Profit or Patients' Health Benefit?

Exploring the Heterogeneity in Physician Altruism

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ABSTRACT

This paper investigates physician altruism toward patients' health benefit using behavioral data from the fully incentivized laboratory experiment of Hennig-Schmidt et al. (2011). This setup identifies both physicians' profits and patients' health benefit resulting from medical treatment decisions.

We estimate a random utility model applying multinomial logit regression, finding that physicians attach a positive weight on patients' health benefit. Furthermore, physicians vary substantially in their degree of altruism. Finally, we provide some implications for the design of physician payment schemes.

1 Introduction

In the health economics literature, it has become quite common to explicitly model the physicians' concern for their patients. Numerous papers account for this concern—sometimes assumed to be driven by medical ethics[1]—with a physician's utility function that depends on the patient's health benefit (see McGuire 2000, p.521). Here, the physician's concern for the patient is traded off against the physician's self-interest (see, e.g., Woodward and Warren-Boulton 1984; Ellis and McGuire 1986; Ma 1994; Chalkley and Malcomson 1998; Ma and Riordan 2002 and Allard et al. 2011).

In this framework, the weight the physician attaches to the patient's health benefit—often referred to as physician altruism—has important implications for the design of optimal incentives, i.e., payment, schemes. Ellis and McGuire (1986) point out that if a physician cares about net revenue and patient health benefit in the same way as a social planner does—so that the physician is a 'perfect agent'—then full prospective payment is optimal. Moreover, Chalkley and Malcomson (1998) show that if the physician places any value on patient health benefit, then a prospective payment will induce optimal cost-reducing effort, and some positive, but sub-optimal, level of quality. In both papers, the optimal cost-sharing rate depends on the extent to which the physician incorporates patient benefit when making decisions about how to treat a patient.

In Jack (2005), the assumption that the purchaser knows the degree of physician altruism is relaxed, and an optimal menu of cost-sharing schemes that induce providers to reveal their types, is derived. A necessary condition for a separating equilibrium in this model is that there is a sufficient number of physicians with a low degree of altruism.

Choné and Ma (2011) explicitly model asymmetric information from physician agency where the purchaser does not know about the patient's valuation of health benefit, as well as the physician's weight on patient's health benefit and own profit. They show that the optimal payment mechanism depends on the physician's weight on patient's health benefit.

In a principal-agent model with reputation, Siciliani (2009) investigates the impact of performance pay on the amount of supplied medical services when providers differ in

[1] In his seminal article, Arrow (1963) emphasized the importance of the physicians' concern for medical ethics. A formal treatment of ethical constrains in medical decision-making can be found in Ma and McGuire (1997).

altruism. He shows that providers' reaction to changes in performance incentives depend on physician altruism.

Allard et al. (2011) model general practitioners' treatment and referral decisions under a gatekeeping regime, and show that more altruistic GPs will require more precision in their diagnosis setting before treating a patient themselves rather than referring a patient to specialty care. Further, their result indicates that the distribution of altruism in the physician population determines which payment mechanisms will meet the objectives of the regulator. Allard et al. propose to conduct more thorough empirical analysis to shed light on the distribution of physician altruism, in order to provide reliable policy recommendations. In spite of its considerable importance, surprisingly little is known empirically about physician altruism. The purpose of the present paper is to fill this gap. To the best of our knoweldge, we are the first to do so. In particular, we explore physician altruism and the heterogeneity therein, by using behavioral data from the controlled laboratory experiment by Hennig-Schmidt et al. (2011). In their fully incentivized experiment, prospective physicians decide on the quantity of medical services for patients either under a fee-for-service or a capitation payment scheme. A physician's quantity choice simultaneously determines own profit and the patient's health benefit. Thus, their medical decision-making setting captures the fundamental trade-off assumed in theoretical models. Behavioral results from Hennig-Schmidt et al. show that financial incentives influence behavior—patients are over- and underserved under fee-for-service and capitation, respectively. However, Hennig-Schmidt et al. also report that the patients' health benefit had been of considerable importance for physicians' quantity choices. Here, our investigation into the heterogeneity of physician altruism departs. Behavioral data allow us to identify and measure the weight that individual physicians attach to their own profits and to the patients' health benefit.

Applying a multinomial logit regression to the experimental data, we find that almost all physicians put a positive weight on patients' health benefit. However, our results indicate considerable heterogeneity in physician altruism. Some physicians attach a higher value to their own profit than to the patient benefit (21%). The majority of physicians either attach equal weights to profit and health benefit (31%) or put an even higher weight on the patient (48%). Our results suggest the inclusion of fixed- or capitated-payment components in a one-size-fits-all payment system for physician services.

The paper proceeds as follows. A simple model illustrating a physician's decision situation is presented in Section 2. Behavioral data are described in Section 3. In Section 4, we specify the econometric model, while results are presented in Section 5. In Section 6, we conclude.

2 Physician altruism and payment methods

The absence of externalities in production and consumption of goods is a well-known precondition in order for social efficiency to be achieved through competitive markets. If physicians enjoy improving the health of patients, then one may argue that such externalities are present. This particular externality is often believed to mitigate the problems caused by other sources of market failure, such as the presence of aymmetric information between physicians and patients. If the regulator is informed about the degree of physician altruism, however, the efficient quantity of services may be implemented by designing an appropriate payment mechanism. The calibration of this optimal payment system depends crucially on the degree of physician altruism. Below we illustrate that the hypothesis of selfish profit-maximizing behavior is likely to discount important factors when benevolence towards the patient is inherent in the physician's decision-making process.

Similar to Ellis and McGuire (1986), several authors describe the physician's objective function as a weighted sum of the physician's own profit and the patient's health benefit (e.g., Newhouse 2002; Léger 2008 and Choné and Ma 2011). Following Léger (2008), the physician decides on the quantity of medical services, q. The physician is assumed to be concerned about both her own net profit, $\pi(q)$, and the patient's health benefit, $H(q)$, depending on the quantity of medical services provided. The physician's objective function is $U(q) = \beta\ \pi(q) + \theta\ H(q)$, where β and θ indicate the physician's valuation of own profit and patient benefit, respectively.[2] The marginal rate of substitution between patient health benefit and physician profit in this model is $MRS_{H\pi} = -\frac{d\pi(\ )}{dH(\ )} = \frac{\theta}{\beta}$.

The fraction $\frac{\theta}{\beta}$ thus expresses how many units of own profit the physician is willing to give up in order to increase the patient's health benefit by one unit. This measure is often interpreted as the degree of physician altruism. The health benefit function, $H(q)$, is assumed to be increasing and strictly concave in q (similar to Ellis and McGuire 1986; Ma 1994; and Choné and Ma 2011). The properties of the function expressing the physician's net profit as a function of quantity depends on the payment mechanism and the cost struc-

[2] A normalized version of the physician's objective function is often applied where the β and θ are scaled in order to sum to unity. The normalized version can be expressed simply by dividing both sides of the equation by $\beta + \theta$. Both versions equivalently represent ordinal preferences.

ture. More specifically, the physician's objective function is $U(q) = \beta[F + pq - cq] + \theta\, H(q)$, where marginal cost, c, is constant, and the payment mechanism is a combination of a fixed prospective payment F and a fee-for-service payment p.

In this model, the patient is assumed to be passive and fully insured, simply accepting each amount of medical services provided. Quantity of health care services is optimal when marginal benefit equals marginal cost, i.e., $H'(q) = c$. In this model a mixed payment system consisting of prospective payment and cost reimbursement is necessary in order to implement the optimal quantity of services. The rate of cost reimbursement will imply supply-side cost sharing for the case of partly altruistic physicians. It is also shown that the proportion of marginal costs carried by the physician needs to be higher for more altruistic physicians. This result, which corresponds to that of Ellis and McGuire (1986), shows that knowledge of the size of physician altruism is a necessary prerequisite when designing optimal payment mechanisms in situations where the regulator is uninformed about the marginal health benefits of patients.

Another interpretation of $\frac{\theta}{\beta}$ is that it serves as an index for the degree to which the physician acts as an agent on the patient's behalf when deciding on the quantity of medical services. Following Chalkley and Malcomson (1998), we distinguish between three cases:

- *Case 1.* If $\frac{\theta}{\beta} < 1$, the physician is partially altruistic. The patient's health benefit influences a physician's decisions. A necessary but not sufficient condition for first-best quantity to be achieved is that the fee-for-service rate is set less than her marginal costs, i.e., $p^* < c$. In the special case where $\theta = 0$, the patient's health benefit does not enter the physician's objective function, and supply-side cost sharing is no longer optimal. A necessary condition for first-best quantity to be achieved is that the fee-for-service rate is set equal to marginal costs, i.e., $p^* = c$.

- *Case 2.* If $\frac{\theta}{\beta} = 1$, the physician equally weighs own profit and patient benefit. It can be shown that this type of physician will provide the socially optimal quantity of health care services if and only if the fee-for-service rate it set equal to zero, i.e., $p = 0$.

- *Case 3.* If $\frac{\theta}{\beta} > 1$, the physician is substantially influenced by the patient's benefit. That means, the physician attaches a higher weight to it than to her own profit. With respect to the optimal payment mechanism, the fee-for-service rate should be such that $p < 0$.

The aim of this paper is to get information on the size of $\frac{\theta}{\beta}$. In Section 4, we estimate $\frac{\theta}{\beta}$ allowing for altruism to show variation across physicians.

3 Behavioral data

Our behavioral data stem from the laboratory experiment of Hennig-Schmidt et al. (2011) who analyze physicians' provision behavior under fee-for-service (FFS) and capitation (CAP) incentives. 42 medical students took part in their computerized experiment conducted at the Laboratory for Experimental Economics at the University of Bonn. Data from their controlled experiment are appropriate to explore physician altruism because selfish behaviors and concerns for patients health benefit are both identifiable.

In Hennig-Schmidt et al.'s experiment, medical students in the role of physicians, decided on the provision of medical services for several different patients. More specifically, each medical student, henceforth physician, made 15 individual decisions on the quantity of medical services for three patient-types with five abstract illnesses. Quantities could be chosen from the closed interval $[0, 10]$. Patient-types differ in their benefits gained from medical services. Each combination of patient-type and illness represents a particular patient. By choosing a quantity of health services for a patient, the physician simultaneously determines her profit and the patient's health benefit—measured in monetary terms. The physician's profit and patient's benefit vary across decisions. Physicians are provided with an incentive for favorable behavior toward their patients, as their decisions are consequential for real patients outside the lab. In particular, the aggregated patient benefit is transferred to a charity caring for real patients.[3]

For each patient $i \in [1, 15]$, physician n is faced with a menu of 11 treatment alternatives (j), corresponding to providing a discrete quantity of health care services. When deciding on the quantity of medical services, physicians are aware about the resulting remuneration R_{nij}, costs c_{ij}, profit $\pi_{nij} = R_{nij} - c_{ij}$, and patient health benefit H_{nij}, because parameters are shown in a table format on subjects' decision screens. Decisions are incentivized by FFS and CAP for physicians $n \in [1, 20]$ and $n \in [21, 42]$, respectively. When paid by FFS, physicians receive a monetary amount p_{nij} depending on the alternative, i.e., quantity of the chosen medical services. Under CAP, physicians are paid a lump-sum payment per patient independent of the number of medical services chosen.

[3] For more details on the experimental design and procedure see Section 3 in (Hennig-Schmidt et al. 2011).

Remuneration is, thus, $R_{nij} = F_n + p_{nij}$.

Under both payment schemes, physician n faces a tradeoff between own profit maximization and rendering the optimal benefit to patient i. For each patient i, an alternative j is maximizing physician n's profit and another (different) one renders the optimal health benefit to the patient. The patient is assumed to be passive and to accept each level of medical service chosen by the physician. Table 1 shows pairs of physician n's profit and patient i's health benefit for each alternative j, i.e., (π_{nij}, H_{nij}).

4 Modeling and estimation

Let U_{nij} denote the utility that physician n obtains when treating patient i and choosing treatment alternative j. Utility is equal to the sum of the components that are functions of observable variables, often called representative utility, V_{nij}, and components that are unobservable and random, ε_{nij}, i.e.,

$$U_{nij} = V_{nij} + \varepsilon_{nij}, \quad n = 1, 2, 3 \ldots, N, \quad i = 1, 2, 3 \ldots, I, \quad \text{and} \quad j = 1, 2, 3 \ldots, J. \tag{1}$$

We allow for heterogeneity in the representative utility. First, physician-specific heterogeneity is likely to occur because the expected utility obtained by one physician when treating certain patients may differ from that of another physician. We denote by α_n^d, the physician-specific constant capturing physician heterogeneity. Second, providing services to one patient may result in a level of expected utility, among the set of physicians, that differs from the expected utility when treating another patient. Let α_i^p be a constant, capturing patient-specific heterogeneity entering the representative utility. A specification of representative utility as a linear function of the observable variables PROFIT, henceforth denoted by π_{nij}, and HEALTHBENEFIT, henceforth H_{nij}, can now be expressed as

$$V_{nij} = \pi_{nij}\beta + H_{nij}\theta_n + \alpha_n^d + \alpha_i^p. \tag{2}$$

Because we allow for heterogeneity in the marginal effect of HEALTHBENEFIT, the coefficient assigned to H_{nij} is indexed by n . To simplify notation and exposition, we introduce the index k and let this index refer to a matched physician-patient pair ni. Equation (2) can thus be rewritten as

$$V_{kj} = \pi_{kj}\beta + H_{kj}\theta_n + \alpha_k, \quad k = 1, 2, 3 \ldots, NI, \quad \text{and} \quad j = 1, 2, 3 \ldots, J, \tag{3}$$

Table 1: Pairs of profit and patient benefit

	i	π_{ni0}, H_{ni0}	π_{ni1}, H_{ni1}	π_{ni2}, H_{ni2}	π_{ni3}, H_{ni3}	π_{ni4}, H_{ni4}	π_{ni5}, H_{ni5}	π_{ni6}, H_{ni6}	π_{ni7}, H_{ni7}	π_{ni8}, H_{ni8}	π_{ni9}, H_{ni9}	π_{ni10}, H_{ni10}
For $n \in [1, 20]$	1	0.00, 0.00	1.60, 0.75	3.00, 1.50	4.20, 2.00	8.40, 7.00	8.00, 10.00	7.40, 9.50	7.20, 9.00	7.10, 8.50	6.80, 8.00	6.60 7.50
	2	0.00, 0.00	0.90, 0.75	2.00, 1.50	2.60, 2.00	6.40, 7.00	5.90, 10.00	5.80, 9.50	11.10, 9.00	11.60, 8.50	11.90, 8.00	12.50 7.50
	3	0.00, 0.00	1.70, 0.75	3.20, 1.50	4.50, 2.00	5.60, 7.00	6.50, 10.00	7.20, 9.50	7.70, 9.00	8.00, 8.50	8.10, 8.00	8.30 7.50
	4	0.00, 0.00	1.90, 0.75	3.60, 1.50	5.10, 2.00	6.40, 7.00	5.50, 10.00	11.40, 9.50	12.00, 9.00	12.50, 8.50	13.20, 8.00	13.60, 7.50
	5	0.00, 0.00	0.90, 0.75	1.60, 1.50	5.10, 2.00	5.10, 7.00	5.10, 10.00	7.40, 9.50	7.40, 9.00	11.60, 8.50	12.40, 8.00	13.00, 7.50
	6	0.00, 0.00	1.60, 1.00	3.00, 1.50	4.20, 10.00	8.40, 9.50	8.00, 9.00	7.40, 8.50	7.20, 8.00	7.10, 7.50	6.80, 7.00	6.60, 6.50
	7	0.00, 0.00	0.90, 1.00	2.00, 1.50	2.60, 10.00	6.40, 9.50	5.90, 9.00	5.80, 8.50	11.10, 8.00	11.60, 7.50	11.90, 7.00	12.50 6.50
	8	0.00, 0.00	1.70, 1.00	3.20, 1.50	4.50, 10.00	5.60, 9.50	6.50, 9.00	7.20, 8.50	7.70, 8.00	8.00, 7.50	8.10, 7.00	8.30 6.50
	9	0.00, 0.00	1.90, 1.00	3.60, 1.50	5.10, 10.00	6.40, 9.50	5.50, 9.00	11.40, 8.50	12.00, 8.00	12.50, 7.50	13.20, 7.00	13.60 6.50
	10	0.00, 0.00	0.90, 1.00	1.60, 1.50	5.10, 10.00	5.10, 9.50	5.10, 9.00	7.40, 8.50	7.40, 8.00	11.60, 7.50	12.40, 7.00	13.00 6.50
	11	0.00, 0.00	1.60, 0.75	3.00, 2.20	4.20, 4.05	8.40, 6.00	8.00, 7.75	7.40, 9.00	7.20, 9.45	7.10, 8.80	6.80, 6.75	6.60 3.00
	12	0.00, 0.00	0.90, 0.75	2.00, 2.20	2.60, 4.05	6.40, 6.00	5.90, 7.75	5.80, 9.00	11.10, 9.45	11.60, 8.80	11.90, 6.75	12.50 3.00
	13	0.00, 0.00	1.70, 0.75	3.20, 2.20	4.50, 4.05	5.60, 6.00	6.50, 7.75	7.20, 9.00	7.70, 9.45	8.00, 8.80	8.10, 6.75	8.30 3.00
	14	0.00, 0.00	1.90, 0.75	3.60, 2.20	5.10, 4.05	6.40, 6.00	5.50, 7.75	11.40, 9.00	12.00, 9.45	12.50, 8.80	13.20, 6.75	13.60 3.00
	15	0.00, 0.00	0.90, 0.75	1.60, 2.20	5.10, 4.05	5.10, 6.00	5.10, 7.75	7.40, 9.00	7.40, 9.45	11.60, 8.80	12.40, 6.75	13.00 3.00
For $n \in [21, 42]$	1	12.00, 0.00	11.90, 0.75	11.60, 1.50	11.10, 2.00	10.40, 7.00	9.50, 10.00	8.40, 9.50	7.10, 9.00	5.60, 8.50	3.90, 8.00	2.00 7.50
	2	12.00, 0.00	11.90, 0.75	11.60, 1.50	11.10, 2.00	10.40, 7.00	9.50, 10.00	8.40, 9.50	7.10, 9.00	5.60, 8.50	3.90, 8.00	2.00 7.50
	3	12.00, 0.00	11.90, 0.75	11.60, 1.50	11.10, 2.00	10.40, 7.00	9.50, 10.00	8.40, 9.50	7.10, 9.00	5.60, 8.50	3.90, 8.00	2.00 7.50
	4	12.00, 0.00	11.90, 0.75	11.60, 1.50	11.10, 2.00	10.40, 7.00	9.50, 10.00	8.40, 9.50	7.10, 9.00	5.60, 8.50	3.90, 8.00	2.00 7.50
	5	12.00, 0.00	11.90, 0.75	11.60, 1.50	11.10, 2.00	10.40, 7.00	9.50, 10.00	8.40, 9.50	7.10, 9.00	5.60, 8.50	3.90, 8.00	2.00 7.50
	6	12.00, 0.00	11.90, 1.00	11.60, 1.50	11.10, 10.00	10.40, 9.50	9.50, 9.00	8.40, 8.50	7.10, 8.00	5.60, 7.50	3.90, 7.00	2.00 6.50
	7	12.00, 0.00	11.90, 1.00	11.60, 1.50	11.10, 10.00	10.40, 9.50	9.50, 9.00	8.40, 8.50	7.10, 8.00	5.60, 7.50	3.90, 7.00	2.00 6.50
	8	12.00, 0.00	11.90, 1.00	11.60, 1.50	11.10, 10.00	10.40, 9.50	9.50, 9.00	8.40, 8.50	7.10, 8.00	5.60, 7.50	3.90, 7.00	2.00 6.50
	9	12.00, 0.00	11.90, 1.00	11.60, 1.50	11.10, 10.00	10.40, 9.50	9.50, 9.00	8.40, 8.50	7.10, 8.00	5.60, 7.50	3.90, 7.00	2.00 6.50
	10	12.00, 0.00	11.90, 1.00	11.60, 1.50	11.10, 10.00	10.40, 9.50	9.50, 9.00	8.40, 8.50	7.10, 8.00	5.60, 7.50	3.90, 7.00	2.00 6.50
	11	12.00, 0.00	11.90, 0.75	11.60, 2.20	11.10, 4.05	10.40, 6.00	9.50, 7.75	8.40, 9.00	7.10, 9.45	5.60, 8.80	3.90, 6.75	2.00 3.00
	12	12.00, 0.00	11.90, 0.75	11.60, 2.20	11.10, 4.05	10.40, 6.00	9.50, 7.75	8.40, 9.00	7.10, 9.45	5.60, 8.80	3.90, 6.75	2.00 3.00
	13	12.00, 0.00	11.90, 0.75	11.60, 2.20	11.10, 4.05	10.40, 6.00	9.50, 7.75	8.40, 9.00	7.10, 9.45	5.60, 8.80	3.90, 6.75	2.00 3.00
	14	12.00, 0.00	11.90, 0.75	11.60, 2.20	11.10, 4.05	10.40, 6.00	9.50, 7.75	8.40, 9.00	7.10, 9.45	5.60, 8.80	3.90, 6.75	2.00 3.00
	15	12.00, 0.00	11.90, 0.75	11.60, 2.20	11.10, 4.05	10.40, 6.00	9.50, 7.75	8.40, 9.00	7.10, 9.45	5.60, 8.80	3.90, 6.75	2.00 3.00

This table shows pairs of physician n's profit and patient i's health benefit for each of the eleven alternatives $j \in [0, 10]$, i.e., (π_{nij}, H_{nij}). The mode of payment is fee-for-service and capitation for physicians $n \in [1, 20]$ and $n \in [21, 42]$, respectively.

where $\alpha_k = \alpha_n^d + \alpha_i^p$. The specification of Equation (3) is based on the prior expectation that the physician's representative utility, to some degree, may include the monetary value of the patient's health benefit in addition to personal monetary rewards resulting from alternative treatments. If there is any learning effect, such that the physician's utility from treating a patient is sensitive to the sequence of decisions, this effect is controlled for by the inclusion of α_k in the representative utility.

The coefficient β, which may be interpreted as the marginal utility of profit, is specified to be a fixed coefficient for all physicians. We will allow for the possibility that altruism shows variation between physicians. This implies that for some relatively altruistic physicians, the patient health benefit associated with alternative treatments would have a strong effect on physician utility, whereas for other, less altruistic physicians, the profit associated with alternative treatments would have a stronger effect on physician utility. The coefficient θ_n, which may be interpreted as the marginal utility of patients' health benefit, is therefore assumed to be specific to the individual physician, n, allowing for θ_n to reflect different degrees of altruism among physicians. Due to the fact that data facilitate observing the chosen treatment alternative among 15 independent choice sets for each physician, we are able to identify how HEALTHBENEFIT interacts with unobservable heterogeneity at the level of the decision maker, even when including a fixed effect at the level of the physician-patient coalition in our specification. The within decision-maker variation in PROFIT and HEALTHBENEFIT is exploited when identifying the marginal utilities. Physician-specific marginal utilities of HEALTHBENEFIT, θ_n, are identified by interacting HEALTHBENEFIT with unobservable physician-specific heterogeneity. Let $\theta_n = \mathbf{u}\boldsymbol{\gamma}_n$, where $\mathbf{u}$ is a $(1 \times N)$ vector of dummy variables such that component n of the vector equals 1 for observations describing physician n, and 0 for the $N-1$ other observations, etc. $\boldsymbol{\gamma}_n$ is a $(N \times 1)$ vector of coefficients assigned to a vector of interaction terms, allowing for marginal utility of HEALTHBENEFIT to show variation across decision makers.

The choice of the medical treatment is a qualitative choice. The assumptions about the unobservable and random components of utility determine the type of qualitative-choice model. Due to computational feasibility and convenience, the most popular class of qualitative-choice models is the logit model. A virtue of the logit model compared with other models, such as the probit model, is that its closed form renders the possibility of conditioning the fixed effect terms α_k out of the likelihood (Chamberlain 1980). The conditional log-likelihood function can be shown to not depend on α_k (Cameron and Trivedi

2005, p. 782), and maximizing the conditional log-likelihood function with respect to β and $\boldsymbol{\gamma}_n$ ensures consistent estimators. The crucial part of the assumptions underlying the standard multinomial logit model is that the random factors, ε_{kj}, are uncorrelated over alternatives, and have constant variance across alternatives. In the context of this paper, these assumptions seem to be quite reasonable since data are from a laboratory experiment. Let utility be expressed as

$$U_{kj} = \pi_{kj}\beta + H_{kj}\mathbf{u}\boldsymbol{\gamma}_n + \alpha_k + \varepsilon_{kj}. \tag{4}$$

Formally, we assume that each ε_{kj} is distributed independently, identically extreme value, type 1. As described by Train (2003, p. 79) the probability that coalition k chooses alternative j can then be expressed as

$$P_{kj} = \frac{e^{V_{kj}}}{\sum_l e^{V_{kl}}}.$$

The $N+1$ parameters β and $\boldsymbol{\gamma}_n$ are estimated by means of a multinomial logit regression with conditional fixed effect at the level of the physician-patient coalition k.

5 Results

In this section, we first present estimation results from the multinomial logit regression. Then, we use these estimates to investigate physicians' degree of altruism, i.e., physicians' marginal rates of substitution between own profit and patient's health benefit.

Estimation results shown in Table 2 indicate that the physician's own profit has a significant effect on the probability of choosing a particular medical treatment among alternatives. Moreover, Table 2 shows 42 estimated coefficients that capture the decision-maker specific impact of patients' health benefit on choice probabilities. We observe that the point estimates are positive for all physicians. Moreover, the patient's health benefit has a statistically significant effect on choice probabilities for the vast majority of physicians.

We now compute the marginal rate of substitution (MRS) between own profit and patient health benefit. The MRS for subject n is simply a non-linear combination of the estimated marginal utilities, and can be expressed as

$$MRS_n = \frac{\mathbf{u}\boldsymbol{\gamma}_n}{\beta}. \tag{5}$$

Table 2: Results from estimation of choice model by means of multinomial logit regression

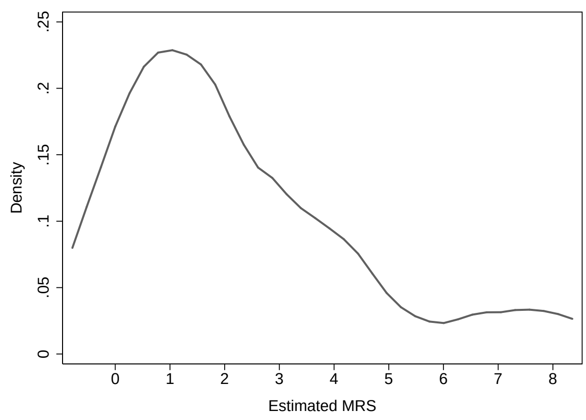
Variable	Estimate	Std. Err.
Profit	0.84**	0.06
$H * subject_1$	2.54**	0.45
$H * subject_2$	0.58*	0.27
$H * subject_3$	6.33**	1.24
$H * subject_4$	40.19	2976.63
$H * subject_5$	1.33**	0.40
$H * subject_6$	2.37**	0.44
$H * subject_7$	1.38**	0.40
$H * subject_8$	0.13	0.18
$H * subject_9$	2.88**	0.49
$H * subject_{10}$	1.00**	0.35
$H * subject_{11}$	0.21	0.19
$H * subject_{12}$	1.84**	0.42
$H * subject_{13}$	2.74**	0.47
$H * subject_{14}$	2.73**	0.47
$H * subject_{15}$	0.13	0.18
$H * subject_{16}$	1.72**	0.42
$H * subject_{17}$	40.19	2976.63
$H * subject_{18}$	3.47**	0.57
$H * subject_{19}$	1.07**	0.37
$H * subject_{20}$	3.51**	0.58
$H * subject_{21}$	0.57**	0.12
$H * subject_{22}$	0.68**	0.15
$H * subject_{23}$	3.64**	1.32
$H * subject_{24}$	4.36**	1.57
$H * subject_{25}$	0.04	0.08
$H * subject_{26}$	38.64	3333.41
$H * subject_{27}$	0.63**	0.14
$H * subject_{28}$	1.03**	0.28
$H * subject_{29}$	0.60**	0.13
$H * subject_{30}$	38.64	3333.41
$H * subject_{31}$	6.31**	2.31
$H * subject_{32}$	6.31**	2.31
$H * subject_{33}$	0.21**	0.07
$H * subject_{34}$	38.64	3333.41
$H * subject_{35}$	0.57**	0.12
$H * subject_{36}$	0.71**	0.16
$H * subject_{37}$	0.34**	0.08
$H * subject_{38}$	1.51**	0.47
$H * subject_{39}$	0.42**	0.09
$H * subject_{40}$	2.56**	0.90
$H * subject_{41}$	38.64	3333.41
$H * subject_{42}$	1.29**	0.38
No. of subjects		42
No. of observations		6930
Pseudo R^2		0.6808
Log likelihood		-637.64

* (**) Estimate is statistically different from zero at a 5% (1%) level in a two-sided z-test.

Figure 1 provides an overview of the distribution of the estimated MRS by physician. This kernel-density distribution is right-skewed with a peak at 1. First, this indicates that a substantial share of physicians put approximately equal weight on own profit and patients' health benefit. Second, it indicates a certain heterogeneity in physician altruism, with a majority of physicians putting more weight on the patients' health than on own profit.

In Table 3, we present the estimated MRSs and corresponding 95% confidence intervals

Figure 1: Distribution of physician altruism: the kernel density of physicians' marginal rate of substitution between profit and patient health benefit



To specify the density, the Epanechnikov kernel is used. Also note that those subjects are excluded with an insignificant coefficient from the multinomial logit regression (see Table 2), thus, the density plot comprises 36 estimated MRS.

for each of the 42 subjects in the experiment.[4] The results indicate that nine subjects (21%) are willing to give up less than one monetary unit of own net profit in order to improve health benefit by one monetary unit. If classified within the confines of the illustrative model in Section 2 these individuals would be alloted to case 1. The estimated MRS for thirteen physicians (31%) are not statistically different from 1. These individuals may be categorized as belonging to Case 2. The results also indicate that the other twenty individuals are willing to give up more than one monetary unit of own profit in order to increase the patient's health benefit with one unit, and these individuals may thus be categorized as Case 3. Interestingly, results indicate substantial variation in the MRS between physicians, and further that a substantial share of the physicians appear to be highly altruistic.

Moreover, we conducted several robustness checks of the results. We fitted several versions of the MNL model, and the results from these models are very close to the results presented. In particular, we fitted the model after removing all Pareto-dominated alternatives from the physicians' menus. Then, we fitted the model after removing six physicians who appear to be maximizing patients' health benefits.[5] Further, we fitted

[4]Standard errors necessary to compute confidence intervals are based on the delta method. For more on the delta method see, e.g., Hole (2007).

[5]These six physicians are subjects 4, 17, 26, 30, 34, and 41; see Table 2

Table 3: Estimates and 95% confidence intervals of the subjects' marginal rate of substitution between profit and patient health benefit

Subject	Estimate	95% conf. int.	
1	3.01***	2.01	4.02
2	0.69*	0.06	1.32
3	7.52***	4.68	10.36
4	47.73	-6881.30	6976.76
5	1.58***	0.67	2.49
6	2.81***	1.83	3.79
7	1.64***	0.72	2.57
8	0.16	-0.26	0.58
9	3.42***	2.33	4.50
10	1.18**	0.37	2.00
11	0.25	-0.19	0.69
12	2.18***	1.22	3.15
13	3.26***	2.20	4.31
14	3.24***	2.20	4.29
15	0.15	-0.27	0.56
16	2.04***	1.08	3.00
17	47.73	-6881.30	6976.76
18	4.12***	2.84	5.39
19	1.28**	0.43	2.12
20	4.17***	2.87	5.46
21	0.68***	0.40	0.96
22	0.81***	0.46	1.16
23	4.32**	1.21	7.42
24	5.18**	1.48	8.87
25	0.05	-0.13	0.24
26	45.89	-7713.65	7805.42
27	0.75***	0.43	1.07
28	1.23***	0.58	1.88
29	0.71***	0.42	1.01
30	45.89	-7713.65	7805.42
31	7.49**	2.07	12.92
32	7.49**	2.07	12.92
33	0.25**	0.09	0.41
34	45.89	-7713.65	7805.42
35	0.68***	0.40	0.96
36	0.84***	0.47	1.21
37	0.40***	0.22	0.58
38	1.79***	0.70	2.89
39	0.49***	0.29	0.70
40	3.04**	0.91	5.17
41	45.89	-7713.65	7805.42
42	1.53***	0.65	2.42

* (**) Estimate is statistically different from zero at 5% (1%) level in a two-sided z-test.

a model applying physician-specific fixed effect instead of case-specific fixed effect, still leading to estimation results very close to the ones presented above.

6 Concluding remarks

The present study investigates physician valuation of patient's health benefit—often referred to as physician altruism in the health economics literature—when deciding about the provision of medical care. Our results suggest that physicians attach a positive weight to patients' health, and further, that the magnitude of this weight is such that it is likely to constitute an important factor when designing payment mechanisms.

Also, our results indicate substantial heterogeneity in physician altruism, and such variation may also have implications for the design of payment schemes. Whenever a purchaser of medical care is constrained such that the same payment mechanism must be offered to each of the providers, a large variation in altruism makes it impossible for a regulator to implement an optimal payment mechanism motivating first-best service volume. A second or third best can, at best, be achieved (e.g., Jack 2005). Our results indicate that the purchaser would need to set the rate of supply-side cost sharing such that the altruistic physicians harvest rents in order to ensure participation among the less altruistic providers. Consequently, non-binding participation constraints will be the case for a substantial share of the physicians in the market. Further, the results indicate that inclusion of any positive fee-for-service payment is likely to result in overprovision of care. For the majority of physicians, overprovision of care will result even when the fee-for-service payment is less than marginal costs: our estimation results imply that 79% of respondents will provide more than optimal quantity of care if offered any positive fee-for-service payment. Hence, our results strongly support the inclusion of a capitation component in the payment mechanism.

An important feature of Hennig-Schmidt et al.'s experimental design is that more services for one patient do not imply opportunity costs in the form of fewer services for another patient. The results should, thus, be interpreted in a context of excess capacity. A policy implication would thus be that implementing payment mechanisms consisting dominantly of fee-for-service payment, is inefficient in situations of physician abundance.

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