Physician performance pay: Experimental evidence

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Outline

Why do we care?

- Understanding how physicians respond to incentives is important for policy-makers and researchers alike
- The traditional payment system: fee-for-service may incentivize "too many" services; overtreatment (e.g., Ellis and McGuire 1986, JHE)
- A prominent attempt to control costs: lump-sum capitation (CAP) payments (e.g., in managed care)
- CAP may lead to underprovision of medical services (e.g., Cutler 1995, ECMA)
- Pay for performance (P4P) programs are frequently suggested to improve the quality of health care (e.g., UK, USA)
- Ongoing health policy debate on the introduction and design of P4P

Mixed empirical evidence

- Inconclusive evidence on the effect of performance pay on the quality of care (e.g., Epstein 2012, NEJM; Witter et al. 2012, Cochrane Rev.; Eijkenaar et al. 2013, EJHE; Milstein and Schreyögg, 2016, HP)
- If at all, moderate effects (e.g., Mullen et al. 2010, RAND; Li et al. 2014, HE; Scott et al. 2018, MCRR)
- Possible reasons:
  - Biased or difficult to observe health outcomes (e.g., Campbell et al. 2009, NEJM; Gravelle et al. 2010, EJ; Roland and Olesen 2016, BMJ)
  - Simultaneous interventions (e.g., Cutler et al. 2004, AER; Kolstad 2013, AER)
  - Effects of P4P-design elements not well understood (e.g., Scott et al., 2018)
  - Self selection into payment schemes (e.g., Cadena and Smith, 2021)
  - Heterogeneity in physicians' responses typically not considered (e.g., Donato et al. 2017, AER)

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▷ Causal effect of performance pay on physicians' behavior and the quality of health care is difficult to infer using field data

Design of P4P: Size of bonus and unintended consequences

- How the size of the performance bonus affects physicians' medical service provision not well understood
- Unintended effects like a crowding-out of physicians' altruistic (patient-regarding) behavior and motivation might occur
- Other-regarding motivations are fundamental in public service provision (e.g., Besley and Ghatak 2005, AER; Prendergast 2007, AER; Delfgaauw and Dur 2008, EJ) particularly in health (Arrow 1963, AER)
- Financial incentives might lead to crowding-out of intrinsic motivation (e.g., Deci 1971; Frey et al. 1996, JPE; Frey 1997, EJ; Maynard 2012, HE)
- Some experimental evidence for motivation crowding-out (e.g., Gneezy and Rustichini 2000, QJE; Ariely et al. 2009, REStud; Huffman and Bognanno 2018, MS)

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▷ No causal evidence on the behavioral effect of bonus levels and on whether P4P crowds-out physicians' altruistic behavior

This paper

- Artefactual field experiment (Harrison and List 2004, JEL) with primary care physicians from a representative sample of resident physicians in Germany
- 'Clean' performance measure tied to the patient-optimal quality of medical care
- Within-subjects: Exogenous variation from CAP to blended CAP + P4P
- Between-subjects comparison of different bonus levels
- Random selection of subjects in experimental treatments
- Link of behavioral data to physicians' practice characteristics such as location and annual profit

Why an experiment?

Behavioral experiments: A complementary approach in health economics and health policy research (Galizzi and Wiesen 2018, ORE)

- Lab and artefactual field experiments are well suited to testing explicit predictions of simple theoretical models under controlled conditions.
- No patients are harmed due to unintended effects of an intervention.
- Experiments often provide unique opportunities to study behavior that is hidden or prohibited in the field.
- Experimental data, combined with field studies and social surveys, can help us understand sources of heterogeneity in behaviors.
- Experiments are highly replicable and scalable.
- Experiments are a good way to pre-test designs and behavioral mechanisms for more expensive and cumbersome field experiments and RCTs.

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  Lab and artefactual field experiments could be seen as the health economist's equivalent of animal trials in medical research.

Related behavioral experiments in health

- Fee-for-service, capitation, and salary:

  Hennig-Schmidt et al. (2011, JHE), Green (2014 JEBO), Hennig-Schmidt and Wiesen (2014, SSM), Brosig-Koch et al. (2016, JEBO); Lagarde and Blauuw (2017, SSM), Green et al. (2017, JEBO), Di Guida et al. (2019, HE); Reif et al. (2020, IJERPH); Wang et al. (2020, EER); Waibel and Wiesen (2021, EER)

- Mixed payment systems:

  Brosig-Koch et al. (2017, HE)

- P4P:

  Oxholm et al. (2021, SSM); Green et al. (2020, BMJ Quality and Safety) Brosig-Koch et al. (2021)

Research questions

1. How does performance pay affect physicians' behavior?
2. Does the bonus level affect physicians' behavior (Low bonus of 5% vs. High bonus of 20% on top of baseline CAP)?
3. How do physicians' practice characteristics relate to their medical service provision?
4. Does performance pay crowd-out physicians' patient-regarding (altruistic) behavior?

Our physician sample

- Overall, 104 primary care physicians (PCPs) participated in our artefactual field experiment
- Sub-sample ($\sim$10%) of PCPs enrolled in the Zi practice panel (ZiPP) which comprises a representative sample of resident physicians in Germany
- ZiPP is run annually with about 5,000 resident physicians
- In Germany, around 54,000 resident PCPs contract with the statutory health insurance (GKV), about 1,000 PCPs participate in the ZiPP

Sample characteristics

- Average age: 56 years (ZiPP: 54, German PCPs: ∼53 years)
- Share of female PCPs: 35% (ZiPP: 39% German PCPs: ∼44%)
- Distribution of locations similar to ZiPP
  - City: ∼30%; ZiPP: ∼34%
  - Outer conurbation: ∼36%; ZiPP: ∼37%
  - Rural: ∼34%; ZiPP: ∼29%
- Annual profit: ∅150,383 EUR (ZiPP: ∅158,733 EUR)
- Our sample is not significantly different from non-participating PCPs of the ZiPP

Experimental design

- Within-subject design: Introduction of P4P with two different bonus levels

Experimental condition	First payment system	Second payment system	# Sub. (# pat.)
Low bonus (5%)	CAP	CAP+P4P-5%	53 (954)
High bonus (20%)	CAP	CAP+P4P-20%	51 (918)

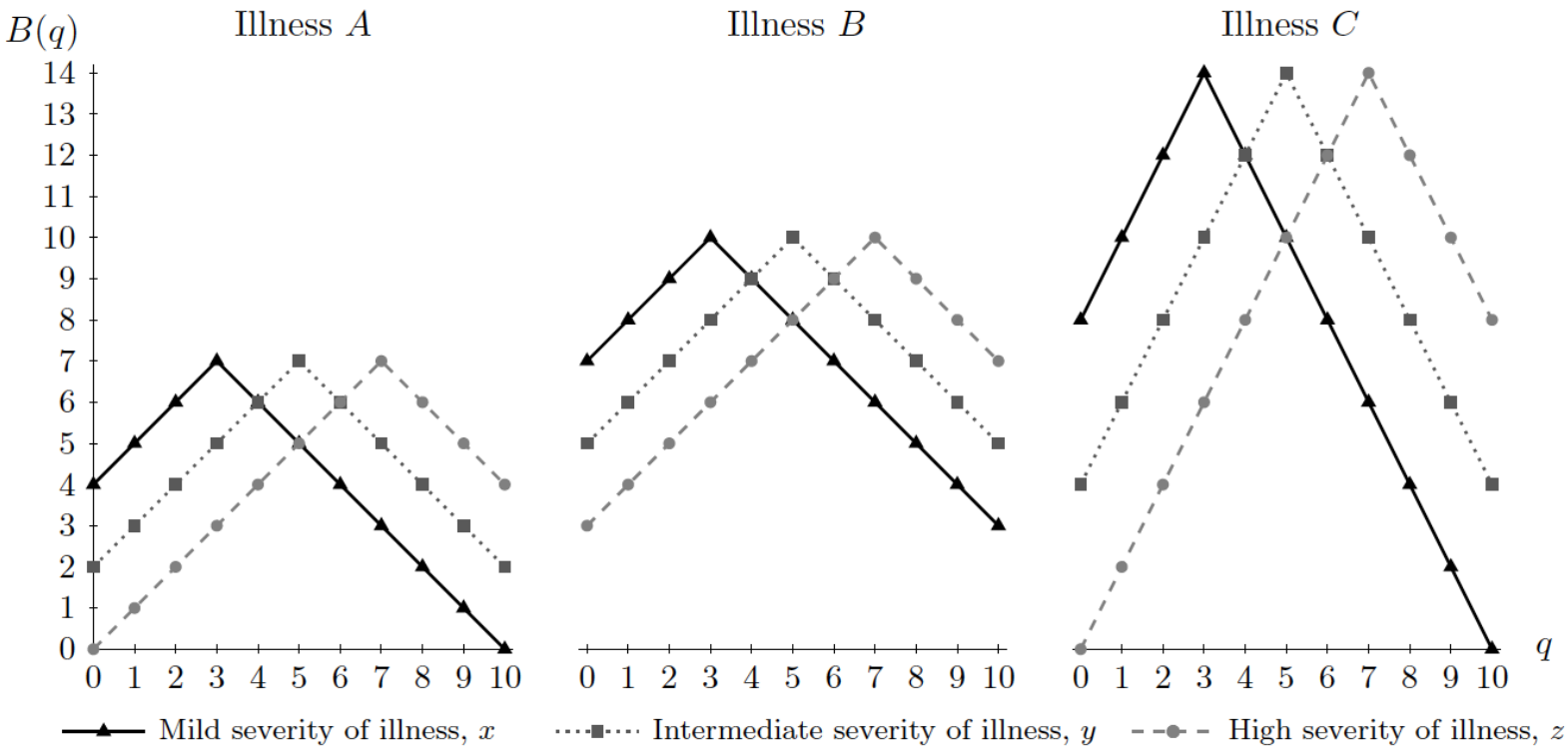
- Between-subject comparison for performance-pay systems
- Control treatments with medical students

Decision situation

- Framed physician decision-making experiment
- Physicians decide on the quantity of medical services q
- Individual decisions on $q \in \{0, 1, \ldots 10\}$ for 9 abstract patients
- Subjects simultaneously determine profit and the patient's health benefit (measured in monetary terms)
- Framing and setting are the same for all payment systems

Patients' health benefit

- Systematic variation of health benefits; constant for all payment systems
- Illnesses A, B, C with three severities x (mild), y (interm.), z (high)



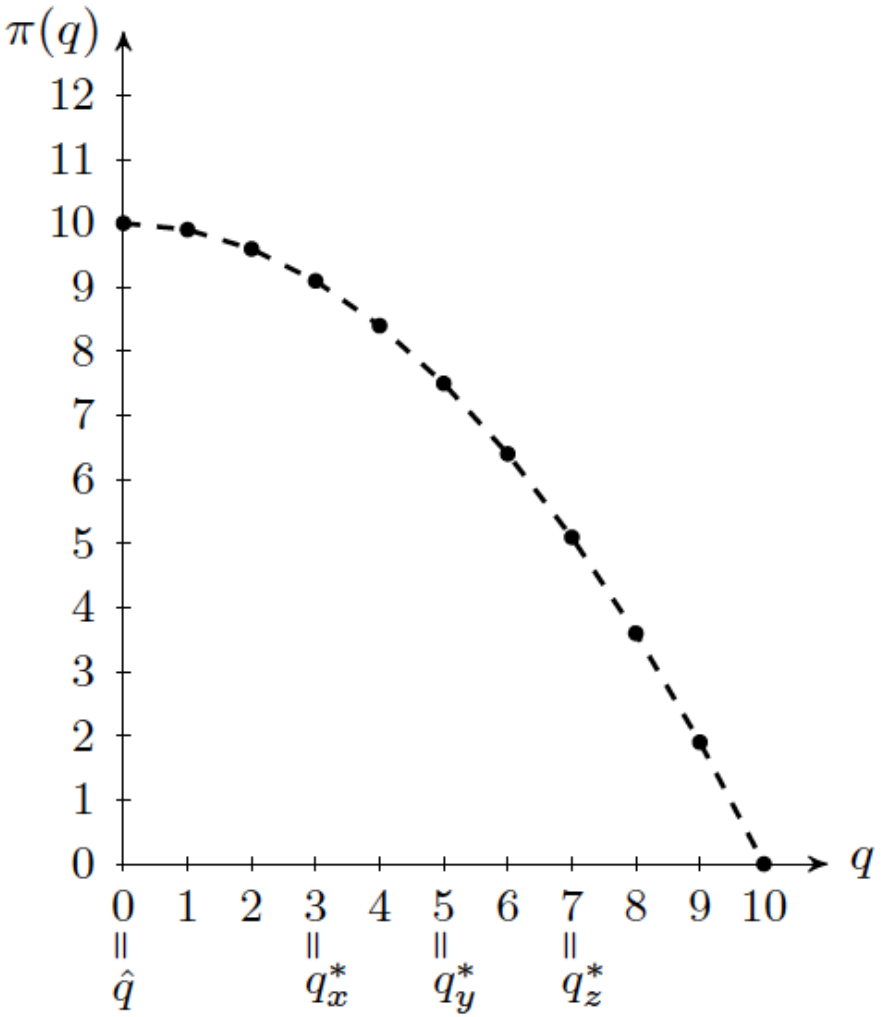
- Salient incentive: Patients' health benefit measured in monetary terms, benefits real patients' health outside the lab

Payment systems

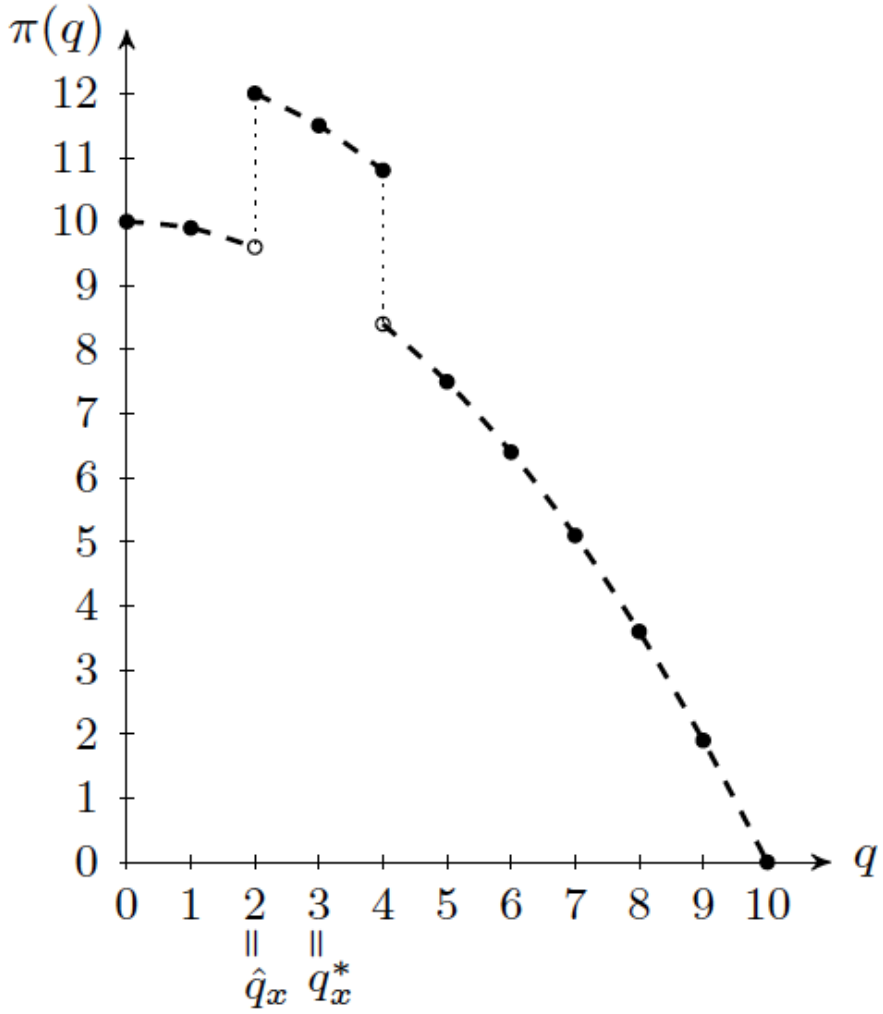
- CAP: lump-sum payment of 25 EUR for physicians
- Performance pay linked to patients' benefit (health outcome) and adjusted for severities of illness
- Discrete bonus is granted if quality threshold is reached $|q - q^*| \leq 1$
- Reflects asymmetric information between payer and physician
- Cost are convex $c(q) = q^2/10$

Parameters: Illustration of physicians' profits

CAP



CAP+P4P



Sample decision screen

Patient with illness B, mild severity (x)

Round 1: Patient 1 **Link to instructions**

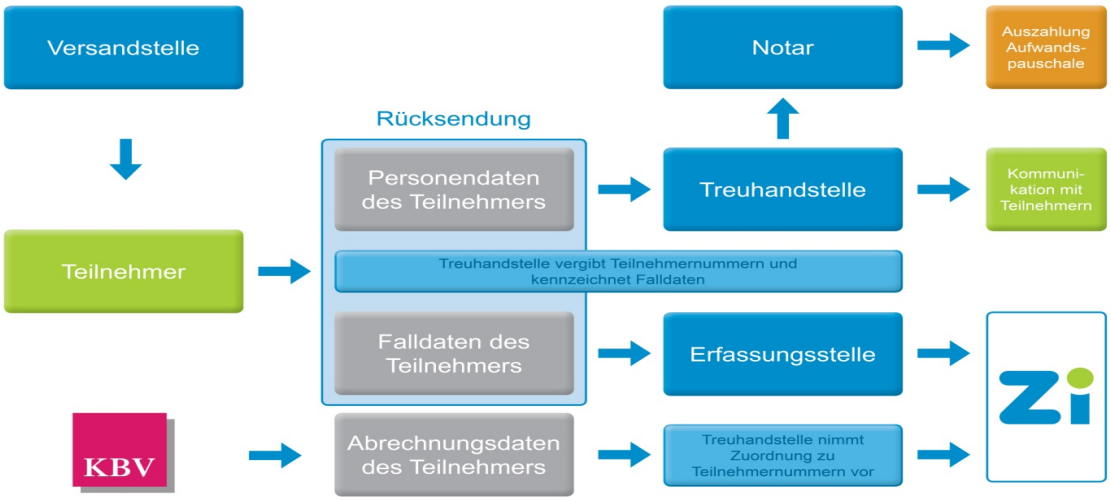
Quantity of medical services	Your lump-sum remuneration (in Euro)	Your bonus payment (in Euro)	Your costs (in Euro)	Your payoff = remuneration + bonus – costs (in Euro)	Benefit of the patient with illness B and severity x (in Euro)
0	25	0.00	0.00	25.00	17.5
1	25	0.00	0.25	24.75	20.0
2	25	2.25	1.00	26.25	22.5
3	25	2.25	2.25	25.00	25.0
4	25	2.25	4.00	23.25	22.5
5	25	0.00	6.25	18.75	20.0
6	25	0.00	9.00	16.00	17.5
7	25	0.00	12.25	12.75	15.0
8	25	0.00	16.00	9.00	12.5
9	25	0.00	20.25	4.75	10.0
10	25	0.00	25.00	0.00	7.5

Which quantity of medical services do you want to provide?

send...

Facilitation of the artefactual field experiment

ZiPP: Data collection procedure



- Double-blind procedure
- Anonymity of subjects ensured
- Experiment followed the data security guidelines of the ZiPP
- Payment procedure via notary office

Experimental protocol

- Experiments with physicians were run in March 2016; average duration of about 30 minutes
- Post experimental questionnaire (e.g., risk attitudes, altruism)
- Random payment technique: One decision is randomly selected for payment in each part
- Average payment per subject: 45.93 EUR (total: 4,823 EUR)
- Average payment per patient: 47.64 EUR (total: 5,003 EUR)
- Behavioral data linkage: Administrative data on practice characteristics (e.g., annual profit, location) are provided by Zi

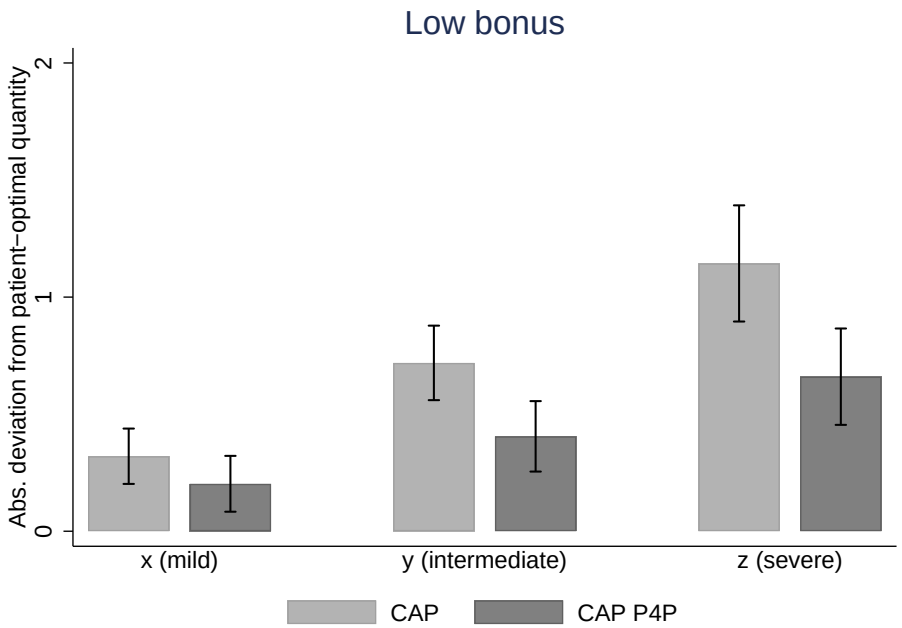
Behavioral results

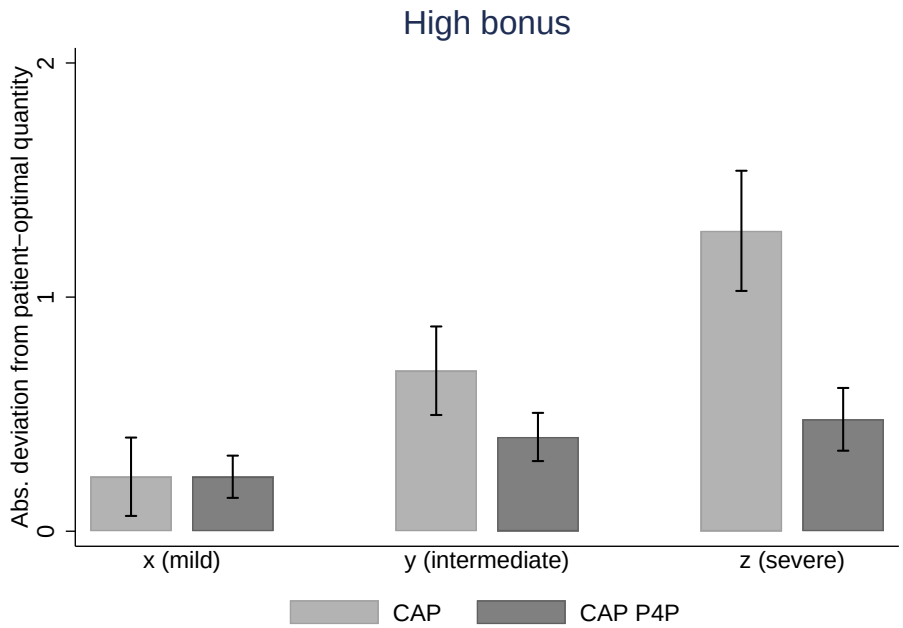
Physicians' medical service provision in CAP (first part of the experiment)

- Physicians significantly underprovide medical services in CAP for patients with intermediate and high severity of illness ($p \leq 0.014$, Wilcoxon signed-rank test; comparison with q^* for all illnesses)
- Underprovision increases in patients' severity of illness, patients' marginal benefit does not significantly affect behavior
- Consistent with findings in the experimental literature
  (e.g., Hennig-Schmidt et al. 2011, JHE; Brosig-Koch et al. 2017, HE)

How performance pay affects physicians' behavior

Deviation from the patient-optimal quantity





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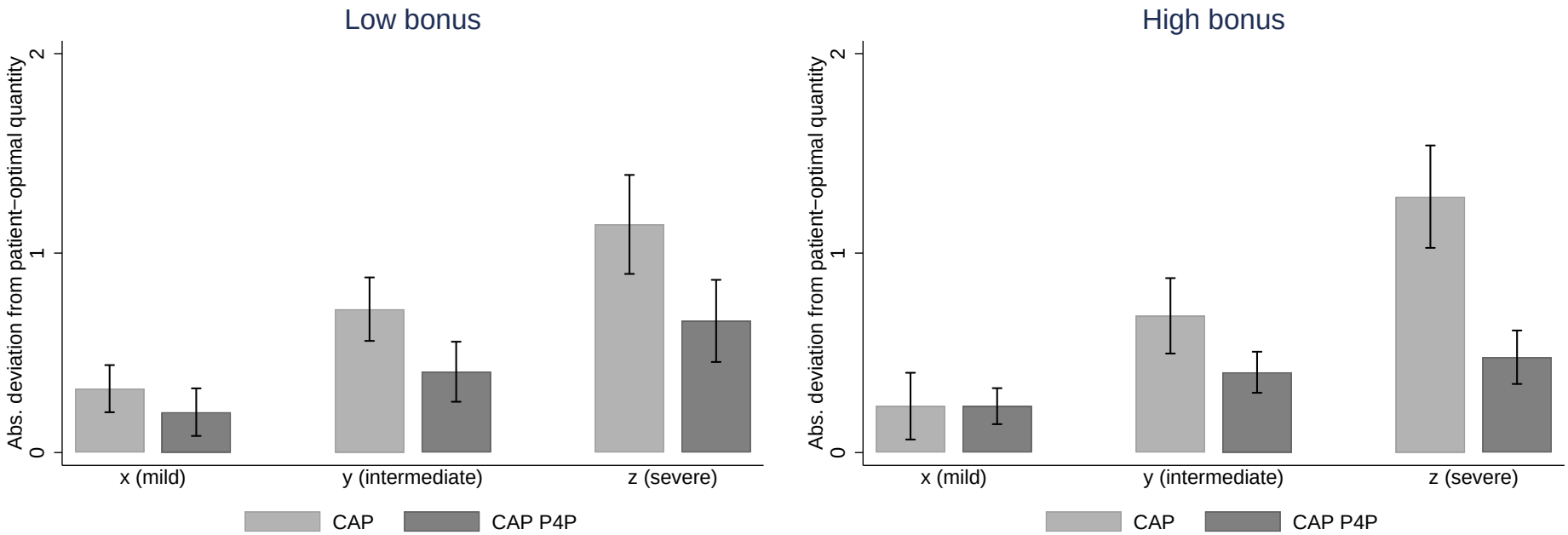
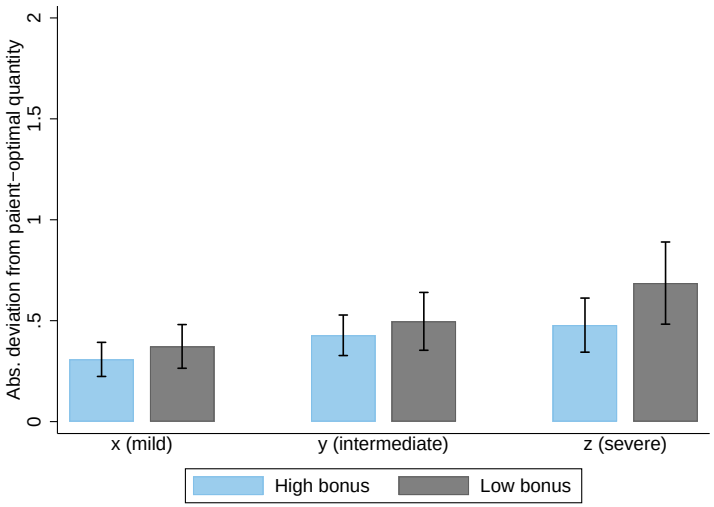


- Underprovision is significantly reduced for intermediately (y) and severely ill (z) patients in CAP+P4P-20% and CAP+P4P-5% ($p \leq 0.094$, Wilcoxon signed-rank test)
- For mild severity patients (x), the reduction in underprovision is not significant ($p > 0.162$)

Does the size of the bonus affect behavior?

Absolute deviation from the patient-optimal quantity (second part of the experiment)



- Very similar behavioral responses for the two different bonus levels
- No statistically significant differences ($p > 0.4964$, Mann-Whitney U-Test)

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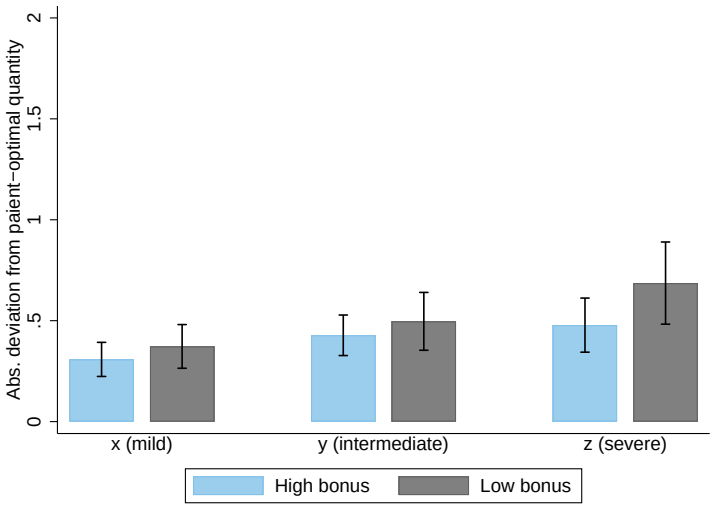

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- No statistically significant differences ($p > 0.4964$, Mann-Whitney U-Test)

▷ The bonus level does not significantly affect physicians' behavior.

Physicians' characteristics and the quality of care

Multilevel mixed effects regressions on the relative quality of care

Model:	(1)	(2)	(3)	(4)	(5)
Performance pay (P4P)	0.068***	0.068***	0.068***	0.055***	0.072***
	(0.007)	(0.007)	(0.007)	(0.009)	(0.012)
High annual profit ($>$ 147k EUR)	-0.050*		-0.058**	-0.072**	-0.058**
	(0.027)		(0.028)	(0.029)	(0.028)
City		-0.030	-0.042	-0.042	-0.042
		(0.036)	(0.037)	(0.037)	(0.038)
Outer conurbation		0.005	-0.003	-0.003	0.003
		(0.033)	(0.034)	(0.034)	(0.035)
P4P x High annual profit				0.029**	
				(0.014)	
P4P x City					-0.001
					(0.017)
P4P x Outer conurbation					-0.012
					(0.017)
Constant	0.815***	0.784***	0.812***	0.819***	0.810***
	(0.057)	(0.059)	(0.066)	(0.066)	(0.066)
Observations	1764	1764	1764	1764	1764
Physicians	98	98	98	98	98

Notes. This table shows parameter estimates (fixed effects) from multilevel mixed-effects REML regressions. All models include subject-specific random effects and controls for gender, years of practice and bonus size. Standard errors are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

So far...

- P4P significantly increases the quality of care
- Quality in the experiment is lower for physicians with high annual practice profit
- Physicians with high annual profits respond significantly stronger to P4P incentives
- Physicians' location does not significantly affect the quality of care

Unintended consequences: Crowding-out of patient-regarding behavior

Descriptive analysis

- Analysis is based on how (104x9) individual patients are treated in both parts
- Behavioral patterns:
  - Profit maximization (PM)
  - Benefit maximization (BM)
  - Trade-off (TO)
- Behavioral patterns by part of the experiment:
  - 1st part (CAP): PM: 1%; BM: 54%; TO: 42%; Other: 3%
  - 2nd part (CAP+P4P): PM: 30%; BM: 64%; TO: 0%; Other: 6%
- Transitions:
  - Crowding out: BM $\longrightarrow$PM: 7% ($\sim$ 14% of BM); TO $\longrightarrow$ PM: 22%
  - Crowding in: PM $\longrightarrow$ BM: 1%; TO $\longrightarrow$ BM: 17%

Main takeaways

- Controlled artefactual field experiments to test the effect of introducing performance pay on physicians' behavior
- Underprovision in CAP is significantly reduced under performance pay
- Patients' severities of illness affect physicians' behavior
- Surprisingly, the level of the bonus pay does *not* significantly affect physicians' behavior
- Physicians with higher practice profits respond significantly stronger to P4P
- Non-negligible evidence for crowding-out of patient-regarding behavior

Some policy implications...

...within the confines of our experiment

Gains in patient benefit and additional remuneration cost

- Increase of health benefit:
  - Low bonus: 8%
  - High bonus: 7.5%

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- Arc-elasticity of patient benefit with respect to remuneration (similar to Brot-Goldberg et al. 2017, QJE):
  - Low bonus: 0.18
  - High bonus: 0.08

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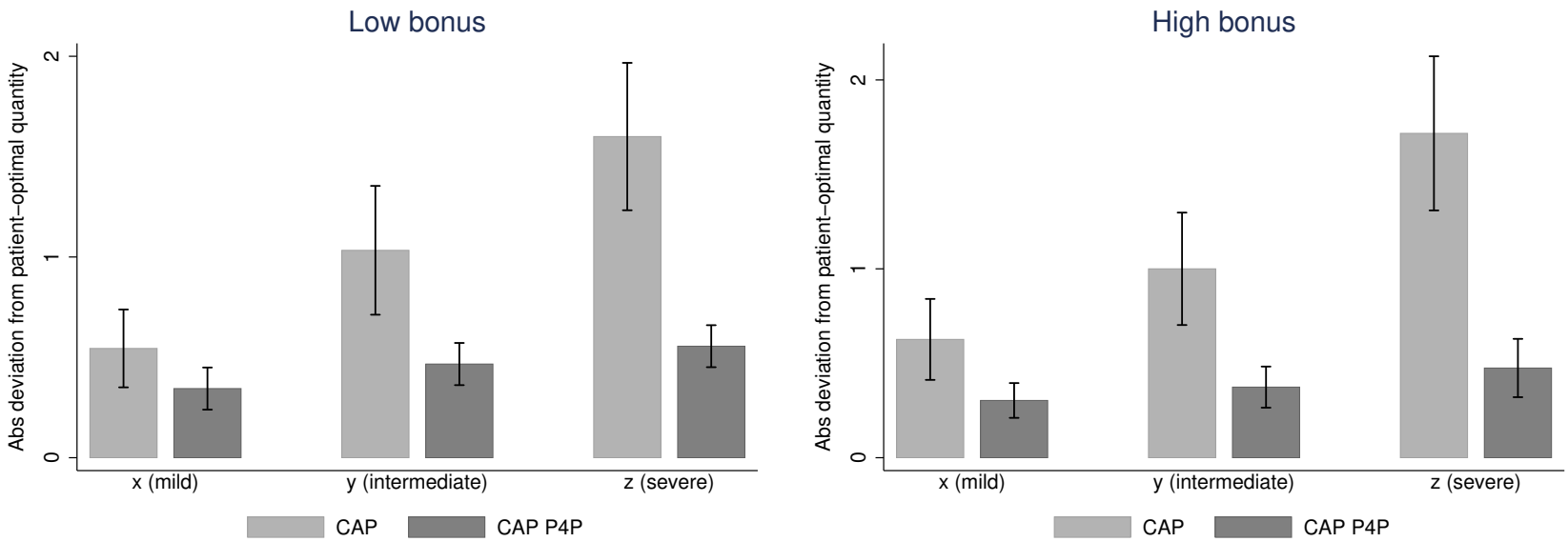
- Arc-elasticity of patient benefit with respect to remuneration (similar to Brot-Goldberg et al. 2017, QJE):
  - Low bonus: 0.18
  - High bonus: 0.08
- Low bonus sufficient to change behaviors and more cost efficient

THANK YOU!

APPENDIX

Does the behavior of physicians and med. students differ?



- Within-subjects: Underprovision in CAP is significantly reduced under performance pay
- Level of bonus pay does not significantly affect students either

▷ Performance pay affects students' behavior very similarly.

Robustness of results: Evidence from control treatments with medical students

- "Taking performance pay away" (reverse order) does not affect medical students behavior in a significant way compared to introducing performance pay
- No significant differences under constant maximum incentives (increased capitation)

▷ Findings are robust across subject pools and towards order of payment systems as well as levels of incentives.