Do physicians care about patients' utility?

Evidence from an experimental study of treatment choices under demand-side cost sharing

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Abstract

Out-of-pocket spending by patients is a substantial share of aggregate health expenditures in many countries, and the level of demand-side cost sharing is a distinguishing feature of health insurance contracts. Medical decisions affect a patient's well-being in two different ways in the case of demand-side cost sharing, as health status and consumption opportunities are both affected. It is desirable for a patient to receive treatment recommendations from a physician who cares about patient well-being. Professional norms and pro-social preferences are therefore key elements that shape markets for medical care. If physicians are concerned about the overall well-being of their patients, they would, *ceteris paribus*, prefer treatment alternatives where reductions in patients' consumption are smaller. We ask whether the physician's treatment choices are affected by demand-side cost sharing. In order to identify and quantify preferences under demand-side cost sharing, we design and conduct an incentivized laboratory experiment where only medical students are recruited to participate. In our experiment we achieve saliency of all three attributes of treatment alternatives, *profit*, *health benefit* and *patient consumption*: The choices in the laboratory experiment determine the amount of medical treatment and the future consumption level of a real patient admitted to the nearest hospital. In our experiment we vary demand-side cost sharing while preferences and bargaining power of the patient is fixed. We estimate decision-makers' preference parameters in a variety of random utility models. We find strong evidence suggesting that the amount of demand-side cost sharing affects medical decisions.

Keywords: Physician preferences, Demand-side cost sharing, Incentivized laboratory experiment

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1. Introduction and background

Knowledge on the determinants of physician behavior is of fundamental importance for society and a core topic in health economics. In his seminal paper Arrow (1963) described the presence of asymmetric information in medical decision-making as a fundamental aspect of the market for medical care. Physicians are experts holding information superior to patients and insurers, and the physician's relationships with patient and insurer are often described as relationships characterized by imperfect agency, where medical decision-making are tasks delegated to the physician (McGuire, 2000, 2012). While medical treatment decisions are of great concern to patients and insurers, asymmetric information limit their influence on medical decision-making. Questions concerning optimal design of health insurance contracts and physician payment mechanisms in the presence of imperfect physician agency have motivated numerous theoretical and empirical contributions to the health economic literature. Arrow (1963) also noted that different behaviors are expected from physicians as opposed to typical businesspersons: It is commonly assumed that physicians care for the well-being of their patients. Following papers by Ellis and McGuire (1986) and Farley (1986), it has become conventional to include a concern for the patient in economic models of physician behavior. A reoccurring result in the literature is that knowledge on actors' response to economic incentives is necessary for designing health insurance contracts and payment mechanisms which target certain goals.

Demand-side cost sharing occurs when a patient is required to pay for a portion of treatment costs. Out-of-pocket payment by patients can take the form of co-payments according to a fixed fee schedule, or in the form of specific co-insurance rates. Demand-side cost sharing can be the result of national policy in single payer systems such as the scandinavian countries, where out-of pocket payment for various health services are set by the government. In markets where consumers may choose from several health insurance plans, the amount and specific features of demand-side cost sharing will typically vary substantially between plans, and plans with less cost sharing will necessarily imply higher premiums. Consumers purchasing health insurance in the US can choose between alternative health insurance plans with different levels of demand-side cost sharing, and consumers may acquire health insurance with relatively low premiums, in exchange for more cost sharing (Pauly, 2017). Many studies have examined the influence of demand-side cost sharing on health expenditures and health service utilization. One of the most influential empirical study is the Rand Health Insurance Experiment (HIE) (Newhouse, 1974). Their results indicate a significant effect of demand-side cost sharing on health care expenditure. A 95% coinsurance plan with ceiling for yearly out-of-pocket expenses reduced total expenditure by 31% compared to a plan with full coverage (Manning et al., 1987). They further calculated the price elasticity to be approximately -0.2.

The hypothesis that physicians changed their practice style in response to demand-side cost sharing is discussed in Rice and Morrison (1994). It was not possible to distinguish between patient responses and physician responses to the cost sharing in HIE. Recent studies on physician's concern for patient's out-of-pocket payment have analyzed physician prescribing behavior. Several survey studies report physicians' attitude towards patient out-of-pocket costs. Survey evidences show that the majority of physicians (for example, 88% in Reichert et al. (2000) and 93.5% in Khan et al. (2008)) agree that the patient out-of-pocket payment for medicine is an important consideration in their prescribing decisions. In addition, some physicians (71% in Reichert et al. (2000)) state that they are willing to trade off efficacy in order to make treatment more affordable to their patients. Observational studies however show mixed evidence. Hu et al. (2017) analyzed data on physician visits for elderly patients and found that the introduction of Medicare Part D, which offers a more generous coverage on prescription and generic drugs, increased the number of prescription drugs prescribed or continued per visit by 32% and number of generic drugs prescribe or continued by 46%. By studying records of all pharmaceuticals dispensed from two pharmacies in a Swedish municipality, Lundin (2000) found patients borne with larger out-of-pocket payment are more likely to have generic instead of trade-name drugs prescribed than those with more costs reimbursed. In a study of prescribing of generic versus brand-name pharmaceuticals, Hellerstein (1998) did not find a strong evidence suggesting that the patient's insurance status systematically influences the prescribing of generica.

There are several aspects that cannot be controlled for in many of the studies applying field data. One essential concern is how well informed physicians are about patients' out-of-pocket payment or prescription drug coverage of the insured patients. In the study by Hu et al. (2017), physicians are expected to be well-informed about patients' health insurance plan, since Medicare Part D was implemented nationally and was an important health program providing drug coverage for Medicare beneficiaries. However, it is not clear how much physicians knew about their patients' prescription drug coverage in Hellerstein (1998)'s study.

To seperately identify physician- and patient responses to demand-side cost sharing, Lu (2014) conducted a controlled field experiment. In her experiment, all the physician subjects are informed of patient's health insurance status and the patients are instructed to fully accept physician's decisions on prescription drugs. This design ensures physician knowledge of patient insurance coverage and isolates the physician's behavioral response to demand-side cost share. She finds that when physicians are provided with financial incentives in prescribing, they prescribe higher volumes and more expensive drugs to insured patients. Physicians without financial incentives to prescribe do not respond to patient insurance status, however, and the interpretation is that physicians do not care about the consumption opportunities of their patients. A limitation in their study is that they were not able to control for the health benefits of different prescribed drugs, which might very likely affect physicians' decisions.

This paper contributes to the literature on physician behavior in several respects. First, we acquire data by conducting a laboratory experiment where medical students are recruited to participate.

The choices in the experiment determine the amount of medical treatment and the future consumption level of a real patient admitted to the nearest hospital. Second, our experiment differs from most recent health economic laboratory experiments designed to identify changes in experimental tokens resulting from changes in experimental conditions. The present experiment is designed to enable estimation of preferences parameters. The set of choice scenarios implemented in the experiment is selected to satisfy formal criteria for efficient design and ensure identification of preference parameters. Treatment alternatives are completely described in terms of three attributes: physician profit, patient health benefit and patient consumption after co-payment. In order to ensure saliency, all three attributes are incentivized with money, and we refrain from introducing conditions or variables that are not incentivized. We find robust evidence suggesting that medical treatments are affected by cost sharing, when patient-preferences and patient bargaining power is kept constant. We find significant heterogeneity in preferences of medical students, and the results suggest profit and patient health benefits are complements in the utility function of the *median individual*.

The paper proceeds as follows: We discuss two influential models of physician behavior in Section 2. In Section 3, we describe the experimental design and protocol. We specify our empirical model in Section 4, and report the estimation results in Section 5. In Section 6, we discuss and conclude.

2. Models of physician behavior

Theoretical models of physician behavior are often specified the purpose of analyzing a particular question. They vary in the elements included in the utility functions due to different focuses of specific research questions. Scott (2000) give a review of model specification sin the literature on physician behavior. Models often include income and leisure as the arguments, and some incorporated an "ethical" argument that represents not only physicians' professionalism but also their altruistic concern for patients' well-being. Specifically for the latter specifications, patients' utility or health benefit is included to explicitly model the trade-off between physician's profit motive and patient-regarding patient motives. Other models have also included in the physician utility function arguments such as reputation, practice characteristics, intellectual satisfaction and autonomy.
The purpose of our study is to explore physicians' trade-off between own profit and patients' well-being.In the paper by Farley (1986), the physician is assumed to have both profit motives and patient-regarding preferences and, the patient's utility is an argument in the physician's utility function. The patient's utility is has two arguments: health benefit B, and consumption C. The physician's objective in Farley (1986) can be written:

$$W(\pi, U). \tag{1}$$

The patient's consumption opportunities are unaffected by medical decisions in the special case where the patient has full insurance, and there is no loss in generality from specifying the physician objective as in the study by Ellis and McGuire (1990):

$$W(\pi, B), \tag{2}$$

As discussed by Ellis and McGuire (1990), an objective given by (2), where patient consumption is not part of the physician objective, can be motivated from the fact that medical ethics focus on the patient's health outcomes from treatment rather than patient utility. Physicians' reputation and risk of malpractice claims also relate to the health outcomes of treatments, not the overall welfare of the patient. Their model has been used in many studies to derive results on optimal payment schemes, referral decisions and optimal cost sharing programs. The main research question addressed in this paper is whether physician preferences are best represented by (1) or (2). We derive the specific hypothesis to be tested when specifying our empirical model in Section 4.

3. Experimental design and procedure

3.1. General design

We conduct a fully incentivized laboratory experiment. We recruited 202 medical students to the experiment. In our experiment, each participant plays a role of a physician. They make a series of decisions independently and anonymously. Payment to participants depends on their choices in the experiment. We recruited medical students from different semesters to the experiment. A decision task is to choose treatment alternative A or B for a patient who has an endowment of 50 Chinese Yuan (7.55 USD).

Each subject chooses treatment alternative on 23 different occasions. The patient does not have full insurance, and the patient needs to "pay" out of pocket for the provided treatment. The patient is assumed to be passive and accept the treatment chosen by the subject, without interacting with the subject. The choice of treatment A or B simultaneously determines the subject's profit, the patient's health benefit and the patient's consumption after the co-payment.

There are no real patients participating in the experiment. The medical students take the role of a physician in the experiment. However, the choices made by subjects in the experiment have consequences for a real patient at the nearest hospital. The patient was chosen randomly from a short list provided by the hospital. The money corresponding to the health benefits provided by subjects in one of the 23 occasions in the experiment is transferred to the hospital account of the real patient and can only be used for medical treatment. Subjects' choices determine the co-payments and the amount of money available for patient consumption, and the latter is transferred in cash, directly to the same hospital patient.

3.2. Choice menus

The choice menus and the specific level of attributes for the alternatives are the result of a Bayesian-efficient design where the so-called D-efficiency is optimized. We used the Stata module *dcreate*

(Hole, 2017) to obtain an efficient design. The D-efficient design is a block design with four blocks, which in total comprise 80 choice menus. We enforced some overlap of the four blocks by picking one choice menu from each block and including them in all four blocks. This means that each block contains 19 choice menus that are unique for the block, and 4 choice menus that overlap with choices sets in the other blocks. All three attributes are coded as continuous variables. Subjects were randomly assigned to blocks. The choice menu given in Figure 1 shows an example presented to the participants.

Patient 1, Initial endowment: 50 Yuan

	Treatment A	**Treatment B**
Your profit	15	10
Health benefit for the patient	40	5
Money available to the patient (after co-payment)	5	10

Which treatment would you prefer? Please tick only one.

Treatment A ☐ Treatment B ☐

Figure 1: An example of physician's decision task

Choice menus have three attributes, and we present attribute levels in Table (1). The attributes are "Your profit", "Health benefit for the patient" and "Money available to the patient". "Your profit" indicates how much money the subject would earn from choosing a treatment. "Health benefit for the patient" indicates how much money that would be transferred to the patient's hospital account when choosing a treatment. "Money available to the patient" indicates how much cash that would be transferred directly to the patient when choosing a treatment. To ensure clarity and saliency of this attribute, and make sure subjects understand the difference between the attributes "Health benefit for the patient" and "Money available to the patient", careful descriptions and test questions were given before starting the experiment. Subjects were explained that the choice of treatment determines the "Money available to the patient", which refers to the remaining disposable amount of money to the patient after paying for the medical treatment. The co-payment for the treatment can then be calculated by subtracting "Money available to the patient" from the initial endowment of 50 Yuan.

Each attribute has eight levels, each ranging from 5 Yuan (0.76 USD) to 40 Yuan (6.04 USD) with a 5 Yuan (0.76 USD) interval.

Table 1: Attributes and levels

Attributes	**Levels**	**Coding mode**	**Expected sign**
Your profit	5,10,15,20,25,30,35,40	Continuous	+
Health benefit for the patient	5,10,15,20,25,30,35,40	Continuous	+
Money available to the patient (after co-payment)	5,10,15,20,25,30,35,40	Continuous	+

3.3. Experimental protocol

This experiment was conducted at the Lecture Hall of School of Medicine at Shandong University in China on 4th April 2017. The medical students were recruited one week before the experiment. The Lecture Hall could host all the participants at the same time. To insure no interaction between participants could take place, we recruited and trained 10 assistants to supervise in the experiment. Upon arrival, the participants were randomly allocated to an ID number and they were led to their seat according to a seat map. This was to guarantee no participant receives the same block of choice menus as his left and right neighbor, and to avoid friends sitting together. The description of experiment was then read out loud by the experimenter and enough time was given for the participants to clarify and ask any questions privately to the assistants. Three comprehensive questions were then asked to the participants to familiarize them with the decision tasks. After having made 23 decisions and completed a short questionnaire about the background, each participant received the payment in private. Each participant's pay consists of two parts: 25 Yuan (3.77 USD) show-up compensation and an amount equal to *Your profit* from a randomly drawn decision. Approximate assessments of expected experiment duration and expected payment to participants were made based on experience. The expected payment to participants was set to match the pay of a typical student job.

The transfer to the real hospital patient consists of two parts: the money corresponding to the total sum of "Health benefit for the patient" and the money corresponding to the total sum of "Money available to the patient". The amounts were calculated for the randomly drawn choice occasion. The total "Health benefit for the patient" was transferred to the hospital account of the patient. This transfer could only be used for medical treatment. The total "Money available to the patient" was given as cash to the same hospital patient. To validate these two transfers, a monitor was randomly selected from the participants of the experiment. Similar protocols have been applied in recent literature (Hennig-Schmidt et al., 2011). The monitor supervised the procedure and executed the transaction together with the experimenter. An additional 30 Yuan (4.53 USD) was paid to the monitor at the end.

The duration of the experiment was 1.5 hours. Subjects earned 49.5 Yuan (7.47 USD) on average. In total, 6080 Yuan (917.69 USD) were transferred to the hospital account and 4635 Yuan (699.59 USD) were given as cash to the patient. Ethical review and approval of the experimental procedure was given by Norwegian Social Science Data Services (reference #53301).

3.4. Subject characteristics

We did not collect any identifying information from subjects, and we base the description of our study sample in Table 2 on the post experiment questionnaire. Of the 202 subjects, 72 were males, 129 were females, and one subject did not provide gender information. Their age range from 18 to 23 with the majority (67.83%) being between 20 to 22 years old. The recruited students were from study year one to four[4]. The third and fourth year students account for 69.80% of the pool and they have had up to six months experience assisting doctors at the hospitals. The rest were first-two-year students (30.20%) who had voluntary training at the hospital in the summer time. Students above year 4 were not available on campus due to medical training in hospitals.

Table 2: Subject characteristics

	Frequency	Percent
Gender		
Male	72	35.64
Female	129	63.86
Unknown	1	0.50
Age		
18	21	10.40
19	31	15.35
20	41	20.30
21	55	27.23
22	41	20.30
23	11	5.45
Unknown	2	0.99
Year of study		
1	46	22.77
2	15	7.43
3	103	50.99
4	38	18.81
$N = 202$		

[4]The students invited were undertaking either the 5-year undergraduate medical degree or the 7-year program in clinical medicine leading directly to a master's degree. A modern three-level medical degree system: Bachelor of Medicine (BM), Master of Medicine (MM), and Doctor of Medicine (DM) was introduced in China in 1981 (Wu et al., 2014). The BM curriculum is the same as the first five years of MM in Shandong University.

4. Empirical specification

We model a physician's choice of health care treatment, in a situation where the patient does not have full insurance. The choice of medical treatment therefore determines the patients health benefit B and the patients out-of-pocket payment P in addition to physicians' net profit π. We specify an objective function for physicians, where physicians are assumed to care for the "overall well-being of the patient" (Farley, 1986). We represent this concern by parameterizing physicians' valuation of patient health benefit B and patient consumption C. Patient consumption level is determined by subtracting out-of-pocket payment from the patient's endowment y^o: $C = y^o - P$. Assume physician i chooses a treatment within a finite set of treatments, $j = 1, 2, 3, ...J$. Physician i's utility from providing treatment j at choice occasion t can be expressed as:

$$U_{ijt} = \beta_i^{'} x_{ijt} + \varepsilon_{ijt}, \tag{3}$$

where $\beta_i^{'}$ is a (1×9) vector of preference parameters to be estimated, x_{ijt} is a (9×1) vector of variables, and ε_{ijt} is a noise term. The noise term is assumed type I extreme value distributed. Hence, the specification in (3) is a logit model (McFadden, 1974; Train, 2009).

While the functional form of utility functions has been a discussed in other economic applications (Koppelman, 1981; Van Soest, 1995; Keane and Moffitt, 1998; Kim et al., 2016), less attention has been paid to the specifications of utility in the discrete choice literature within health domain. In health economic applications, the most commonly assumed utility specification is linear additive in all choice attributes[5]. This type of specification captures only the main effect of each attribute on individual's decision which imposes the restriction that the effect of one attribute does not depend on the level of any attribute. In our study, linear utility specification implies that the marginal utility of physician's profit is constant and does not vary with the level of any one of the three attributes. Despite the challenge that it requires a larger sample to estimate a more specific utility function, several studies in health have included attribute-by-attribute interactions (Lancsar et al., 2007) and second order terms (Van Der Pol et al., 2010; Kolstad, 2011) in the utility specifications and found significant effects. However, most studies do not discuss the nonlinearities in more details. Two recent studies (van der Pol et al., 2014; Holte et al., 2016) investigate the results from different utility specifications and call for more attention to questions concerning functional form.

While any random utility model can be approximated by a linear (in parameter) mixed logit specification (McFadden and Train, 2000; Train, 2009) it remains a challenge to choose the ideal mixing and functional form. In the following we estimate both linear and non-linear functional forms with and without preference heterogeneity. Finally, the preferred model is selected based on the Log-Likelihood value, the Akaike information criterion (AIC) and the Bayesian information criterion

[5] In the context of this study, linear or non-linear utility function means linear or non-linear in explanatory variables, not parameters. Recently, Andersen et al. (2012) studied several benefits of parametric non-linear functions.

(BIC). The linear utility is a commonly applied specification. The linear specification is achieved by constraining six of the parameters in the β_i' vector to be zero. Hence, the linear specification is a restrictive specification, and we use this specification as a baseline for comparison with the other specifications. The non-linear utility specification is a quadratic utility with second degree polynomial in all three variables. By Taylors theorem, further expanding the polynomial in the specifications would provide better approximations. Such improvements in approximation of functional forms are costly, however, as more and richer data is required to quantify additional parameters. In addition, larger samples and additional parameters also raise computation costs. Hence, the choice of a quadratic form is a convenience choice.

The available alternatives are described completely by the attribute vector x_{ijt}:

$$x_{ijt} = \begin{pmatrix} \pi \\ B \\ C \\ \pi \times B \\ \pi \times C \\ B \times C \\ \pi^2 \\ B^2 \\ C^2 \end{pmatrix}. \tag{4}$$

And the vector of parameters to be estimated in quadratic specification, β_i, is given by:

$$\beta_i = \begin{pmatrix} \beta_\pi \\ \beta_{\mathrm{B}} \\ \beta_{\mathrm{C}} \\ \beta_{\pi\mathrm{B}} \\ \beta_{\mathrm{BC}} \\ \beta_{\pi\mathrm{C}} \\ \beta_{\pi\pi} \\ \beta_{\mathrm{BB}} \\ \beta_{\mathrm{CC}} \end{pmatrix}. \tag{5}$$

We observe that in the special case where only β_π and β_{B} in equation 3 are different from zero, the physician objective coincides with Ellis and McGuire (1990). Our data comprises observed choices of treatment alternatives, when available alternatives differ in profit, patient benefit, and patient consumption. Individuals' valuation of x_{ijt} is captured by the preference parameters. Models where homogeneous preferences are assumed are standard conditional logit models, where estimates are obtained by means of maximum likelihood estimation. We apply maximum simulated likelihood (MSL) estimation to obtain parameter estimates of models with heterogeneous preferences. In describing the latter procedure, we closely follow the presentation in Hole (2007). We let β_i denote a realization from the distribution $f(\beta|\theta)$, where θ are the parameters of the distribution. We assume that conditional on knowing β_i, the probability of subject i choosing alternative j on choice occasion t is given by

$$L_{ijt}(\beta_i) = \frac{exp(\beta_i^{'}x_{ijt})}{\sum_{j=0}^{10} exp(\beta_i^{'}x_{ijt})}.$$

Next, we may express the probability of the sequence of choices over the choice occasions *conditional* on β_i by

$$S_i(\beta_i) = \prod_{t=1}^{T} L_{ij(i,t)}(\beta_i),$$

where the notation $j(i,t)$ refer to the alternative chosen by individual i upon choice occasion t. The *unconditional* probability of the sequence of choices is given by integrating the *conditional* probability over β_i:

$$P_i(\theta) = \int S_i(\beta_i) f(\beta|\theta) d\beta.$$

The log likelihood is given by

$$SLL(\theta) = \sum_{i=1}^{I} lnP_i(\theta),$$

which can not be solved analytically, and need to be approximated by means of simulation methods. The simulated log likelihood is given by

$$SLL(\theta) = \sum_{i=1}^{I} ln\left[\frac{1}{R}\sum_{r=1}^{R} S_i(\beta^r)\right],$$

where R is the number of replications, and β^r is the r^{th} draw from the $f(\beta|\theta)$ distribution. The maximum simulated likelihood estimator $\hat{\beta}_i^{'}$ is a consistent estimator, converging in probability to $\beta_i^{'}$ as sample size, I and simulation draws r increase (Lee and Ingram, 1991; Hajivassiliou and Ruud, 1994).

5. Estimation results

For an overview of specifications of all estimated models and corresponding fit criteria, please see Appendix A. Table 3 presents the estimated parameters from two utility specifications assuming homogeneous preferences[6]. Both model 1 and 2 are standard conditional logit models. The difference between these two models is that model 1 assumes a linear utility in the main effects of physician's own profit π, patient health benefit B and patient consumption after cost-sharing C, while model 2 follows a quadratic utility specification allowing for investigation of non-linearity in

[6]In all estimations in this paper, we rescaled all variables by dividing them by 10.

Table 3: Conditional logit models. Homogeneous preferences

	Model 1		Model 2	
Parameter	Estimate	Std. Error†	Estimate	Std. Error†
β_π	0.529***	(0.0324)	1.085***	(0.170)
β_{B}	1.401***	(0.0640)	2.139***	(0.243)
β_{C}	0.668***	(0.0509)	0.761***	(0.217)
$\beta_{\pi\mathrm{B}}$			0.0509***	(0.019)
β_{BC}			-0.0214	(0.021)
$\beta_{\pi\mathrm{C}}$			0.0532***	(0.017)
$\beta_{\pi\pi}$			-0.140***	(0.026)
β_{BB}			-0.140***	(0.031)
β_{CC}			-0.0179	(0.028)
N	9290		9290	
Log Likelihood	-2097.5		-1985.6	
AIC	4200.9		3989.1	
BIC	4222.3		4053.4	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. † clustered at the level of the individual.

variables. Not surprisingly, the model fit criteria, log likelihood, AIC, and BIC are all in favor of the non-linear model and a likelihood ratio test[7] ($p = 0.000$) confirms that model 2 is a better fit. The estimates from these two models imply that marginal utilities of all variables are positive and they are decreasing once we allow for non-linearity[8].

We now relax the assumption of homogeneous preferences. In Table (4) we report estimation results from Model 3, which is a mixed logit model where we assume random coefficients of preference variables (Godager and Wiesen, 2013). We report the estimated means, standard deviations and medians (for log-normal coefficients) of the coefficient distributions. The coefficients $\beta_\pi, \beta_{\mathrm{B}}, \beta_{\pi\mathrm{C}}, \beta_{-\pi\pi}, \beta_{\text{-BB}}$ and $\beta_{\text{-CC}}$ are all chosen to be log-normally distributed because we expect physicians to have positive and decreasing marginal utilities of all variables based on results from the first two models[9]. The coefficients of $\beta_{\pi\mathrm{B}}, \beta_{\mathrm{BC}}$ and $\beta_{\pi\mathrm{C}}$ are all assumed to be normally distributed, thereby allowing for the possibility that preferences can be heterogeneous with regard to whether attribute pairs are substitutes or complements.

The magnitudes of estimates from our three models are not directly comparable, due to different utility specifications and coefficients distributions. The significant standard deviations in Model 3, however, provides evidence to suggest heterogeneity in preferences.

[7]The likelihood test is only valid if used to compare nested models and not for models with clustered standard errors. Hence when we ran the test, we used models without clustering.

[8]The magnitudes of marginal utilities depend on the values of all three variables in non-linear model. The calculated marginal utilities from model 2 are positive at all possible combinations of variable levels. The negative coefficients of the second-order terms indicate decreasing marginal utilities in Model 2.

[9]The magnitudes of coefficients of the main effects are much larger than those of the interaction and second-order terms, hence the former almost dominantly decides the sign of the marginal utilities. We therefore constrain coefficients of the main effects to be positive.

Table 4: Mixed logit model. Heterogeneous preferences

		Model 3	
Parameter		Estimate	Std. Error
β_π	Mean	2.079***	(0.337)
	Median	1.880***	(0.366)
	SD	0.980***	(0.130)
β_{B}	Mean	4.045***	(0.415)
	Median	3.973***	(0.424)
	SD	0.775***	(0.198)
β_{C}	Mean	1.961***	(0.334)
	Median	1.892***	(0.350)
	SD	0.532***	(0.088)
$\beta_{\pi\pi}$	Mean	-0.225***	(0.051)
	Median	-0.222***	(0.050)
	SD	0.040	(0.033)
β_{BB}	Mean	-0.252***	(0.058)
	Median	-0.252***	(0.058)
	SD	0.020	(0.041)
β_{CC}	Mean	-0.114**	(0.047)
	Median	-0.085**	(0.042)
	SD	0.099***	(0.024)
$\beta_{\pi B}$	Mean	0.117***	(0.039)
	SD	0.0938**	(0.043)
β_{BC}	Mean	-0.0244	(0.040)
	SD	0.181***	(0.035)
$\beta_{\pi C}$	Mean	0.0710***	(0.027)
	SD	0.0331	(0.039)
N		9290	
Log Likelihood		-1555.1	
AIC		3146.3	
BIC		3274.7	

Normal distributed coefficients: $\beta_{\pi B}$, β_{BC} and $\beta_{\pi C}$.
The remaining coefficients are log-normal distributed.
To facilitate negative second-order derivatives the square terms where multiplied by -1.
Model is estimated by means of MSD, and 3000 Halton draws are used.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Comparing results in Table (4) with results in Table (3), we see that the model fit improves when we relax the assumption of preference homogeneity, and the AIC and BIC confirm that Model 3 has the best fit[10]. We therefore focus on estimates from Model 3 in Table (4) when we proceed with the detailed interpretations and post-estimation results.

We now describe marginal utilities, marginal rates of substitution, and whether individuals consider attributes to be complements or substitutes. Suppressing subscripts, the utility function in Model

[10] We note that the reductions in the information criteria and the log-likelihood are much larger from homogeneous to heterogeneous preferences than from linear to non-linear functional forms.

3 can be written:

$$U = \beta_\pi \pi + \beta_{\mathrm{B}} B + \beta_{\mathrm{C}} C + \beta_{\pi\mathrm{B}} \pi B + \beta_{\mathrm{BC}} BC + \beta_{\pi\mathrm{C}} \pi C + \beta_{\pi\pi} \pi^2 + \beta_{\mathrm{BB}} B^2 + \beta_{\mathrm{CC}} C^2 \quad , \tag{6}$$

with first- and second order derivatives given by:

$$\begin{aligned} U'_\pi &= \beta_\pi + \beta_{\pi\mathrm{B}} B + \beta_{\pi\mathrm{C}} C + 2\beta_{\pi\pi}\pi, & U''_{\pi\pi} &= 2\beta_{\pi\pi}, & U''_{\pi\mathrm{B}} &= \beta_{\pi\mathrm{B}}, \\ U'_{\mathrm{B}} &= \beta_{\mathrm{B}} + \beta_{\pi\mathrm{B}} \pi + \beta_{\mathrm{BC}} C + 2\beta_{\mathrm{BB}} B, & U''_{\mathrm{BB}} &= 2\beta_{\mathrm{BB}}, & U''_{\mathrm{BC}} &= \beta_{\mathrm{BC}}, \\ U'_{\mathrm{C}} &= \beta_{\mathrm{C}} + \beta_{\mathrm{BC}} B + \beta_{\pi\mathrm{C}} \pi + 2\beta_{\mathrm{CC}} C, & U''_{\mathrm{CC}} &= 2\beta_{\mathrm{CC}}, & U''_{\pi\mathrm{C}} &= \beta_{\pi\mathrm{C}}, \end{aligned} \tag{7}$$

In our non-linear utility specification, there are two sources of variation in marginal utilities. Marginal utilities depend on the levels of the variables and will in addition vary due to the preference heterogeneity. We need to use simulation in order to describe how marginal utilities and marginal rates of substitution vary over variable levels as well as preference parameters. We obtain simulated marginal utility distributions by inserting draws[11] from the distributions that are parametrized according to the estimation results in Table (4) into the formulas for the marginal utilities given in (7). We report the simulated marginal utilities in Table 5.

As expected, the magnitudes of marginal utilities vary across levels of variables and percentiles of the preference distributions. The table therefore consists of three panels presenting marginal utilities at combinations of low (15), middle (20) and high (25) level of variables. We also describe marginal utilities within each panel at the 25th, 50th and 75th percentile of the population. Our first observation is that all three marginal utilities are positive and declining, showing diminishing marginal utility. Further, we observe that marginal utility of patient health benefit is larger than the two other marginal utilities, and that this holds true for the whole population at all combinations of attributes. Whether the marginal utility of profit is larger or smaller than the marginal utility of patient consumption, depends on the level of these two variables: When profit is high relative to patient consumption, marginal utility of profit is smaller than the marginal utility of patient consumption, and the opposit is true when profit is low relative to patient consumption.

Following the definitions by Seidman (1989), we only discuss so called quantity complements (quantity substitutes) in this paper. For example, π and B are complements (substitutes) if an increase in π raises (decreases) the marginal utility of B. Hence, two attributes are complements whenever the cross partial derivative in (7) is positive, and substitutes if the cross partial derivative is negative. The estimation and simulation results provide interesting results with regard to whether attribute pairs are substitutes or complements. Since we allow for normal distributed cross partial derivatives, we do not restrict attributes to be either complements or substitutes for all individuals. Two attributes may be complements for some individuals, and substitutes for other individuals. The

[11] We used 10,000 draws in the simulations.

Table 5: Marginal utilities based on estimates from Model 3

$\pi = 15$		C=15			C=20			C=25		
		U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}
B=15	25 %	0.99	2.84	1.25	1.02	2.81	1.14	1.06	2.77	1.02
	50 %	1.50	3.36	1.66	1.53	3.36	1.57	1.57	3.35	1.47
	75 %	2.17	3.94	2.10	2.21	3.96	2.01	2.24	3.98	1.93
B=20	25 %	1.04	2.59	1.22	1.08	2.55	1.09	1.11	2.52	0.97
	50 %	1.55	3.11	1.66	1.60	3.11	1.56	1.63	3.10	1.46
	75 %	2.23	3.70	2.12	2.27	3.71	2.03	2.30	3.73	1.96
B=25	25 %	1.10	2.33	1.16	1.14	2.30	1.05	1.17	2.26	0.93
	50 %	1.62	2.85	1.65	1.66	2.85	1.55	1.69	2.85	1.46
	75 %	2.31	3.44	2.15	2.34	3.46	2.06	2.38	3.48	1.98

$\pi = 20$		C=15			C=20			C=25		
		U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}
B=15	25 %	0.77	2.90	1.29	0.80	2.87	1.17	0.83	2.83	1.06
	50 %	1.28	3.43	1.70	1.31	3.42	1.60	1.35	3.42	1.51
	75 %	1.94	4.01	2.13	1.99	4.03	2.05	2.02	4.05	1.98
B=20	25 %	0.82	2.64	1.25	0.85	2.61	1.13	0.89	2.57	1.01
	50 %	1.34	3.18	1.69	1.37	3.17	1.59	1.41	3.16	1.50
	75 %	2.01	3.76	2.16	2.05	3.77	2.07	2.09	3.79	1.99
B=25	25 %	0.87	2.39	1.20	0.91	2.36	1.08	0.94	2.32	0.96
	50 %	1.40	2.92	1.68	1.43	2.92	1.58	1.47	2.91	1.48
	75 %	2.08	3.51	2.18	2.11	3.53	2.09	2.16	3.54	2.01

$\pi = 25$		C=15			C=20			C=25		
		U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}	U'_{π}	U'_{B}	U'_{C}
B=15	25 %	0.54	2.94	1.32	0.57	2.92	1.21	0.60	2.87	1.09
	50 %	1.05	3.48	1.73	1.09	3.48	1.64	1.12	3.46	1.55
	75 %	1.73	4.07	2.17	1.77	4.09	2.09	1.81	4.10	2.01
B=20	25 %	0.59	2.70	1.28	0.63	2.66	1.17	0.66	2.62	1.04
	50 %	1.11	3.24	1.73	1.15	3.23	1.63	1.19	3.22	1.53
	75 %	1.79	3.83	2.19	1.84	3.84	2.11	1.87	3.86	2.03
B=25	25 %	0.65	2.44	1.23	0.68	2.40	1.11	0.72	2.36	1.00
	50 %	1.18	2.98	1.72	1.21	2.97	1.62	1.25	2.96	1.52
	75 %	1.87	3.57	2.22	1.90	3.59	2.13	1.94	3.60	2.05

This table presents marginal utilities U'_{π}, U'_{B}, and U'_{C} at different levels of π, B, and C for the 25th, 50th, 75th percentiles of the preference distributions.

estimated means of the cross partial derivatives, reported in Table (4), suggest that the *average individual* considers profit and patient benefit to be complements, and profit and patient consumption to be complements. For the *average individual*, marginal utility of patient health benefit is unaffected by the level of patient consumption.

We can also investigate whether individuals from the three different percentile consider attributes to be substitutes or complements by observing how marginal utilities change along levels of attributes in Table (5). We observe that at any percentile, marginal utility of profit increases as either patient health or consumption rises[12]. This indicates that profit is a complement to patient health or patient

[12] Due to symmetry of cross partials, this is equivalent to that marginal utility of patient health and marginal utility

consumption for most individiduals. With regard to the cross partial derivative of patient health benefit and patient consumption, results indicate that preferences where patient health benefit and patient consumption are complements, and preferences regarding these attributes as substitutes, are both common. For the median individual, marginal utility of patient health does not change with the level of patient consumption[13], and the interpretation is that patient health and patient consumption are considered independent by the median individual. At the 25th percentile, however, marginal utility of patient health benefit decreases as consumption rises, and the interpretation is that patient health and patient consumption are substitutes for the 25th percentile individual. At the 75th percentile, marginal utility of patient health benefit increases as consumption rises, and the interpretation is that patient health and patient consumption are complements for the 75th percentile individual.

To further study physicians' trade-offs between profit, patient health and consumption, we calculate marginal rates of substitution (MRS) by using the simulated marginal utilities. The individuals MRS for profit and patient health benefit is given by $R_{\pi\mathrm{B}} = U'_{\mathrm{B}}/U'_{\pi}$ and expresses how much profit reduction the individual is willing to accept in exchange for an extra unit of patient health benefit, while remaining at the same utility level. Similarly, individuals MRS for profit and patient consumption is given by $R_{\pi\mathrm{C}} = U'_{\mathrm{C}}/U'_{\pi}$. We describe the distribution of MRS in Table 6, which follows the same format as table 5. The MRSs are reported at different combinations of variable levels and at 25th, 50th, 75th percentiles of the preference distribution. As expected, and in line with what we find from Table 5, individuals are willing to sacrifice more profit for unit of patient health, than what they are willing to sacrifice for one unit of patient consumption. We observe that $R_{\pi\mathrm{B}} > R_{\pi\mathrm{C}}$ at every attribute and percentile combination. In addition, $R_{\pi\mathrm{B}}$ is always larger than one while $R_{\pi\mathrm{C}}$ take values both larger and smaller than one. In another words, individuals are always willing to trade-off more than one unit of profit in exchange for a unit increase in patient health benefit, while not all physicians in all situations would sacrifice more than one unit of profit for one unit increase in patient consumption. The two MRSs change value on difference combinations of variable levels. We find in general that $R_{\pi\mathrm{B}}$ and $R_{\pi\mathrm{C}}$ increase with physician own profit, and decrease with patient health and consumption. The interpretation is that as individuals experience more profits, or as patient's utility decline (lower health benefits or lower consumption), physicians are willing to sacrifice more profit to improve patient utility.

of consumption increase as profit rises.

[13] Again, due to symmetry of cross partials, this is equivalent to that marginal utility of patient consumption does not change with the level of patient health.

Table 6: Marginal rates of substitution based on estimates from Model 3

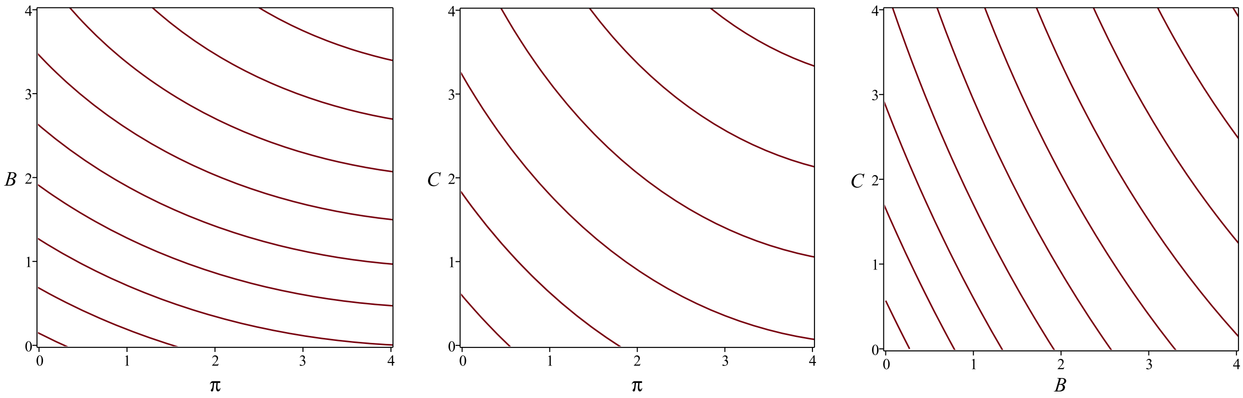
$\pi = 15$		C=15 $R_{\pi B}$	C=15 $R_{\pi C}$	C=20 $R_{\pi B}$	C=20 $R_{\pi C}$	C=25 $R_{\pi B}$	C=25 $R_{\pi C}$
B=15	25 %	1.48	0.67	1.44	0.59	1.40	0.52
	50 %	2.23	1.08	2.17	0.99	2.11	0.89
	75 %	3.48	1.75	3.37	1.61	3.25	1.47
B=20	25 %	1.32	0.63	1.28	0.56	1.25	0.49
	50 %	1.98	1.03	1.92	0.93	1.88	0.85
	75 %	3.08	1.66	2.96	1.52	2.88	1.41
B=25	25 %	1.15	0.59	1.13	0.52	1.09	0.45
	50 %	1.74	0.97	1.70	0.89	1.65	0.81
	75 %	2.69	1.59	2.60	1.47	2.54	1.36

$\pi = 20$		C=15 $R_{\pi B}$	C=15 $R_{\pi C}$	C=20 $R_{\pi B}$	C=20 $R_{\pi C}$	C=25 $R_{\pi B}$	C=25 $R_{\pi C}$
B=15	25 %	1.64	0.74	1.60	0.67	1.56	0.59
	50 %	2.60	1.26	2.53	1.15	2.46	1.05
	75 %	4.38	2.19	4.25	2.01	4.10	1.84
B=20	25 %	1.46	0.70	1.43	0.62	1.39	0.55
	50 %	2.30	1.19	2.25	1.09	2.19	1.00
	75 %	3.86	2.08	3.70	1.90	3.58	1.74
B=25	25 %	1.28	0.66	1.26	0.58	1.22	0.51
	50 %	2.03	1.14	1.98	1.03	1.92	0.94
	75 %	3.35	1.96	3.23	1.79	3.15	1.66

$\pi = 25$		C=15 $R_{\pi B}$	C=15 $R_{\pi C}$	C=20 $R_{\pi B}$	C=20 $R_{\pi C}$	C=25 $R_{\pi B}$	C=25 $R_{\pi C}$
B=15	25 %	1.70	0.77	1.68	0.70	1.66	0.62
	50 %	2.94	1.42	2.87	1.30	2.80	1.20
	75 %	5.41	2.72	5.24	2.48	5.05	2.28
B=20	25 %	1.53	0.74	1.52	0.67	1.49	0.59
	50 %	2.63	1.36	2.56	1.25	2.50	1.13
	75 %	4.77	2.56	4.59	2.34	4.43	2.14
B=25	25 %	1.37	0.70	1.35	0.62	1.32	0.55
	50 %	2.31	1.29	2.26	1.18	2.20	1.08
	75 %	4.11	2.39	4.01	2.21	3.86	2.02

This table presents marginal rates of substitution, $R_{\pi B}$ and $R_{\pi C}$, at different levels of π, B, and C for the 25th, 50th, 75th percentiles of the preference distributions.

Figure 2: Indifference curves



(a) π and B axes,. C=20 (b) π and C axes, B=20 (c) B and C axes, π=20

We provide visual representation of preferences in the form of indifference curves in Figure (2). The indifference curves represent the preferences of the median individual based on estimates from Model 3. In each of the three two-dimensional diagrams, we present indifference curves for two attributes while holding the third attribute fixed. The indifference curves of patient health and consumption in (c) are straighter than the indifference curves in the other maps. The interpretation is that the median individual is willing to exchange patient health and patient consumption at a nearly constant rate.

6. Conclusion and discussion

It is commonly expected that physicians are concerned about their patients. In economic models, physicians' valuation of alternative medical treatments are often specified to be influenced by patient health benefits in addition to their own profit. In this paper, we ask whether physicians valuation of medical treatments are affected by demand-side cost sharing. In the case that physicians are concerned about the overall well-being of their patients, they would *ceteris paribus* prefer treatment alternatives where reductions in patient consumption is smaller level. In order to identify and quantify providers preference under demand-side cost sharing, we design and conduct an incentivized laboratory experiment in which saliency of all three attributes of treatment alternatives, *profit*, *health benefit* and *patient consumption* are ensured. We find robust evidence suggesting that physicians' choice of medical treatments are indeed influenced by patient demand-side cost sharing.
This study is to our knowledge the first to quantify the trade-offs between profit, patient consumption, patient health benefit. The study provides evidence suggesting that medical treatment decisions are influenced by a concern for the overall well-being of the patient, and not only the health effects. This result contributes with new knowledge on physician preferences which is useful for designing physician payment schemes and health insurance contracts. The results implies that even in cases where physicians receive fee-for-service payment and have strong bargaining power when consulting patients, demand-side cost sharing will reduce service provision.

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Appendices

A. Model specifications

The table below gives a summary of all the estimated models with log likelihood, AIC and BIC listed at the end. Panel A and B respectively presented results from seven linear and five non-linear utility specifications. The selected models discussed and compared in the article are model A, H and L, of which L is the preferred model.

Table A.1: Log-likelihood and information criteria from all model specifications

Panel A: Linear utility			
$U = \beta_\pi \pi + \beta_{\text{B}} B + \beta_{\text{C}} C + \varepsilon$			
Specification of heterogeneity, if present	**Log Likelihood**	**AIC**	**BIC**
(A) No heterogeneity [**Model 1**]	-2097.5	4200.9	4222.3
(B) β_B, β_C (normal)	-1801.1	3612.1	3647.8
(C) $\beta_\pi, \beta_B, \beta_C$ (normal)	-1742.9	3497.7	3540.5
(D) $\beta_\pi, \beta_B, \beta_C$ (correlated, normal)	-1718.8	3455.7	3519.9
(E) β_B, β_C (Log-normal)	-1816.7	3643.5	3679.1
(F) $\beta_\pi, \beta_B, \beta_C$ (Log-normal)	-1730.6	3473.2	3516.0
(G) $\beta_\pi, \beta_B, \beta_C$ (correlated, Log-normal)	-1713.7	3445.5	3509.7
Panel B: quadratic utility			
$U = \beta_\pi \pi + \beta_{\text{B}} B + \beta_{\text{C}} C + \beta_{\pi\text{B}} \pi B + \beta_{\text{BC}} BC + \beta_{\pi\text{C}} \pi C + \beta_{\pi\pi} \pi^2 + \beta_{\text{BB}} B^2 + \beta_{\text{CC}} C^2 + \varepsilon$			
Specification of heterogeneity, if present	**Log Likelihood**	**AIC**	**BIC**
(H) No heterogeneity [**Model 2**]	-1985.6	3989.1	4053.4
(I) $\beta_\pi, \beta_B, \beta_C$ (normal)	-1575.2	3174.4	3260.0
(J) $\beta_\pi, \beta_B, \beta_C$ (Log-normal)	-1565.4	3154.8	3240.5
(K) All coefficients (normal)	-1561.2	3158.4	3286.9
(L) $\beta_{\pi\text{B}}, \beta_{\text{BC}}, \beta_{\pi\text{C}}$, (normal), $\beta_\pi, \beta_{\text{B}}, \beta_{\text{C}}, \beta_{\pi\pi}, \beta_{\text{BB}}, \beta_{\text{CC}}$ (log-normal) [**Model 3**]	-1555.1	3146.3	3274.7

Notes: individual, alternative, and time subscripts are suppressed in the utility functions.

B. Description of the experiment

General information

Welcome to our experiment. This experiment is part of a research collaboration between the Universities of Shandong (China), Oslo (Norway), and Cologne (Germany).

In the following experiment, you will make several decisions. Following the instructions and depending on your decisions, you can earn money. It is therefore very important to read the description carefully.

Your decisions are anonymous and will be kept strictly confidential. During the experiment you are not allowed to talk to any other participant. Whenever you have a question, please raise your hand. The experimenter will answer your question in private. If you disregard these rules you can be excluded from the experiment without receiving any payment.

All amounts in the experiment are stated in Chinese Yuan (RMB). At the end of the experiment, you will be paid in cash.

After the experiment, we will kindly ask you to complete a short questionnaire and you will get 25 Yuan for carefully completing the experiment and questionnaire.

The experiment will take approximately one hour and a half.

Decision situations in the experiment

During the entire experiment you are in the role of a physician. You decide on the treatment options – Treatment A or Treatment B – of 23 abstract patients. There are no real patients participating in this experiment, but a real patient outside the experiment will be affected by your decisions.

The Treatment A and B differ in terms of **Your profit**, **Health benefit for the patient** and **Money available to the patient (after co-payment)**. We now explain the three elements one by one:

Your profit indicates how much money you would earn from choosing the treatment.

Health benefit for the patient is the patient's expected gain in health status, measured in money, from your choice of treatment.

Each patient you are treating has the same amount of money initially: 50 Yuan. The patients are **not** fully insured. This means that they have to pay a certain amount of co-payment for the treatment. **Money available to the patient (after co-payment)** therefore indicates the amount of money that remains with patient, after the co-payment. The patient can spend the remaining amount of money on any feasible consumption. Hence, your decision on the treatment not only determines your own profit, but also the patient's health benefit and consumption level after co-payment. Note that, in this experiment, we do not consider third party insurer's payment for the treatment.

Patient 6
With an initial endowment of 50 Yuan

	Treatment A	**Treatment B**
Your profit	15	40
Health benefit for the patient	25	5
Money available to the patient (after co-payment)	10	30

Which treatment would you prefer? Please tick only one.
Treatment A   Treatment B
□   □

Consider the following example:

This patient has an initial money endowment of 50 Yuan. You are asked to choose either Treatment A or Treatment B. If you choose Treatment A, you will get 15 Yuan profit. If you choose Treatment B, you will get 40 Yuan profit which is 25 Yuan more than in Treatment A. For the patient, Treatment A gives a health benefit valued at 25 Yuan, and this is 20 Yuan more than in Treatment B. At the same time, the patient has to pay 40 Yuan co-payment for Treatment A and 20 Yuan for Treatment B. Equivalently, the money available to the patient after co-payment is 10 Yuan if Treatment A is chosen, and the money available to the patient after co-payment is 30 Yuan if Treatment B is chosen. You can calculate the co-payment by subtracting the Money available to the patient (after co-payment) from the initial endowment of 50 Yuan.
Once you make your decision, tick the box under your preferred treatment.

The payments in the experiment

After everyone have completed the booklet with decision tasks and questionaire, an assistant will collect the booklet. After collecting all of the booklets, one out of your 23 decisions will be drawn randomly. The payoff for you and the patient will be based on this randomly drawn decision.

There are no real patients participating in this experiment, but your decision on the abstract patient will benefit a real patient in Qilu Hospital. This real patient is randomly chosen from a list of admitted patients who have serious diseases (e.g. lung cancer, uremia, colon cancer or other serious illness) and have to bear a co-payment for his or her medical treatment.

The payment you receive: The amount of **Your profit** from the randomly drawn decision and the participation fee, will be given to you in cash at the end of the experiment.

The transfers to the patient: This transfer consists of two parts. The amount of **Health benefit for the patient** from the decision will be transferred to the patient's hospital account. It can only be used for medical treatment for the patient. At the same time, the amount of **Money available to the patient (after co-payment)** will be given to the patient as cash at his or her disposal.

Procedural details

After the experiment, one of you will be randomly chosen as a monitor who will supervise the transactions to the patient. The monitor and the experimenter will both go to Qilu hospital and supervise the process of transferring the money to the patient's hospital account and give the cash directly to the patient. The visit to Qilu hospital will take place after the experiment. The monitor will receive an hourly payment of 30 Yuan in addition to the payment from the experiment. The monitor verifies, by a signed statement, that the procedure described above is carried out.

After the experiment, the hospital will indicate in an anonymous way to the researchers of Shandong University and the University of Oslo which medical treatments have been conducted for the randomly chosen patient using the transferred money to the patient's hospital account. This document will made accessible to participants of this experiment upon request (Email to: gege@medisin.uio.no).

Now, please answer some questions familiarizing you with the decision situation. The experiment will only start when all subjects have answered the comprehension questions correctly. After your 23 decisions, please answer a short questionnaire about your background.

C. Comprehension questions

Now, please answer the following three questions to familiarize yourself with the decision situation. Once you are done, please raise your hand, and one of our experimenters will check your answers.

1. Are the following statements correct or incorrect?

   A: All 23 decisions are equally important, because one randomly drawn decision will determine my payment.
   □Correct □Incorrect

   B: My decision on the treatment will benefit a real patient.
   □Correct □Incorrect

   C: The patients are fully insured, so they don't bear any co-payment for the treatment.
   □Correct □Incorrect

2. Consider the following choice situation.

Patient 1
With an initial endowment of 50 Yuan

	Treatment A	**Treatment B**
Your profit	10	20
Health benefit for the patient	30	25
Money available to the patient (after co-payment)	15	15

Which treatment would you prefer? Please tick only one.

Treatment A	Treatment B
□	□

Please fill in the blanks with correct numbers.

If you choose Treatment A, you will get ______ Yuan profit, the patient will gain ______ Yuan in health benefit and he or she has to pay ______ Yuan co-payment out of pocket, leaving him or her with a remaining amount of ______ Yuan.

If you choose Treatment B, you will get ______ Yuan profit, the patient will gain ______ Yuan in health benefit and he or she has to pay ______ Yuan co-payment out of pocket, leaving him or her with a remaining amount of ______ Yuan.

3. Consider another choice situation.

Patient 2
With an initial endowment of 50 Yuan

	Treatment A	**Treatment B**
Your profit	20	35
Health benefit for the patient	30	20
Money available to the patient (after co-payment)	15	10

Which treatment would you prefer? Please tick only one.

Treatment A ☐ Treatment B ☐

Please fill in the blanks with correct numbers.

If you choose Treatment A, you will get ______ Yuan profit, the patient will gain ______ Yuan in health benefit and he or she has to pay ______ Yuan co-payment out of pocket, leaving him or her with a remaining amount of ______ Yuan.

If you choose Treatment B, you will get ______ Yuan profit, the patient will gain ______ Yuan in health benefit and he or she has to pay ______ Yuan co-payment out of pocket, leaving him or her with a remaining amount of ______ Yuan.

This is the end of the comprehension questions. Please raise your hand and wait for an experiment assistant to check your answers.

D. Invitation letter (English)

To medical students at Shandong University:

Invitation to participate in a decision experiment

You are invited to participate in a health economic experiment. This experiment is part of a research collaboration between the Universities of Shandong (China), Oslo (Norway), and Cologne (Germany). The research is funded by the Research Council of Norway. With your participation, you support our research. You can earn money during the experiment, in addition to receiving 25 Yuan in participation fee.

The experiment consists of making decisions using pen and paper, and no prior knowledge is necessary. All information collected during the experiment is strictly anonymous and confidential and will only be used for the purpose of this research. We will not store any of your personal information. The experiment takes about 1.5 hours, and will be carried out at 7:00 PM, Tuesday April 4, in the Lecture Hall of School of Medicine. The participation is voluntary and you can withdraw from the experiment at any time.

Please contact Professor Wang Jian for registration. Remember to bring your student ID to participate in the experiment.

Your sincerely,

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