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Jeannette Brosig-Koch
Heike Hennig-Schmidt
Nadja Kairies
Daniel Wiesen

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Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Editorial Office

Joachim Schmidt
RWI, Phone: +49 (0) 201/81 49-292, e-mail: joachim.schmidt@rwi-essen.de

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Jeannette Brosig-Koch, Heike Hennig-Schmidt, Nadja Kairies, and Daniel Wiesen[1]

How to Improve Patient Care? – An Analysis of Capitation, Fee-for-Service, and Mixed Payment Schemes for Physicians

Abstract

In recent health care reforms, several countries have replaced pure payment schemes for physicians (fee-for-service, capitation) by so-called mixed payment schemes. Until now it is still an unresolved issue whether patients are really better off after these reforms. In this study we compare the effects resulting from pure and mixed incentives for physicians under controlled laboratory conditions. Subjects in the role of physicians choose the quantity of medical services for different patient types. Real patients gain a monetary benefit from subjects' decisions. Our results reveal that overprovision observed in fee-for-service schemes and underprovision observed in capitation schemes can, in fact, be reduced by mixed incentives. Interestingly, even the presentation of pure incentives as mixed incentives already significantly affects physicians' behavior. Moreover, the mixed payment schemes generally provide a higher benefit-remuneration ratio than the respective pure payment schemes. Our findings provide some valuable insights for designing health care reforms.

JEL Classification: C91, I11

Keywords: Physician incentive schemes; fee-for-service; capitation; mixed payment; laboratory experiment; presentation effect; benefit-remuneration analysis

April 2013

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[1] Jeannette Brosig-Koch, Nadja Kairies, Daniel Wiesen, University of Duisburg-Essen; Heike Hennig-Schmidt, University of Bonn. – Financial support provided by the Deutsche Forschungsgemeinschaft (German Research Foundation) is gratefully acknowledged. – All correspondence to Jeannette Brosig-Koch, University of Duisburg-Essen, Faculty of Economics and Business Administration, Universitätsstr. 12, 45117 Essen, Germany, E-Mail: jeannette.brosig-koch@ibes.uni-due.de.

1. Introduction

Traditionally, capitation (CAP) and fee-for-service (FFS) schemes were predominantly used to pay physicians in health care. With CAP physicians receive a fixed monetary amount for each patient assigned to them – irrespective of the quantity of medical care provided. FFS schemes pay a fixed amount of money for each medical service offered. Both payment schemes might incentivize physicians to deviate from the optimal treatment of their patients, however. While, with CAP, physicians are incentivized to provide less care than being optimal for their patients, FFS schemes embed an incentive to deliver more than the optimal level of medical service (see, e.g., Ellis and McGuire, 1986, or McGuire, 2000). This might result in detrimental effects for patients' health (see, e.g., McGuire, 2000). In order to counteract possible negative incentive effects for patients' health, recent reforms in the European and North American health care systems have replaced pure payment schemes by so-called mixed payment schemes or remuneration, i.e. schemes that combine CAP and FFS. As theoretically argued by Ellis and McGuire (1986), such mixed schemes can reduce the deficiencies of pure schemes.

Although, mixed payment schemes are often assumed as a 'cure' to the negative effect caused by pure incentives, comparisons of the consequences of both payment schemes, respectively, have received little attention in the empirical literature yet. Some studies suggest, at least, that patients are better off after this replacement using indirect measures to analyze the impact on patients' health benefit. For example, Krasnik et al. (1990) conducted a panel study in Denmark and found that general practitioners respond to a replacement of pure lump-sum payments by CAP supplemented by a FFS component by raising diagnostic and curative services and decreasing referrals to secondary care. Concerning referral rates, Iversen and Lurås (2000) obtain a similar result for Norway. They observe that referrals from primary to secondary care revealed by Norwegian general practitioners are larger under a CAP-scheme with a reduced FFS-component than under a scheme with a fixed payment (practice allowance component) complemented by a FFS-payment. The increase in referral decisions may, however, not only be attributable to CAP, but rather to the lower FFS-component. Dumont et al. (2008) analyze data on primary care services from the Canadian province Quebec before and after a variation from FFS to a mixed scheme with a base wage and a reduced FFS payment. Their results suggest that physicians respond to the mixed incentives by reducing the volume of services, but increasing the time spent per service and per nonclinical service. Also employing data from the Quebec payment reform, Échevin and Fortin (2011) analyze hospital patients' length of stay and risk of readmission. They find that the hospital length of stay of patients treated in departments under a mixed payment scheme increased substantially. Nevertheless, the risk of readmission with the same diagnosis does not appear to be overall affected by the reform.

Some field studies focusing on pure payment schemes find a rather weak or even no relationship between physicians' payment and their supply of medical services (see Gosden et al., 2001, or Sørensen and Grytten, 2003, for an overview). For example, Hutchinson et al. (1996) compare hospital utilization rates in Ontario (Canada) under FFS and CAP incentives and do not find any difference. Similarly, Hurley and Labelle (1995) conclude that the responses to pure payment incentives among Canadian physicians are rather mixed. After controlling for characteristics of patients and physicians, Grytten and Sørensen (2001) report that the impact of payment schemes on Norwegian physicians' behavior is rather small.

Since many of the field studies vary more than one component of the payment scheme simultaneously or might suffer from selection biases regarding patient characteristics, causal inferences on the direction and the strength of an effect are rather difficult. In addition, these studies are often based on self-reports which are not unlikely to differ from actual behavior (e.g., Camerer and Hogarth, 1999). In order to overcome some of the methodological deficiencies, Fuchs (2000) proposed to incorporate economic experiments as a complementary method to field studies in health economic research. Hennig-Schmidt et al. (2011) are among the first ones to follow this research agenda. They experimentally investigate the behavioral effects of FFS and CAP under controlled laboratory conditions. Their results demonstrate that these payment incentives significantly influence physician provision behavior. That is, they find support for the theoretically predicted underprovision with capitation and overprovision with fee-for-service, though patient benefits prove to be important as well.

Our study investigates the effects on physicians' provision behavior and consequences for patients' health that are associated with a replacement of pure payment incentives by mixed incentives. We base our study on controlled laboratory experiments, similar to Hennig-Schmidt et al. Our experimental design of pure payment incentives differs in three important aspects from the one of Hennig-Schmidt et al. (2011), however. First, our design allows directly comparing the two pure payment schemes and different mixtures of them with each other. Second, it allows identifying physician's responses to specific patient characteristics. Third, it allows assessing the effects of budget variations which often accompany a change of payment schemes. In contrast to field data, the experimental data allows measuring the impact of pure and mixed payment schemes directly on patients' health.

Our experiment particularly addresses the following questions: Do patients benefit from mixed incentives? That is, do mixed payment schemes mitigate over- and underprovision as predicted by theory (Ellis and McGuire, 1986)? Do the observed effects depend on specific patient characteristics? That is, how do the patient's illness and the severity of this illness affect the physician's behavior? Does it pay off for policy-makers in health care to implement mixed incentives? That is, does the 'patient benefit-physician remuneration' ratio improve with a mixed payment scheme?

The paper is organized as follows. Section 2 presents our experimental design and procedure. The results are provided in section 3. Section 4 summarizes our findings and concludes.

2. Experimental design and procedure

The aim of this study is to analyze the impact of different payment schemes on physicians' supply of medical services and on the patients' health benefits. Except for these schemes, no other experimental parameter is varied. The experiment, thus, allows for a controlled *ceteris paribus* analysis of the payment method.

In all experimental conditions subjects face the following decision situation: Each subject decides in the role of a physician and chooses a quantity of medical services for a given patient whose health benefit is influenced by that choice. More specifically, physician i decides on the quantity of medical services $q = \{0, 1, \dots, 10\}$ for nine patients $j \in [0,1, \dots ,9]$. Patients differ in their illnesses $k \in [A, B, C]$ and in the severities $l \in [x, y, z]$ of these illnesses. The physician receives a certain payment which depends on the experimental condition (see below) and has to bear costs that depend on the quantity of medical services he or she chooses. Costs are assumed to be $c_{kl}(q) = 0.1 \cdot q^2$ in all conditions.[1] With each decision, the physician simultaneously determines her profit π_{kl}^{i} (payment *R* – cost *c*) and the patient's health benefit B_{kl}, both measured in monetary terms. The patient is assumed to be passive and fully insured, accepting each level of medical service provided by the physician.

A common characteristic of the patient benefit functions is a global optimum on the quantity interval [0,10] (see Figure 1).[2] Illnesses A, B, C each imply a different level of health benefit. In particular, illnesses are modeled in a way that each illness is characterized by a different level of maximum health benefit $B_{Al}(q^*) = 7$, $B_{Bl}(q^*) = 10$, and $B_{Cl}(q^*) = 14$ and a certain slope of the benefit function (i.e., a certain change of benefit resulting from an additional unit of medical service). While the slope of the benefit function is the same for illnesses A and B, it is different for illness C. The optimal quantity q^* yielding patients the maximum health benefit $B_{kl}(q^*)$ from medical services depends only on the severity of an illness – moderate (x), intermediate (y) and severe (z). In our experiment, the patient's optimal quantities are $q^* = 3$ for severity *x*, $q^* = 5$ for severity *y*, and $q^* = 7$ for severity *z.* Taking q^* as the benchmark for the optimal medical treatment for the patient, we can identify overprovision and underprovision, respectively.[3] The optimal amount of medical services is specified for each patient and is known to the physician. Thus, there is no uncertainty about the impact of the chosen quantity of medical services on the patients' health benefit, and behavioral patterns like defensive medicine (see, e.g., Kessler and McCellan, 1996) can be neglected.

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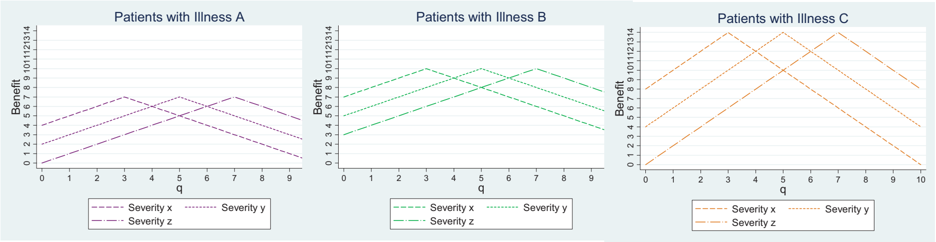
[1] In line with the theoretical literature, we assume convex cost functions (e.g., Ma, 1994, and Choné and Ma, 2010).

[2] A concave patient benefit function has been widely assumed in theoretical papers (see, e.g., Ellis and McGuire, 1986, Ma, 1994, Choné and Ma, 2010).

[3] From a medical point of view there might be several acceptable treatment variations among different physicians. This is not addressed in our simplified experimental setup. We, rather, assume that a specific amount of medical services renders the optimal health benefit to a patient.

Figure 1: Benefit functions for illnesses k and severities l



Patients are not actual subjects participating in the experiment. Real patients' health outside the lab is affected by decisions in the experiment, however. Subjects are informed accordingly, i.e., they know that the monetary equivalent to the patient benefit resulting from their decisions is transferred to a charity caring for real patients (the *Christoffel Blindenmission*, see also section 2.2.).

In order to study the change of payment schemes, we employ a within-subject design. That is, each subject participates in a session consisting of two parts. In part *I*, subjects decide under a pure payment scheme – either CAP or FFS. In part *II*, they decide under a mixed payment scheme (in the following labeled as MIX) – either with more weight on FFS or on CAP. Besides the within-subject comparison of pure and mixed incentive schemes (part *I* vs. part *II*), this design also allows for an across-subject comparison of the two pure incentive schemes in part *I* as well as of the different mixed incentives schemes in part *II*. In the following, the experimental conditions, i.e. payment schemes, are explained in more detail.

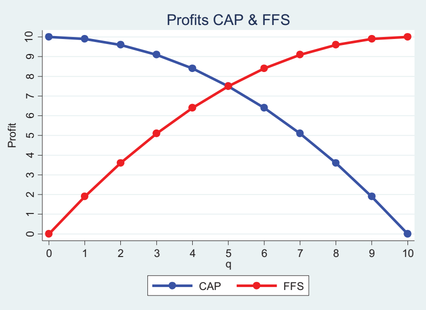
2.1. Experimental conditions

2.1.1. Pure payment schemes

Under CAP, each physician receives a lump-sum payment per patient of 10 regardless of illness k and severity l, i.e. $R = LS = 10$. Physician i's profit per patient is thus $\pi_{kl}^{i}(q) = 10 - c_{kl}(q)$. Under FFS, physicians are paid a fee of $p = 2$ per service they provide, i.e. $R(q) = 2q$ independent of illnesses k and severities l of an illness. Accordingly, physician i's profit per patient is $\pi_{kl}^{i}(q) = 2q - c_{kl}(q)$.

The maximum profit a physician can achieve is equal for both pure payment schemes, i.e. $\hat{\pi}_{kl}^{CAP} = \hat{\pi}_{kl}^{FFS} = 10$. Moreover, the marginal changes of profits are also the same in CAP and FFS. The only difference between the two schemes is the profit maximizing quantity of medical services $\hat{q}$, which is 0 for CAP and 10 for FFS. Quantity $\hat{q}$ does not depend on illness k and severities l of an illness. See Figure 2 for the profit functions in CAP and FFS (and Appendix B for the complete set of parameter values).

Figure 2: Profit functions in the pure payment schemes CAP and FFS



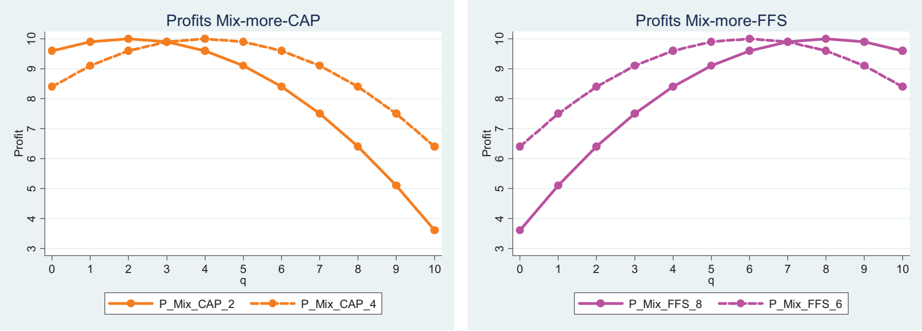
2.1.2. Mixed payment schemes

The mixed payment schemes comprise both a lump-sum and a fee-for-service component. More formally, $R_{kl} = \mu LS + (1-\mu)pq$. In the *MIX-more-CAP schemes,* we put more weight on the lump-sum component. To ensure that the maximum profit in MIX-more-CAP is the same as in the pure payment schemes (i.e., that physicians can earn as much under the pure as under the mixed schemes) the fee-for-service component p is adjusted. We implemented two schemes: MIX-more-CAP(2) and MIX-more-CAP(4). In MIX-more-CAP(2), the profit maximizing quantity $\hat{q}$ is 2, the weight of the lump-sum component μ is 0.96, and the fee per service p is 10. Accordingly, the payment for the physician is $R_{\text{MIX-more-CAP(2)}}$ = $(0.96)10$ + $(0.04)10q$. In MIX-more-CAP(4), the values are $\hat{q} = 4$, $\mu = 0.84$, and $p = 5$, i.e., $R_{\text{MIX-more-CAP(4)}}$ = $(0.84)10$ + $(0.16)5q$.

In the *MIX-more-FFS schemes*, the FFS component has a higher weight. To guarantee that the maximum profit is the same as in the MIX-more-CAP and pure payment schemes, we adjusted the lump-sum component LS. Again, we implemented two schemes: MIX-more-FFS(8) and MIX-more-FFS(6). In MIX-more-FFS(8), $\hat{q} = 8$, the weight of the FFS component $(1-\mu)$ is 0.80, and the lump-sum payment is 18. Accordingly, the payment for the physician is $R_{\text{MIX-more-FFS(8)}}$ = $(0.20)18$ + $(0.80)2q$. In MIX-more-FFS(6), the values are $\hat{q}_{kl} = 6$, $(1-\mu) = 0.60$, and $LS = 16$, i.e. $R_{\text{MIX-more-FFS(6)}}$ = $(0.40)10$ + $(0.60)2q$.

The profit functions of the MIX schemes are illustrated in Figure 3. By choosing $\hat{q} = 2$ and 4 in the MIX-more-CAP schemes and by choosing $\hat{q} = 6$ and 8 in the MIX-more-FFS schemes, we ensure that profit maxima are closer to the patient optima than in the pure payment schemes, but do not coincide with them. That is, we reduced the trade-off between profit-maximization and benefit maximization, though this trade-off does not vanish completely.

Figure 3: Profit functions in the mixed payment schemes

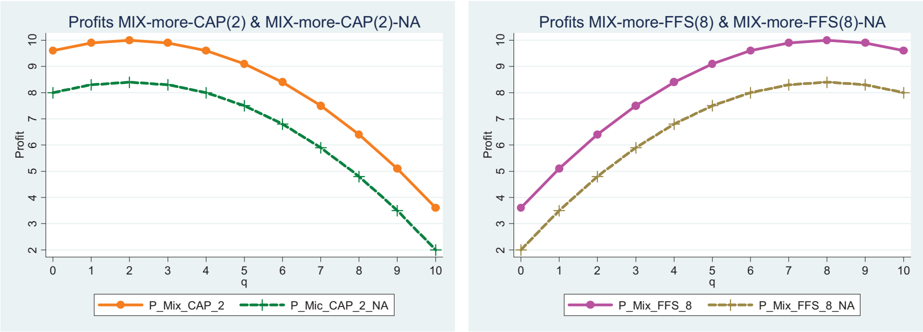


Keeping the maximum profit constant across pure and mixed payment schemes comes at the cost that the fee-for-service component and the lump-sum component have to be adjusted in the MIX schemes. Implementing the components from the pure schemes and using the same profit maximum quantities $\hat{q}_{kl}$ as in the MIX schemes would imply a lower profit maximum for the physician in the resulting 'non-adjusted' mixed payment schemes. That is, under these schemes it would not be possible for the physician to earn as much as under the pure payment schemes. This might significantly decrease physicians' incentives to consider the patient health benefit compared to the 'adjusted' mixed schemes.

From a perspective of a policy-maker not only the nature of physicians' payment schemes and the resulting incentives on physicians’ behavior, but also the total cost for physicians' remuneration are relevant to judge upon the effectiveness of a reform of payment schemes. Accordingly, the total expenditures resulting from the different payment schemes have to be estimated. As long as we can assume that physicians are rational and purely selfish decision-makers, they will always choose the profit maximum and the total expenditure for the third-party payer is the same in the pure as in the 'adjusted' mixed schemes, while it is lower in the 'non-adjusted' mixed schemes. But if we assume, e.g., that physicians choose each possible quantity of medical service with equal probability, then the expected total expenditure in an 'adjusted' mixed scheme is higher than that in a pure scheme (which is equal to the one in the 'non-adjusted' mixed scheme).

In order to control for the incentive and expenditure effects that are associated with a lower profit maximum, we run two additional conditions with 'non-adjusted' mixed schemes, one with more weight on CAP and another with more weight on FFS. The two non-adjusted schemes are labeled MIX-more-CAP(2)-NA and MIX-more-FFS(8)-NA. Implementing these schemes should give more insights into the policy-makers' trade-off between introducing an effective mixed incentive scheme and keeping the total expenditure for physicians’ payment constant. The scheme MIX-more-CAP(2)-NA is designed in a way that, first, both $R^{CAP} = LS = 10$ and $R^{FFS} = 2q$ from the pure payment schemes are included and, second, the physician's profit maximum is at $\hat{q}_{kl} = 2$ as in MIX-more-CAP(2). The weight on the lump-sum component μ is chosen such that these two criteria are met, i.e., $\mu = 0.80$. Also in scheme MIX-more-FFS(8)-NA, both $R^{CAP} = LS = 10$ and $R^{FFS} = 2q$ are included while the physician's profit maximum is at $\hat{q}_{kl} = 8$ as in MIX-more-FFS(8). The weight attached to the FFS component $(1-\mu)$ is 0.80. The profit functions used in the two control conditions are illustrated in Figure 4. As this Figure reveals, the physician's maximum profit in the non-adjusted payment schemes is equal to 8.40 and, thus, lower than that in the pure and the non-adjusted mixed schemes (which is equal to 10).

Figure 4: Profit functions in the non-adjusted mixed payment schemes



Profits MIX-more-CAP(2) & MIX-more-CAP(2)-NA

Profits MIX-more-FFS(8) & MIX-more-FFS(8)-NA

2.1.3. Presentation and experience effects

In condition CAP-Presentation, we aim to test whether already the presentation of the payment scheme – either as a CAP or as a mixed scheme – influences physicians' behavior. That the presentation of monetary rewards alone can substantially affect behavior has been demonstrated in a number of studies (see, e.g., Pruitt 1967, 1970, Selten and Stoecker, 1986, Hannan et al., 2005, Gürerk and Selten, 2012, and Hossain and List, 2012).[4] For example, in a field experiment on an agricultural company, Englmaier et al. (2012) observe that a higher salience of incentives for quantity (i.e., the piece-rate) tends to increase the total amount of lettuce harvested. It is an open question whether such effects also translate to the presentation of physicians' payment schemes, however.

In order to isolate the effect of presentation, we design incentives, i.e., physicians' profit functions, in a way that they are exactly the same for both, part I and II. Only *how* the payment is presented to physicians (either as CAP or as mixed payment) differs between the two parts. This design allows us to identify the impact of the presentation on physicians' behavior at a within-subject level. To implement equal profits in a pure and a mixed scheme, we choose the cost function c_{kl}^{Pres} and the lump-sum payment per patient LS^{Pres} such that profits in the pure payment scheme CAP^{Pres} are exactly the same as those in the non-adjusted mixed payment scheme Mix-more-CAP(2)-NA. That is, in part I physician *i*

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[4] See also the extensive literature on framing effects, i.e. effects that are caused by "*the decision-maker's conception of the acts, outcomes, and contingencies associated with a particular choice*" (Tversky and Kahneman, 1981, p. 453). While the seminal paper in this field was provided by Tversky and Kahneman (1981), more recent literature is surveyed by Kühberger (1998) and Levin et al. (1998).

receives $\pi^i_{kl}(q) = 15 - c^{Pres}_{kl}(q)$, with $c^{Pres}_{kl}(q) = 0.1q^2 - 0.4q + 7$. Costs c^{Pres}_{kl} are convex on the quantity interval $[0,10]$ with a minimum at 2 medical services.

In addition to the effect of presentation, we control for the effect of experience. That is, we control whether being confronted with a pure payment scheme in the part I affects decisions made in part II. Since the aim of our study is to test the replacement of pure payment schemes by mixed schemes, choosing a within-subject design (i.e., asking for their decisions in both payment schemes consecutively) is an appropriate approach.[5] Nevertheless, it might be interesting to isolate the behavioral effects which are due to the experience of subjects made in a pure payment scheme. Accordingly, in conditions MIX-more-CAP(4) and MIX-more-FFS (6), we implement the two mixed payment schemes without running a pure payment scheme beforehand. All experimental conditions and the number of participants are summarized in Table 1.

Table 1: Experimental conditions

Name	Condition	Part *I*	Part *II*	# Subjects
A-C2	CAP–MIX-more-CAP(2)	CAP	MIX-more-CAP(2)	22
A-C4	CAP–MIX-more-CAP(4)	CAP	MIX-more-CAP(4)	24
A-F8	FFS–MIX-more-FFS(8)	FFS	MIX-more-FFS(8)	24
A-F6	FFS–MIX-more-FFS(6)	FFS	MIX-more-FFS(6)	24
NA-C2	CAP–MIX-more-CAP(2)-NA	CAP	MIX-more-CAP(2)-NA	22
NA-F8	FFS–MIX-more-FFS(8)-NA	CAP	MIX-more-FFS(8)-NA	22
P-C2	CAP-Presentation	CAP^{Pres}	MIX-more-CAP(2)-NA	24
Ex-C4	MIX-more-CAP(4)	MIX-more-CAP(4)	–	23
Ex-F6	MIX-more-FFS (6)	MIX-more-FFS(6)	–	20

2.2. Experimental protocol

The computerized experiment was programmed with z-Tree (Fischbacher, 2007) and conducted at elfe, the Essen Laboratory for Experimental Economics at the University of Duisburg-Essen, Germany. Overall 205 students from the University of Duisburg-Essen participated in our experimental sessions. They were recruited by the online recruiting system ORSEE (Greiner, 2004).[6] Since we did not observe significant differences between decisions of medical students (who are supposed to become physicians in the future) and non-medical students in CAP and FFS, respectively (CAP/FFS: p=0.1880/0.1274, Fisher Pitman Permutation test for two independent samples (FPPI), two-sided), our subject pool is not restricted to students with a background in medicine.

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[5] See, e.g., Kagel and Roth (2000) who use a similar approach to test the performance of centralized clearinghouse mechanisms.

[6] Students who registered in ORSEE to participate in laboratory experiments at the Essen Laboratory for Experimental Economics were invited via automatically generated e-mails and registered for a special session. We can thus say that subjects were randomly allocated to the experimental conditions. Moreover, subjects were not informed about the content of the experimental conditions unless they participated in a session.

The procedure was as follows: Upon arrival, subjects were randomly allocated to the cubicles. Then, they were given plenty of time to read the instructions for part *I* and to ask clarifying questions which were answered by the same experimenter in private. Subjects were informed that the experiment consisted of two parts, but received detailed instructions for part *II* only after having finished part *I* of the experiment. To check for subjects' understanding of the decision task, they had to answer a set of control questions. The experiment did not start unless all subjects had answered the control questions correctly. In each of the two parts of the experiment, subjects then subsequently decided on the quantity of medical service for each of the nine patients, i.e. for each possible combination of illnesses and severities. The order of patients was randomly determined and kept constant for all subjects in all conditions (see Table 2).

Table 2: Randomized order of illnesses and severities of illness

Patient *j*	1	2	3	4	5	6	7	8	9
Illness *k*	B	C	A	B	B	A	C	A	C
Severity *l*	*x*	*x*	*z*	*Y*	*z*	*y*	*z*	*x*	*y*

Before making their decision for a specific patient, subjects are informed about their payment, their cost and profit, as well as about the patient's benefit for each quantity from 0 to 10. All monetary amounts are given in Taler, our experimental currency unit, the exchange rate being 1 Taler = €0.08.[7] The procedure was exactly the same in part II of the experiment.

When all subjects had made their decisions, we randomly determined one decision in each part of the experiment to be relevant for a subject's actual payoff and the patient benefit. After the experiment, subjects were paid in private according to these two randomly determined decisions and were dismissed.

To verify that the money corresponding to the sum of patient benefits in a session was actually transferred, we applied a procedure similar to the one used in Hennig-Schmidt et al. (2011) and Eckel and Grossman (1996). To this end, one of the participants was randomly chosen to be the monitor. After the experiment, the monitor verified that an order on the aggregated benefit in the respective session was written to the financial department of the University of Duisburg-Essen to transfer the money to the *Christoffel Blindenmission*. The order was sealed in an envelope and the monitor and experimenter then walked together to the nearest mailbox and deposited the envelope. The monitor was paid an additional €5.

Sessions lasted for about 70 minutes. Subjects earned, on average, €15.74. The average benefit per patient was €12.94. In total, €2,652.70 were transferred to the *Christoffel Blindenmission*. The money supported surgical treatments of cataract patients in a hospital in Masvingo (Zimbabwe) staffed by ophthalmologists of the *Christoffel Blindenmission*.

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[7] Instructions (including examples of the decision screen) and control questions are included in Appendix A.

Average costs for such an operation amounted to about €30. Thus, the money from our experiment allowed treating 88 patients.[8]

3. Results

3.1. Provision behavior under pure payment schemes

Before investigating the behavioral effects of introducing mixed incentive schemes, we compare physician's choices made in the two pure payment schemes of parts *I* of the MIX conditions. Aggregate data on decisions made in the pure payment schemes is included in Table 3.

Table 3: Descriptive statistics for behavior under pure payment schemes

Name	Condition	Part *I*	
		Mean	s.d.
A-C2	CAP–MIX-more-CAP(2)	3.04	2.08
A-C4	CAP–MIX-more-CAP(4)	3.44	1.90
A-F8	FFS–MIX-more-FFS(8)	7.57	2.34
A-F6	FFS–MIX-more-FFS(6)	7.19	1.94
NA-C2	CAP–MIX-more-CAP(2)-NA	2.78	1.96
NA-F8	FFS–MIX-more-FFS(8)-NA	6.89	2.10

In the experimental conditions A-C2, A-C4, and NA-C2, we used the same CAP payment scheme in part *I* of the experiment. Since physicians' choices under this payment scheme do not differ significantly between the three conditions either on the aggregate level (p>0.1398) or on the patient level, except for three of the 3x9 comparisons (A2-C2/A-C4: patient 3 p=0.0900, A-C2/NA-C2: patient 1 p=0.0480, A-C4/NA-C2: patient 7 p=0.0520, FPPI, two-sided), we pool data over these CAP conditions when analyzing the incentive effects of the two pure payment schemes. Similarly, in conditions A-F8, A-F6, and NA-F8, we used the same FFS payment scheme in part *I*. Since physicians' choices under FFS do not differ significantly between these conditions either on the aggregate level (p>0.2140) or at the patient level except for one of the 3x9 comparisons (A-F8/NA-F8: patient 9 p=0.0686, FPPI, two-sided), we also pool data over these FFS conditions in our analysis of pure payment schemes.

Comparing physicians' quantity choices between the CAP and the FFS payment schemes for all three illnesses k and severities l reveals that physicians do respond to financial incentives. We particularly observe that patients are underprovided in CAP and that they are overprovided in FFS (see Figures 5 and 6). That is, the quantity chosen by the physician is lower in CAP and higher in FFS than the quantity yielding the maximum health benefit for the patient. This effect is significant for all patients (p<0.0002, Wilcoxon-signed-rank-test, two-sided).

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[8] Subjects were not informed about the money being assigned to a developing country to avoid motives like compassion.

Figure 5: Benefit functions, profit functions, and average quantities per severity in CAP

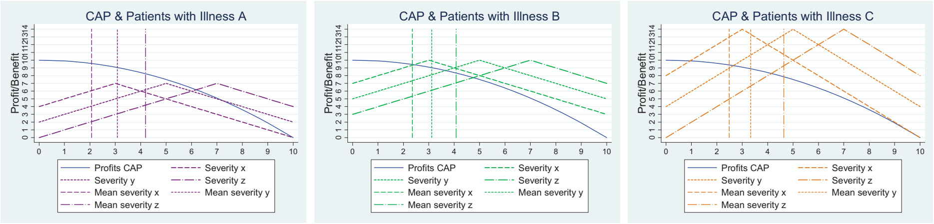
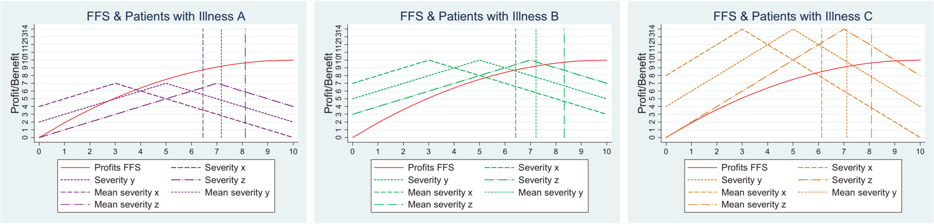
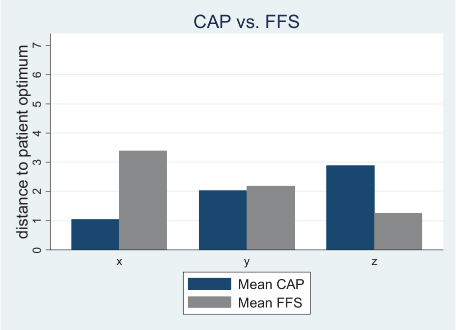


Figure 6: Benefit functions, profit functions, and average quantities per severity in FFS



Our results, thus, confirm the significant underprovision with capitation and the significant overprovision with fee-for-service observed for different parameters by Hennig-Schmidt et al. (2011). Our results, thus, also relate to earlier field studies by Gaynor and Gertler (1995) or by Gaynor and Pauly (1990). However, we extend the findings on pure payment schemes insofar as we systematically vary benefit functions representing certain characteristics of a patient. Accordingly, we are able to associate the degree of underprovision and overprovision, respectively, with these patient characteristics. In particular, we find that, under both pure payment schemes and in all conditions, physicians' decisions do significantly respond to the severity of an illness ($p<0.0054$), but hardly to the illness itself ($p>0.1049$, except for two of the 3x2x3 comparisons where $p<0.0135$, Fisher Pitman Permutation test for paired replicates (FPPP), two-sided). That is, neither the level of patient health benefit that could be maximally realized by the physician, nor the increase (and decrease, respectively) of health benefit that results from an additional unit of medical service (both are implied by an illness; see Section 2.1.1) systematically affects physicians' behavior. Only the quantity yielding the maximum health benefit (which is implied by the severity of an illness) clearly influences the choice of medical services. The more the optimum quantity for the patient deviates from the profit maximizing quantity for the physician, the more underprovision in CAP and overprovision in FFS, respectively, is observed. More specifically, calculating the distance between the quantity chosen by the physician and the quantity that is optimal for the patient we find that this distance significantly increases the more severe the illness is in CAP and the less severe the illness is in FFS ($p<0.0000$, FPPP, two-sided). Figure 7 illustrates these findings. In the following, we pool physicians' decisions over the three illnesses A, B, C.

Figure 7: Distance between patient optimum and chosen quantity per severity



Finally, due to the symmetry of our pure payment schemes we are able to test whether incentives to underprovide in CAP are equally strong as incentives to overprovide in FFS. From a psychological point of view, people might regard choosing a higher quantity of medical services for the patient (which is incentivized in FFS) less severe than omitting this quantity from the patient (which is incentivized in CAP) - though, in our experiment the loss of benefit for the patient is the same in both cases. Accordingly, the problem of overprovision in FFS might be more severe than the problem of underprovision in CAP. Comparing the distance between the quantity chosen by the physician and the quantity that is optimal for the patient between the two pure payment schemes does not support this supposition, however (CAP: 1.99 vs. FFS: 2.28; p=0.2754, FPPI, two-sided).[9]

Result 1 (Provision behavior under pure payment schemes)
We observe significant underprovision with CAP and significant overprovision with FFS. The deviations from the patient optimal quantity of medical services observed with the two payment schemes are equally severe. Under both schemes, the severity of an illness has a significant and systematic effect whereas the illness itself does not.

3.2. Comparison of pure and mixed payment schemes

Effects from changes of the payment method from a pure to a mixed scheme on physician provision behavior can be identified by our within-subject design. Aggregate data on decisions in the mixed payment schemes is included in Table 4. Note that, also in the mixed schemes, physicians' decisions hardly ever respond to the patient's illness (p>0.1049, except for A-F6: A vs. B p=0.0017 and B vs. C p=0.0134), but they do significantly so to its severity (p<0.0053, FPPP, two-sided). Accordingly, we pool physicians' decisions in the mixed payment schemes over the three illnesses A, B, C for all subsequent analyses.

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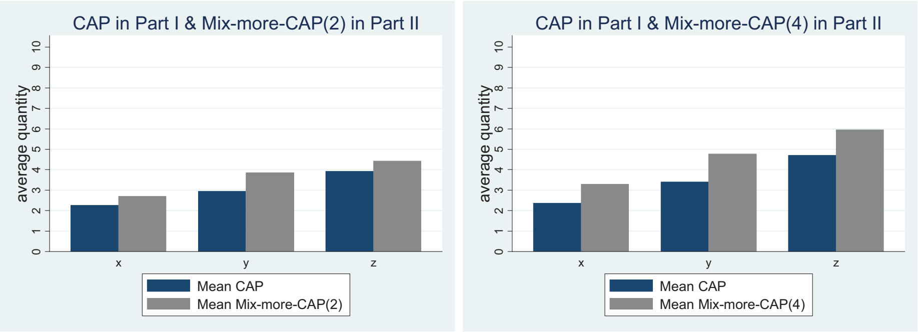
[9] Symmetry for the distance to the patient optimum holds also for comparisons of Mix-more-CAP(2) with Mix-more-FFS(8), and Mix-more-CAP(4) with Mix-more-FFS(6). Also between the symmetric mixed incentive schemes we find no significant difference regarding this distance (p>0.2283, FPPI, two-sided).

Table 4: Descriptive statistics for behavior under mixed payment schemes

Name	Condition	Part *II*	
		Mean	s.d.
A-C2	CAP–MIX-more-CAP(2)	3.66	1.74
A-C4	CAP–MIX-more-CAP(4)	4.65	1.32
A-F8	FFS–MIX-more-FFS(8)	6.92	1.73
A-F6	FFS–MIX-more-FFS(6)	5.62	1.21
NA-C2	CAP–MIX-more-CAP(2)-NA	3.46	1.43
NA-F8	FFS–MIX-more-FFS(8)-NA	6.50	1.53

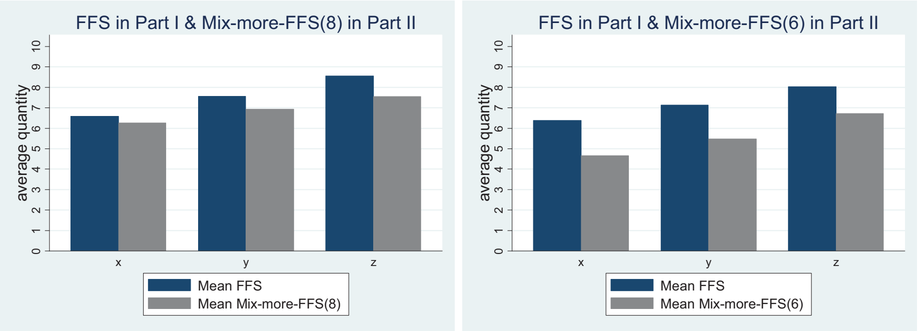
Comparing behavior of physicians in the pure CAP payment scheme (in part *I)* with their behavior in the respective (adjusted) MIX-more-CAP scheme (in part *II)* yields a significantly higher provision of services in the latter (A-C2: over all severities p=0.0017; differentiated per severity p≤0.0000; A-C4: average over all severities p=0.000; differentiated per severity: p≤0.0416, FPPP, two-sided). That is, introducing a mixed payment scheme that yields the same profit maximum as in CAP significantly reduces the underprovision observed in CAP. This effect increases with decreasing lump-sum component in the mixed payment scheme (0.96 in MIX-more-CAP(2) vs. 0.84 in MIX-more-CAP(4); p=0.0002, FPPI, two-sided). Though, in both mixed schemes and for all severities there is still a significant deviation from the quantity of medical services that is optimal for the patient (p<0.0040, Wilcoxon signed rank test, two-sided). The results are illustrated in Figure 8.

Figure 8: Average quantity choices in CAP and MIX-more-CAP payment schemes



Comparing behavior of physicians under FFS in part *I* with their behavior in the respective (adjusted) MIX-more-FFS scheme in part *II* yields a significantly lower quantity of medical service in the latter (A-F6: over all severities p=0.0082; differentiated per severity p≤0.0000; A-F8: average over all severities p=0.000; differentiated per severity: *x*: p=0.2436, *y*: p=0.0299, *z*: p=0.0003, FPPP, two-sided). That is, introducing a mixed incentive scheme that yields the same profit maximum for the physician as in FFS significantly reduces the overprovision observed in FFS. This effect is stronger the less weight is given to the FFS component in the mixed payment scheme (0.80 in MIX-more-FFS(8) and 0.60 in MIX-more-FFS(6); p=0.0004, FPPI, two-sided). Though, in both mixed schemes and for all severities there is still a significant deviation from the quantity of medical services that is optimal for the patient (p<0.0038, FPPP, two-sided). The results are illustrated in Figure 9.

Figure 9: Average quantity choices in FFS and MIX-more-FFS payment schemes



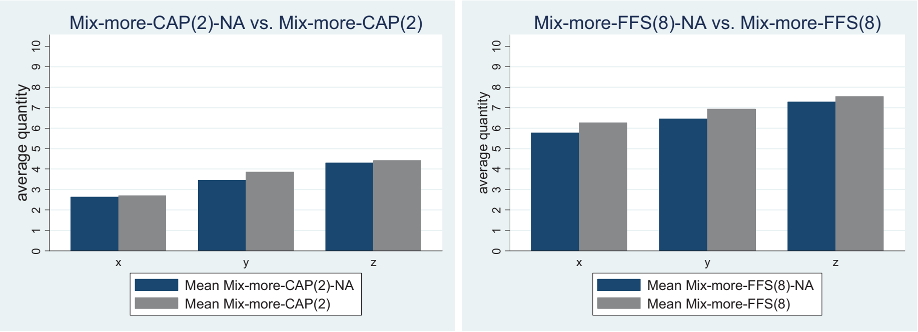
Result 2 (Impact of the introduction of mixed payment schemes)

Introducing mixed incentive schemes significantly reduces the underprovision observed with CAP and the overprovision observed with FFS, respectively.

3.3. Analysis of non-adjusted mixed schemes: Incentive and expenditure effects

In order to ensure that a physician can earn as much under the pure as under the mixed payment schemes, we adjusted the fee-for-service component and the lump-sum component in the mixed schemes tested in conditions A-C2, A-C4, A-F6, and A-F8, respectively. Without this adjustment, the physician's profit maximum (and, correspondingly, the physicians' monetary incentives) would be lower in the mixed schemes than in the pure payment schemes. In order to control for the incentive and expenditure effects that are associated with a lower profit maximum, we compare behavior in the adjusted and non-adjusted mixed schemes (i.e., MIX-more-CAP(2) vs. MIX-more-CAP(2)-NA and MIX-more-FFS(8) vs. MIX-more-FFS(8)-NA). Interestingly, we find neither a significant effect for the MIX-more-CAP schemes (p=0.5804, all FPPI, two-sided) nor for the MIX-more-FFS schemes (p=0.2886, all FPPI, two-sided). That is, reducing the maximal payoff physicians can achieve in the mixed payment schemes does not affect the quantity of medical services provided. Accordingly, also when introducing the two non-adjusted mixed payment schemes physicians tend to reduce their deviation from the patient's optimal quantity compared to the pure payment schemes (CAP vs. MIX-more-CAP(2)-NA: p=0.0001; differentiated per severity p≤0.0004, FFS vs. FFS–MIX-more-FFS(8)-NA: p=0.03206; differentiated per severity x: p=0.3256, y: p=0.1893, z: p=0.0268; FPPP, two-sided). Figure 10 illustrates these findings.

Figure 10: Average quantity choices in the non-adjusted and the adjusted mixed schemes



Looking at the third-party's total expenditure for physicians' payment (i.e., their remuneration) in the adjusted and non-adjusted mixed payment schemes, we find that this is significantly higher in the former than in the latter (MIX-more-CAP(2)-NA vs. MIX-more-CAP(2): p=0.0000 and MIX-more-FFS(8)-NA vs. MIX-more-FFS(8) p=0.0007, FPPI, two-sided; see Table 5 below). But how do the expenditures that result in the adjusted and non-adjusted mixed schemes relate to the ones that result in the pure payment schemes? Comparing total expenditures for physicians payment between the non-adjusted mixed and the pure schemes we find significantly lower expenditures in the former than in the latter (NA-C2: p = 0.0000, NA-F8: p = 0.0018, FPPP, two-sided). The adjusted mixed schemes with a larger CAP component yield significantly higher expenditures than CAP (A-C2: p=0.0000; A-C8: p=0.0000), while the adjusted mixed schemes with a larger FFS component yield significantly lower expenditures than FFS, if at all (A-F8: p=0.3344, A-F6: p=0.02573).

Result 3 (Provision behavior under non-adjusted mixed payment schemes)
A lower maximum profit for physicians does not significantly affect physicians' behavior, but yields a lower expenditure for physicians' payment in the non-adjusted mixed schemes (which is also lower than the expenditure in the respective pure payment schemes).

Although total expenditures in the adjusted Mix-more-CAP schemes are higher than those in the pure schemes, from a perspective of a policy-maker both, the remuneration for physicians and the benefit for patients, are important to judge the effectiveness of a reform of payment schemes. Result 3 implies that keeping the nature of incentives constant suffices to achieve a physician behavior similar to a high-powered incentive scheme resulting in higher expenditures for the third-party payer. The next section provides an in-depth benefit-remuneration analysis of the pure and the mixed payment schemes.

3.4. Benefit-remuneration analysis of pure and mixed payment schemes

When reforming physician payment schemes, third-party payers often rely on cost benefit analyses of the impact of reforms on patient welfare and health care costs (see, e.g., Garber, 2000). In field studies, prominent measures for patients' health benefit have been, among others, the time spent with a patient, the number of patient visits, or the referrals to specialists (see, e.g., Dumont et al., 2008). Obviously, implications for the patients' health benefit are rather indirect, rendering a full-fledged analysis of patients' welfare difficult in the field. The behavioral data from our experiment are suitable for the analysis of third payers' costs as our design allows to control and to directly measure variations in physicians' remuneration and corresponding changes in patients' health benefit. Although, admittedly, the experimental setting is stylized, it gives important insights into the relative performance of pure and mixed payment schemes resulting from physicians' treatment behavior.

Our results in the last sections reveal that the health benefit of an average patient is higher in a mixed payment scheme than in the corresponding pure payment scheme (see Table 5). For the cost of physicians' payment, the picture resulting from a comparison of pure and mixed schemes is less clear-cut (see section 3.3.). In particular, physicians' remuneration is lower in the adjusted mixed schemes with a larger FFS component and in both non-adjusted mixed schemes than in the corresponding pure schemes, while in the adjusted mixed schemes with a larger CAP component the remuneration is higher than in CAP.

Table 5: Descriptive statistics on patients' health benefit and physicians' remuneration by payment scheme

	Part *I* (*pure payment schemes*)		Part *II* (*mixed payment schemes*)	
Condition	Avg. Patient Benefit	Avg. Remuneration	Avg. Patient Benefit	Avg. Remuneration
CAP–MIX-more-CAP(2)	7.42	10.00	8.27	11.06
CAP–MIX-more-CAP(4)	8.31	10.00	9.64	12.12
FFS–MIX-more-FFS(8)	6.84	15.14	7.68	14.67
FFS–MIX-more-FFS(6)	7.47	14.38	9.26	13.15
CAP–MIX-more-CAP(2)-NA	7.34	10.00	8.27	9.38
FFS–MIX-more-FFS(8)-NA	7.72	13.78	8.35	12.41

In the following, we analyze the average ratios of patient benefit and physician's remuneration for both the pure and the mixed payment schemes (see Table 6). Replacing a pure scheme by a mixed scheme usually improves the benefit-remuneration ratio. This effect is significant for the replacement of a fee-for-service payment scheme by an adjusted mixed scheme with a relatively high weight on the lump-sum component (0.40) and by a non-adjusted mixed scheme (FFS vs. MIX-more-FFS(6): p=0.0280, FFS vs. MIX-more-FFS(8)-NA: p=0.0891) and for replacing a capitation payment scheme by a non-adjusted mixed scheme (CAP vs. MIX-more-CAP(2)-NA: p=0.0000).

Comparing the benefit-remuneration ratio between the two pure incentive schemes, we find a significantly higher ratio in CAP than in FFS (p=0.0027, FPPI, two-sided). Similarly, also the mixed schemes with a higher weight on the lump-sum component imply a significantly higher ratio than the schemes with a higher weight on the FFS component (p=0.0027, FPPI, two-sided). That is, compared over all payment schemes, we observe the highest benefit-remuneration ratio in the MIX-more-CAP(2)-NA scheme.

Table 6: Analysis of patients' health benefit and physicians' remuneration ratio

Condition	Part I *(pure payment schemes)* Avg. (Benefit/ Remuneration)	Part II *(mixed payment schemes)* Avg. (Benefit/ Remuneration)
CAP–MIX-more-CAP(2)	0.74	0.75
CAP–MIX-more-CAP(4)	0.83	0.80
FFS–MIX-more-FFS(8)	0.60	0.57
FFS–MIX-more-FFS(6)	0.61	0.71
CAP–MIX-more-CAP(2)-NA	0.73	0.88
FFS–MIX-more-FFS(8)-NA	0.68	0.73

Result 4 (Ratio of health benefit and remuneration)

Almost all mixed payment schemes yield a higher benefit-remuneration ratio than the respective pure payment schemes. Payment schemes comprising a CAP-component attain the highest values.

Taken at its face value, our results render for a third-party payer who is interested in the ratio of benefits and remuneration the non-adjusted Mix-more-CAP scheme most attractive. Naturally, the lowest remuneration for the average physician observed in this scheme contributes to the favorable benefit-remuneration ratio. A third-party payer giving more weight to the patient health benefit might opt for an adjusted Mix-more-CAP scheme with a higher weight on the lump-sum component instead.

3.5. Presentation and experience effects

Finally, we test whether the presentation of physicians' profit as the result of a pure payment scheme (part *I*) or as the result of a mixed scheme (part *II*) already influences behavior. Our results reveal, in fact, significant differences regarding this presentation: physicians choose a significantly higher quantity of medical service if the profit results from a mixed payment scheme than if it results from a pure payment scheme (p=0.01741, FPPP, two-sided). Differentiating according to severities, we find this effect to be due to a highly significant difference for severity *y* only (*x*: p=0.3282; *y*: p=0.0012; *z*: p=0.2452, all FPPP, two-sided).

In order to find out to what extend the reported benefit-improving effects of the mixed incentive schemes are due to the experience of subjects made with the pure schemes in part *I* of the experiment, we repeated two of the mixed payment schemes without a first part (MIX-more-CAP(4) and MIX-more-FFS (6)). Comparing the two mixed schemes with and without part *I* of the experiment, we find no significant differences (p=0.9638 and p=0.1243, all FPPI, two-sided). That is, subjects' experience does not alter their behavior in part *II* of the experiment, at least not to a significant degree.

Result 5 (Presentation and experience)
While the presentation of a profit function as being the result of a mixed payment scheme significantly improves patient benefits, the experience of subjects with a pure payment scheme does not significantly affect behavior.

4. Discussion and Concluding Remarks

This study provided a laboratory test of the effects that are associated with a health care provider payment reform – i.e., the replacement of pure payment incentives by mixed incentives. Regarding the pure incentive schemes, our data support the significant underprovision with capitation payment and significant overprovision with fee-for-service payment as predicted by theory (Ellis and McGuire, 1986) and suggested by results from previous studies (see, e.g., Hennig-Schmidt et al., 2011). In addition to previous research, our systematic variation of patient characteristics – illness and severity of illness – reveals that neither the level of patient health benefit that could be maximally realized by the physician, nor the increase (and decrease, respectively) of health benefit that results from an additional unit of medical service systematically affects physicians' decisions. Only the quantity yielding the maximum health benefit clearly influences the choice of medical services. The more the optimum quantity for the patient deviates from the profit maximizing quantity for the physician, the more underprovision in a capitation payment scheme or overprovision in a fee-for-service payment scheme, respectively, is observed.

Combining capitation with fee-for-service incentives, we find that the significant underprovision and overprovision of medical services observed with CAP and FFS, respectively, can be mitigated significantly. Even if the supplemented pure scheme receives relatively little weight, we observe a significant increase of the quantity of medical service provided by physicians. Accordingly, our experimental data - providing a *direct* measure for the patients' health benefit - reveal that patients experience a higher health benefit in mixed payment schemes compared to pure payment schemes. Interestingly, our finding relates to evidence from field studies arguing that patient are better off after the change from a pure to a mixed scheme (e.g., Krasnik et al., 1990, or Iversen and Luras, 2000). Moreover, presenting physician's profit as the result of a mixed incentive scheme instead of a capitation scheme already significantly increases physicians' care for the patient. That is, mixing pure payment schemes with each other positively affects provision behavior beyond the mere monetary incentives.

Our analysis of total expenditures for physicians' payment demonstrates that it is possible to design mixed schemes that *decrease* the total payment for physicians, but still reduce the physicians' deviation from the patient optimal quantity of medical care. These results are appealing from a welfare economics perspective. Calculating the ratio of patient benefits and physicians’ remuneration we find that our non-adjusted mixed scheme with a relatively high weight on the capitation component yields the highest benefit-remuneration ratio.

As such, our experimental study provides valuable implications for healthcare reforms that include the introduction of mixed payment schemes for physicians. A policy maker or a third-party payer focusing on a well-balanced ratio between expenditures for physicians’ remuneration and patients’ health benefit would favor a mixed capitation scheme that does not adjust physicians' maximum payment to the level of the previous pure capitation payment scheme. A third-party payer interested in the patient health benefit would opt for an adjusted capitation scheme with a high weight on the lump-sum component instead.

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Appendix A: Instructions + Comprehension Questions

Welcome to the Experiment!

Preface

You are participating in an economic experiment on decision behavior. You and the other participants will be asked to make decisions for which you can earn money. Your payoff depends on the decisions you make. At the end of the experiment, your payoff will be converted to Euro and paid to you in cash. During the experiment, all amounts are presented in the experimental currency Taler. 10 Taler equals 8 Euro.

The experiment will take about 90 minutes and consists of two parts. You will receive detailed instructions before each part. Note that none of your decisions in either part have any influence on the other part of the experiment.

Part One

Please read the following instructions carefully. We will approach you in about five minutes to answer any questions you may have. If you have questions at any time during the experiment, please raise your hand and we will come to you.

Part one of the experiment consists of 9 rounds of decision situations.

Decision Situations

In each round you take on the role of a physician and decide on medical treatment for a patient. That is, you determine the quantity of medical services you wish to provide to the patient for a given illness and a given severity of this illness.

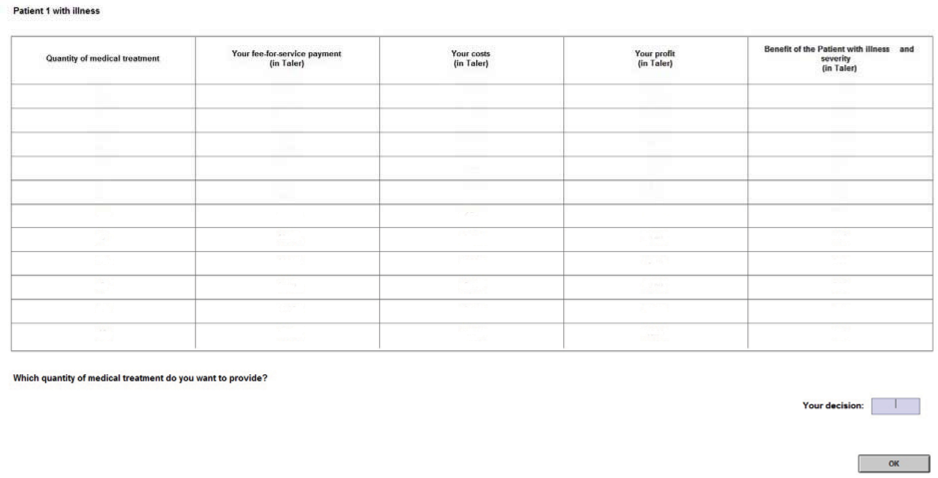
Every patient is characterized by one of three illnesses (A, B, C), each of which can occur in three different degrees of severity (x, y, z). In each consecutive decision round you will face one patient who is characterized by one of the 9 possible combinations of illnesses and degrees of severity (in random order). Your decision is to provide each of these 9 patients with a quantity of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 medical services.

Profit

In each round you receive a fee-for-service (capitation) remuneration for treating the patient. Your remuneration increases with the amount of medical treatment (is irrespective of the amount of medical treatment) you provide. You also incur costs for treating the patient, which likewise depend on the quantity of services you provide. Your profit for each decision is calculated by subtracting these costs from the fee-for-service (capitation) remuneration.

Every quantity of medical service yields a particular benefit for the patient – contingent on his illness and severity. Hence, in choosing the medical services you provide, you determine not only your own profit but also the patient's benefit.

In each round you will receive detailed information on your screen (see below) for the respective patient the illness, your amount of fee-for-service (capitation) remuneration - for each possible amount of medical treatment - your costs, profit as well as the benefit for the patient with the corresponding illness and severity.

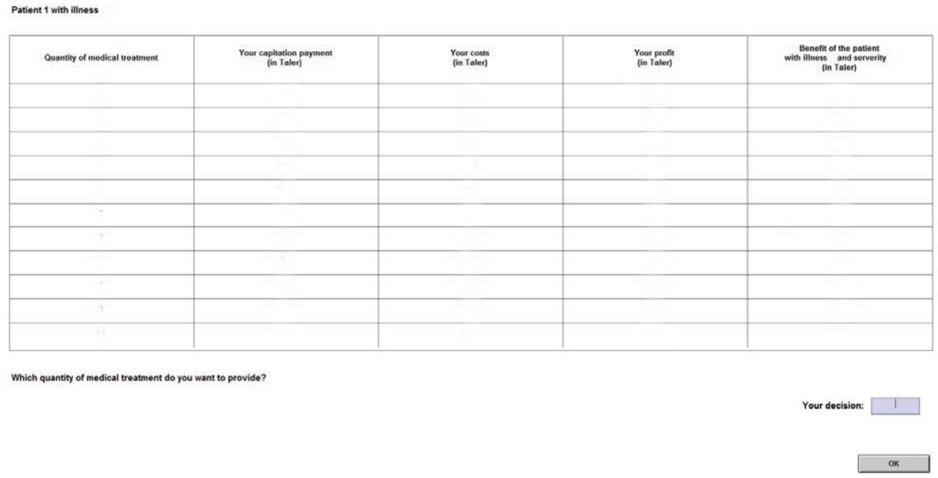


Patient 1 with illness

Quantity of medical treatment	Your fee-for-service payment (in Taler)	Your costs (in Taler)	Your profit (in Taler)	Benefit of the Patient with illness and severity (in Taler)

Which quantity of medical treatment do you want to provide?

Your decision:



Patient 1 with illness

Quantity of medical treatment	Your capitation payment (in Taler)	Your costs (in Taler)	Your profit (in Taler)	Benefit of the patient with illness and serverity (in Taler)

Which quantity of medical treatment do you want to provide?

Your decision:

Payment

At the end of the experiment one of the 9 rounds of part one will be chosen at random. Your profit in this round will be paid to you in cash.

For this part of the experiment, no patients are physically present in the laboratory. Yet, the patient benefit does accrue to a real patient: The amount resulting from your decision will be transferred to the Christoffel Blindenmission Deutschland e.V., 64625 Bensheim, an organization which funds the treatment of patients with eye cataract.

The transfer of money to the Christoffel Blindenmission Deutschland e.V. will be carried out after the experiment by the experimenter and one participant. The participant completes a money transfer form, filling in the total patient benefit (in Euro) resulting from the decisions made by all participants in the randomly chosen situation. This form prompts the payment of the designated amount to the Christoffel Blindenmission Deutschland e.V. by the University of Duisburg-Essen's finance department. The form is then sealed in a postpaid envelope and posted in the nearest mailbox by the participant and the experimenter.

After the entire experiment is completed, one participant is chosen at random to oversee the money transfer to the Christoffel Blindenmission Deutschland e.V. The participant receives an additional compensation of 5 Euro for this task. The participant certifies that the process has been completed as described here by signing a statement which can be inspected by all participants at the office of the Chair of Quantitative Economic Policy. A receipt of the bank transfer to the Christoffel Blindenmission Deutschland e.V. may also be viewed here.

Comprehension Questions

Prior to the decision rounds we kindly ask you to answer a few comprehension questions. They are intended to help you familiarize yourself with the decision situations. If you have any questions about this, please raise your hand. Part one of the experiment will begin once all participants have answered the comprehension questions correctly.

Part II

Please read the following instructions carefully. We will approach you in about five minutes to answer any questions you may have. If you have questions at any time during the experiment, please raise your hand and we will come to you.

Part two of the experiment also consists of 9 rounds of decision situations.

Decision Situations

As in part one of the experiment, you take on the role of a physician in each round and decide on medical treatment for a patient. That is, you determine the quantity of medical services you wish to provide to the patient for a given illness and a given severity of this illness.

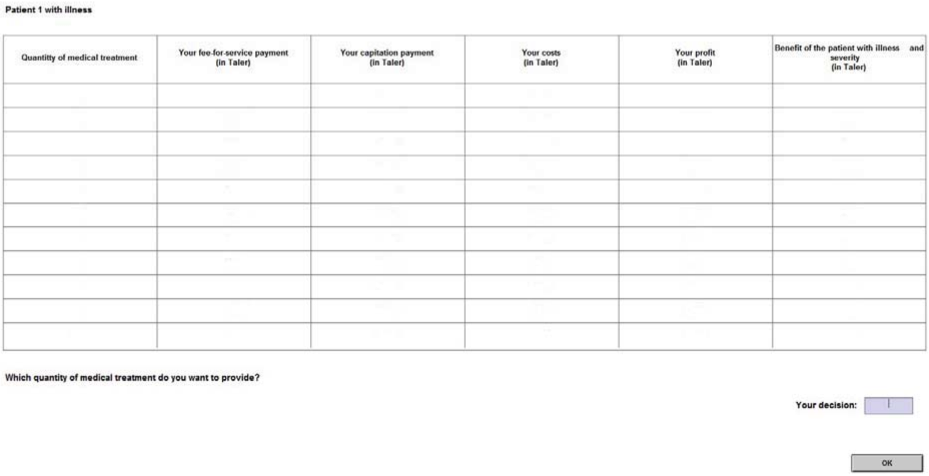
Every patient is characterized by one of three illnesses (A, B, C), each of which can occur in three different degrees of severity (x, y, z). In each consecutive decision round you will face one patient who is characterized by one of the 9 possible combinations of illnesses and degrees of severity (in random order). Your decision is to provide each of these 9 patients with a quantity of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 medical services.

Profit

In each round you are remunerated for treating the patient. In each round you receive a fee-for-service (capitation) remuneration for treating the patient. Your remuneration increases with the amount of medical treatment (is irrespective of the amount of medical treatment) you provide. In addition to this, in each round you receive a capitation remuneration which is irrespective of the amount of medical treatment (a fee-for-service remuneration which increases with the amount of medical treatment). You also incur costs for treating the patient, which likewise depend on the quantity of services you provide. Your profit for each decision is calculated by subtracting these costs from the sum of your fee-for-service (capitation) and capitation (fee-for-service) remuneration.

As in part one, every quantity of medical service yields a particular benefit for the patient – contingent on his illness and severity. Hence, in choosing the medical services you provide, you determine not only your own profit but also the patient's benefit.

In each round you will receive detailed information on your screen (see below) for the respective patient the illness, your amount of fee-for-service (capitation) remuneration - for each possible amount of medical treatment - the amount of your capitation (fee-for-service) remuneration, your costs, profit as well as the benefit for the patient with the corresponding illness and severity.

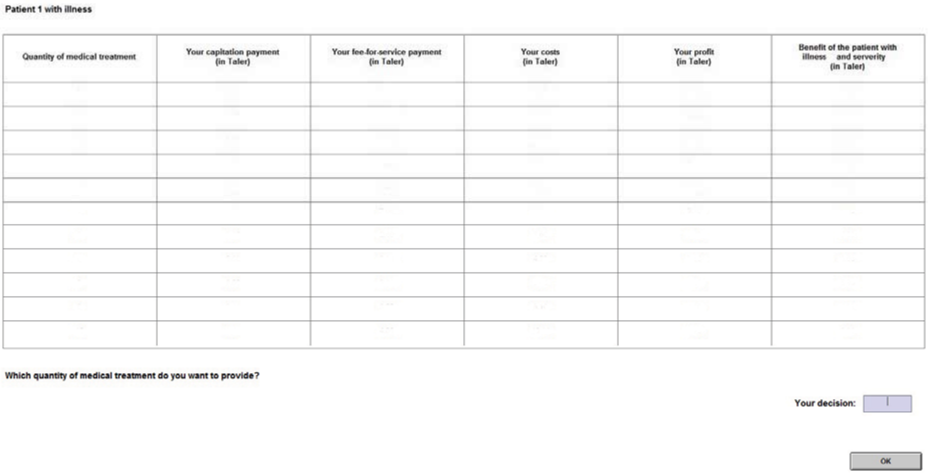


Patient 1 with illness

Quantity of medical treatment	Your fee-for-service payment (in Taler)	Your capitation payment (in Taler)	Your costs (in Taler)	Your profit (in Taler)	Benefit of the patient with illness and severity (in Taler)

Which quantity of medical treatment do you want to provide?

Your decision:



Patient 1 with illness

Quantity of medical treatment	Your capitation payment (in Taler)	Your fee-for-service payment (in Taler)	Your costs (in Taler)	Your profit (in Taler)	Benefit of the patient with illness and serverity (in Taler)

Which quantity of medical treatment do you want to provide?

Your decision:

Payment

At the end of the experiment one of the 9 rounds of part two will be chosen at random. Your profit in this round will be paid to you in cash, in addition to your payment from the round chosen for part one of the experiment.

After the experiment is over, please remain seated until the experimenter asks you to step forward. You will receive your payment at the front of the laboratory before exiting the room.

As in part one, no patients are physically present in the laboratory for part two of the experiment. Yet, the patient benefit does accrue to a real patient: The amount resulting from your decision will be transferred to the Christoffel Blindenmission Deutschland e.V., 64625 Bensheim, an organization which funds the treatment of patients with eye cataract.

The process for the transfer of money to the Christoffel Blindenmission Deutschland e.V. as described for part one of the experiment will be carried out by the experimenter and one participant.

Comprehension Questions

Prior to the decision rounds we kindly ask you to answer a few comprehension questions. They are intended to help you familiarize yourself with the decision situations. If you have any questions about this, please raise your hand. Part two of the experiment will begin once all participants have answered the comprehension questions correctly.

Finally, we kindly ask you to not talk to anyone about the content of this session in order to prevent influencing other participants after you. Thank you for your collaboration!

Comprehension Questions Part *I*: CAP (FFS)

Questions Tables 1-4:

1-4 a) What is the capitation (fee-for-service)?
1-4 b) What are the costs?
1-4 c) What is the profit?
1-4 d) What is the patient benefit?

Quantity of medical treatment	Capitation (Fee-for-service) (in Taler)	Costs (in Taler)	Profit (in Taler)	Benefit of the patient with illness F and severity y (in Taler)
0	20.00 (0.00)	0.00	20.00 (0.00)	15.00
1	20.00 (4.00)	0.20	19.80 (3.80)	16.00
2	20.00 (8.00)	0.80	19.20 (7.20)	17.00
3	20.00 (12.00)	1.80	18.20 (10.20)	18.00
4	20.00 (16.00)	3.20	16.80 (12.80)	19.00
5	20.00 (20.00)	5.00	15.00 (15.00)	20.00
6	20.00 (24.00)	7.20	12.80 (16.80)	19.00
7	20.00 (28.00)	9.80	10.20 (18.20)	18.00
8	20.00 (32.00)	12.80	7.20 (19.20)	17.00
9	20.00 (36.00)	16.20	3.80 (19.80)	16.00
10	20.00 (40.00)	20.00	0.00 (20.00)	15.00

1. Assume that a physician wants to provide 2 quantities of medical treatment for the patient depicted above.
2. Assume that a physician wants to provide 9 quantities of medical treatment for the patient depicted above.

Quantity of medical treatment	Capitation (Fee-for-service) (in Taler)	Costs (in Taler)	Profit (in Taler)	Benefit of the patient with illness G and severity z (in Taler)
0	20.00 (0.00)	0.00	20.00 (0.00)	10.00
1	20.00 (4.00)	0.20	19.80 (3.80)	12.00
2	20.00 (8.00)	0.80	19.20 (7.20)	14.00
3	20.00 (12.00)	1.80	18.20 (10.20)	16.00
4	20.00 (16.00)	3.20	16.80 (12.80)	18.00
5	20.00 (20.00)	5.00	15.00 (15.00)	20.00
6	20.00 (24.00)	7.20	12.80 (16.80)	22.00
7	20.00 (28.00)	9.80	10.20 (18.20)	24.00
8	20.00 (32.00)	12.80	7.20 (19.20)	22.00
9	20.00 (36.00)	16.20	3.80 (19.80)	20.00
10	20.00 (40.00)	20.00	0.00 (20.00)	18.00

3. Assume that a physician wants to provide 2 quantities of medical treatment for the patient depicted above.
4. Assume that a physician wants to provide 9 quantities of medical treatment for the patient depicted above.

Comprehension Questions Part *II*: Mix-more-CAP(FFS)

1-4 a) What is the capitation (fee-for-service)?
1-4 a) What is the fee-for-service (capitation)?
1-4 b) What are the costs?
1-4 c) What is the profit?
1-4 d) What is the patient benefit?

Quantity of medical treatment	Capitation (Fee-for-service (in Taler)	Fee-for-Service (Capitation) (in Taler)	Costs (in Taler)	Profit (in Taler)	Benefit of the patient with illness F and severity y (in Taler)
0	19.20 (0.00)	0.00 (7.20)	0.00	19.20 (7.20)	15.00
1	19.20 (3.20)	0.80 (7.20)	0.20	19.80 (10.20)	16.00
2	19.20 (6.40)	1.60 (7.20)	0.80	20.00 (12.80)	17.00
3	19.20 (9.60)	2.40 (7.20)	1.80	19.80 (15.00)	18.00
4	19.20 (12.80)	3.20 (7.20)	3.20	19.20 (16.80)	19.00
5	19.20 (16.00)	4.00 (7.20)	5.00	18.20 (18.20)	20.00
6	19.20 (19.20)	4.80 (7.20)	7.20	16.80 (19.20)	19.00
7	19.20 (22.40)	5.60 (7.20)	9.80	15.00 (19.80)	18.00
8	19.20 (25.60)	6.40 (7.20)	12.80	12.80 (20.00)	17.00
9	19.20 (28.80)	7.20 (7.20)	16.20	10.20 (19.80)	16.00
10	19.20 (32.00)	8.00 (7.20)	20.00	7.20 (19.20)	15.00

1. Assume that a physician wants to provide 1 quantities of medical treatment for the patient depicted above.
2. Assume that a physician wants to provide 8 quantities of medical treatment for the patient depicted above.

Quantity of medical treatment	Capitation (Fee-for-service (in Taler)	Fee-for-Service (Capitation) (in Taler)	Costs (in Taler)	Profit (in Taler)	Benefit of the patient with illness G and severity z (in Taler)
0	19.20 (0.00)	0.00 (7.20)	0.00	19.20 (7.20)	10.00
1	19.20 (3.20)	0.80 (7.20)	0.20	19.80 (10.20)	12.00
2	19.20 (6.40)	1.60 (7.20)	0.80	20.00 (12.80)	14.00
3	19.20 (9.60)	2.40 (7.20)	1.80	19.80 (15.00)	16.00
4	19.20 (12.80)	3.20 (7.20)	3.20	19.20 (16.80)	18.00
5	19.20 (16.00)	4.00 (7.20)	5.00	18.20 (18.20)	20.00
6	19.20 (19.20)	4.80 (7.20)	7.20	16.80 (19.20)	22.00
7	19.20 (22.40)	5.60 (7.20)	9.80	15.00 (19.80)	24.00
8	19.20 (25.60)	6.40 (7.20)	12.80	12.80 (20.00)	22.00
9	19.20 (28.80)	7.20 (7.20)	16.20	10.20 (19.80)	20.00
10	19.20 (32.00)	8.00 (7.20)	20.00	7.20 (19.20)	18.00

3. Assume that a physician wants to provide 1 quantities of medical treatment for the patient depicted above.
4. Assume that a physician wants to provide 8 quantities of medical treatment for the patient depicted above.

Appendix B: Parameter Tables

Table B.1

		Quantity (q)										
Treatment	Variable	0	1	2	3	4	5	6	7	8	9	10
A-C2	R_{kl}^{I}	10	10	10	10	10	10	10	10	10	10	10
	$R_{kl}^{II\,CAP}$	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
	$R_{kl}^{II\,FFS}$	0	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
A-C4	R_{kl}^{I}	10	10	10	10	10	10	10	10	10	10	10
	$R_{kl}^{II\,CAP}$	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
	$R_{kl}^{II\,FFS}$	0	0.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8
A-F8	R_{kl}^{I}	0	2	4	6	8	10	12	14	16	18	20
	$R_{kl}^{II\,CAP}$	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	$R_{kl}^{II\,FFS}$	0	1.6	3.2	4.8	6.4	8	9.6	11.2	12.8	14.4	16
A-F6	R_{kl}^{I}	0	2	4	6	8	10	12	14	16	18	20
	$R_{kl}^{II\,CAP}$	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
	$R_{kl}^{II\,FFS}$	0	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	10.8	12
NA-C2	R_{kl}^{I}	10	10	10	10	10	10	10	10	10	10	10
	$R_{kl}^{II\,CAP}$	8	8	8	8	8	8	8	8	8	8	8
	$R_{kl}^{II\,FFS}$	0	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
NA-CF8	R_{kl}^{I}	0	2	4	6	8	10	12	14	16	18	20
	$R_{kl}^{II\,CAP}$	2	2	2	2	2	2	2	2	2	2	2
	$R_{kl}^{II\,FFS}$	0	1.6	3.2	4.8	6.4	8	9.6	11.2	12.8	14.4	16
all	c_{kl}	0	0.1	0.4	0.9	1.6	2.5	3.6	4.9	6.4	8.1	10
A-C2	π_{kl}^{I}	10	9.9	9.6	9.1	8.4	7.5	6.4	5.1	3.6	1.9	0
	π_{kl}^{II}	9.6	9.9	10	9.9	9.6	9.1	8.4	7.5	6.4	5.1	3.6
A-C4	π_{kl}^{I}	10	9.9	9.6	9.1	8.4	7.5	6.4	5.1	3.6	1.9	0
	π_{kl}^{II}	8.4	9.1	9.6	9.9	10	9.9	9.6	9.1	8.4	7.5	6.4
A-F8	π_{kl}^{I}	0	1.9	3.6	5.1	6.4	7.5	8.4	9.1	9.6	9.9	10
	π_{kl}^{II}	3.6	5.1	6.4	7.5	8.4	9.1	9.6	9.9	10	9.9	9.6
A-F6	π_{kl}^{I}	0	1.9	3.6	5.1	6.4	7.5	8.4	9.1	9.6	9.9	10
	π_{kl}^{II}	6.4	7.5	8.4	9.1	9.6	9.9	10	9.9	9.6	9.1	8.4
NA-C2	π_{kl}^{I}	10	9.9	9.6	9.1	8.4	7.5	6.4	5.1	3.6	1.9	0
	π_{kl}^{II}	8	8.3	8.4	8.3	8	7.5	6.8	5.9	4.8	3.5	2
NA-CF8	π_{kl}^{I}	0	1.9	3.6	5.1	6.4	7.5	8.4	9.1	9.6	9.9	10
	π_{kl}^{II}	2	3.5	4.8	5.9	6.8	7.5	8	8.3	8.4	8.3	8
all	B_{Ax}	4	5	6	7	6	5	4	3	2	1	0
	B_{Ay}	2	3	4	5	6	7	6	5	4	3	2
	B_{Az}	0	1	2	3	4	5	6	7	6	5	4
	B_{Bx}	7	8	9	10	9	8	7	6	5	4	3
	B_{By}	5	6	7	8	9	10	9	8	7	6	5
	B_{Bz}	3	4	5	6	7	8	9	10	9	8	7
	B_{Cx}	8	10	12	14	12	10	8	6	4	2	0
	B_{Cy}	4	6	8	10	12	14	12	10	8	6	4
	B_{Cz}	0	2	4	6	8	10	12	14	12	10	8

Table B.2 Experimental Parameters in Condition P-C2

Variable	0	1	2	3	4	5	6	7	8	9	10
R_{kl}^{I}	15	15	15	15	15	15	15	15	15	15	15
$R_{kl}^{II\ CAP}$	8	8	8	8	8	8	8	8	8	8	8
$R_{kl}^{II\ FFS}$	0	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
$c_{kl}^{I\ Pres}$	7	6.7	6.6	6.7	7	7.5	8.2	9.1	10.2	11.5	13
c_{kl}^{II}	0	0.1	0.4	0.9	1.6	2.5	3.6	4.9	6.4	8.1	10
$\pi_{kl}^{I\ Pres}$	8	8.3	8.4	8.3	8	7.5	6.8	5.9	4.8	3.5	2
π_{kl}^{II}	8	8.3	8.4	8.3	8	7.5	6.8	5.9	4.8	3.5	2