. Therefore, the premium paid

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<sup>5</sup> The reason for this is that PHI companies calculate (risk-based) premiums that are smoothed over the remaining life expectancy by building up capital funded aging provisions using surpluses at younger age to mitigate premium increases in older age. Getting insured at an older age comes along with less periods of saving and reduced compound interest effects of the capital funded aging provisions by the same time.

<sup>6</sup> The free of charge provision in SHI depends on certain conditions as the income of the partner and the age of children. See Busse et al. [25] for an detailed illustration of the SHI system in Germany.

in PHI only has to cover the remaining cost risk (**Table 1**). This subsidy, called “Beihilfe” in German, additionally includes a cost coverage of up to 70 percent for the civil servant in PHI. In SHI, before the reform, this group had to pay the full income-related contribution of 15.50 percent by themselves. Since the introduction of the Hamburg reform, the contribution rate has been halved to 7.75 percent.<sup>7</sup>

**Table 1:** Overview of payments and benefits for civil servants and their families in SHI and PHI

	Social health insurance (SHI)		Private health insurance (PHI)
<b>Payment</b>	Principle	Income-related contributions	
	Civil servant	Before reform: 15.50% of wage After reform: 7.75% of wage	Morbidity-related premiums for remaining health care costs Government pays for 50% of health care expenditures during active service and 70% in retirement
	Partner	Free of charge	Government pays for 70% of health care expenditures
	Children	Free of charge	Government pays for 80% of health care expenditures
<b>Benefit</b>	SHI benefit level		SHI benefit level + additional services (e.g. glasses) + higher payments for health care professionals

Source: Own illustration; the contribution rate is based on the year 2013 to reflect our data source, the German Income and Consumption Survey (EVS).

In the model we differentiate between influencing factors that exist ex-ante, and those that the individual can only observe ex-post. As illustrated in , we use three different morbidity groups to represent the ex-ante available information on the morbidity level of the civil servant. This is of relevance as it influences the morbidity-related premium in PHI. The “low morbidity” group characterizes the base case, while “medium morbidity” is defined as a 15 percent premium surcharge on that base group. Finally, the cluster with a “high morbidity” faces a 30 percent premium surcharge. This specific clustering of morbidity levels in three groups mimics the pattern that can typically be seen in real world data from German PHI.<sup>8</sup>

Consequently, ex-ante morbidity-related risk factors are reflected in higher benefit levels, e.g. the high morbidity group will have on average 30 percent higher benefits than the base group.<sup>9</sup> Additionally, the average benefits an individual receives over his life time are furthermore determined by a morbidity-related ex-post risk factor. This factor is randomly derived for each individual from the typical distribution of medical expenses which can be observed for SHI in Germany [28] but also for instance in the US [29]. It illustrates that, as a rule, a relatively small

<sup>7</sup> The contribution rate in 2019 differs in the range of 14.60 and 16.30 percent between the about one hundred different SHI funds. Furthermore, there is a maximum income of 54,450 Euro p.a. that is subject to contributions.

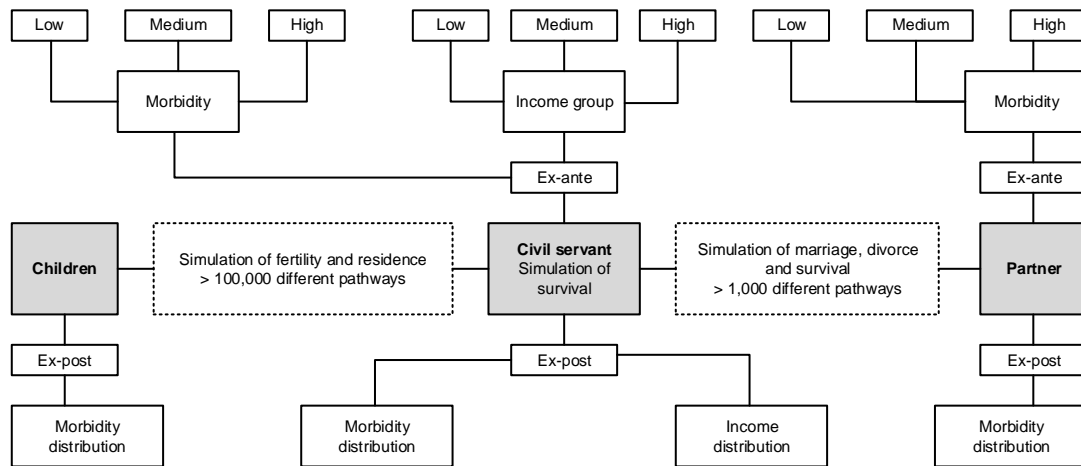
<sup>8</sup> As a result of a voluntary commitment by private health insurers, morbidity-related premium supplements for civil servants are limited to 30 percent.

<sup>9</sup> Those average benefit profiles for PHI are taken from insurance claims data of German PHI [26]. Their respective counterpart for SHI is derived from the German Federal Insurance Office [27], comprising expenditure data for the population that is currently socially insured. We adjust these profiles to account for the supposedly better morbidity of civil servants.



proportion of the insured has severe and chronic diseases and therefore causes very high levels of costs, while the vast majority are more likely to receive lower benefits. We use this distribution as a proxy to determine the relative morbidity of an insured.

**Figure 1:** Integrated risk factors in the life-cycle simulation of a household in the microsimulation model



Source: Own illustration, see **Table 3** of the appendix for a summary of data sources and modelling assumptions

In contrast to morbidity-related premiums in PHI, SHI is characterized by (labour) income-related contribution payments. Therefore, we split the population of civil servants at the beginning of their career into three income groups (low, medium and high) of equal size, using the German Income and Consumption Survey (EVS) with the base year of 2013. In the course of a working life, this income that is subject to contribution may vary due to different career paths, such as workload or promotions. Therefore, we additionally integrate a factor derived from the EVS to reflect the ex-ante variation of income. At this point the highlighted reform of the state of Hamburg described in the introduction affects the contribution burden for civil servants. In the previous regulation, they had to pay the full contribution entirely themselves. After the reform, the employer now participates and pays half of it.

Given this information, an overview of payments and benefits for the single civil servant can be derived. For other household (or family) members we integrate existing ex-ante and ex-post risks in the same way including some exceptions. We limit our analysis to partner with no significant individual income, as a cost sharing of the state in PHI under the "Beihilfe" scheme is only possible in this case. Since there are no contributions for partners without income in SHI, no income risk needs to be modelled either. Furthermore, children can also be insured free of charge in SHI until they take up a relevant job or reach the maximum age of 26. In addition, no morbidity-related ex-ante risk has to be determined in this case, since there is no premium differentiation in PHI for children.

In a next step we simulate households with given ex-ante and ex-post risks over the life cycle of the respective civil servant. To do so, we use specific survival probabilities for German civil

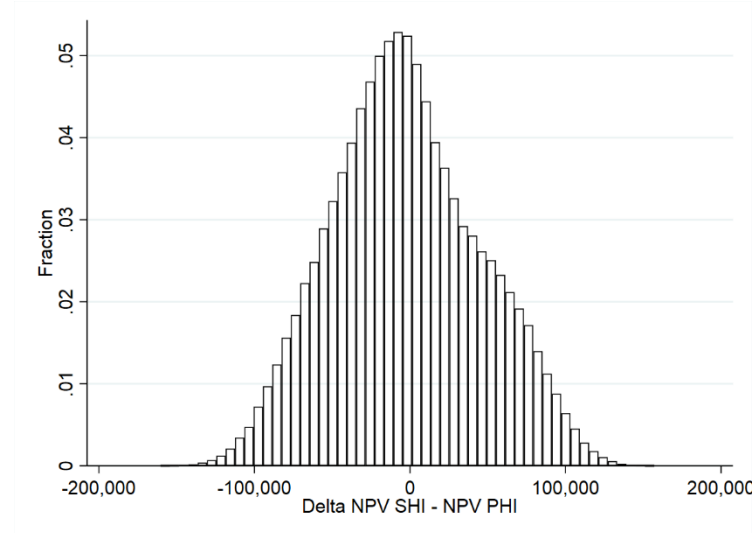
servants [30]. Additionally, we determine if and when a partner is present in the household based on marriage, divorce and surviving probabilities derived from official statistics. In another step, we use German age-specific fertility rates to determine the likelihood of having children and age-specific labour participation rates to identify when children will take up employment. In conjunction with the age limit this tells us when children are leaving the household.

Finally, we distinguish for our microsimulation model three scenarios regarding the difference in benefit levels between PHI and SHI. We therefore split this effect and use a variant as the base scenario, where the benefit level in both schemes is at the level of SHI. A second scenario, labelled “higher generosity”, takes into account the more generous health basket of PHI, such as reimbursement for glasses or dental care which are not included in SHI's basket. And a third scenario, referred to as “pricing effect”, which covers that in the private system health care practitioners are paid higher fees for the same services. By doing so, we contribute to the literature regarding the influence of “heterogeneous preferences” on the choice of health insurance. Combining those three simulation scenarios finally enables us to determine the present value of benefits and payments of all household members over the civil servant's life cycle in SHI and PHI.

### 3. Results and Analysis

For our decision criterion, we form the difference of the net present values (i.e. the difference between the present value of benefits and payments) a household would receive over the expected remaining time period from SHI and PHI (NPV SHI minus NPV PHI).<sup>10</sup> **Figure 2** shows the distribution of this difference as a result of the simulation in the baseline scenario assuming an equal distribution of all individual and household factors. In this scenario, benefit levels in both schemes are the same, leading to values that are approximately ranging between plus and minus 160,000 Euro. Without any further differentiation, it can be seen that slightly less than half of households have positive values. This indicates that the NPV in SHI is larger than in PHI, thus illustrating that those households are economically better off in SHI.

**Figure 2:** Histogram plot of the difference between NPV SHI and the NPV PHI in the baseline scenario



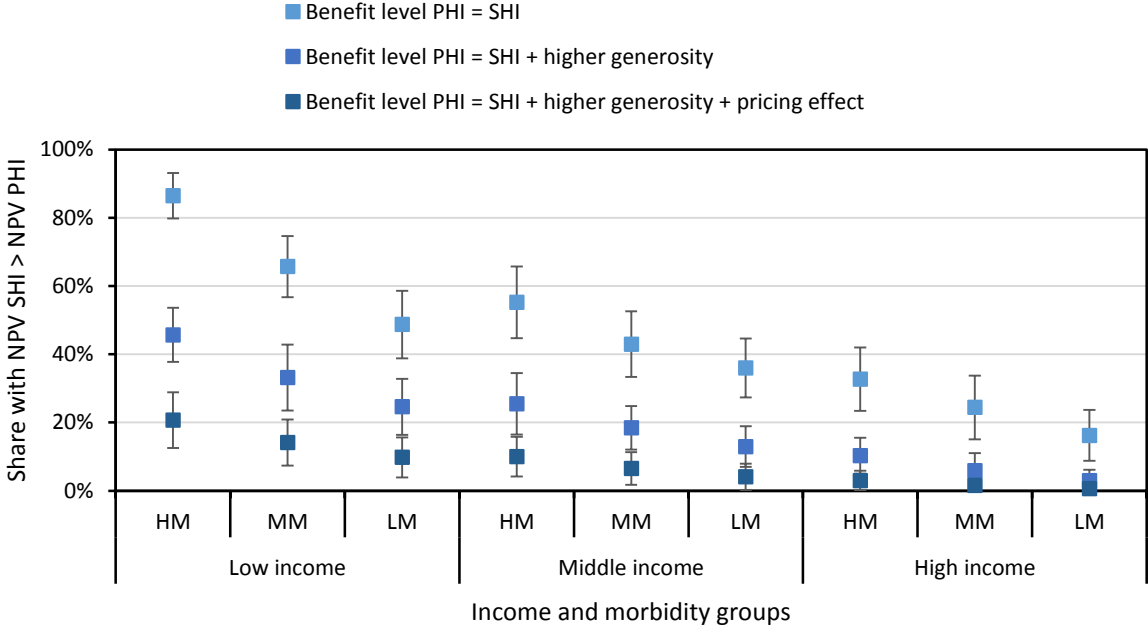
Source: own calculation; results based on 200,000 simulations assuming an equal distribution of all risk factors and a starting age of 25. See **Table 3** of the appendix for a summary of data sources and modelling assumptions.

#### 3.1. The influence of civil servant's individual risk factors and their family situation

We then break down our results into what we perceive as the two key factors determining risk selection: first, the individual morbidity and income level of civil servants and second, their family situation. **Figure 3** shows the share of households where the NPV in SHI is larger than in PHI for all three scenarios of benefit levels. The results are illustrated by income level and morbidity, highlighting in the effects that result from individual characteristics of the civil servant while family related factors are equally distributed.

<sup>10</sup> The remaining life expectancy at the age of 25 is 63/66 years for men/women.

**Figure 3:** Share of households that is economically better off in SHI by income and morbidity of civil servant and benefit level scenario



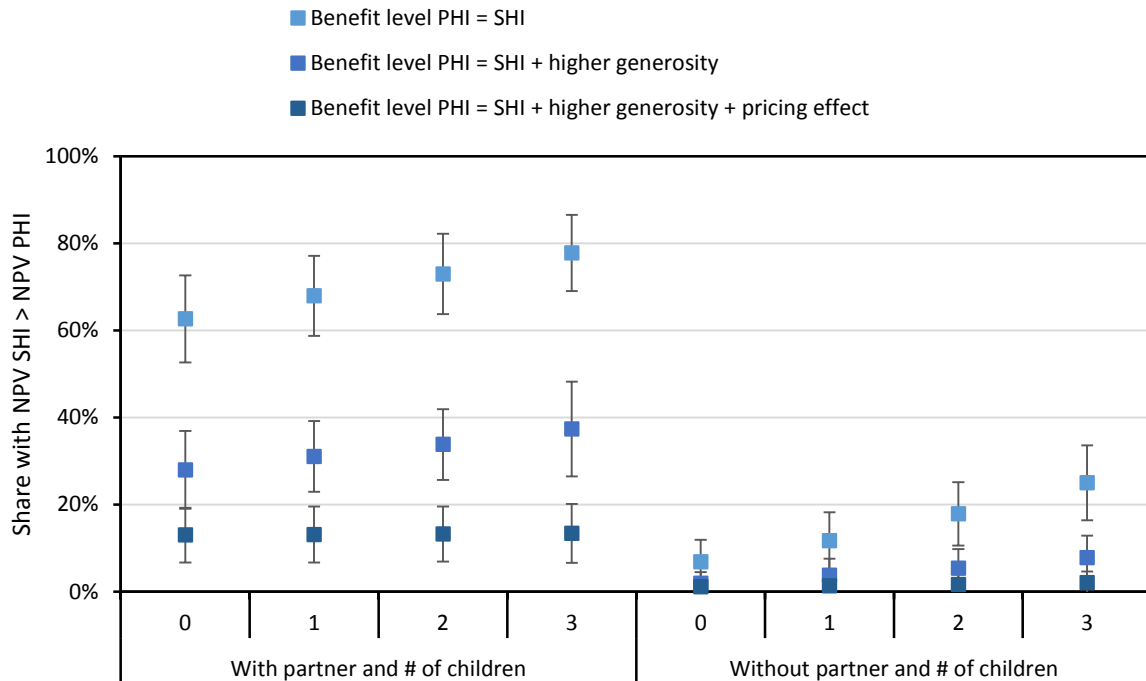
Source: own calculation; results based on 100 bootstrap simulations with sample size 100. HM = high morbidity, MM = medium morbidity, LM = low morbidity. Illustrated are the mean and the 95% confidence interval. See **Table 3** of the appendix for a summary of data sources and modelling assumptions.

Looking at the high morbidity and low income group in the baseline scenario, where benefit levels are the same in both regimes, 87 percent of households are economically better off in SHI than PHI. This value is about three times higher than the 33 percent in households with high morbidity and high income civil servants, illustrating the selection incentive that is developed between income groups. Furthermore, given a medium income, household shares range from 55 percent (high morbidity) and 36 percent (low morbidity) in favour of SHI, expressing the highly selective morbidity based selection incentive. Comparing between scenarios, the baseline value of 55 percent in the aforementioned group is turning into 25 percent taking into account the higher generosity in PHI and a 10 percent share in the scenario additionally including the pricing effect. Regarding the uncertainty of the outcome, the high morbidity and low income group highlights that confidence intervals are comparable in absolute terms, but larger in relative terms with regard to the respective mean if a higher generosity and the pricing effect is included. This is relating to the stochastic nature of the simulation model, as benefit differences are adding variance to the individual outcome.

Focusing in a second step on the effects of family related factors, thereby holding individual income level and morbidity equally distributed, we find that in the baseline scenario about 70 percent of households, where a partner is present during the life cycle, have a larger NPV in SHI (**Figure 4**). In contrast, this proportion in households without a partner is only 16 percent. In the latter group, an additional child leads to an increase in SHI's share of about 6 to 7 percentage points. In households with a partner, however, this effect is smaller, which is due

to the fact that the economic effect of a partner is much larger than that of children. Thus, the presence of the partner dominates the effect by children, since in many cases it determines the decision per SHI per se.<sup>11</sup>

**Figure 4:** Share of households that are economically better off in SHI by family status and benefit level scenario



Source: own calculation, results based on 100 bootstrap simulations with sample size 100. Illustrated are the mean and the 95% confidence interval. See **Table 3** of the appendix for a summary of data sources and modelling assumptions.

### 3.2. Disentangling effects using a logistic model

The relationship between the effect size of an additional child and the presence of a partner reveals its interdependence. Therefore, we apply a logistic model in order to analyse the various influencing factors and disentangle their effects, both on an individual income and morbidity-related level, as well as on a family level. In doing so, we use the results of the simulation model and assign a “1” if a household's NPV in SHI exceeds the NPV in PHI or “0” conversely. As illustrated in **Table 2**, we use this information to find out, by means of a logistic regression, to what extent income level (in 1,000 Euro) and morbidity of the civil servant (low = 1, medium = 2 and high = 3), the presence of a partner, the morbidity of the partner and the number of the children (maximum of 3) as well as the gender of the civil servant (male = 1, female = 0) influence the odds of being economically better off in SHI looking from a household perspective.

<sup>11</sup> In many federal states the premium of the civil servant is reduced after the second child in the family, as the governmental subsidy is increased from 50 to 70 percent. We did not include this regulation in our model as recently some federal states began to remove this subsidy adjustment. Considering this regulation would increase the effect of the second and third child.

Considering family related factors, the significant influence of a partner becomes clear again. In our baseline scenario, the odds for a household to profit from SHI due to the presence of a spouse is increased by a factor of 32 compared to households without. This effect is exacerbated if the partner is facing morbidity-related risk surcharges in PHI. The reason for this is that spouses receive full benefits in SHI without having to pay contributions, while being charged a proportional basic premium in PHI and, depending on the case, a risk surcharge. Likewise, an additional child increases the chances to improve thru choosing SHI by about 58 percent in the baseline scenario. Furthermore, a morbidity-related risk surcharge for the civil servant increases the odds for the household by about 173 percent. Looking at income-related incentives, earning 1,000 Euro more will decrease the odds by more than 20 percent. Interestingly enough, gender, while having different age-specific benefit profiles, does not play a relevant role as soon as we control for other factors.

**Table 2:** Results of logistic regression by scenario of benefit level in PHI

VARIABLES	Odds ratios		
	(1) PHI benefit level = SHI	(2) PHI benefit level = SHI + higher generosity	(3) PHI benefit level = SHI + higher generosity + pricing effect
Gender	1.032** (0.013)	0.973** (0.013)	1.023 (0.019)
Income	0.777*** (0.001)	0.831*** (0.001)	0.836*** (0.002)
Morbidity of civil servant	2.733*** (0.024)	1.802*** (0.015)	1.677*** (0.019)
Partner	32.481*** (0.598)	10.291*** (0.194)	8.383*** (0.256)
Morbidity of partner	1.397*** (0.016)	1.262*** (0.012)	1.257*** (0.015)
Number of children	1.577*** (0.010)	1.256*** (0.008)	1.033*** (0.008)
Constant	108.901*** (5.116)	8.029*** (0.397)	2.986*** (0.228)
Observations	200,000	200,000	200,000
Pseudo R-squared	0.452	0.276	0.207

Robust standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05

Source: own calculations; results based on 200,000 simulations. Income is measured in 1,000 Euro, morbidity is measured as follows: low morbidity = 1, medium morbidity = 2, high morbidity = 3. Partner = 1 if a partner in life cycle, 0 otherwise. Number of children is limited to 3. Gender = 1 for male and 0 for female. See **Table 3** of the appendix for a summary of data sources and modelling assumptions.

Taking into account a higher benefit level in PHI by looking at the other two scenarios, hedging in the PHI system naturally becomes more attractive overall. Therefore, the chances (for example through the presence of a partner) of profiting from an insurance in SHI are reduced. In fact, in the scenario taking into account the higher generosity of services in PHI and the

pricing effect, the number of children hardly plays a role. The reason for this is that the higher benefit level in PHI compensates for the additional premium payments. This case is possible because, as explained in section 2, the state subsidies in PHI for children require to pay a premium for only 20 percent of the costs incurred.

## 4. Conclusion and Discussion

Our analysis shows that considering a rational choice of health insurance coverage, a clearly enhanced selection effect could arise for German civil servants in the future. While these so far almost always have chosen PHI, the Hamburg reform creates significant incentives for low income and high morbidity groups as well as families in particular to hedge in SHI. High income groups and childless people, on the other hand, would continue to do far better in PHI. Thus, the spread of insurance risks could now cover the hitherto homogeneous privately insured group of civil servants. From the perspective of SHI and its previously insured, this may even result in additional burdens as these new groups are likely to be net beneficiaries in the SHI system. Looking at households with a male civil servant, the results of the microsimulation model in the baseline scenario indicate that those, who would benefit from SHI coverage, have a much lower ratio of payments to benefits than the average of all households. In fact, from a life-cycle perspective, this group is depriving more resources of the system than supplying. Households with a female civil servant who are better off in SHI are also more likely to be net beneficiaries. However, the effect is smaller, which is mainly due to the fact that women use fewer health resources over their life cycle.

Our model illustrates a rational risk-neutral perspective of households with a young decision maker looking over the entire life span. If the insured are receptive to pecuniary incentives, significant differences of net present values should change switching behaviour. There is mixed evidence for the German market about the effect of prices (or monetary incentives) on the choice of health insurance. The literature focuses on the SHI population and related switching behaviour between sickness funds. Schmitz and Ziebarth [31] find high price elasticities while Tamm et al. [32] estimate such elasticities to be small in the short but significant in the long-run.

Our calculations based on the framework before the Hamburg reform show that barely any households would be better off in SHI, while the German parliament estimates that about 8 percent of all civil servants are currently insured in the social system. The explanation for this difference could be either rare cases (extreme pre-existing conditions of insured), historic legal changes or plain ideology as in the German debate the choice for PHI is often labelled as “leaving solidarity”. However, our model estimates are in the same dimension as figures presented in the media for the Hamburg reform. Assuming the real distribution of risk factors

(with regard to morbidity, income and partner), the model suggests that about 12.5 percent of the entire population is better off by hedging in SHI. This value is determined, in particular, by the fact that only a relatively small proportion of households has to pay morbidity-related risk surcharges in PHI. Given the higher generosity of PHI the share decreases to 4 percent and adding the price effect to 1.4 percent. Relating to this, German media is reporting preliminary numbers that less than 1 percent of new civil servants in Hamburg are choosing SHI instead of PHI.

Another peculiarity of health insurance in Germany which might contribute to this finding is the outsourcing of the risk of long-term care in a separate insurance branch. It basically applies that long term care and health risks, even though in separate branches, must be hedged within the same insurance company. Thus, a decision on health insurance in the SHI scheme is also accompanied by a long-term care insurance.<sup>12</sup> In contrast to health insurance, the benefits of long-term care insurance are identical in both systems. Differences exist however, again on the financing side. In this case as well, contributions in SHI are levied on an income basis in a pay-as-you-go system, in PHI on the other hand in a capital funded model. Thus, as in the SHI, the risk of a significant increase in contribution rates in the near future attributed to demographic change comes into play. Given the same benefits (and most likely lower payments for long-term care insurance in PHI) this certainly represents a neglected factor that may influence the decision for the health insurance system and should generally be in favour of PHI.

Even if our model suggests that the overall market effect of the Hamburg reform will be small, we show that it will lead to misallocation through adverse selection. The general aim of the reform was more freedom of choice for (younger) civil servants between PHI and SHI and therefore a strengthening of the SHI in the public eye. We provide evidence that through this increased freedom, especially certain groups with risk-factors like higher morbidity and non-working spouses will opt for SHI. This will add a burden for those insured so far in SHI. In the long-run, remaining PHI insured will be better off as their premiums will eventually go down and so will be public coffers of the state of Hamburg as subsidy payments (at least at the margin) will decrease. Thus, the law of unintended consequences remains intact.

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<sup>12</sup> Civil servants can also get health insurance in SHI and secure the long-term care risk in PHI. In this case, long-term care insurance should not be a relevant factor.



## 5. Appendix

**Table 3:** Data sources, assumptions and modelling

Description	Sources and modelling
<b>A) Cash flows in starting year and household composition</b>	
1) Benefits in PHI	Data on age and gender-related benefit profiles for civil servants [26].
2) Benefits in SHI	Current age and gender-related benefit profiles in SHI are calculated based on data from the German Federal Insurance Office [27]. These are adjusted to account for diverging patterns of benefit profiles of civil servants and their families that can be seen within PHI [33]. Additionally, a morbidity factor of 0.9 is applied to cover differences between insured in SHI and PHI.
3) PHI premiums	Premiums are calculated to cover the current level of benefits in PHI, see A)1), over the remaining life expectancy. Additionally, we assume an administration surcharge of 10 percent.
4) SHI contributions	Income levels are based on the income that is subject to contribution of civil servants aged between 25 and 35 using the Income and Consumption Survey (EVS) with the base year 2013.
5) Household composition	Rates of marriage, divorce, fertility and employment are taken from the German Federal Statistical Office. Eligibility rate of partners for the "Beihilfe" scheme is taken from EVS with the base year 2013.
<b>B) Parameters for discount and growth rates</b>	
1) Discount rate $r$	3 percent p.a., [34].
2) Productivity growth rate $g$	1.5 percent p.a., [34].
3) Medical-technical progress ( $\Delta$ MTP)	0.5 percent p.a. as a lower bound version of Breyer et al. [35].
<b>C) Future extrapolation</b>	
1) Survival probabilities	Survival probabilities of the German population [36] adapted to the analysis for civil servants [30].
2) Benefits in PHI	Annual growth by $g$ and $\Delta$ MTP
3) Premiums in PHI	The initial premium calculation does not include $\Delta$ MTP or rising expenditures due to wage growth driven by $g$ . Therefore, we calculate a growth rate that remains constant over lifetime to cover the resulting difference.
4) Benefits in SHI	Annual growth by $g$ and $\Delta$ MTP
5) Contributions in SHI	Annual growth by $g$ and predicted future contribution rates based on own calculations. Contribution rates will rise from 15.50 percent in 2013 to 24 percent in 2060.
<b>D) Distribution of ex-post risk factors</b>	
1) Morbidity distribution	Random factor derived from a left-skewed distribution [28].
2) Income distribution	Random factor derived from a normal distribution. Variance taken from EVS.

## 6. References

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