The role of physician altruism in the physician-industry relationship: Evidence from linked experimental and observational data*

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Abstract

Altruism is a key professional norm that underlies the physician's role as a representative agent for patients. However, physician behavior can be influenced when private gains enter the objective function. We study the relationship between altruism and physicians' receipt of financial benefits from pharmaceutical manufacturers, as well as the extent to which altruism mitigates physicians' responsiveness to these industry payments. We link data on altruistic preferences for 280 physicians, identified using a revealed preference economic experiment, with information on their receipt of monetary and in-kind transfers from pharmaceutical firms along with drug prescription claims data. Non-altruistic physicians receive industry transfers that are on average 2,184 USD (95% CI: 979.3–3,388.5) or 254% higher than altruistic physicians. While industry transfers are associated with higher drug spending and brand prescribing rates, these relationships are predominantly driven by non-altruistic physicians. Our results indicate that altruism is an important determinant of physicians' relationships with and responses to industry benefits.

Keywords: Physician behavior; Professional norms; Industry payments; Drug prescribing

JEL codes: I11; D64; L14; C91

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1 Introduction

In the medical profession, altruism is a core norm that mandates prioritizing patient benefits over personal profits in physician's role as a representative agent for patients. For example, the American Board of Internal Medicine underscores that 'professionalism in medicine requires the physician to serve the interests of the patient *above his or her self-interest*' (American Board of Internal Medicine 1995).

However, if physicians are not fully altruistic, clinical decision-making may be affected by the potential to obtain personal gains. Concerns regarding personal gains are particularly pronounced in the context of industry ties that are often expressed through financial channels. Close relationships between physicians and pharmaceutical manufacturers have attracted substantial media and policy attention, as they frequently involve financial and in-kind benefits for physicians who engage with drug company marketing efforts.[1] However, the relationship between physician altruism and financial benefits from industry transfers remains unexplored.

In this study, we combine experimental data with administrative data to examine the role of altruism in the physician-industry relationship and clinical practice. We match altruistic preferences elicited for 280 physicians in the United States to data on their receipt of monetary or in-kind transfers from pharmaceutical firms and claims data on their drug prescriptions. Our analysis focuses on the association between altruism and industry payments, and how this relationship moderates physicians' prescribing behaviors. Altruism, within our context, is characterized by the utility weight that physicians place on benefits that extend beyond themselves, such as those directed toward patients and society overall, as opposed to the weight on their own benefits. Less altruistic physicians prioritize their private gains, such as those from receiving industry payments. Interactions between physicians and the pharmaceutical industry often involve financial benefits, such as purchasing meals and beverages, lucrative consulting fees, or invitations as paid speakers at promotional events. We first develop a stylized model of altruism in brand prescription choices and physicians' decisions to engage with drug firms. We then empirically investigate how physician altruism relates to transfers from the pharmaceutical industry to physicians, and whether adherence to altruistic norms is associated with the relationship between industry transfers and drug prescribing.

We establish that non-altruistic physicians have stronger ties to the pharmaceutical industry. On average, the monetary value of yearly industry transfers to non-altruistic physicians is 2,184 USD (95% CI: 979.3–

[1] For example, ProPublica focused on industry payments to physicians in 'Dollars for Doctors', a series of highly publicized media reports (see the 'Dollars for Doctors' project, last access: 23 Nov 2023), which was mirrored by a European initiative (see the 'Euros for Docs' project, last access: 23 Nov 2023). Recently, direct-to-physician marketing practices related to the drug Ozempic have been heavily criticized (see reporting by Fortune: Ozempic manufacturer Novo Nordisk spent $11 million last year 'wining and dining' doctors. Experts slam the move as a breach of doctor-patient trust, last access: 23 Nov 2023). Legislative efforts such as the United States Physician Payments Sunshine Act or the French Sunshine Law attempt to increase the transparency of physician-industry relations nationwide.

3,388.5) or 254% higher than average payments to altruistic physicians. These findings indicate a strong selection of who engages with pharmaceutical firms that may seek to influence prescription behavior.

Next, we study the relationship between altruistic preferences and drug prescribing. To capture the potential effects of marketing efforts, we measure prescribing by the share of brand claims over all prescriptions and per-claim spending. Our prescribing variables hold the number of prescriptions fixed to examine whether physicians substitute brand for generic prescriptions, as well as expensive for low-cost treatments. We find no evidence that altruistic preferences are related to prescription decisions and health care costs directly. Instead, our results point toward altruism serving as a moderating variable for the relationship between industry payments and prescriptions, such that the relationship between industry payments and prescriptions differs by altruistic preferences. We replicate previous findings, which have shown that industry transfers are associated with higher drug spending and brand prescribing rates across a range of drug classes and physician specialties (Mitchell et al. 2021). However, we find that this positive association is consistently driven by non-altruistic physicians.

For an increase in payments, physicians with non-altruistic preferences respond more strongly by prescribing more brand treatments and incurring higher drug spending. In fact, once we control for the interaction between altruism and payments, we do not find a statistically significant association between aggregate industry transfers and drug spending or brand prescribing rates. Our estimates suggest that a 1% increase in payments to a less altruistic physician over an altruistic physician is associated with an *additional* increase of 0.005 percentage points (0.027%) in the share of brand claims (1% significance level). Per-claim costs increase by additionally 2.3% (not statistically significant) among non-altruistic physicians, and are higher by additionally 5.8% conditional on receiving any payments (10% significance level). Our results indicate that altruistic preferences might determine the strength of the relation between the amount of industry payments physicians receive and physicians' drug prescribing.

A back-of-the-envelope calculation suggests that a physician with non-altruistic preferences incurs approximately 3,155 USD more in annual expenditures compared to physicians with altruistic preferences. Our main results are consistent with specifications in which we focus on drug-specific payments and prescribing patterns. We find little evidence that patient pool characteristics, such as patient vulnerability, change the relationship between payments and prescribing among non-altruistic physicians. While physicians who treat more vulnerable patient groups, such as patients with a higher diagnostic risk score or a higher low-income patient share, are less responsive to industry payments overall, non-altruistic preferences offset physicians' lower responsiveness to payments among more vulnerable patient pools. Instead, altruism moderates the correlation between industry payments and drug prescribing to similar extents on most dimensions of patient heterogeneity.

Our work contributes to the knowledge of direct-to-physician marketing and the impact of such interactions on physicians' treatment decisions. Physicians are central in deciding whether brand drugs are chosen over less expensive alternatives (Hellerstein 1998). Previous studies have demonstrated a strong association between industry payments and physicians' prescribing decisions, and consistently find that industry transfers are linked to physicians' prescribing of branded medical drugs (Iizuka and Jin 2007; Dejong et al. 2016; Ansari 2021). In addition, industry payments have been found to heavily influence physicians' selection of medical devices (Bergman et al. 2021, 2024; Amaral-Garcia 2022).

Several mechanisms could drive a positive correlation between marketing efforts and physicians' treatment choices. For example, industry transfers might have a promotional value that directly induces physicians to prescribe these drugs (Carey et al. 2021b,a; Mitchell et al. 2022). Apart from the persuasive elements of drug detailing, interactions between physicians and the pharmaceutical industry can also have informational value and benefit patients when new treatments are introduced (Ching and Ishihara 2012; Grennan et al. 2021). Alternatively, pharmaceutical firms might target certain physicians for promotional activities, such as those who are already high prescribers of branded drugs or hold influential positions (Agha and Zeltzer 2022). We do not take a stance on the causal direction between payments and prescribing, and we do not rule out the possibility that marketing aimed at physicians can unintentionally improve efficiency by increasing prescribing for novel, underused drugs. Instead, we focus on understanding which types of physicians are more likely to accept payments and participate in industry relations (Newham and Valente 2024). Our study highlights the role of professional norms of altruism, which prompt physicians to prioritize societal benefits over personal gains, and suggests that variation in compliance to such norms contributes substantially to heterogeneity in physicians' ties to pharmaceutical firms and the extent to which private financial benefits enter physicians' prescribing decisions.

Our study further complements existing evidence on the impact of altruism on physicians' treatment decisions. Altruism, as opposed to self-interest, is considered the 'accepted norm' of the physician profession (Arrow 1963). Professional norms of altruistic behavior underlie the role of physicians as agents for their patients, determining the degree to which self-serving motives enter into physicians' treatment decisions (Arrow 1963; Farley 1986; Ellis and McGuire 1990; Kesternich et al. 2015). However, previous research has highlighted sizeable variation in altruistic preferences among medical students and physicians (Godager and Wiesen 2013; Brosig-Koch et al. 2017; Li et al. 2017, 2022). In observational settings, heterogeneity among physicians, such as habit persistence, play a major role in brand prescribing decisions (Crea et al. 2019), while more altruistic providers are found to prescribe fewer opioid drugs (Schnell 2022).[2] In experiments,

[2]The definition of altruism varies across studies. Crea et al. (2019) define altruism as the internalization of patient costs and find no evidence that physicians' prescribing decisions consider patient out-of-pocket expenses or insurance coverage. Schnell (2022) define altruism as physicians' utility weight on patient health relative to own revenues, measured by the adoption of a

medical students consider patient cost-sharing, alongside patient health, when making prescribing decisions (Ge et al. 2022).

While an existing body of literature uses either experimental or observational methods in order to measure altruistic preferences of (future) physicians, few studies link experimentally elicited information to clinical behavior. (Li 2018) find that variation in social preferences among medical students accounts greatly for the choice of medical specialty. Gertler and Kwan (2024) find, in a 'lab-in-the-field' setting, a higher share of false positively reported Malaria tests and profit-driven overprescribing among less altruistic physicians in Kenya. Similarly to these studies, our work contributes methodologically by combining experimental data on physician preferences with data 'outside the lab', from administrative sources. However, the extent to which physicians' adherence to professional norms interacts with third-party influence has remained unexplored. Our study examines physician altruism to investigate the interaction with industry payments as a mechanism for how differences in prescribing patterns may develop. Overall, our findings emphasize the importance of social preferences and professional norms in explaining whether tight industry-physician relationships arise.

The remainder of the paper is organized as follows. Section 2 sets up a conceptual framework that links physician altruism, payments, and prescribing decisions, and states the resulting hypotheses to test. Section 3 describes the construction of our analysis sample based on experimental and observational data. Section 4 establishes empirical tests of our hypotheses and shows the regression results. Section 5 discusses threats and extensions to our main analysis. Section 6 concludes.

2 A stylized model of altruism in prescribing with payments

We examine a physician's decision-making process when she is presented with the opportunity to interact with pharmaceutical representatives in exchange for monetary and in-kind transfers. The physician's commitment to the professional norm of altruism is defined by $\alpha \in [0, 1]$. A higher value of α represents more weight on the physician's private benefits, and thus weaker adherence to altruistic norms. Put differently, we formalize altruistic preferences as the opposite of selfish preferences defined by a low value of α. Our conceptual framework explores a two-period model where the physician, given the level of altruism, first decides whether to accept a predetermined level of industry transfers offered to her, and subsequently determines her brand prescribing propensity in anticipation of potential future payments. The two-period setup captures the main dynamic considerations of physicians and pharmaceutical representatives in a simplified model. Based on this setup, we study the comparative statics of the equilibrium as to explore the relationship between the

safer opioid reformulation. In contrast, our study defines altruism by the degree to which physicians weigh their own utility relative to other-regarding motivations, and we measure physician altruism experimentally. In addition, we take into account that the presence of industry transfers may impact physicians' prescribing patterns.

physician's acceptance of industry transfers, her prescribing decisions, and her adherence to altruistic norms.

We begin by describing the physician's decision on the level of industry transfers to accept. Then, we discuss the optimal propensity to prescribe branded drugs.

2.1 Industry payments acceptance decision

We consider a physician who is approached by pharmaceutical representatives in the first period and given the opportunity to interact. Interactions are in the form of free meals, travels, or paid speaking opportunities, and correspond to in-kind or cash transfers with a fixed positive monetary payment value within a period. However, accepting industry transfers negatively impacts the physician's professional integrity. The physician thus trades off the monetary value of the transfer with its professional costs.

The decision to participate in these interactions for payment is contingent upon both the monetary value of the payment, represented by $\bar{p} > 0$, and the physician's level of altruism $\alpha \in [0, 1]$ where higher α represents lower altruism. We denote the realized payment to the physician by $p \in \{0, \bar{p}\}$: The physician either receives the fixed value $\bar{p}$ as offered by the drug firms, or she receives 0 if no interactions with the pharmaceutical industry take place.

Let the physician's utility from the payment acceptance decision be given by:

$$U_p(p; \alpha) = p - R(p; \alpha),$$

where $R(p; \alpha) \geq 0$ represents the professional costs associated with accepting the payment, such as reputational damage (among patients and colleagues), moral guilt, and fear of conflicts of interest.[3] Without payments, the physician does not face these professional costs, such that $R(p = 0; \alpha) = 0$ and $U_p(0; \alpha) = 0$. With payments, professional costs enter the physician's utility as a negative term.

We assume that professional costs increase with a higher accepted payment value at an accelerating rate, but that the slope at any given payment level is lower for less altruistic physicians. Each additional dollar that a physician accepts thus progressively harms her professional integrity, such that $R(p; \alpha)$ is a convex function of p, or $\frac{\partial R}{\partial p} > 0$ and $\frac{\partial^2 R}{\partial p^2} > 0$. Such a relationship corresponds, for example, to findings that higher accepted industry transfers increasingly undermine patient trust (Hwong et al. 2017). However, the marginal increase in a physician's professional costs for accepting an additional dollar becomes smaller with weaker altruistic preferences, such that $\frac{\partial^2 R}{\partial p \partial \alpha} < 0$. This could be justified by the fact that, all else being equal, a physician committed to altruistic norms may have stronger concerns about the undue influence of payments

[3] These professional costs can imply financial losses, for example due to patients choosing providers according to physicians' reputation reflected in public ratings (Bensnes and Huitfeldt 2021). In addition, these costs represent physicians' non-pecuniary and reputational motives under information disclosure (Kolstad 2013; Godager et al. 2016).

deviating her treatment choices from those that she would make if she only considered patient and societal interests without accepting the transfers from the pharmaceutical industry.

The physician accepts a given payment value $\bar{p}$, as offered by the pharmaceutical industry, if and only if her net utility from accepting the transfer is higher than if she does not engage in it; that is, $\bar{p} - R(\bar{p}; \alpha) \geq 0$. We denote the payment at which the physician's participation constraint is binding by:

$$p^{\max}(\alpha) = R(p^{\max}; \alpha). \tag{1}$$

A physician with given altruistic preferences α accepts any payment $0 < \bar{p} < p^{\max}(\alpha)$, where $p^{\max}(\alpha)$ is the maximum payment she is willing to accept. For professional costs that are convex in payments and increasing with altruism, the maximum transfer to the physician decreases with the level of altruism (increases in α).

2.2 Optimal propensity to prescribe branded drugs

In the second period, the physician chooses her propensity to prescribe a brand-named drug over its less expensive alternatives, such as generic versions or older compounds. We represent the physician's brand prescribing propensity by b, corresponding to the proportion of claims that she fills for branded drugs. When deciding how to prescribe, the physician considers any utility gains to herself, indexed by s, as well as any altruistic motivations that may arise from benefits to others, indexed by o. In particular, she considers the benefits and costs to patients and society for a given brand drug propensity b, denoted by $\pi_o(b)$, as well as the private value of prescribing brand drugs, denoted by $\pi_s(b, p)$.

Let the physician's utility for the propensity to prescribe branded drugs be given as:

$$\begin{aligned} U_b(b; p, \alpha) =& (1-\alpha)\pi_o(b) + \alpha\pi_s(b, p) \\ =& (1-\alpha)[H_o(b) - C_o(b)] + \alpha\pi_s(b, p), \end{aligned}$$

where $\pi_o(b)$ is comprised of $H_o(b)$, which represents the health of the patients the physician sees; $C_o(b)$, which represents the total costs to society for the treatment of these patients; and $\pi_s(b, p)$, which represents the physician's anticipation of future payments that is influenced by her prior decision of payments and her brand prescribing propensity. Note that a fully altruistic physician's ($\alpha = 0$) optimal prescribing is determined by maximizing the net benefit to patients and society, π_o, and a fully selfish physician's ($\alpha = 1$) optimal prescribing is determined by maximizing the private value of prescribing π_s. In fact, $\alpha \in (0, 1)$ captures the marginal rate of substitution between the net benefits to others for benefits to the physician herself: $MRS_{o,s} = -\frac{\partial U_b/\partial \pi_o}{\partial U_b/\partial \pi_s} = -\frac{(1-\alpha)}{\alpha}$. In the special case of $\alpha = 0.5$, a physician would be willing to trade off a marginal reduction in her private benefit by the exact same amount of gains to patients and society.

The net benefit to patients and society, $\pi_o(b)$, is a function of the proportion of patients who are prescribed branded drugs. We assume that a higher brand prescribing rate affects patient health positively, as branded drugs typically correspond to newer drug classes or may have more information available about their safety and efficacy. However, brand drugs are associated with often substantial price premia over their alternatives. The higher prices are carried by patients and insurance, and also reflect rising inefficiencies due to the monopoly power of brand drug companies (Lakdawalla and Sood 2009). We assume that the marginal health benefits and costs of a higher brand prescribing propensity are positive, with $\frac{\partial H_o}{\partial b} \geq 0$ and $\frac{\partial C_o}{\partial b} \geq 0$, but that the marginal health benefit increases at a slower rate than the marginal societal costs of additional brand drug use as costs eventually surpass the health benefits of additional brand drug use:

$$\frac{\partial^2 H_o}{\partial b^2} < \frac{\partial^2 C_o}{\partial b^2}.$$

We denote the private continuation value of engaging with the pharmaceutical industry by $\pi_s(b, p)$. Without loss of generality, we assume that without industry payments, the physician does not incur any private benefits from prescribing branded drugs, $\pi_s(b, p) = 0$ for $p = 0$. In other words, choosing a higher brand prescribing propensity only benefits the physician privately once pharmaceutical firms can interact with her. If no industry transfers could take place, a fully selfish physician ($\alpha = 1$) is indifferent at every brand prescribing propensity, whereas physicians who are not fully selfish $0 < \alpha \leq 1$ weigh societal costs/benefits to determine the optimal brand prescribing propensity b_o^*, such that $\frac{\partial H_o}{\partial b} = \frac{\partial C_o}{\partial b}$.

The physician only derives any private benefits from prescribing the brand-name drug, $\pi_s(b, p) \geq 0$, if she accepts a positive payment $p > 0$. If in Period 1, she refuses to interact with the drug firm, her brand prescribing propensity would not affect future payments. The physician's decision to accept payments is thus linked to her prescribing decision by increasing the private value of brand drug prescribing, for example in the case of a novel drug producer targeting those physicians who have engaged with the pharmaceutical industry in prior interactions and who were responsive in their treatment choices. We assume that the private value from brand prescribing is weakly increasing in payments due to the anticipation of future payments from a maintained relationship with the drug company:

$$\frac{\partial \pi_s}{\partial p} \geq 0.$$

Lastly, we assume that the private returns to a higher brand prescribing propensity are positive but decreasing, for example as future industry payments are expected to increase with brand prescribing but at a decreasing rate:

$$\frac{\partial \pi_s}{\partial b} > 0, \quad \frac{\partial^2 \pi_s}{\partial b^2} < 0.$$

We denote the optimal brand prescribing propensity by $b^*(\alpha)$. By applying the implicit function theorem to our setup, we can show that the optimal brand drug prescribing propensity moves up with higher payments.[4] Importantly, within this setup, the optimal brand prescribing propensity increases with payments at a higher rate for less altruistic physicians:

$$\frac{\partial^2 b^*}{\partial p \partial \alpha} = -\frac{\frac{\partial \pi_s}{\partial p}\left(\frac{\partial^2 H_o}{\partial b^2} - \frac{\partial^2 C_o}{\partial b^2}\right)}{\left((1-\alpha)\left(\frac{\partial^2 H_o}{\partial b^2} - \frac{\partial^2 C_o}{\partial b^2}\right) + \alpha \frac{\partial^2 \pi_s}{\partial b^2}\right)^2}, \tag{2}$$

such that $\frac{\partial^2 b^*}{\partial p \partial \alpha} \geq 0$ for any $\alpha > 0$. Thus, brand drug use is more responsive with regard to payments with increasing weight on physicians' private benefits.

2.3 Model predictions

Our main observation from the two-period model is that industry payments interact with the level of altruism in determining prescribing decisions. We summarize our observations in the following predictions:

- *Non-altruistic physicians accept higher payments.* If payments progressively harm physicians' professional integrity, and these professional costs increase at a higher rate for more altruistic physicians, then Equation (1) defines the maximum value of transfers, and thus the range of payments, to be lower for more altruistic physicians than for less altruistic physicians. In the aggregate, we expect that payments made to non-altruistic physicians are higher than payments made to altruistic physicians.

- *Non-altruistic physicians are more responsive to payments.* If the marginal patient benefit from using brand drugs increases at a slower rate than the marginal societal costs, and physicians' accepted payments are linked to their private benefits from using brand drugs through an ongoing industry relationship, then Equation (2) indicates that less altruistic physicians are more responsive to industry transfers in their use of brand drugs compared to more altruistic physicians. We thus expect that the relationship between prescribing and payments is stronger for non-altruistic physicians than for

[4] We show the full derivations for the comparative statics of the optimal brand prescribing propensity in Appendix A.

altruistic physicians.

In the empirical implementation, we test our main predictions on the payment receipt and the responsiveness to payments in prescribing among physicians who prioritize gains to others over gains to themselves ('Altruistic', $\alpha < 0.5$), compared to physicians who do not prioritize net gains to others ('Non-altruistic', $\alpha \geq 0.5$).

3 Data

3.1 Eliciting altruism in the experiment

Our empirical analysis studies whether adherence to altruistic norms predicts physicians' receipt of industry transfers and drug prescriptions. To do so, we link observed physician behavior from administrative information to experimental data from Li et al. (2022). The experiment elicited physicians' social preferences and identified altruism separately from distributive concerns. For this study, we focus on physicians' altruistic preferences.[5]

In the experiment, each physician is presented with a sequence of modified dictator games. Additionally, a survey questionnaire collects information about physicians' practice experience and educational background.

Our sample includes 283 individual physicians who participated in the experiment. All participating physicians are clinically active, either as primary care providers or as cardiologists. Physicians were recruited for the experiment by contacting leaders of medical groups, which are groups of physicians (often of the same specialty but can be of different specialties) who work together in the same office or group of offices and with shared patient records and office systems. The medical groups were invited via email to participate in a study of physician decision-making, and selected to represent variation in size and geographic region within specialties.[6]

Physicians in the experiment are faced with a web-based graphical representation of a consumption decision problem, that is, choosing a bundle under budget constraints. The experimental task asks physicians to choose a payoff allocation between 'self' and 'other'. This choice affects both the physician's payoff ('self') as well as the payoff of a randomly drawn anonymous respondent from a representative sample of the US adult population ('other'). The randomly drawn US adult represents the general population, as both primary care providers and cardiologists are supposed to serve patients non-selectively.[7] The main experiment is a

[5] An analysis plan on the link between physician altruism and quality of care among Medicare patients was pre-registered in 2022, after the experiment was conducted and before the observational data was merged (https://doi.org/10.17605/OSF.IO/75J8K). The pre-registration does not include an analysis of industry payments, which developed as a separate idea later on. However, the analysis plan proposes a general relationship between spending on care and physician altruism. In this paper, we define altruism as selfless preferences, consistent with the definition used in the pre-registered analysis plan.

[6] Li et al. (2022) discusses the recruitment methods used, and shows that there were no statistically significant differences in social preferences by recruitment method. While our sample might differ from a general population of physicians, we only perform within-sample comparisons of physician behavior. Generally, participants in lab experiments have been shown to behave slightly less altruistic compared to non-participants, but the differences are minor (Snowberg and Yariv 2021).

[7] The representative sample of US adults is part of the Understanding America Study. All physicians are provided with

modified dictator game, where the physician allocates an endowment across 'self' $\tilde{\pi}_s$ and 'other' $\tilde{\pi}_o$ at prices p_s and p_o. For a normalized endowment of 1, the set of possible budget lines is thus provided by:

$$p_s\tilde{\pi}_s + p_o\tilde{\pi}_o = 1.$$

Each physician plays 50 rounds of independent modified dictator games, where the budget line is drawn randomly. Physicians choose an allocation on a given budget line through a point-and-click interface. At the end of the experiment, one of the 50 rounds of decisions is chosen randomly. The physician receives $\tilde{\pi}_s$, and the anonymous respondent from the general population receives $\tilde{\pi}_o$ as determined by the physician in the randomly chosen allocation.

After the experiment is conducted, each physician is asked to complete a survey questionnaire in order to receive payment from the experiment. The survey provides details on sociodemographic characteristics of the physician as well as institutional information on the physician's practice.

To measure altruistic preferences, we assume that physicians' utility function $u_s(\tilde{\pi}_s, \tilde{\pi}_o)$ exhibits Constant Elasticity of Substitution (CES).[8] Physicians' utility from trading off the payoffs to 'self' compared to 'other' is then given by:

$$u_s = [\alpha\tilde{\pi}_s^\rho + (1-\alpha)\tilde{\pi}_o^\rho]^{1/\rho}. \tag{3}$$

Parameter $\alpha \in [0,1]$ in Equation 3 measures altruistic preferences: $\alpha = 0$ indicates fully altruistic preferences, where utility weight is exclusively placed on payoffs to 'other'. In contrast, $\alpha = 1$ indicates selfish preferences and $\alpha = 0.5$ indicates impartial social preferences. Parameter $\rho \leq 1$ in Equation 3 measures the equality-efficiency trade-off in response to relative price changes separately from social preferences.[9]

We estimate parameters α and ρ on the CES expenditure function of the payoff to 'self', which we obtain by maximizing the utility function (3):

information on the distribution of demographic, socio-economic, and geographical characteristics within respondents.

[8] To ensure that the observed behavior complies with the Generalized Axiom of Revealed Preferences (GARP), we compute Afriat (1972)'s Critical Cost Efficiency Index (CCEI). The mean CCEI across physicians is 0.96, with a median of 0.998, indicating that almost all physicians act perfectly rational and GARP is satisfied.

[9] $\rho \in (0,1]$ indicates that distributional preferences are weighted towards efficiency, that is, increasing total payoff as relative prices between payoff to 'self' in relation to 'other' change. $\rho \in (-\infty, 0)$ indicates preferences toward equality, that is, reducing differences in payoffs as relative prices change. $\rho \to 0$ indicates that the relative allocation of payoffs does not change in response to relative price changes.

$$p_s\tilde{\pi}_s = \frac{g}{(p_s/p_o)^r + g},$$

where $r = \rho/(1-\rho)$ and $g = [\alpha/(1-\alpha)]^{1/(1-\rho)} \in [0,1]$. We employ nonlinear tobit maximum likelihood to estimate g and r and then infer the underlying parameters α and ρ separately for each physician, using 50 observations from the repeated games. Our analysis focuses on estimates of α, the altruism parameter.

Physicians could achieve a maximum possible payoff of 250 USD in the experiment, and they could receive a payoff of about 156 USD on average if they never chose to give money away. On average, physicians obtained 87 USD. [10] Details on the experiment, survey, and methodological background are described in Li et al. (2022).

3.2 Sample construction

To prepare the analysis sample, we complement data from the experiment with administrative data from the Open Payments database on industry payments, along with Medicare Part D Public Use Files on physician claims filed for the years 2014 to 2019. We discuss the administrative data sources and the sample construction below.

The Open Payments program is a national disclosure initiative published by the Centers for Medicare & Medicaid Services (CMS) and made publicly accessible in order to promote transparency of physician-industry relations. Since February 2013, Open Payments has collected data on all physician-industry encounters that involve either monetary or in-kind transfers, such as meals, consulting fees, speaker fees, or any detailing efforts. The disclosure of transfers is federally mandated, and penalties are imposed against reporting violations under Section 6002 of the Affordable Care Act from 2010 (Physician Payments Sunshine Act). In addition to information on transfers, the Open Payments database contains physicians' names and practice locations, as well as their alternative names and addresses. However, the National Provider Identifier (NPI) for physicians is not included until the 2021 release. We use a fuzzy matching procedure to match physicians' experimental data to the older Open Payments data covering 2014 to 2019, where we rely on physicians' names and addresses. We infer a match if a physician's name is unique in a licensed state according to the National Plan and Provider Enumeration System (NPPES) registry. We manually check all remaining physicians for potential matches. Lastly, we use the NPIs reported in the 2021 Open Payments release to check against our matching procedure. We assume that no monetary or in-kind gifts were made to physicians

[10] The average session duration was 15 minutes, excluding sessions that lasted longer than two hours in which physicians had likely did not log out.

not appearing in the Open Payments database.

We then link drug claims data from the Medicare Part D Public Use Files by physicians' NPI. Out of 1,981 physician-year observations from 283 physicians, we drop 364 observations in which drug prescribing was insufficient so that drug spending or the number of generic prescription claims cannot be determined.[11] The final sample contains 1,616 physician-year observations from 280 physicians.

3.3 Main variables

Altruism. Our main variable of interest is altruism, denoted by α. The parameter α quantifies the utility weights assigned by a physician to their own gains relative to the benefits received by others. When $\alpha = 0.5$, a physician weighs private gains the same as benefits obtained by others, and she trades off a marginal reduction in her private utility for that exact amount of gains obtained by agents beyond herself. We motivate our categorical definition of altruism based on related literature, in which physicians assigning half of the utility weight to private gains, $\alpha = 0.5$, emerges as a special case.[12] We use one-sided t-tests to categorize physicians as having impartial social preferences ($\alpha = 0.5$ cannot be rejected), selfish preferences ($\alpha \leq 0.5$ can be rejected), or selfless preferences ($\alpha \geq 0.5$ can be rejected). In the main analysis we categorize altruistic preferences dichotomously, distinguishing between physicians with selfless preferences (Altruistic), and physicians with impartial or selfish preferences (Non-altruistic). Altruistic physicians prioritize gains to others over their private benefits, thus allowing a natural interpretation. In addition, this definition does not require us to rely on assumptions about the representativeness of our sample compared to the broader physician population, unlike using, for example, a median. In Section 5 we discuss alternative specifications with continuous measures of altruistic preferences, where we either use α, the marginal rate of substitution as transformation of α, or α standardized within our sample. The results are generally consistent with our main estimates but less precise.

Payments. We aggregate the monetary value of all transfers recorded in the Open Payments database in a given year to construct the USD value of industry payments on the physician-year level. For payments as an outcome, we rely on estimates based on level payments to calculate marginal effects on the mean.[13] In addition, we construct the natural logarithm of payments for any positive transfers, measuring the intensive margin, as well as an indicator variable for any payment, measuring the extensive margin of payments.

[11] We drop one additional physician-year observation for which average patient age and risk score are missing, as we would not be able to control for these basic patient pool characteristics in our main estimations.

[12] In the corresponding models of provider behavior, physicians only internalize their own net gains of health care provision and patient health. Then, for physicians assigning equal weights on private and patient gains, a first-best social optimum can be achieved under prospective flat payments with fully insured patients (Godager and Wiesen 2013; Ellis and McGuire 1990). Note that this literature focuses on physician compensation schemes rather than payments from third parties, and is thus not fully comparable to our case with industry payments.

[13] In a sensitivity check, we show results from log-transformed payments based on the natural logarithm of 1 + payments.

To measure industry payments, we only consider transfers included as general payments in the database, which excludes research and ownership payments or investment interests.[14] We aggregate payment records, as about 15% of entries from the Open Payments database for our sample of physicians are not associated with any product, and some entries refer to generic categories, such as 'general therapies', 'circulatory support', or 'general'. In additional analyses, we consider drug-specific payments and prescriptions.

In additional analyses, presented in Section 5, we also consider the sum of payments on the physician-level over the period between 2014–2019.

Drug prescribing. We construct two measures in order to capture the association between industry payments and drug prescribing: Log per claim spending, and Share of brand claims. To measure drug spending imposed on patients and the Medicare system, we take the natural logarithm of the total drug spending divided by the number of drug claims in a year. Note that, by construction of our sample, per-claim costs are never zero. We measure prescribed drug types by the share of claims associated with brand drugs, that is, the share of prescriptions of non-generic drugs among all claims in a year.[15]

3.4 Additional variables

We include control variables that are not associated with altruism but might be determinants of industry payments to physicians or prescribing decisions. In addition, we investigate whether the relationship between altruism, industry payments, and drug prescribing differs between physicians with varying patient pools in heterogeneity analyses.

Individual controls. Age and gender have been identified as important determinants of the industry-physician relationship (Han et al. 2022). In addition, our sample comprises both primary care providers (including family medicine and internal medicine) and cardiologists, representing groups that are likely to be targeted differently by pharmaceutical companies. As basic individual control variables, we thus include indicators for physicians' age category, gender, and specialty.

Institutional controls. Physicians in our sample also differ in institutional characteristics. The organizational structure of a clinic, such as the type of ownership or size of the medical group, can impact the extent to which physicians are able to engage with the pharmaceutical industry. To account for such differences, we include physicians' practice ownership type and practice size category as indicator variables.

State-controls. Some states restrict the level of payments physicians may receive. We identify Vermont, Massachusetts, Minnesota, Washington D.C., West Virginia, California, Connecticut, Louisiana, and Nevada

[14]In Appendix B we provide additional information on the individual drugs that are associated with high prescriptions or payments. Table 7 lists the names of the most commonly prescribed drugs, and Table 6 lists the names of the drugs for which physicians in our sample received the highest-valued transfers.

[15]Non-generic drugs include brand or other drugs. For simplicity, we refer to all non-generic drugs as brand drugs.

as states with payment regulations that are more restrictive than the federal level.[16] From these, only Vermont, Minnesota, Washington D.C., and California appear in our analysis.

Patient pool heterogeneity. For the analysis of drug prescribing, we additionally include control variables to characterize the pool of physicians' Medicare beneficiaries. We construct indicator variables based on the following patient characteristics, averaged for each physician in a given year: Risk score as evaluated by the Centers for Medicare and Medicaid Services (CMS-HCC Risk Adjustment Model), Age, Share of female patients, Share of non-white patients, and Share of dual (Medicare and Medicaid) eligibility patients. The indicator variables characterize the quartiles of a given patient pool characteristics. Because information about physicians' patient pools is incomplete, we also construct indicator variables that are one if a characteristic is missing for each patient pool characteristic.

3.5 Descriptive evidence

Table 1 presents summary statistics for our main variables of interest and control variables. Panel A of the table reports summary statistics for key physician characteristics. In our sample, 17% of the 280 physicians are identified with altruistic preferences. Moreover, 79% of physicians in our sample receive any payments from the pharmaceutical industry during the years 2014–2019, and the sample consists primarily of primary care providers, although 34% are cardiologists.

Panel B of the table summarizes industry payments and total drug prescribing in Medicare Part D at the physician-year level. We observe industry transfers to physicians in 52% of all 1,616 physician-years. This share is similar in comparable physician populations: For example, in 2015, 41.0% of primary care providers and 81% of cardiologists in our sample received general payments, compared to national levels of between 39.6% and 51.1% in primary care and 74.9% in cardiology, respectively (Tringale et al. 2017). Yearly payments in our sample amount to 2,262.56 USD on average but are skewed to the right, with the median payment at 14 USD. The Panel also shows summary statistics for the share of brand drug claims and drug spending as our two main measures of prescribing. On average, branded drugs make up 20% (standard deviation: 0.06) of all claims, close to the median of 19%. The average drug claim is associated with costs of about 85 USD (standard deviation: 64.28), not far from a median of about 73 USD. Note that log per claim costs are the simple natural logarithm of per claim costs, as drug expenses are never zero.

Panel C of Table 1 shows summary statistics for the patients covered in Medicare Part D by the physicians in our sample. We observe considerable variation in the patient pools of physicians. We include control variables to adjust for the variation in patient characteristics in physicians' drug prescribing decisions.

[16]See Physician Payments Sunshine Act: Review of Individual State Reporting Requirements (Thomas Sullivan, 6 May 2018), last access: 30 Nov 2022.

Table 1: Summary statistics

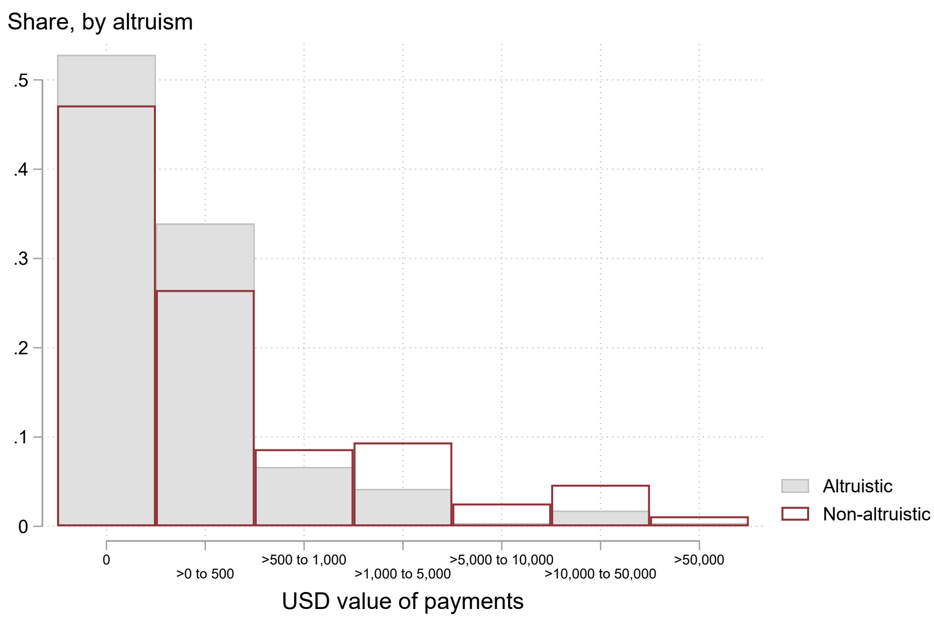
	Mean	Std. dev.	Min.	Median	Max.	Obs.
A: Physician characteristics						
Altruism parameter α	0.61	0.25	0.00	0.57	1.00	280
Altruistic	0.17	0.38	0.00	0.00	1.00	280
Any payment, all years	0.79	0.41	0.00	1.00	1.00	280
Total USD value of payments, all years[a]	14,391.92	57,255.64	0.00	460.00	575,250.00	280
Log (Total USD value of payments, all years + 1)	5.54	3.62	0.00	6.12	13.26	280
Female	0.39	0.49	0.00	0.00	1.00	280
Age below 39	0.30	0.46	0.00	0.00	1.00	280
Age 40-49	0.33	0.47	0.00	0.00	1.00	280
Age 50-59	0.22	0.42	0.00	0.00	1.00	280
Age above 60	0.16	0.36	0.00	0.00	1.00	280
Cardiology	0.34	0.47	0.00	0.00	1.00	280
Nonprofit hospital	0.16	0.37	0.00	0.00	1.00	280
Academic medical center	0.59	0.49	0.00	1.00	1.00	280
Physician-owned practice	0.25	0.43	0.00	0.00	1.00	280
Practice size: 1–35	0.16	0.36	0.00	0.00	1.00	280
Practice size: 36–350	0.48	0.50	0.00	0.00	1.00	280
Practice size: 351–1600	0.36	0.48	0.00	0.00	1.00	280
B: Industry payments and total drug prescribing						
Any payment	0.52	0.50	0.00	1.00	1.00	1,616
USD value of payments[a]	2,262.56	10,809.20	0.00	14.00	215,100.00	1,616
Log (USD value of payments + 1)	3.16	3.40	0.00	2.63	12.28	1,616
Number of claims[a]	2,834.62	3,387.60	10.00	1,580.00	28,110.00	1,616
Share of brand drug claims	0.20	0.06	0.00	0.19	0.54	1,616
Total drug spending[a]	219,262.40	275,702.59	120.00	133,160.00	3,287,350.00	1,616
Per claim spending	84.89	64.28	5.61	72.73	1,122.73	1,616
Log per claim spending	4.30	0.49	1.72	4.29	7.02	1,616
Altruistic: Any payment	0.47	0.50	0.00	0.00	1.00	286
Altruistic: USD value of payments[a]	860.40	5,276.09	0.00	0.00	71,320.00	286
Altruistic: Number of claims[a]	3,017.45	3,138.52	10.00	1,980.00	16,780.00	286
Altruistic: Share of brand drug claims	0.19	0.05	0.05	0.18	0.48	286
Altruistic: Per claim spending	82.03	75.66	12.25	72.75	866.79	286
C: Patient pool characteristics						
Average patient risk score	1.47	0.48	0.60	1.42	4.10	1,616
Average patient age	71.17	4.22	34.52	71.84	83.69	1,616
Share of female patients	0.58	0.13	0.22	0.56	1.00	1,508
Share of non-white patients	0.30	0.23	0.00	0.23	1.00	1,496
Share of dual-recipient patients	0.28	0.20	0.00	0.22	1.00	1,342
Share of patients below age 65	0.18	0.13	0.00	0.15	1.00	1,155
Share of patients above age 84	0.12	0.05	0.00	0.11	0.38	901
Share of low-income patients	0.35	0.24	0.00	0.28	1.00	1,574

[a] To ensure anonymity, the median, minimum, and maximum are rounded to the nearest 10. The median for *USD value of payments* is rounded to the nearest integer.

We next inspect differences in the distribution of payment receipts between altruistic and non-altruistic physicians. Figure 1 shows the distribution of payment values over different payment categories, separately for physicians with altruistic preferences and physicians with non-altruistic preferences. We group together physicians with impartial and physicians with selfish preferences, for whom a Kolmogorov–Smirnov test does not reject equality of the distribution of payments ($D = 0.0414, p = 0.667$). We observe that a higher share of altruistic physicians, compared to non-altruistic physicians, receives no payments or average payments up to 500 USD. In contrast, in every higher payment category, non-altruistic physicians are over-represented.

We observe that the distribution of payments to non-altruistic physicians is shifted to the right compared to that of non-altruistic physicians for high payment categories. A Kolmogorov-Smirnov test shows that this difference in distributions is significant on the 1% level ($D = 0.1345, p < 0.001$).[17]

Figure 1: Industry payments to physicians, by altruistic or non-altruistic preferences



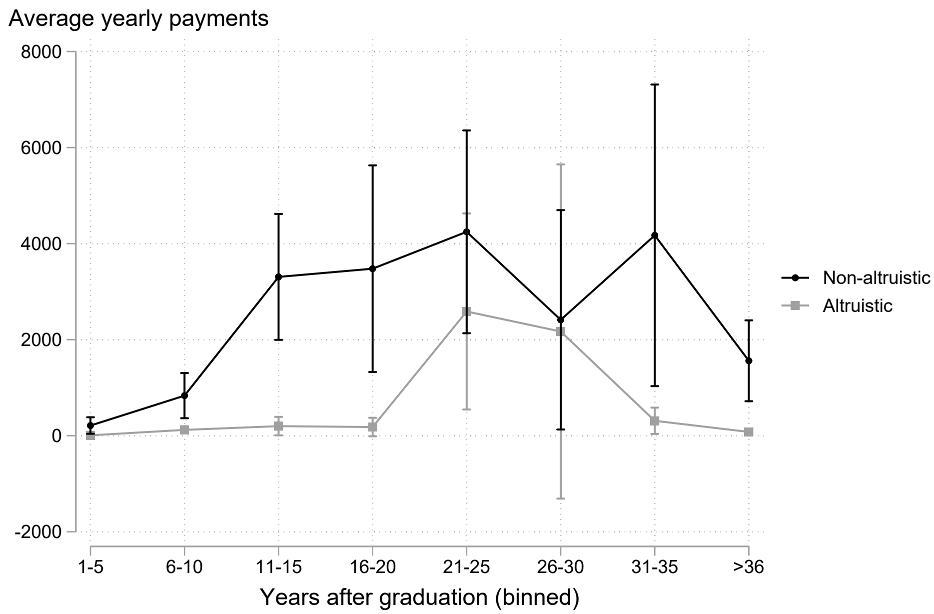
Notes: This figure shows the share of physician-year observations over categories of payment values, separately for altruistic and non-altruistic physicians. Grey bars for altruistic and red bars for non-altruistic physicians each sum to one. Kolmogorov–Smirnov tests reject equality of the distribution of payments for physicians with altruistic (not selfless) preferences compared to non-altruistic (selfless or impartial) preferences on a 1% significance level ($D = 0.1345, p < 0.001$).

To explore differences in payment receipts between altruistic and non-altruistic physicians further, Figure 2 traces how industry payments evolve over physicians' careers. For both physician types, the level of average payments is low during the first years after medical school. However, non-altruistic physicians in our sample begin receiving higher payments earlier over the course of their careers. The difference in payments by altruism is largest for mid-career physicians, between eleven and twenty years after graduation. Payments to physicians with altruistic preferences evolve slower and reach similar levels as payments to physicians with non-altruistic preferences only after more than twenty years of experience. For non-altruistic preferences, payments are similar between mid-career and experienced physicians, whereas for altruistic preferences, highly experienced physicians receive lower payments. Most notably, average industry transfers are, consistently throughout the career, higher for non-altruistic physicians.

Lastly, we examine differences between altruistic and non-altruistic physicians in their responsiveness

[17] Figure 6 in Appendix C.1 shows that the financially largest categories of payments are associated with speaking engagements, consulting, travel, and invitations to meals. Notably, within each individual payment category, non-altruistic physicians receive larger average payments than altruistic physicians.

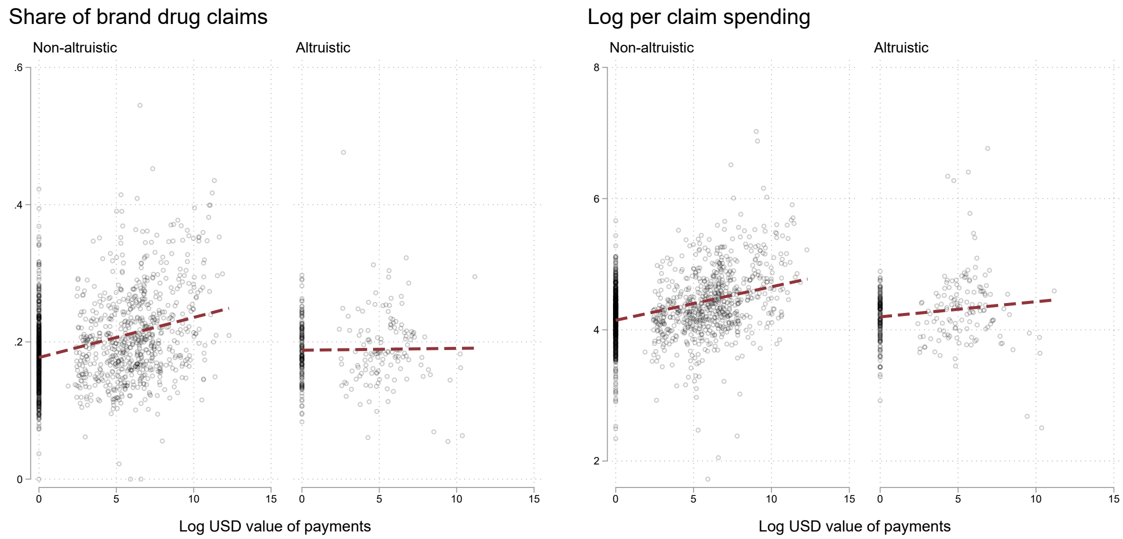
Figure 2: Average payments over physician careers, by altruistic or non-altruistic preferences



Notes: Each point represents mean payment values over all physician-year observations in a given bin of years after graduation. Lines represent the 95% confidence interval of the estimated mean.

in to industry payments in our raw data. Figure 3 shows scatter plots of the relationship between drug prescribing and log-transformed industry payments by altruistic compared to non-altruistic social preferences. We observe that, both in terms of brand shares in prescribing as well as costs, the concurrent increase in prescribing and payments is steeper for non-altruistic physicians than for altruistic physicians.

Figure 3: Scatter plots of payments and prescribing, by altruistic or non-altruistic preferences



Notes: These figures plot the relationship between prescribing and payments, separately for non-altruistic and altruistic physicians. Each point represents a physician-year. Prescribing is measured by the share of brand drug claims in the left panel, and by the natural logarithm of costs per claim in the right panel. Payments are measured by the natural logarithm of (USD value of payments + 1). The dashed lines represent simple regressions between the prescribing measure and payments.

4 Empirical framework

4.1 Altruism and payments

In the first step of the empirical analysis, we study whether altruistic preferences are associated with physicians' receipt of industry payments. Our stylized model predicts that a non-altruistic physician accepts payments at least as often as an altruistic physician.

We hypothesize that non-altruistic physicians accept transfers from pharmaceutical firms associated with higher financial benefits on average. To test this prediction, we estimate the following regression equation:

$$\log E[p_{it}] = \beta \textit{Non-altruistic}_i + \delta x_{it} + \varepsilon_{it}, \tag{4}$$

where p_{it} denotes the value of industry payments that physician i receives in year t, $\textit{Non-altruistic}_i$ is an indicator for non-altruistic preferences, x_{it} is a vector of individual- and time control variables including a constant term, and ε_{it} is the error term. β is a parameter and δ is a vector of parameters associated with the control variables.

Our preferred estimate of the marginal effect of altruism on the mean payment is based on estimating Equation 4 as a generalized linear model with the gamma distribution and log link, where the outcome variable is the USD value of payments. This model specification is suitable for continuous, nonnegative, and heavily right-skewed outcome variables such as healthcare expenses or, as in our case, payments. Given the large variance of industry payments, alternative generalized linear models may result in overdispersion and inefficient standard errors. As payment values can be zero, log transformations do not yield well-defined marginal effects.[18]

We additionally estimate Equation 4 on a subsample with any positive payments, in order to test whether non-altruistic preferences are related to the level of payments given any transfers, thus the intensive margin of payments.

To measure physician altruism, we use an indicator variable for non-altruistic preferences, as opposed to altruistic preferences. Our parameter of interest is β, which is informative about whether industry transfers differ between altruistic and non-altruistic physicians. A positive value of β indicates that physicians with non-altruistic preferences obtain higher industry payments on average than altruistic physicians.

As our preferred set of control variables x_{it}, we include the age and gender of the physician (individual controls), characteristics of the physician practice (institutional controls), as well as year and state indicators in all regressions. In Section 5, we discuss specifications with alternative sets of controls, where results are similar to our main specifications. We cluster standard errors on the physician-level, the level of variation for altruistic preferences.

Table 2 shows results from estimating Equation 4. Column (1) of Table 2 shows the estimated average marginal effect of altruism along with coefficient estimates from estimating a generalized linear model of payments. Our analysis implies that physicians with non-altruistic preferences receive on average 2,184 USD (95% CI: 979.3–3,388.5) higher industry transfer per year than altruistic physicians who receive 860 USD on average, implying that non-altruistic physicians obtain 254% more payments. The point estimate associated with non-altruistic preferences is 1.133 and statistically significant (1%).

In the main specification, we estimate a common effect over both the extensive and intensive margin, as our main predictions concern the range of payments to physicians and thus the average payment level received. However, we also estimate the implied marginal effects of altruism on the intensive and extensive margin of payments separately. Column (2) of Table 2 is based on the main generalized linear model specification and tests whether altruistic preferences are associated with payments in the subset of physician-years that are associated with any payment, thus reflecting the intensive margin of payments. The results suggest that non-altruistic physicians also receive higher-valued transfers conditional on receiving any payments. The

[18] Chen and Roth (2023) show that when outcome variables that can be zero are log-transformed, regression estimands, including treatment effects as well as non-causal estimands, can take arbitrary values depending on the scale of the outcome. In addition, Mullahy and Norton (2024) discuss that marginal effects are often incorrect when estimated by OLS on a log-transformed outcome variable with a statistical mass at zero. Nonetheless, we show largely similar results based on alternative econometric specifications, including ones based on log-transformed payments, in the sensitivity analysis.

coefficient estimate is lower than for our main specifications on overall payments, indicating that altruistic payments may be related to both, whether and how high, payments are that physicians obtain. In Column (3) an indicator for any payment receipt is the dependent variable of a linear model, thus reflecting the extensive margin of payments. While we do not find that altruism is a statistically significant predictor of any receipt of industry transfers, the point estimate indicates that physicians with non-altruistic preferences are also more likely to receive any transfer in a given physician-year.

4.2 Altruism and prescribing

We next investigate how altruistic preferences shape physicians' prescribing practices. We first discuss the potential direct effects of altruism on drug prescribing and then focus on how altruistic preferences interact with industry transfers to shape prescribing behavior.

Our stylized model implies that a more altruistic physician places more weight on the societal net benefit of a drug compared to a less altruistic physician when making a drug prescribing decision. In addition, prescriptions can be affected by direct-to-physician marketing and other industry-physician interactions. Our previous results indicate selection by physician altruism into engaging with the pharmaceutical industry or targeting by drug firms, which may differentially affect prescribing decisions. Without accounting for industry transfers, we do not find a direct relationship between altruism and drug prescribing, as shown in Table 8 in Appendix C.2.

However, rather than directly affecting prescribing, altruism might act as a moderating factor in the relationship between payments to physicians and physicians' prescribing behavior. Prescribing decisions from both more and less altruistic physicians can be affected by interacting with the pharmaceutical industry. Our stylized model predicts that, in general, the decision to choose a brand drug over cheaper alternatives is affected by payments. Table 9 in Appendix C.3 provides evidence that brand prescribing as well as drug spending are positively correlated with industry payments. Our model further predicts that a given level of payment shifts the drug prescribing decisions of a less altruistic physician *more easily* toward a brand alternative than it would do for a more altruistic physician. Altruistic and non-altruistic physicians might thus respond differently to any given payment level.

We test whether altruistic preferences predict the relationship between industry payments to physicians and their drug-prescribing behavior by estimating the following regression equation:

$$b_{it} = \gamma(\textit{Non-altruistic}_i \times log(p_{it})) + \tilde{\delta}\tilde{x}_{it} + \nu_{it}, \quad (5)$$

where b_{it} measures physician i's drug prescribing practices in year t, $\textit{Non-altruistic}_i$ indicates that physician

i has non-altruistic preferences, p_{it} denotes industry payments to physician i in year t, $\tilde{x}_{it}$ is a vector of control variables, and ν_{it} is the error term. γ and $\tilde{\delta}$ denote parameters.

In Equation 5 our parameter of interest is γ, associated with the interaction between non-altruistic preferences and the amount of industry payments that a physician receives. The parameter γ captures whether social preferences moderate the relationship between industry payments and physicians' prescribing practices. A positive value of γ indicates that the drug prescriptions of physicians with non-altruistic preferences are more sensitive to payments from pharmaceutical firms.

Table 3 shows OLS estimation results for Equation 5, controlling for physicians' individual and institutional characteristics, as well as indicators for calendar year and state. In addition, we include indicators for the quartile of patient pool characteristics in order to account for differences in prescribing due to patient differences. Standard errors are clustered on the physician-level.

In Columns (1) – (3) in Table 3, we investigate how drug prescribing, measured by the share of brand drug claims, is associated with the interaction between altruistic preferences and industry payments. Column (1) shows the association of brand prescribing with the log USD value of all payments, by altruistic preferences. Columns (2) and (3) focus on the interaction of altruistic preferences with the intensive and the extensive margin margin of payments, respectively. The interaction term between altruistic preferences and payments is statistically significant (at least 5% level) in all specifications and fully accounts for the positive association between payments and a higher share of brand drug claims. Our point estimate in Column (1) indicates that for a non-altruistic compared to an altruistic physician, a 1% increase in the USD value of payments is on average associated with a 0.005 percentage points higher increase in the Share of brand claims.[19] This estimate corresponds to an increase of 0.027% at an average brand share of 18.86% among altruistic physicians in our sample, or to about 8% of the overall standard deviation of 0.06 (see Table 1).

In Columns (4) – (6) of Table 3, we investigate the relation between drug spending measured by log per claim spending and the interaction between altruism and industry transfers. Column (4) shows that the association between spending and total payments is estimated to be larger for physicians with non-altruistic preferences than for altruistic physicians by 2.4% (not statistically significant). Column (5) shows that given any payments, costs per claim are higher by 5.8% for a 1% increase in payments among non-altruistic physicians than among altruistic physicians (10% significance level). In Column (6), we observe for drug spending a positive, statistically insignificant, interaction between altruism and the extensive margin of receiving any payments. In all cases, no positive correlation between payments and drug spending remains once we account for the interaction between altruistic preferences and payments.

[19] The estimate implies a change in brand prescribing by 0.005/100 units, given the linear-log specification of our model. As brand prescribing is a share between 0 and 1, a 1% increase in payments corresponds to a change by $0.005/100 * 100 = 0.005$ percentage points.

4.3 Interpretation of the regression estimates

Our regression estimates help to roughly assess the potential average financial savings if it was possible to improve physicians' compliance with professional norms of altruism. Comparing non-altruistic and altruistic physicians, the difference in the relationship between log payments and the share of brand claims is a coefficient of 0.005 based on Column (1) in Table 3. The difference in the relationship between payments and log per claim spending by altruistic preferences is a coefficient of 0.024 based on Column (4) of Table 3. We estimate in Column (1) of Table 2 that average payments of non-altruistic physicians are higher by $2,183$ USD compared to payments of about 860 USD to altruistic physicians, corresponding to a log difference of about $\log(2,183 + 860) - \log(860) = 0.549$.

We use the point estimates above in order to perform rough back-of-the-envelop calculations and evaluate how modifying physicians' altruism could affect total drug expenditures through their interaction with industry payments. This exercise considers a non-altruistic physician at the mean and asks how brand prescribing and yearly drug spending would change if that physician was altruistic instead.

To calculate additional brand prescribing by a non-altruistic physician, we use the linear-log specification of Column (1) in Table 3 and predict that the physician would prescribe a $0.005 * 0.549 = 0.0027$ units lower brand share if she was altruistic instead. This difference corresponds to $0.0027 * 100 = 0.27$ percentage points, or 1.37% at an average brand share of 19.65% among non-altruistic physicians. To calculate additional drug expenditure, we use the log-log specification of Column (4) in Table 3 and predict that per claim costs for a non-altruistic physician are $\exp(0.024 * 0.5488) = 1.0132$ times the average claim cost among altruistic physicians. Thus, imposing altruistic preferences would correspond to a decrease of $(1.0132 - 1) * 100 = 1.32\%$, or 1.13 USD at an average claim cost of 85.51 USD among non-altruistic physicians. For an average number of about 2,795 claims per year, our estimates suggest that a non-altruistic physician would impose 3,155 USD less in annual drug expenditures if she adhered to altruistic norms instead.

Table 2: Industry payments and physician altruism

	Payments	Int. margin	Ext. margin
	USD[a]	USD[a]	Any pay[b]
	(1)	(2)	(3)
Marginal effects			
Altruism			
Non-altruistic	2183.886***	2350.872**	0.074
	(614.591)	(983.844)	(0.049)
Coefficient estimates			
Altruism			
Non-altruistic	1.133***	0.752*	0.074
	(0.324)	(0.386)	(0.049)
Individual controls			
Age below 39 (omitted)	-	-	-
Age: 40–49	0.881**	0.739**	0.059
	(0.364)	(0.319)	(0.052)
Age: 50–59	-0.012	-0.156	0.123**
	(0.327)	(0.313)	(0.052)
Age above 60	1.345***	0.611	0.187***
	(0.489)	(0.400)	(0.058)
Female	-1.539***	-1.393***	-0.090**
	(0.302)	(0.264)	(0.043)
Specialty: Other (omitted)	-	-	-
Specialty: Cardiology	2.146***	1.121***	0.363***
	(0.324)	(0.351)	(0.049)
Specialty: Family medicine	-0.077	-0.473	0.031
	(0.423)	(0.329)	(0.061)
Institutional controls			
Ownership: Other (omitted)	-	-	-
Ownership: Academic medical center	-0.290	0.339	-0.236***
	(0.418)	(0.395)	(0.061)
Ownership: Physician-owned	0.487	0.549	-0.025
	(0.531)	(0.523)	(0.074)
Practice size: 1–36 (omitted)	-	-	-
Practice size: 36–350	-0.432	-0.245	-0.096
	(0.421)	(0.425)	(0.076)
Practice size: 351–1600	0.417	0.550	-0.030
	(0.488)	(0.441)	(0.080)
Constant	4.860***	6.089***	0.520***
	(0.656)	(0.586)	(0.107)
Year controls	Yes	Yes	Yes
State controls	Yes	Yes	Yes
Altruistic: Mean outcome	860.398	1822.769	0.472
Observations	1,616	838	1,616

This table presents the results from estimating Equation (4) by regressing industry payments to physicians onto a binary variable indicating altruistic preferences. In Column (1), the outcome variable is overall payments. In Column (2), payments are measured on the intensive margin when restricting the sample to any payment. In Column (3), payments are measured on the extensive margin, with an indicator for any payment as the outcome variable. Standard errors of coefficient estimates in parentheses are clustered on the physician level.

* p<0.10, ** p<0.05, *** p<0.01.

[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares. Standard errors for average marginal effects are calculated using the delta method.

[b] Linear models estimated by Ordinary Least Squares. The average marginal effect is given by the coefficient estimate.

Table 3: Drug prescribing and the interaction between industry payments and altruism

	Share of brand drug claims			Log per claim spending		
	(1)	(2)	(3)	(4)	(5)	(6)
Payments by altruism						
Non-altruistic × Log (1 + USD)	0.005***			0.024		
	(0.002)			(0.017)		
Non-altruistic × Log USD, given any payment		0.010***			0.058*	
		(0.004)			(0.032)	
Non-altruistic × Any payment			0.020**			0.092
			(0.009)			(0.091)
Payments						
Log (1 + USD)	-0.000			0.021		
	(0.001)			(0.016)		
Log USD, given any payment		-0.004			0.010	
		(0.004)			(0.030)	
Any payment			-0.001			0.101
			(0.008)			(0.087)
Altruism						
Non-altruistic	-0.010	-0.047**	-0.005	-0.052	-0.303*	-0.016
	(0.006)	(0.023)	(0.006)	(0.045)	(0.181)	(0.045)
Individual controls						
Age below 39 (omitted)	-	-	-	-	-	-
Age: 40–49	-0.004	-0.003	-0.003	0.037	0.023	0.048
	(0.006)	(0.010)	(0.006)	(0.053)	(0.083)	(0.055)
Age: 50–59	-0.004	-0.007	-0.003	0.024	-0.026	0.032
	(0.006)	(0.009)	(0.006)	(0.051)	(0.084)	(0.051)
Age above 60	-0.005	-0.008	-0.005	0.088	0.036	0.094
	(0.007)	(0.009)	(0.008)	(0.059)	(0.082)	(0.063)
Female	-0.000	-0.004	-0.004	0.060	0.131	0.029
	(0.007)	(0.011)	(0.007)	(0.066)	(0.102)	(0.068)
Specialty: Other (omitted)	-	-	-	-	-	-
Specialty: Cardiology	0.019**	0.022**	0.026***	0.108*	0.149*	0.177***
	(0.008)	(0.010)	(0.008)	(0.065)	(0.077)	(0.066)
Specialty: Family medicine	-0.005	-0.006	-0.004	-0.105**	-0.076	-0.092*
	(0.006)	(0.008)	(0.006)	(0.048)	(0.066)	(0.049)
Institutional controls						
Ownership: Nonprofit hospital (omitted)	-	-	-	-	-	-
Ownership: Academic medical center	-0.001	-0.003	-0.003	0.016	-0.025	-0.007
	(0.009)	(0.011)	(0.009)	(0.064)	(0.074)	(0.070)
Ownership: Physician-owned	-0.035***	-0.030**	-0.035***	-0.272***	-0.272***	-0.279***
	(0.010)	(0.013)	(0.010)	(0.077)	(0.102)	(0.083)
Practice size: 1–36 (omitted)	-	-	-	-	-	-
Practice size: 36–350	0.009	0.014	0.010	0.109	0.215*	0.119
	(0.009)	(0.013)	(0.009)	(0.088)	(0.112)	(0.092)
Practice size: 351–1600	-0.013	-0.014	-0.012	-0.094	-0.041	-0.078
	(0.009)	(0.013)	(0.009)	(0.079)	(0.099)	(0.082)
Constant	0.189***	0.208***	0.187***	4.009***	4.051***	3.995***
	(0.017)	(0.031)	(0.017)	(0.140)	(0.256)	(0.143)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of patient pool characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Altruistic: Mean outcome	0.189	0.190	0.189	4.257	4.343	4.257
Observations	1,616	838	1,616	1,616	838	1,616

This table presents the results from estimating Equation 5, and captures the relationship between prescribing and payments by altruistic preferences. In Columns (1)–(3), prescribing is measured by the share of claims for brand drugs over all drug claims. In Columns (4)–(6), prescribing is measured by the natural logarithm of average per claim spending. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* p<0.10, ** p<0.05, *** p<0.01.

5 Additional analysis

5.1 Sensitivity of the econometric specification

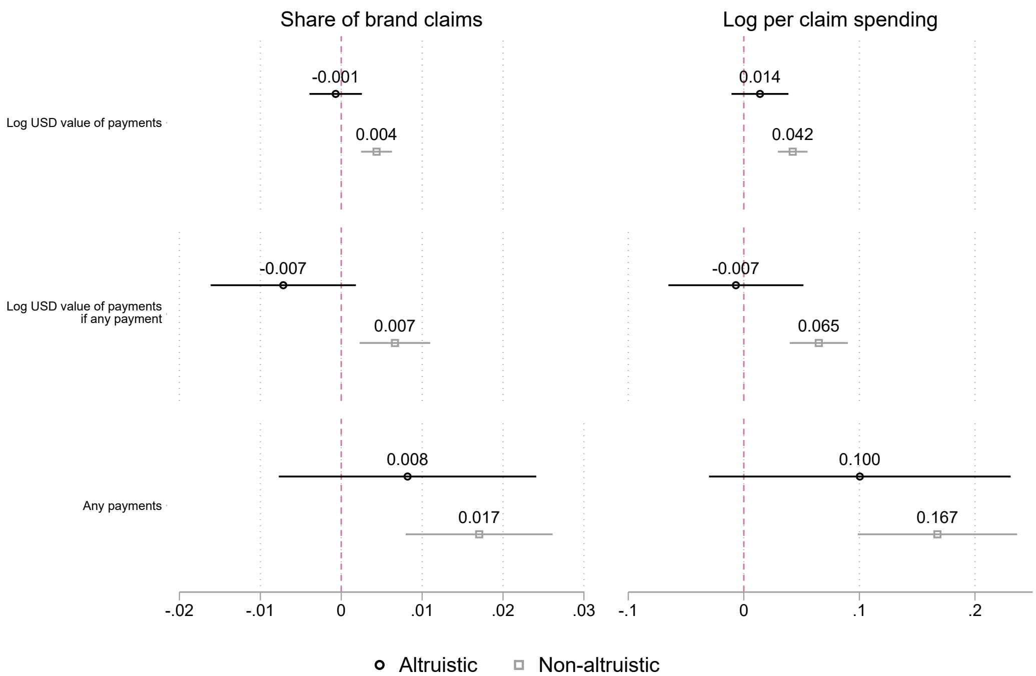
We next discuss potential threats to our econometric analysis of the relationship between altruism and payments, as well as possible extensions.

Stratified models. In order to allow coefficient estimates to vary flexibly by altruism, we estimate stratified regressions of drug prescribing on payments, separating altruistic and non-altruistic physicians. Figure 4 shows results from these regressions. The results demonstrate that the positive relation between any measure of payments and prescribing is driven entirely by non-altruistic physicians, whereas there is no statistically significant relation between payments and prescribing for altruistic physicians. The point estimates indicate that a 1% increase in the USD value of payments is associated with an average increase in the share of brand claims by approximately 0.004 percentage points and an increase in per-claim spending by approximately 0.042% among non-altruistic physicians, compared to an average increase by −0.001 percentage points in the brand share and 0.014% in the per claim spending among altruistic physicians. The results from estimating stratified regressions are similar to our main estimates from Table 3.

Alternative sets of control variables. We perform estimations of our main regression models for payments (Equation 4) and prescribing (Equation 5) with different sets of control variables. Results are presented in Tables 10 and 11 in Appendix D.1. Table 10 shows that, for payments, the estimates are consistent with our main results but lose precision with a reduced set of control variables. Table 11 indicates that, for both brand prescribing and costs, the estimated coefficient associated with the interaction between payments and altruism remains essentially unchanged when reducing the set of control variables.

Alternative econometric models. For payments, our preferred generalized model specification in Column (1) of Table 2 implies that non-altruistic physicians obtain industry transfers which are higher by 2,184 USD. Table 12 in Appendix D.2 presents corresponding estimates from alternative estimation strategies. First, we estimate a two-part model that accommodates statistical mass at zero payments and estimates marginal effects for the extensive and intensive margin of payments jointly (Belotti et al. 2015). The estimated marginal effect indicates that payments to non-altruistic physicians are on average 1,340 USD higher than payments to altruistic physicians, thus a lower but still sizeable estimate compared to our main specification. Second, we estimate an OLS regression on the USD value of payments. Results from this specification indicate higher payments to non-altruistic physicians by 1,822 USD, again in line with our main results. Finally, as a widely used specification, we also estimate a linear model on the natural logarithm of (1 + payments) by OLS. Estimates from this specification have to be interpreted with caution, as log-transforming an outcome variable that can take zero values results in coefficient estimates that cannot be used to infer marginal effects

Figure 4: Association between drug prescribing and industry payments, by altruistic and non-altruistic preferences



Notes: The figures show estimated coefficients from regressing the Share of brand drug claims (left) and Log per claim prescribing costs (right) on payments, separately for physicians with experimentally estimated altruistic or non-altruistic preferences. Each panel represents regression results estimated by Ordinary Least Squares with observations separated by altruistic or non-altruistic preferences. Results are based on different measures of industry payment. The upper panels show payments measured by log (1 + USD), the middle panels show log payments conditional on any payment, and the lower panels show any payment. All regressions include individual controls, institutional controls, patient pool heterogeneity, state controls, and calendar years. Lines represent the 95% confidence intervals. Robust standard errors are clustered on the physician-level.

(Chen and Roth 2023; Mullahy and Norton 2024). The estimation results imply that non-altruistic physicians receive 968.37 USD higher payments, thus below but close to the 95% confidence interval of 979.3–3,388.5 USD from our main specification. Our alternative specifications thus suggest the same qualitative results as our main analysis and yield coefficient estimates which are consistent with our main estimates.

For drug prescribing, Table 3 indicates that the relationship between industry payments and prescribing differs by altruistic preferences. As robustness check, we estimate two alternative specifications in Table 13 in Appendix D.2. First, we estimate the regression model in Equation 5, but instead of a log-transformation we use an inverse hyperbolic sine transformation on payments. Second, we estimate a specification that interacts the indicator for non-altruistic preferences with log-transformed payments where zero replaces missing values, and we include an indicator for no payments as a control variable. The estimates are essentially unchanged compared to those in our main specifications.

Aggregated payments and prescriptions. We show results for payments and prescriptions aggregated on the physician-level in Tables 14 and 15 in Appendix D.3. The estimates are generally consistent with our main estimates, but the extensive margin of payments appears to matter more in aggregate payments.

Continuous measure of altruism. We use a binary measure of physician altruism based on a cutoff of $\alpha = 0.5$, defining the utility weight that a physician places on private benefits compared to the benefits to others, while simultaneously accounting for estimation uncertainty in α. Defining altruistic physicians as those who place less weight on their own benefits than on others comes with three advantages. First, it allows for a natural interpretation of physician altruism: Non-altruistic physicians place equal or more utility weight on private gains relative to patient and society benefits. Second, we avoid making assumptions about the representativeness of our sample of physicians compared to the general population of physicians since we do not use any within-sample physician ranks. Third, we account for statistical noise in the estimate of altruistic preferences by using a t-test to identify non-altruistic physicians. Nonetheless, we replicate our main analysis with continuous measures of altruistic preferences based on the values of α elicited in the experiment, using either the raw or a transformed estimate of α.

Results are shown in Table 13 in Appendix D.4. While the raw estimate of α measures altruistic preferences directly, regression results based on α do not have a direct interpretation. We also transform the point estimate of α, either by standard-normalization within our sample or by computing the marginal rate of substitution between private and social benefits to increase interpretability. Note that a unit increase in raw or transformed α only corresponds, qualitatively, to less altruism, but the estimates cannot be compared to our main estimates in Tables 2 and 3.

Results from these specifications are consistent with our main conclusions on the relationship between altruism and payments but lose precision substantially.[20] Our results on the interaction between altruistic preferences and prescribing are not statistically significant, but point toward the same direction as in our main estimations. Excluding physicians with impartial preferences ($\alpha = 0.5$ cannot be rejected) yields results in line with our main estimates, indicating that our results may be driven by larger contrasts in altruistic preferences and a power issue.

Causal effects of physician altruism. We do not impose a causal link between physician altruism and payments in our empirical analysis. Nonetheless, we note that a reversed causal effect of payments on physician altruism is unlikely. Moreover, Tables 17 in Appendix D.5 show that a contemporary relationship between altruism, payments, and prescribing is present even if we restrict our analysis to observations from 2019, the year in which the experiment was conducted.

In addition, we can examine the potential role of confounders which would threaten the link between altruistic preferences and payments to physicians. Table 18 in Appendix D.6 shows little correlation between altruism and any of our observable physician characteristics apart from a weak association with practice size. In particular, we observe that altruism is not correlated with physician age, gender, specialty, or clinic ownership, which are important predictors of payments as shown in Table 2. We cannot rule out that, apart from observable characteristics, unobserved factors violate conditional independence between altruism and payments. However, these results suggest that professional norms such as altruism shape the physician-industry relationship in ways extending beyond observable physician traits.

Skewed payments. We observe that industry payments are right-skewed, with few physicians obtaining highly valued transfers in only some years. To trace the source of variation better, we analyze quartiles of payments in Table 19 of Appendix D.8. In separate regressions, we dichotomize payments into indicators of receiving payments in the upper three quartiles, above median, or the upper quartile. We observe that altruism is most strongly associated with selection into the upper quartile of payments. Non-altruistic preferences are associated with an 11.6 percentage points increase (1% significance level) in the probability of obtaining payments in the upper quartile, where received payments amount to at least 437 USD per year. Non-altruistic physicians still drive sizeable correlation between prescribing of brand drugs and payments in the upper quartile. At other quartiles, our estimates associated with altruism are numerically smaller or not statistically significant. However, we note that our main effects are in general not driven by individual outliers, but rather by statistical mass at the upper quartile. For example, Table 20 of Appendix D.8 shows that our estimates are numerically similar or qualitatively consistent when we run regressions with payments winsorized at the 95th and the 90th percentile.

[20] Generally, physicians with low α (high altruism) only obtain low monetary values, if any. Figure 7 in Appendix D.4 shows descriptively the relationship between raw α and industry payments, and demonstrates that there are no physicians with both low α and high payments.

5.2 Drug-level analysis

We replicate our main analysis on the drug-physician-year observation level. That is, we investigate whether altruistic preferences predict a physician's receipt of payments for a given drug, and whether accepting such a payment increases prescriptions for *that drug*. This drug-level analysis helps strengthen the direct link between payments and prescriptions, and physician altruism in relation to this link.

We measure payments in relation to a specific drug using information on industry interactions provided in the Open Payments database. Up to five products can be recorded in one interaction. To compute the value of a single transfer associated with a specific drug, we take the total USD value of the interaction and divide it by the number of listed products. We then construct our payment variables as in the main analysis, by aggregating transfers on a yearly level. In addition, we consider again the intensive margin of payments (payments related to a drug given any transfers), and the extensive margin (any payment related to a given drug).

To investigate prescribing for a given drug, we analyze the relative number of claims, measured by the Share of total claims, as well as relative costs, measured by Share of total spending. We compute the Share of total claims for a drug by the number of a physician's claims for a given drug and year, divided by the total number of all claims the physician makes in that year. To measure costs, we take the total costs for a given drug and year, divided by the overall drug spending incurred by a physician in that year. We focus on relative prescribing in order to account for differences in overall prescribing intensities, for example due to patient differences.

We consider all drugs that have been associated with at least one payment during our sample period in the analysis, which selects 135 drugs with any marketing efforts in the entire sample. We exclude all transfers related to non-drug products by focusing on medicinal prescriptions with an Anatomical Therapeutic Chemical (ATC) code. From the full sample of 280 physicians, we consider 272 physicians with at least 50 overall claims of individual drug prescriptions in the drug-specific Medicare Part D data. The final data set is balanced at the physician-year-drug level. Our analysis includes drug fixed effects to account for between-drug differences in industry transfers or prescriptions. These fixed effects also account for differences in the relationship between payments and prescribing due to variation in the propensity to prescribe a given drug in the Medicare system.

Table 4 shows results on the relation between altruistic preferences and payments on the drug level. We obtain marginal effects estimates from Poisson pseudo-maximum likelihood regressions in order to ensure that the estimation procedure converges given all drug fixed effects (Correia et al. 2020). While the quasi-Poisson distribution, compared to the gamma distribution in our main specification, imposes assumptions on the conditional variance of the outcome that may not hold for heavily right-skewed payments, these regressions estimate coefficients consistently. We replicate a similar qualitative direction as in the main analysis but, given that we analyze drug-specific payments, at lower levels. For the drugs included in the analysis, our estimates imply that non-altruistic physicians obtain, on average, 8 USD more than altruistic physicians while accounting for the full set of control variables as well as drug-specific fixed effects. Compared to our main analysis, the analysis on a drug level cannot account for any transfers that are specified as generic payments or where no product name is mentioned. In addition, the drug level analysis does not account for indirect spillovers from industry interactions onto products that are not listed as Open Payment entries.

Table 4: Drug-specific industry payments and physician altruism

	Payments	**Int. margin**	**Ext. margin**
	USD[a] (1)	USD[a] (2)	Any pay[b] (3)
Marginal effects			
Altruism			
Non-altruistic	8.347***	368.558***	0.007
	(3.195)	(127.876)	(0.005)
Coefficient estimates			
Altruism			
Non-altruistic	2.029***	1.570**	0.007
	(0.740)	(0.783)	(0.005)
Drug fixed effects	Yes	Yes	Yes
Year controls	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes
State controls	Yes	Yes	Yes
Altruistic: Mean outcome	1.102	76.539	0.014
Observations	201,150	3,911	201,150

This table presents the results from estimating Equation (4) by regressing drug-specific industry payments to physicians onto a binary variable indicating altruistic preferences. We incude 272 physicians with sufficient drug-level claims and 135 drugs with any payments in the analysis. The final data set is balanced at the physician-year-drug level. Columns (1) reports results with overall drug-specific payments as the outcome variable. Columns (2) shows results for payments measured on the intensive margin when restricting the sample to any payment for a given drug. Column (3) shows results for payments measured on the extensive margin, with an indicator for any payment for a given drug as the outcome variable. Observations are on the physician-year-drug level and the regressions include drug fixed effects. Standard errors of coefficient estimates in parentheses are clustered on the physician level. Standard errors for average marginal effects are calculated using the delta method.

* p<0.10, ** p<0.05, *** p<0.01.

[a] Generalized linear model estimated by poisson pseudo-maximum likelihood (Correia et al. 2020).

[b] Linear models estimated by Ordinary Least Squares.

Table 5 shows that our main results are consistent with the estimated relationship between altruism, payments, and prescribing on the drug level. Columns (1) – (3) shows that payments related to a given drug are associated with a stronger increase of relative claims for that given drug for non-altruistic physicians compared to physicians with altruistic preferences, and Columns (4) – (6) shows weaker but positive estimates when we measure prescribing by costs spent for a given drug. We no longer observe that altruism by itself drives the relationship between payments and prescribing except when restricting the sample to any drug-physician-year observation with any payments in Columns (2) and (4). However, our estimated effect sizes of the interaction between altruism and payments are still meaningful compared to mean levels of prescribing. For example, based on our estimates from Column (1), the correlation between payments for a given drug and the share of prescriptions for that drug is twice as high for a non-altruistic physician compared to an altruistic physician. Our drug-specific estimates thus confirm our main results regarding substantial differences in the association between drug-specific payments and prescribing by altruism.

Table 5: Drug-specific prescribing and the interaction between industry payments and altruism

	Share of total claims			**Share of total spending**		
	(1)	(2)	(3)	(4)	(5)	(6)
Payments by altruism						
Non-altruistic × Log (1 + USD payments, drug level)	0.001**			0.002		
	(0.000)			(0.002)		
Non-altruistic × Log USD payments given any payment, drug level		0.003***			0.007	
		(0.001)			(0.004)	
Non-altruistic × Any payment			0.002*			0.004
			(0.001)			(0.007)
Payments						
Log (1 + USD payments, drug level)	0.001***			0.007***		
	(0.000)			(0.002)		
Log USD payments given any payment, drug level		0.000			0.003	
		(0.001)			(0.004)	
Any payment			0.003***			0.021***
			(0.001)			(0.007)
Altruism						
Non-altruistic	-0.000	-0.007**	0.000	-0.000*	-0.019	-0.000
	(0.000)	(0.003)	(0.000)	(0.000)	(0.013)	(0.000)
Drug fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of patient pool characteristics	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes
Altruistic: Mean outcome	0.001	0.005	0.001	0.004	0.036	0.004
Observations	201,150	3,911	201,150	201,150	3,911	201,150

This table presents the results from estimating Equation 5 on the physician-year-drug level, and captures the relationship between drug-specific prescribing and payments by altruistic preferences. We incude 272 physicians with sufficient drug-level claims and 135 drugs with any payments in the analysis. In Columns (1)–(3), prescribing is measured by the share of prescription claims for a given drug over the total number of claims a given physician prescribes in a year. In Columns (4)–(6), prescribing is measured by the share of expenses for a given drug over all drug spending. Observations are on the physician-year-drug level and the regressions include drug fixed effects. Estimation by OLS. Standard errors clustered on the physician-level in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

In Appendix E, we provide additional findings from analyzing two drug classes separately: cardiovascular drugs, which are the most frequently prescribed drug class, and blood thinners, for which we observe the highest number of payment events. Our results reveal differences between these classes, which may be attributed to the varying availability of generics and novelty of the drug class. Specifically, physicians have access to both common generic alternatives and branded options for cardiovascular drugs, including statins such as Atorvastatin (branded as Lipitor), beta-blockers like Carvedilol (branded as Coreg), and ACE inhibitors such as Lisinopril (branded as Zestril). More availability of generic options may increase the role of altruism in physicians' treatment decisions when considering branded cardiovascular drugs. In contrast, blood thinners are a relatively new drug class, with many brands still under patent protection (such as Xarelto, Pradaxa, or Eliquis, as illustrated in Table 7 in Appendix B). Payments for these drugs may contain higher informative value and may limit the room for physicians to substitute expensive treatments with more cost-conscious options based on their altruistic preferences.

5.3 The role of patient risk

Finally, we investigate whether the composition of the patient pool attenuates industry ties among non-altruistic physicians. For example, it could be that non-altruistic physicians place higher weight on private benefits than altruistic physicians, but take their patients' financial or social circumstances into account. Similarly, pharmaceutical firms could be less likely to target non-altruistic physicians whose patient pools are more vulnerable.

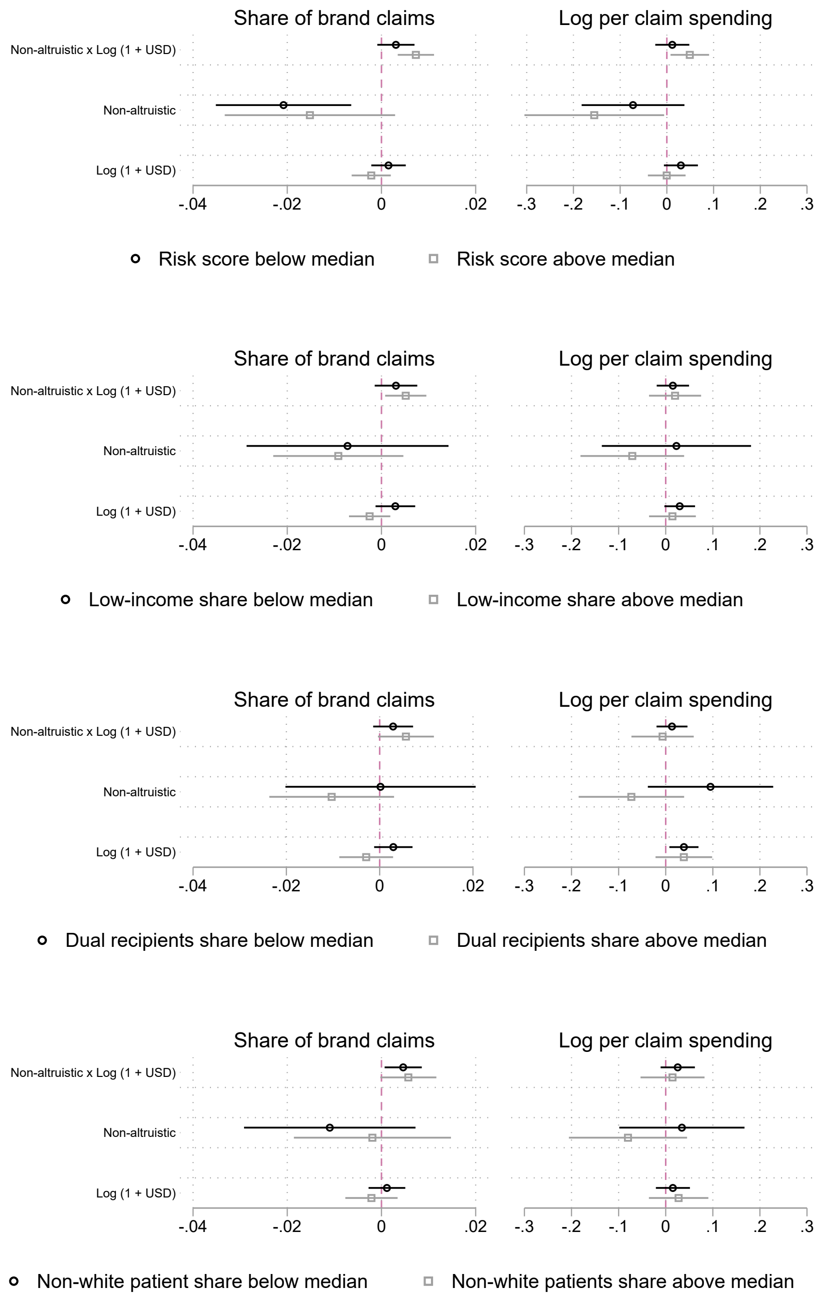
We find some evidence that patient pool vulnerability interacts with physician altruism. Figure 8 in Appendix F shows that non-altruistic preferences no longer predict higher industry payments among physicians who treat higher-risk patients, or when the share of low-income patients, dual recipients of Medicare and Medicaid, or non-white patients is high. Our results on higher payments to non-altruistic physicians thus appear to be driven by those physicians whose patient pools are less vulnerable.

If non-altruistic physicians consider their patients' circumstances even when accepting industry payments, we would expect that a stronger payment-prescribing relationship among non-altruistic physicians is driven by low-risk patient pools. In that case, we might no longer find a positive relation between payments and prescribing for non-altruistic physicians who treat a higher share of vulnerable patients. However, Figure 5 shows that stratifying by differences in patient pools barely affects the estimated relationship between industry payments and prescribing of non-altruistic physicians. While prescribing is in general less responsive to industry payments when physicians treat more vulnerable patient pools, non-altruistic physician preferences offset the lower responsiveness.[21] Across various dimensions of patient pool heterogeneity, we observe differences between altruistic and non-altruistic physicians' prescribing practices in relation to industry payments. If patient pool heterogeneity matters at all, the interaction between non-altruistic preferences

[21] Figure 9 in Appendix F shows that for non-altruistic physicians, the estimated association between payments and prescribing with more vulnerable patient pools is similar to the overall estimates. In contrast, for altruistic physicians, the association between payments and prescribing in more vulnerable patients is weaker than in the overall sample, or even becomes negative. Figure 10 shows the same regressions but compares the first and the last quartile of each patient pool characteristic, with similar results.

and industry payments increases brand prescribing and drug spending slightly *stronger* when patients have an above-median risk score or are lower-income. Our findings indicate that patient characteristics interact with physician altruism in the receipt of payments, for example through the way pharmaceutical firms target physicians, but barely mediate the relationship between payments, prescribing, and altruism.

Figure 5: Altruism and the association between drug prescribing and industry payments, by patient heterogeneity



Notes: The figures show estimated coefficients from regressing Total log drug prescribing costs (left) or Share of brand drug claims (right) on industry payments interacted with an indicator variable for altruistic preferences, separately for physicians with patient pools at the median characteristic or above (above median) and for physicians with patient pools below the median characteristic (below median). Each panel represents OLS regression results with observations separated by a different characteristic. All regressions include individual controls, institutional controls, patient pool quartiles, state controls, and calendar years. Lines represent the 95% confidence intervals. Robust standard errors are clustered on the physician-level.

6 Conclusion

To forgo personal gains for patient and societal benefit is a social norm among physicians. However, pharmaceutical companies often involve controversial direct-to-physician marketing practices that benefit physicians privately. Our results reveal that altruistic preferences, even if typically unobserved, are an essential determinant of the strength of physician-industry ties. We therefore provide first empirical evidence for the role of professional norms in the practice of medicine under potential conflicts of interest.

Although our set-up assumes that physicians' altruistic preferences are intrinsic and do not change within our observational period, we do not exclude the possibility that physician preferences or behaviors can be affected in the long run. For example, different social norms in medicine might form as a result of changes in the education of medical professionals, resulting in generational differences (Li et al. 2022). Altruistic preferences of medical students have been found to change throughout their training rather than to stay fixed since they begin their studies (Attema et al. 2023). In addition, policymakers can influence physicians' treatment decisions by adapting the market structure in which physicians operate and thus changing altruistic motives and competitive incentives (Byambadalai et al. 2023). Our work demonstrates that if professional norms about physicians' social preferences were modified, drug prescribing decisions might shift away from brand-name drugs, such that aggregate drug expenditure decreases.

Even if altruistic preferences were immutable, physician behavior could be affected by the institutional framework. Policies can directly target social preferences and other non-pecuniary motives to improve health care quality. For example, interventions have aimed at intrinsic incentives to perform well by informing physicians about their quality in relation to peers (Kolstad 2013). Similarly, transparency or disclosure policies can hold physicians accountable to their professional norms and change prescription behavior by increasing compliance (Chao and Larkin 2022). More generally, the degree to which non-pecuniary motives drive physician behavior can interact with the regulatory and competitive environment (Jack 2005; Hennig-Schmidt et al. 2011; Scott and Sivey 2022). Our findings suggest that there is room for policymakers, the public, and the medical profession to weaken financial links between the pharmaceutical industry and physicians, for example by reinforcing norms expected of physicians or by changing incentives in healthcare markets.

References

Afriat, S. N. (1972). Efficiency Estimation of Production Functions. *International Economic Review*, 13(3):568–598.

Agha, L. and Zeltzer, D. (2022). Drug Diffusion through Peer Networks: The Influence of Industry Payments. *American Economic Journal: Economic Policy*, 14(2):1–33.

Amaral-Garcia, S. (2022). Medical Device Companies and Doctors: Do their interactions affect medical treatments? Technical report, Working Paper.

American Board of Internal Medicine (1995). Project professionalism. *Philadelphia: ABIM.*

Ansari, B. (2021). Industry payments and physicians prescriptions: Effect of a payment restriction policy. *Social Science & Medicine*, 278:113942.

Arrow, K. J. (1963). Uncertainty and the Welfare Economics of Medical Care. *The American Economic Review*, 53(5):941–973.

Attema, A. E., Galizzi, M. M., Groß, M., Hennig-Schmidt, H., Karay, Y., L'Haridon, O., and Wiesen, D. (2023). The formation of physician altruism. *Journal of Health Economics*, 87:102716.

Belotti, F., Deb, P., Manning, W. G., and Norton, E. C. (2015). Twopm: Two-Part Models. *The Stata Journal*, 15(1):3–20.

Bensnes, S. and Huitfeldt, I. (2021). Rumor has it: How do patients respond to patient-generated physician ratings? *Journal of Health Economics*, 76:102415.

Bergman, A., Grennan, M., and Swanson, A. (2021). Medical Device Firm Payments To Physicians Exceed What Drug Companies Pay Physicians, Target Surgical Specialists: Study examines payments medical device firms pay to physicians. *Health Affairs*, 40(4):603–612.

Bergman, A., Grennan, M., and Swanson, A. (2024). Lobbying Physicians: Payments from Industry and Hospital Procurement of Medical Devices. *The Review of Economic Studies*, forthcoming:58.

Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarz, N., and Wiesen, D. (2017). The Effects of Introducing Mixed Payment Systems for Physicians: Experimental Evidence. *Health Economics*, 26(2):243–262.

Byambadalai, U., Ma, C.-t. A., and Wiesen, D. (2023). Changing preferences: An experiment and estimation of market-incentive effects on altruism. *Journal of Health Economics*, 92:102808.

Carey, C., Daly, M., and Li, J. (2021a). The Effects of Physicians' Financial Transfers from Drug Firms on Prescribing of Physician-Administered Cancer Drugs. Technical report, Working Paper.

Carey, C., Lieber, E. M. J., and Miller, S. (2021b). Drug firms' payments and physicians' prescribing behavior in Medicare Part D. *Journal of Public Economics*, 197:104402.

Chao, M. and Larkin, I. (2022). Regulating Conflicts of Interest in Medicine Through Public Disclosure: Evidence from a Physician Payments Sunshine Law. *Management Science*, 68(2):1078–1094.

Chen, J. and Roth, J. (2023). Logs with Zeros? Some Problems and Solutions. *The Quarterly Journal of Economics*.

Ching, A. T. and Ishihara, M. (2012). Measuring the Informative and Persuasive Roles of Detailing on Prescribing Decisions. *Management Science*, 58(7):1374–1387.

Correia, S., Guimarães, P., and Zylkin, T. (2020). ppmlhdfe: Fast Poisson Estimation with High-Dimensional Fixed Effects. *The Stata Journal: Promoting communications on statistics and Stata*, 20(1):95–115. arXiv:1903.01690 [econ].

Crea, G., Galizzi, M. M., Linnosmaa, I., and Miraldo, M. (2019). Physician altruism and moral hazard: (no) Evidence from Finnish national prescriptions data. *Journal of Health Economics*, 65:153–169.

Dejong, C., Aguilar, T., Tseng, C.-W., Lin, G., Boscardin, J., and Dudley, R. (2016). Pharmaceutical Industry–Sponsored Meals and Physician Prescribing Patterns for Medicare Beneficiaries. *JAMA Internal Medicine*, 176.

Ellis, R. P. and McGuire, T. G. (1990). Optimal payment systems for health services. *Journal of Health Economics*, 9(4):375–396.

Farley, P. J. (1986). Theories of the price and quantity of physician services: A synthesis and critique. *Journal of Health Economics*, 5(4):315–333.

Ge, G., Godager, G., and Wang, J. (2022). Exploring physician agency under demand-side cost sharing—An experimental approach. *Health Economics*, 31(6):1202–1227.

Gertler, P. and Kwan, A. (2024). The Essential Role of Altruism in Medical Decision Making.

Godager, G., Hennig-Schmidt, H., and Iversen, T. (2016). Does performance disclosure influence physicians' medical decisions? An experimental study. *Journal of Economic Behavior & Organization*, 131:36–46.

Godager, G. and Wiesen, D. (2013). Profit or patients' health benefit? Exploring the heterogeneity in physician altruism. *Journal of Health Economics*, 32(6):1105–1116.

Grennan, M., Myers, K., Swanson, A., and Chatterji, A. (2021). No Free Lunch? Welfare Analysis of Firms Selling Through Expert Intermediaries. Technical report, Working Paper.

Han, M., Hogan, S. O., Holmboe, E., Jing, Y., Yamazaki, K., and Trock, B. J. (2022). Trends in Industry Payments to Physicians in the First 6 Years After Graduate Medical Training. *JAMA Network Open*, 5(10):e2237574.

Hellerstein, J. K. (1998). The Importance of the Physician in the Generic versus Trade-Name Prescription Decision. *The RAND Journal of Economics*, 29(1):108.

Hennig-Schmidt, H., Selten, R., and Wiesen, D. (2011). How payment systems affect physicians' provision behaviour—An experimental investigation. *Journal of Health Economics*, 30(4):637–646.

Hwong, A. R., Sah, S., and Lehmann, L. S. (2017). The Effects of Public Disclosure of Industry Payments to Physicians on Patient Trust: A Randomized Experiment. *Journal of General Internal Medicine*, 32(11):1186–1192.

Iizuka, T. and Jin, G. Z. (2007). Direct to Consumer Advertising and Prescription Choice. *The Journal of Industrial Economics*, 55(4):771–771.

Jack, W. (2005). Purchasing health care services from providers with unknown altruism. *Journal of Health Economics*, 24(1):73–93.

Kesternich, I., Schumacher, H., and Winter, J. (2015). Professional norms and physician behavior: Homo oeconomicus or homo hippocraticus? *Journal of Public Economics*, 131:1–11.

Kolstad, J. T. (2013). Information and Quality When Motivation is Intrinsic: Evidence from Surgeon Report Cards. *The American Economic Review*, 103(7):2875–2910.

Lakdawalla, D. and Sood, N. (2009). Innovation and the welfare effects of public drug insurance. *Journal of Public Economics*, 93(3):541–548.

Li, J. (2018). Plastic surgery or primary care? Altruistic preferences and expected specialty choice of U.S. medical students. *Journal of Health Economics*, 62:45–59.

Li, J., Casalino, L. P., Fisman, R., Kariv, S., and Markovits, D. (2022). Experimental evidence of physician social preferences. *Proceedings of the National Academy of Sciences*, 119(28):e2112726119.

Li, J., Dow, W. H., and Kariv, S. (2017). Social preferences of future physicians. *Proceedings of the National Academy of Sciences*, 114(48).

Mitchell, A. P., Mishra Meza, A., Trivedi, N. U., Bach, P. B., and Gönen, M. (2022). Physician Payments from Pharmaceutical Companies Related to Cancer Drugs. *The Oncologist*, 27(10):857–863.

Mitchell, A. P., Trivedi, N. U., Gennarelli, R. L., Chimonas, S., Tabatabai, S. M., Goldberg, J., Diaz, L. A., and Korenstein, D. (2021). Are Financial Payments From the Pharmaceutical Industry Associated With Physician Prescribing? *Annals of Internal Medicine*, 174(3):353–361.

Mullahy, J. and Norton, E. C. (2024). Why Transform Y? The Pitfalls of Transformed Regressions with a Mass at Zero. *Oxford Bulletin of Economics and Statistics*, 86(2):417–447. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/obes.12583.

Newham, M. and Valente, M. (2024). The cost of influence: How gifts to physicians shape prescriptions and drug costs. *Journal of Health Economics*, 95:102887.

Schnell, M. (2022). Physician Behavior in the Presence of a Secondary Market: The Case of Prescription Opioids.

Scott, A. and Sivey, P. (2022). Motivation and competition in health care. *Health Economics*, 31(8):1695–1712.

Snowberg, E. and Yariv, L. (2021). Testing the Waters: Behavior across Participant Pools. *American Economic Review*, 111(2):687–719.

Tringale, K. R., Marshall, D., Mackey, T. K., Connor, M., Murphy, J. D., and Hattangadi-Gluth, J. A. (2017). Types and Distribution of Payments From Industry to Physicians in 2015. *JAMA*, 317(17):1774–1784.

A Comparative statics of the optimal brand prescribing propensity

We denote the optimal brand prescribing propensity by $b^*(\alpha)$ and the utility level at the optimum by U^*.

As discussed in more detail in the main text, we place assumptions on the relationship between brand prescribing and benefits and costs to patients and society, on the relationship between payments and the private value of brand prescribing, and on the relationship between private returns to brand prescribing and the propensity of brand prescriptions. For convenience, we reprint these assumptions below.

The marginal health benefit increases at a slower rate than the marginal societal costs of additional brand drug use:

$$\frac{\partial^2 H_o}{\partial b^2} < \frac{\partial^2 C_o}{\partial b^2}. \tag{6}$$

The private value from brand prescribing is weakly increasing in payments:

$$\frac{\partial \pi_s}{\partial p} \geq 0. \tag{7}$$

The private returns to a higher brand prescribing propensity are positive but decreasing:

$$\frac{\partial \pi_s}{\partial b} > 0, \quad \frac{\partial^2 \pi_s}{\partial b^2} < 0. \tag{8}$$

Then, we can use the implicit function theorem to characterize the level of optimal brand prescribing $b^*(\alpha)$. The first order condition with respect to the brand prescribing propensity is given by:

$$\frac{\partial U}{\partial b} = (1-\alpha)\left(\frac{\partial H_o}{\partial b} - \frac{\partial C_o}{\partial b}\right) + \alpha \frac{\partial \pi_s(p)}{\partial b} = 0 \equiv U^*$$

By the implicit function theorem, $\frac{\partial b^*}{\partial p} = -\frac{\partial U^*}{\partial p} / \frac{\partial U^*}{\partial b}$:

$$\frac{\partial b^*}{\partial p} = -\frac{\alpha \overbrace{\frac{\partial \pi_s}{\partial p}}^{\geq 0 \text{ by } (7)}}{(1-\alpha)\underbrace{\left(\frac{\partial^2 H_o}{\partial b^2} - \frac{\partial^2 C_o}{\partial b^2}\right)}_{<0 \text{ by } (6)} + \alpha \underbrace{\frac{\partial^2 \pi_s}{\partial b^2}}_{<0 \text{ by } (8)}}$$

$\Rightarrow \frac{\partial b^*}{\partial p} \geq 0$. Thus, optimal brand prescribing propensity moves up with higher payments. We can then examine the relationship between brand prescribing propensity, payments, and altruism, by taking the partial derivative with respect to physicians' weight on private benefits, α:

$$\frac{\partial^2 b^*}{\partial p \partial \alpha} = -\frac{\overbrace{\frac{\partial \pi_s}{\partial p}}^{\geq 0 \text{ by } (7)} \overbrace{\left(\frac{\partial^2 H_o}{\partial b^2} - \frac{\partial^2 C_o}{\partial b^2}\right)}^{<0 \text{ by } (6)}}{\left((1-\alpha)\underbrace{\left(\frac{\partial^2 H_o}{\partial b^2} - \frac{\partial^2 C_o}{\partial b^2}\right)}_{<0 \text{ by } (6)} + \alpha \underbrace{\frac{\partial^2 \pi_s}{\partial b^2}}_{<0 \text{ by } (8)}\right)^2}.$$

$\Rightarrow \frac{\partial^2 b^*}{\partial p \partial \alpha} \geq 0$ for $\alpha > 0$. Thus, the optimal brand prescribing propensity moves up faster with increasing payments for physicians with a higher level of α, i.e. who place a higher weight on their private benefits.

B Additional information on drug classes and drugs

Table 6: Most frequently prescribed drugs

Generic name	**ATC codes (level 2)**	**Drug class name**	**Share of all claims**
atorvastatin calcium	c10	Lipid modifying agents	7.01%
lisinopril	c03, c09	Diuretics, Agents acting on the renin–angiotensin system	4.85%
amlodipine besylate	c08, c09	Calcium channel blockers, Agents acting on the renin–angiotensin system	4.70%
levothyroxine	h03	Thyroid therapy	4.03%
metoprolol succinate	c03, c07	Diuretics, Beta blocking agents	3.49%
simvastatin	c10	Lipid modifying agents	2.88%
losartan potassium	c03, c09, r05	Diuretics, Agents acting on the renin–angiotensin system, Cough and cold preparations	2.79%
furosemide	c03	Diuretics	2.71%
metoprolol tartrate	c03, c07	Diuretics, Beta blocking agents	2.48%
omeprazole	a02	Drugs for acid related disorders	2.42%
metformin	a10	Drugs used in diabetes	2.35%
hydrochlorothiazide	c03	Diuretics	2.18%
carvedilol	c07	Beta blocking agents	2.12%
pravastatin	c10	Lipid modifying agents	1.59%
rosuvastatin calcium	c10	Lipid modifying agents	1.50%
gabapentin	n03	Antiepileptics	1.48%
warfarin	b01	Antithrombotic agents	1.48%
clopidogrel bisulfate	b01	Antithrombotic agents	1.42%
apixaban	b01	Antithrombotic agents	1.37%
atenolol	c07	Beta blocking agents	1.32%
potassium chloride	a12, b05, r05	Mineral supplements, Blood substitutes and perfusion solutions, Cough and cold preparations	1.25%
hydrocodone acetaminophen	r05	Cough and cold preparations	1.17%

Table 7: Drugs with highest transfers

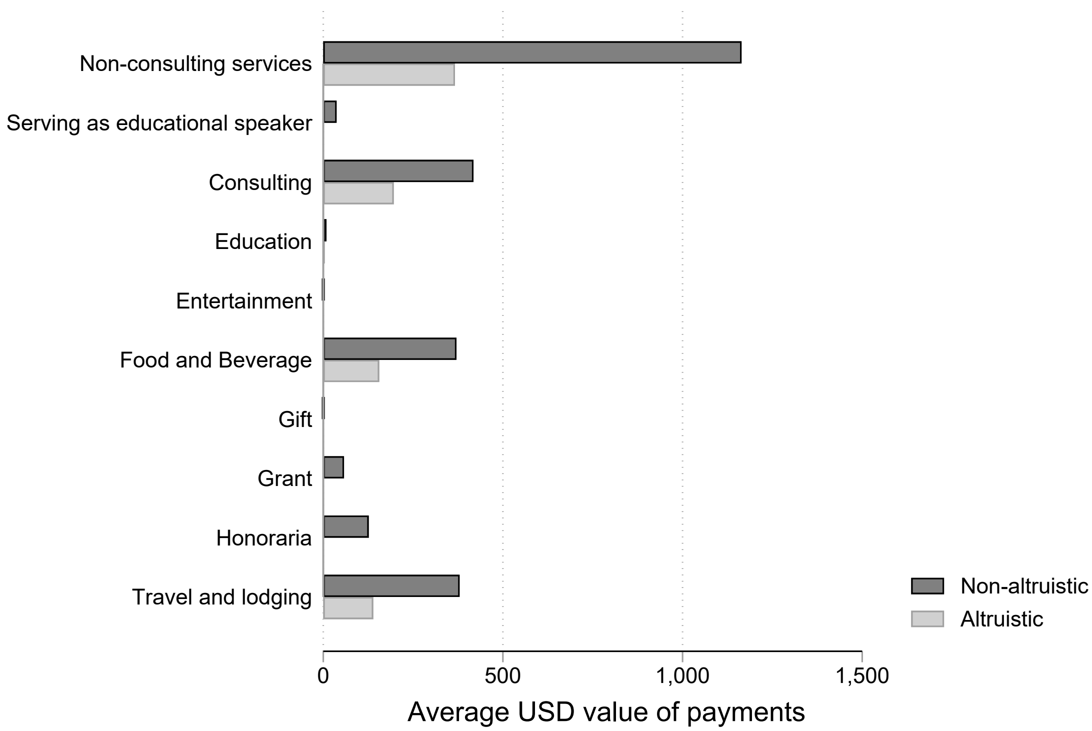
Brand name	**ATC codes (level 2)**	**Drug class name**	**Generic approved before 2020**	**Generic name**	**Total value of transfers**
eliquis	b01	Antithrombotic agents	no	apixaban	$ 447,904.80
xarelto	b01	Antithrombotic agents	no	rivaroxaban	$ 251,448.50
pradaxa	b01	Antithrombotic agents	no	dabigatran etexilate mesylate	$ 151,042.70
repatha	c10	Lipid modifying agents	no	evolocumab	$ 132,398.30
adempas	c02	Antihypertensives	no	riociguat	$ 112,824.40
entresto	c09	Agents acting on the renin–angiotensin system	no	sacubitril and valsartan	$ 108,694.80
crestor	c10	Lipid modifying agents	yes (2016)	rosuvastatin	$ 78,382.71
brilinta	b01	Antithrombotic agents	yes (2019)	ticagrelor	$ 55,797.52
corlanor	c01	Cardiac therapy	no	ivabradine	$ 52,518.27
savaysa	b01	Antithrombotic agents	no	edoxaban	$ 49,457.74
northera	c01	Cardiac therapy	no	droxidopa	$ 32,918.81
praluent	c10	Lipid modifying agents	no	alirocumab	$ 22,492.44
bydureon	a10	Drugs used in diabetes	no	exenatide	$ 20,950.70
tanzeum	a10	Drugs used in diabetes	no	albiglutide	$ 19,092.77
farxiga	a10	Drugs used in diabetes	no	dapagliflozin	$ 16,569.36
invokana	a10	Drugs used in diabetes	no	canagliflozin	$ 13,659.96
multaq	c01	Cardiac therapy	no	dronedarone	$ 12,436.12
effient	b01	Antithrombotic agents	yes (2017)	prasugrel	$ 12,290.05
uptravi	b01	Antithrombotic agents	no	selexipag	$ 9,904.71
toujeo	a10	Drugs used in diabetes	no	insulin glargine	$ 5,239.82
victoza	a10	Drugs used in diabetes	no	liraglutide	$ 4,190.14
jardiance	a10	Drugs used in diabetes	no	empagliflozin	$ 3,221.63
tresiba	a10	Drugs used in diabetes	no	insulin degludec	$ 2,867.16

C Additional descriptive results

C.1 Nature of payment

Figure 6 shows average yearly payments categorized by the nature of payment, separately for non-altruistic and altruistic payments. In both groups of physicians, the highest average payments are associated with non-consulting services (frequently involving sponsored speaking engagements), consulting and travel, followed by transfers related to food and beverage. These categories highlight the importance of privately beneficial interactions with the pharmaceutical industry, including sponsored talks, as well as direct-to-physician marketing strategies, such as meals purchased by company representatives. Notably, non-altruistic physicians receive larger average payments than altruistic physicians within each individual payment category.

Figure 6: USD value of payments over nature of payment, by altruistic or non-altruistic preferences



C.2 Correlation between prescribing and altruism

Table 8: Association between drug prescribing and physician altruism

	Share of brand drug claims	**Log per claim spending**
	(1)	(2)
Altruism		
Non-altruistic	0.005	0.039
	(0.005)	(0.052)
Year controls	Yes	Yes
Individual controls	Yes	Yes
Institutional controls	Yes	Yes
State controls	Yes	Yes
Quartiles of patient pool characteristics	Yes	Yes
Altruistic: Mean outcome	0.189	4.257
Observations	1,616	1,616

This table presents the results from results from regressing drug prescribing on the indicator for non-altruistic preferences. In Column (1), drug prescribing is measured by the share of claims for brand drugs over all drug claims. In Column (2), drug prescribing is measured by the natural logarithm of average per claim spending. All specifications include a constant. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

C.3 Correlation between prescribing and payments

Table 9: Association between industry payments and drug prescribing

	Share of brand drug claims			Log per claim spending		
	(1)	(2)	(3)	(4)	(5)	(6)
Payments						
Log (1 + USD)	0.004***			0.042***		
	(0.001)			(0.006)		
Log USD, given any payment		0.005**			0.062***	
		(0.002)			(0.012)	
Any payment			0.017***			0.180***
			(0.004)			(0.033)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of patient pool characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Altruistic: Mean outcome	0.189	0.190	0.189	4.257	4.343	4.257
Observations	1,616	838	1,616	1,616	838	1,616

This table shows the results from regressing drug prescribing on payments. In Columns (1)–(3), prescribing is measured by the share of claims for brand drugs over all drug claims. In Columns (4)–(6), prescribing is measured by the natural logarithm of average per claim spending. Industry payments are measured by log-transformed payments, log payments given any payment (intensive margin), or any payment (extensive margin). All specifications include a constant. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

D Sensitivity of main results

D.1 Alternative sets of control variables

Table 10: Association between industry payments and physician altruism, with varying sets of control variables

	USD payments[a]		
	(1)	(2)	(3)
Marginal effects			
Altruism			
Non-altruistic	1686.987*	1444.775**	2052.607***
	(897.565)	(718.841)	(588.970)
Coefficient estimates			
Altruism			
Non-altruistic	1.078	0.688	1.070***
	(0.750)	(0.435)	(0.335)
Year controls	Yes	Yes	Yes
Individual controls	No	Yes	Yes
Institutional controls	No	No	Yes
State controls	No	No	No
Altruistic: Mean outcome	860.398	860.398	860.398
Observations	1,616	1,616	1,616

This table presents the results from estimating Equation (4) with overall payments as the outcome variable, and different sets of control variables. Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares. All specifications include a constant. Standard errors of coefficient estimates in parentheses are clustered on the physician level. Standard errors of average marginal effects are calculated using the delta method.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 11: Association between drug prescribing and the interaction of industry payments with physician altruism, with varying sets of control variables

	Share of brand drug claims				**Log per claim spending**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Payments by altruism								
Non-altruistic × Log (1 + USD)	0.005***	0.006***	0.006***	0.006***	0.031	0.035	0.036*	0.033
	(0.002)	(0.002)	(0.002)	(0.002)	(0.022)	(0.022)	(0.021)	(0.021)
Payments								
Log (1 + USD)	0.000	-0.002	-0.001	-0.001	0.023	0.003	0.008	0.010
	(0.001)	(0.001)	(0.001)	(0.002)	(0.021)	(0.021)	(0.020)	(0.021)
Altruism								
Non-altruistic	-0.009	-0.011*	-0.013**	-0.012**	-0.062	-0.081	-0.086*	-0.092*
	(0.007)	(0.007)	(0.006)	(0.006)	(0.056)	(0.055)	(0.049)	(0.047)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes	No	No	Yes	Yes
State controls	No	No	No	Yes	No	No	No	Yes
Quartiles of patient pool characteristics	No	No	No	No	No	No	No	No
Altruistic: Mean outcome	0.189	0.189	0.189	0.189	4.257	4.257	4.257	4.257
Observations	1,616	1,616	1,616	1,616	1,616	1,616	1,616	1,616

This table presents the results from estimating Equation 5, the relationship between drug prescribing and payments interacted with physician altruism, with varying sets of control variables. In Columns (1)–(3), prescribing is measured by the share of claims for brand drugs over all drug claims. In Columns (4)–(6), prescribing is measured by the natural logarithm of average per claim spending. All specifications include a constant. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* p<0.10, ** p<0.05, *** p<0.01.

D.2 Alternative econometric models

Table 12: Association between industry payments and physician altruism, alternative econometric models

	Payments		
	USD	USD	Log USD
	(1)	(2)	(3)
	Linear	*Two-part*	*Linear*
Marginal effects			
Altruism			
Non-altruistic	1340.174***	1822.022*	0.751**
	(508.760)	(988.526)	(0.325)
Probit			
Altruism			
Non-altruistic	0.752**		
	(0.374)		
GLM			
Altruism			
Non-altruistic		0.752**	
		(0.374)	
Year controls	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes
State controls	Yes	Yes	Yes
Altruistic: Mean outcome	860.398	860.398	2.575
Observations	1,616	1,616	1,616
Wald-test: Non-altruistic[a]	$\chi^2(2) = 5.71$		
	$(p = 0.057)$		

This table presents results on the relationship between overall industry payments and physician altruism based on alternative econometric model specifications. Column (1) reports results from a two-part model which combines a probit model for the binary outcome of receiving any payment with a generalized linear model with the log link and gamma distribution for positive payment values, and is estimated by Iterated Reweighted Least Squares. The average marginal effect is based on the full model. The two part model combines a probit model to estimate the binary outcome of receiving any payment, and a generalized linear model with the log link and gamma distribution for the continuous outcome of positive payment values. The overall coefficient of *Non-altruistic* is jointly significant in both parts of the model at a 10%-significance level. Column (2) reports results from a linear model of the USD value of payments estimated using Ordinary Least Squares. Column (3) reports results from a linear model estimated using Ordinary Least Squares with the natural logarithm of 1 + USD payments as outcome variable. The point estimate associated with non-altruistic preferences is 0.751, implying that payments are $(100 * (exp(0.751) - 1)) \approx 111.91\%$ higher compared payments to physicians with altruistic preferences. The estimated coefficient corresponds to a difference in payment levels by 968.37 USD at the average yearly payment of 860.39 USD to an altruistic physician. All specifications include a constant.

Standard errors of coefficient estimates in parentheses are clustered on the physician level. Standard errors for the average marginal effect in the two-part model are calculated using the delta method.

* p<0.10, ** p<0.05, *** p<0.01.

[a] Wald-test to test whether the coefficients associated with Non-altruistic from both parts of the two-part model are jointly zero.

Table 13: Association between drug prescribing and the interaction of physician altruism with industry payments, alternative econometric models

	Share of brand drug claims		Log per claim spending	
	(1)	(2)	(3)	(4)
Payments by altruism				
Non-altruistic × Arcsinh USD	0.004***		0.021	
	(0.001)		(0.015)	
Non-altruistic × Log USD		0.004***		0.020
		(0.002)		(0.018)
Payments				
Arcsinh USD	-0.000		0.019	
	(0.001)		(0.015)	
Log USD		0.002		0.046**
		(0.002)		(0.021)
No payment		0.017		0.164**
		(0.010)		(0.068)
Altruism				
Non-altruistic	-0.010	-0.009	-0.051	-0.048
	(0.006)	(0.006)	(0.045)	(0.046)
Year controls	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes
Altruistic: Mean outcome	0.189	0.189	4.257	4.257
Observations	1,616	1,616	1,616	1,616

This table presents estimation results on the relationship between drug prescribing and payments interacted with physician altruism based on two alternative econometric models. Prescribing is measured by the share of claims for brand drugs over all drug claims in Columns (1)–(2), and by per claim spending in Columns (3)–(4). In Columns (1) and (3), the regression model from Equation 5 is estimated, but payments are inverse hyperbolic sine transformed instead of log-transformed. In Columns (2) and (4), payments are log-transformed with zero replacing missing values, and an indicator for no payments is included as additional control variable. All specifications include a constant. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* p<0.10, ** p<0.05, *** p<0.01.

D.3 Aggregated payments and prescribing

Table 14: Association between industry payments aggregated from 2014-2019 and physician altruism

	Payments	Int. margin	Ext. margin
	USD[a]	USD[a]	Any pay[b]
	(1)	(2)	(3)
Marginal effects			
Altruism			
Non-altruistic	11759.557***	9965.951**	0.142**
	(3476.194)	(4588.083)	(0.066)
Coefficient estimates			
Altruism			
Non-altruistic	0.992***	0.684*	0.142**
	(0.358)	(0.383)	(0.066)
Year controls	No	No	No
Individual controls	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes
State controls	Yes	Yes	Yes
Altruistic: Mean outcome	7,862.884	11,331.803	0.694
Observations	280	221	280

This table presents estimation results for the relationship between overall industry payments, aggregated on the physician level, and physician altruism. Column (1) reports results with overall payments as the outcome variable. Column (2) shows results for payments measured on the intensive margin when restricting the sample to any payment. Column (3) shows results for payments measured on the extensive margin, with an indicator for any payment as the outcome variable. All specifications include a constant. Heteroskedasticity-robust standard errors of coefficient estimates are in parentheses. Standard errors of average marginal effects are calculated using the delta method.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares.

[b] Linear models estimated by Ordinary Least Squares.

Table 15: Association between drug prescribing and the interaction of industry payments and physician altruism, aggregated over all years from 2014-2019

	Share of brand drug claims, all years			**Log per claim spending, all years**		
	(1)	(2)	(3)	(4)	(5)	(6)
Payments by altruism						
Non-altruistic × Log (1 + Total USD, all years)	0.004**			0.006		
	(0.002)			(0.021)		
Non-altruistic × Log total USD given any payment, all years		0.004			-0.043	
		(0.005)			(0.042)	
Non-altruistic × Any payment, all years			0.022*			-0.012
			(0.014)			(0.133)
Payments						
Log (1 + Total USD, all years)	0.000			0.020		
	(0.002)			(0.020)		
Log total USD given any payment, all years		0.003			0.109***	
		(0.005)			(0.041)	
Any payment, all years			-0.010			-0.020
			(0.012)			(0.111)
Altruism						
Non-altruistic	-0.023**	-0.021	-0.015	-0.039	0.238	0.029
	(0.009)	(0.033)	(0.010)	(0.087)	(0.262)	(0.093)
Year controls	No	No	No	No	No	No
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of average patient pool characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Altruistic: Mean outcome	0.191	0.192	0.191	4.323	4.352	4.323
Observations	280	221	280	280	221	280

This table presents results from estimating the relationship between drug prescribing ('Brand share' or 'Spending') and payments interacted with physician altruism, based on prescriptions and payments aggregated on the physician level. The results capture the relationship between prescribing and aggregated payments by altruistic preferences. In Columns (1)–(3), prescribing is measured by the share of claims for brand drugs over all drug claims. In Columns (4)–(6), prescribing is measured by the natural logarithm of average per claim costs. All specifications include a constant. Estimation by OLS. Standard errors in parentheses are clustered on the physician level.
* p<0.10, ** p<0.05, *** p<0.01.

D.4 Continuous measures of altruism

Table 16: The relationship between drug prescribing, industry payments, and physician altruism, with continuous measures of altruism

	Raw α			Raw α, no impartial			Standardized α			$MRS_{o,s}$		
	USD pay[a]	Brand share[b]	Spending[b]	USD pay[a]	Brand share[b]	Spending[b]	USD pay[a]	Brand share[b]	Spending[b]	USD pay[a]	Brand share[b]	Spending[b]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Payments by altruism												
Log (1 + USD) × Raw α		0.001	0.013		0.005*	0.024						
		(0.003)	(0.023)		(0.003)	(0.025)						
Log (1 + USD) × Transformation of α								0.000	0.003		0.001	0.001
								(0.001)	(0.006)		(0.000)	(0.004)
Altruism												
Raw α	1.160**	-0.009	-0.054	1.453**	-0.012	-0.060						
	(0.463)	(0.011)	(0.076)	(0.638)	(0.012)	(0.082)						
Transformation of α							0.296**	-0.002	-0.014	0.197**	-0.001	-0.005
							(0.118)	(0.003)	(0.019)	(0.088)	(0.002)	(0.011)
Payments												
Log (1 + USD)		0.003	0.034**		-0.001	0.018		0.004***	0.042***		0.004***	0.043***
		(0.002)	(0.016)		(0.002)	(0.019)		(0.001)	(0.006)		(0.001)	(0.007)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes[c]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of patient pool characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Mean outcome	2262.558	0.195	4.303	2044.661	0.191	4.284	2262.558	0.195	4.303	2262.558	0.195	4.303
Observations	1,616	1,616	1,616	1,131	1,131	1,131	1,616	1,616	1,616	1,616	1,616	1,616

This table presents results from our main specifications but based on a continuous measure of altruism. Columns (1), (4), (7), and (10) show results from estimating Equation (4), the relationship between overall industry payments ('USD pay') and physician altruism. The remaining columns show results from estimating Equation (5), the relationship between drug prescribing ('Brand share' or 'Spending') and payments interacted with physician altruism. In Columns (1)–(6), altruism is measured by α as defined in Equation (3), with higher values indicating higher weight on private returns, or less altruistic preferences. In Columns (4)–(6), physicians with impartial preferences ($\alpha = 0.5$ cannot be rejected) are excluded. In Columns (7)–(9), α is transformed by a standard normalization within the sample of 280 physicians. In Columns (10)–(12), the estimate of α is transformed as the marginal rate of substitution between social and own benefits, $MRS_{o,s} = -\frac{(1-\alpha)}{\alpha}$, as discussed in Section 2.2. A one-unit increase in $MRS_{o,s}$ thus corresponds to a less altruistic physician, who is willing to give up one additional unit of social benefits for a one-unit increase in own benefit. To regularize for values of α close to zero, $MRS_{o,s}$ is winsorized at the lower five percentiles. All specifications include a constant. Standard errors of coefficient estimates in parentheses are clustered on the physician level.

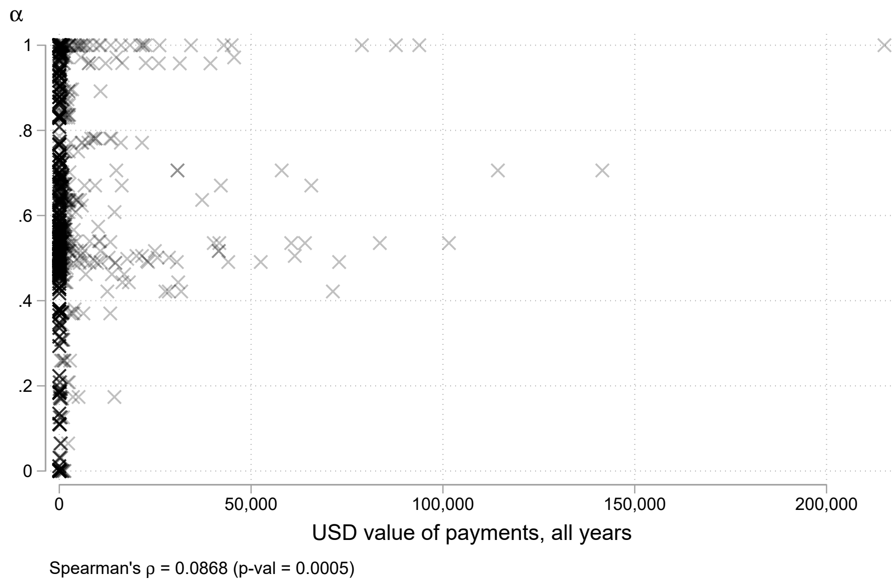
* p<0.10, ** p<0.05, *** p<0.01.

[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares.

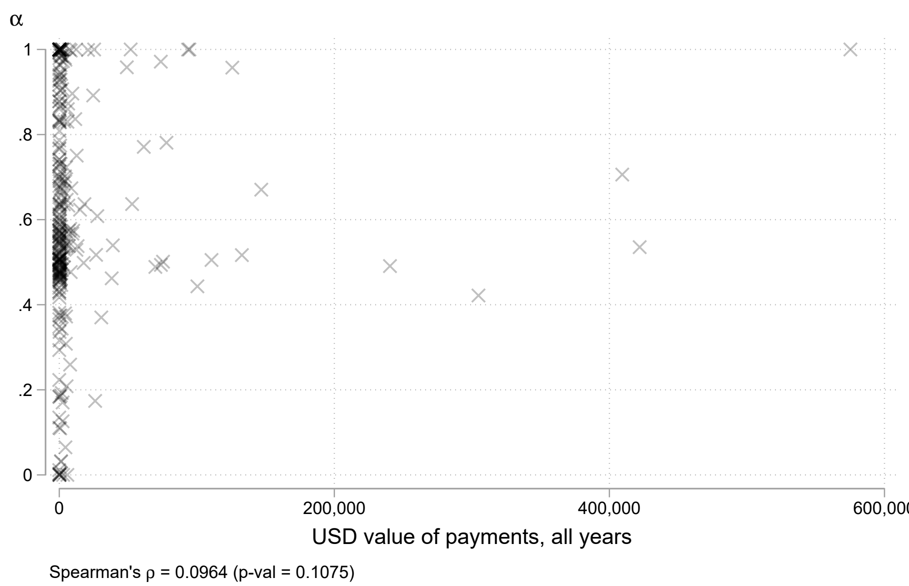
[b] Linear models estimated by Ordinary Least Squares.

[c] To achieve convergence, this specification does not include the practice ownership indicators as control variables.

Figure 7: Scatter plot of raw α and industry payments



(a) Physician-year level



(b) Physician level

Notes: This figure plots the relationship between payments and altruistic preferences. Altruistic preferences are measured by parameter α from Equation (3). Higher values of α correspond to more weight on private benefits (higher selfishness). In the top figure, each point represents a physician-year in the period 2014–2019. In the bottom figure, payments are aggregated for all years between 2014–2019 and each point represents one physician.

D.5 Contemporaneous altruism, payments, and prescribing

Table 17: The relationship between drug prescribing, industry payments, and physician altruism, with contemporaneous data

	Payments, prescribing, and altruism in 2019		
	USD pay[a]	Brand share[b]	Spending[b]
	(1)	(2)	(3)
Payments by altruism			
Non-altruistic × Log (1 + USD)		0.005**	0.004
		(0.002)	(0.024)
Altruism			
Non-altruistic	1.595***	-0.009	-0.056
	(0.427)	(0.008)	(0.074)
Payments			
Log (1 + USD)		0.001	0.049**
		(0.002)	(0.025)
Year controls	No	No	No
Individual controls	Yes	Yes	Yes
Institutional controls	Yes[c]	Yes	Yes
Quartiles of average patient pool characteristics	No	Yes	Yes
State controls	Yes	Yes	Yes
Altruistic: Mean outcome	1861.325	0.164	4.481
Observations	274	274	274

This table presents the results from estimating Equation (4), the relationship between overall industry payments (‘USD pay’) and physician altruism, and Equation (5), the relationship between drug prescribing and payments interacted with physician altruism, on data from the year 2019 when the experiment was conducted. In Column (1), the outcome variable is overall payments in USD. In Column (2), ‘Brand share’ refers to the share of brand claims over all drug claims. In Column (3), ‘Spending’ refers to the natural logarithm of average per claim spending. All specifications include a constant. Standard errors of coefficient estimates in parentheses are clustered on the physician level.

* p<0.10, ** p<0.05, *** p<0.01.

[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares.

[b] Linear models estimated by Ordinary Least Squares.

[c] To achieve convergence, this specification does not include the practice ownership indicators as control variables.

D.6 Correlates of altruism

Table 18: Correlation between physician altruism and observable characteristics

	Physician level	
	Non-altruistic	Raw α
	(1)	(2)
Individual controls		
Age below 39 (omitted)	-	-
Age: 40–49	-0.042	-0.042
	(0.062)	(0.041)
Age: 50–59	-0.058	-0.008
	(0.067)	(0.045)
Age above 60	0.008	-0.037
	(0.072)	(0.045)
Female	0.013	-0.022
	(0.054)	(0.034)
Institutional controls		
Specialty: Other (omitted)	-	-
Specialty: Cardiology	0.001	-0.011
	(0.060)	(0.045)
Specialty: Family medicine	-0.017	-0.006
	(0.070)	(0.044)
Ownership: Nonprofit hospital (omitted)	-	-
Ownership: Academic medical center	-0.070	-0.044
	(0.073)	(0.053)
Ownership: Physician-owned	-0.140	-0.055
	(0.101)	(0.070)
Practice size: 1–36 (omitted)	-	-
Practice size: 36–350	0.207*	0.022
	(0.115)	(0.074)
Practice size: 351–1600	0.155	0.017
	(0.110)	(0.074)
Constant	0.752***	0.667***
	(0.115)	(0.078)
Year controls	No	No
State controls	Yes	Yes
Mean outcome	0.825	0.610
Observations	280	280

This table presents linear regressions of physician altruism on physician-level observable characteristics. Column (1) shows results for our main measure of altruism, an indicator for non-altruistic preferences, as the outcome variable. Column (2) shows results for raw, continuous α defined in Equation (3) as the outcome variable. Estimation by Ordinary Least Squares. Robust standard errors in parentheses.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

D.7 Payment quartiles

Table 19: The relationship between drug prescribing, industry payments, and physician altruism, with industry payments categorized by the 25th, 50th, or 75th percentile

	Payment above 25th percentile				**Payment above median**				**Payment above 75th percentile**			
	Any pay		Brand share	Spending	Any pay		Brand share	Spending	Any pay		Brand share	Spending
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Payments by altruism												
Non-altruistic × Payment above 25th percentile			0.020**	0.092								
			(0.009)	(0.091)								
Non-altruistic × Payment above median							0.026***	0.102				
							(0.009)	(0.091)				
Non-altruistic × Payment above 75th percentile											0.037***	0.276***
											(0.011)	(0.103)
Altruism												
Non-altruistic	0.074	0.352	-0.005	-0.016	0.072	0.346	-0.007	-0.019	0.116***	1.089**	-0.004	-0.037
	(0.049)	(0.272)	(0.006)	(0.045)	(0.049)	(0.273)	(0.006)	(0.044)	(0.042)	(0.445)	(0.005)	(0.050)
Payments												
Payment above 25th percentile			-0.001	0.101								
			(0.008)	(0.087)								
Payment above median							-0.006	0.108				
							(0.008)	(0.086)				
Payment above 75th percentile											-0.005	0.037
											(0.010)	(0.090)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of average patient pool characteristics	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Altruistic: Mean outcome	0.472	0.472	0.189	4.257	0.451	0.451	0.189	4.257	0.150	0.150	0.189	4.257
Observations	1,616	1,616	1,616	1,616	1,616	1,616	1,616	1,616	1,616	1,601	1,616	1,616
Model	Linear[a]	Logit[b]	Linear[a]	Linear[a]	Linear[a]	Logit[b]	Linear[a]	Linear[a]	Linear[a]	Logit[b]	Linear[a]	Linear[a]

This table presents results from our main specifications with industry transfers measured by indicator variables for payments above the 25th, 50th, or 75th percentile. Columns (1)–(2), (5)–(6), and (9)–(10) show results from estimating the relationship between overall industry payments ('USD pay') and physician altruism, with indicator variables of receiving payments in the 25th, 50th, or 75th percentile ('Any pay'), and specified as linear or logit model, respectively. The remaining columns show results from estimating the relationship between drug prescribing and payments interacted with physician altruism. In Columns (3), (7), and (11), prescribing is measured by 'Brand share', referring to the share of brand claims over all drug claims. In Columns (4), (8), and (12), prescribing is measured by 'Spending', referring to the natural logarithm of average per claim spending. All specifications include a constant. Standard errors clustered on the physician-level in parentheses.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

[a] Estimation by Ordinary Least Squares.

[b] Estimation by Maximum Likelihood.

D.8 Winsorized payments

Table 20: The relationship between drug prescribing, industry payments, and physician altruism, with industry payments winsorized at the 95th or 90th percentile

	Winsorized at 95th percentile			**Winsorized at 90th percentile**		
	USD pay[a] (1)	Brand share[b] (2)	Spending[b] (3)	USD pay[a] (4)	Brand share[b] (5)	Spending[b] (6)
Payments by altruism						
Non-altruistic × Log (1 + USD)		0.005***	0.023		0.005***	0.020
		(0.002)	(0.017)		(0.002)	(0.017)
Altruism						
Non-altruistic	0.945***	-0.010	-0.048	0.567**	-0.009	-0.036
	(0.296)	(0.006)	(0.045)	(0.268)	(0.006)	(0.044)
Payments						
Log (1 + USD)		-0.000	0.022		-0.000	0.025
		(0.002)	(0.016)		(0.002)	(0.016)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	Yes	Yes	Yes	Yes	Yes	Yes
State controls	Yes	Yes	Yes	Yes	Yes	Yes
Quartiles of average patient pool characteristics	No	Yes	Yes	No	Yes	Yes
Altruistic: Mean outcome	427.766	0.189	4.257	239.110	0.189	4.257
Observations	1,616	1,616	1,616	1,616	1,616	1,616

This table presents the results from our main specifications with winsorized payments. Columns (1) and (4) show results from estimating Equation (4), the relationship between overall industry payments ('USD pay') and physician altruism. The remaining columns show results from estimating Equation 5, the relationship between drug prescribing and payments interacted with physician altruism. In Columns (2)–(3), prescribing is measured by 'Brand share', referring to the share of brand claims over all drug claims. In Columns (5)–(6), prescribing is measured by 'Spending', referring to the natural logarithm of average per claim spending. All specifications include a constant. Standard errors of coefficient estimates in parentheses are clustered on the physician level. Standard errors for average marginal effects are calculated using the delta method.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares.

[b] Linear models estimated by Ordinary Least Squares.

E Analysis for cardiovascular drugs and blood thinners

We further examine whether drug class specific factors affect the relationship between altruism, prescribing, and payments, by studying blood thinners (antithrombotic agents) and cardiovascular drugs separately. We construct our analysis sample based the list of drugs with Anatomical Therapeutic Chemical code (ATC) code B01 (antithrombotics) or ATC code C (cardiovascular drugs) as included in the FDA Orange Book until 2017, appended by more recent drug approvals as listed in the KEGG DRUG Database. We consider only physicians who are active prescribers of a given drug class and exclude physicians if they prescribe fewer than 50 claims in total and receive no transfers within that drug class. Table 21 provides additional information on drug classes.

Table 22 indicates that altruistic preferences are more strongly associated with the receipt of industry transfers for blood thinners compared to cardiovascular drugs; for both drug classes, we observe higher payments to non-altruistic physicians, but the estimate is only statistically significant for blood thinners. However, for cardiovascular treatments, the difference between altruistic and non-altruistic physicians in the response to payments is statistically significant and substantially larger when compared with baseline prescribing. In contrast, altruistic preferences appear to matter less in the response to industry payments for blood thinners.

These differences between cardiovascular drugs and blood thinners could be explained by a limited availability of lower-cost alternatives for patients who require antithrombotic medications. In contrast, many cardiovascular treatments have been available for an extended period (e.g. statins, beta-blockers, ACE inhibitors). As a result, industry payments for blood thinners would not differentially affect brand shares or costs of blood thinners for altruistic compared to non-altruistic physicians.

Table 21: Prescriptions and payments by drug classes

ATC	Drug class name	Claims share	Expenditure share	Share of physicians		
				with >50 claims	with any pay	excluded
b	Drugs affecting the blood and blood forming organs	6.92%	25.29%	83.46%	38.24%	13.60%
c	Cardiovascular drugs	52.78%	28.09%	98.90%	36.76%	1.10%
a10	Drugs used in diabetes	5.01%	15.58%	61.40%	36.03%	26.10%
b01	Antithrombotic agents	5.47%	24.51%	78.31%	38.24%	18.01%
c03	Diuretics	23.11%	6.40%	97.79%	5.88%	2.21%
c07	Beta blocking agents	10.20%	3.69%	92.65%	10.66%	7.35%
c09	Agents acting on the renin–angiotensin system	15.80%	5.23%	97.43%	25.37%	2.57%
c10	Lipid modifying agents	14.42%	10.58%	95.96%	30.15%	3.31%

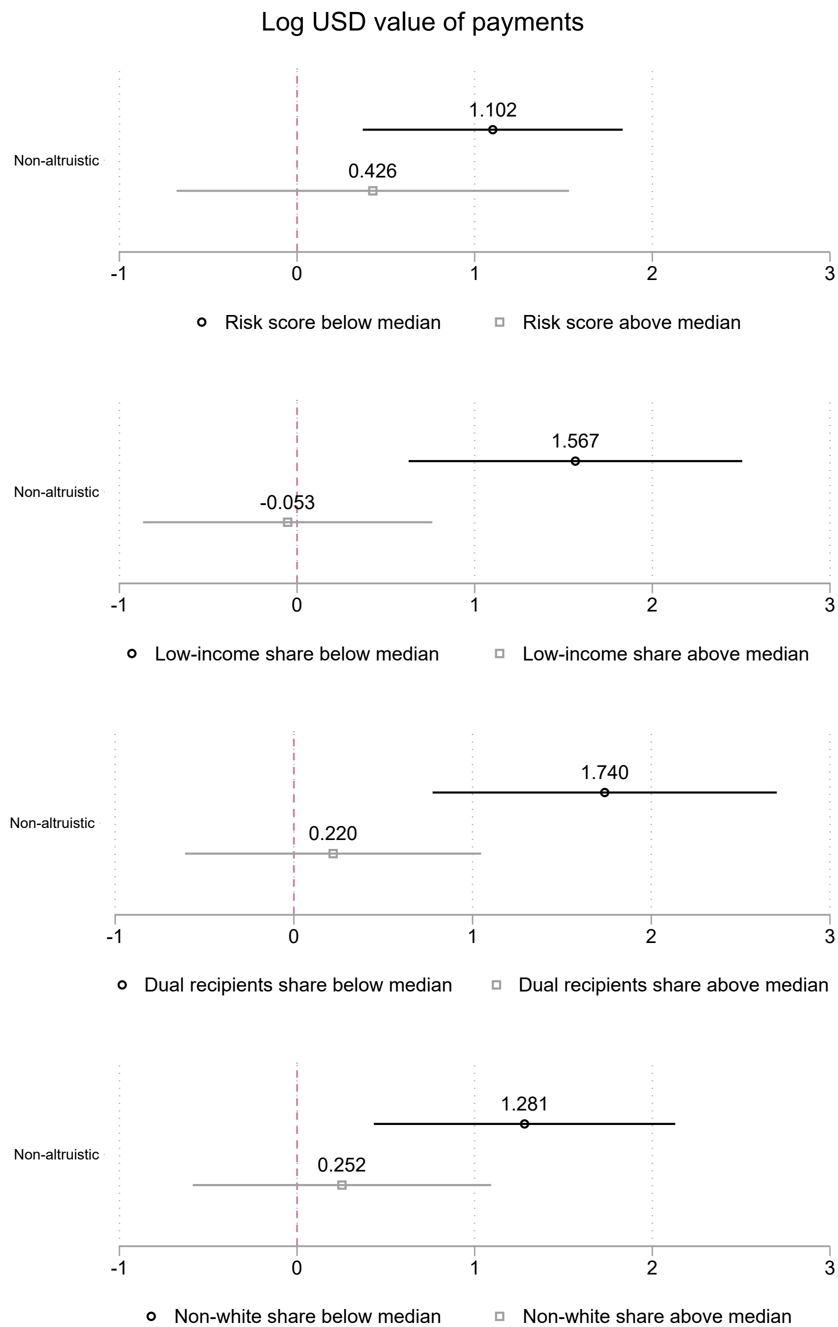
Table 22: The relationship between drug prescribing, industry payments, and physician altruism, for selected drug classes

	Cardiovascular drugs			Blood thinners		
	USD pay[a]	Brand share[b]	Spending[b]	USD pay[a]	Brand share[b]	Spending[b]
	(1)	(2)	(3)	(4)	(5)	(6)
Payments by altruism						
Non-altruistic × Log (1 + USD payments)		0.004**	0.061**		0.006	0.007
		(0.002)	(0.024)		(0.010)	(0.042)
Altruism						
Non-altruistic	0.695	0.004	-0.024	1.647***	0.044	0.153
	(0.547)	(0.004)	(0.082)	(0.604)	(0.035)	(0.157)
Payments						
Log (1 + USD payments)		-0.001	0.008		-0.000	0.026
		(0.002)	(0.021)		(0.010)	(0.039)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Institutional controls	No	Yes	Yes	No	Yes	Yes
Quartiles of patient pool characteristics	No	Yes	Yes	No	Yes	Yes
State controls	No	Yes	Yes	No	Yes	Yes
Altruistic: Mean outcome	48.989	0.024	3.150	79.243	0.329	4.643
Observations	1,616	1,523	1,523	1,616	1,179	1,179

This table presents the results from estimating Equations (4) and (4) with overall payments as the outcome variable, and from estimating Equation 5, separately for cardiovascular drugs (ATC C) and blood thinners (ATC B01). All specifications include a constant. Standard errors of coefficient estimates in parentheses are clustered on the physician level. Standard errors for average marginal effects are calculated using the delta method.
* p<0.10, ** p<0.05, *** p<0.01.
[a] Generalized linear models with a log link and gamma family distribution, estimated by Iterated Reweighted Least Squares. To achieve convergence, only individual controls (age category, gender, specialty) are included.
[b] Linear models estimated by Ordinary Least Squares.

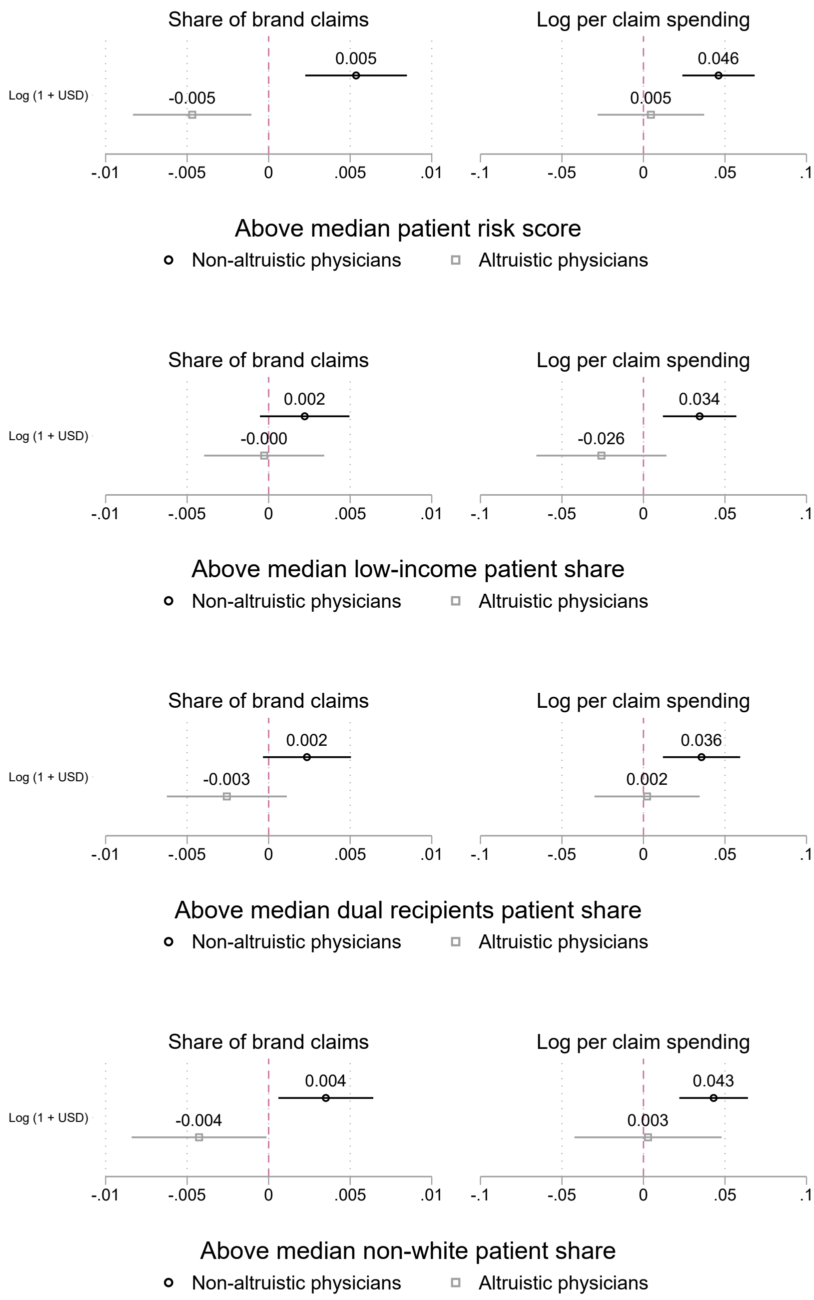
F Patient heterogeneity

Figure 8: The association between altruism and industry payments, by patient heterogeneity



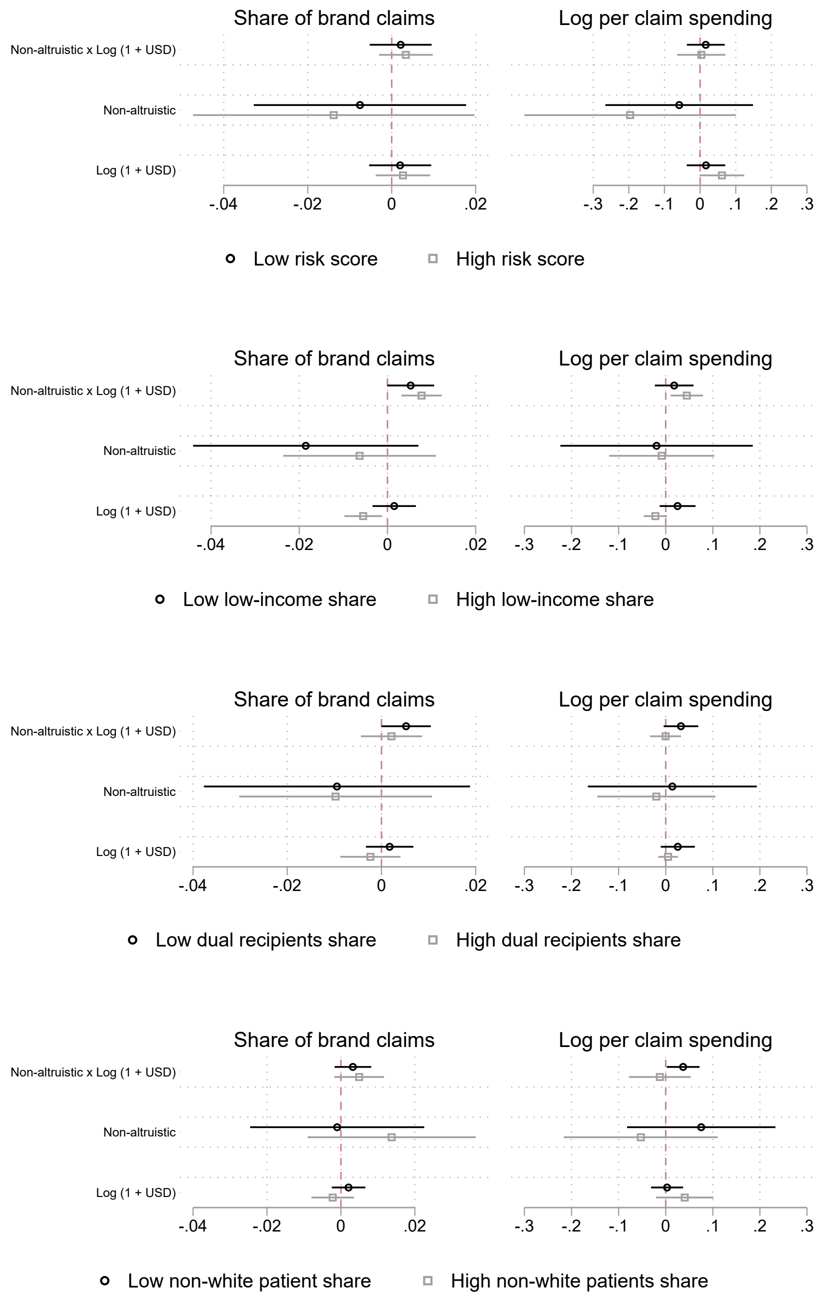
Notes: The figures show estimated coefficients from regressing Log USD value of payments on an indicator variable for altruistic preferences, separately for physicians with patient pools at the median characteristic or above (above median) and for physicians with patient pools below the median characteristic (below median). Each panel represents OLS regression results with observations separated by a different characteristic. All regressions include individual controls, institutional controls, patient pool quartiles, state controls, and calendar years. Lines represent the 95% confidence intervals. Robust standard errors are clustered on the physician-level.

Figure 9: Altruism and the association between drug prescribing and industry payments, for patients with above mean risks



Notes: The figures show estimated coefficients from regressing Total log drug prescribing costs (left) or Share of brand drug claims (right) on industry payments interacted with an indicator variable for altruistic preferences, separately for altruistic and non-altruistic physicians with vulnerable patient pools. Each panel represents OLS regression results with a different subset of physicians by patient pool characteristics and observations separated by altruistic or non-altruistic physicians. All regressions include individual controls, institutional controls, patient pool quartiles, state controls, and calendar years. Lines represent the 95% confidence intervals. Robust standard errors are clustered on the physician-level.

Figure 10: Altruism and the association between drug prescribing and industry payments, by groups of patients in the lowest/highest quartile of a characteristic



Notes: The figures show estimated coefficients from regressing Total log drug prescribing costs (left) or Share of brand drug claims (right) on industry payments interacted with an indicator variable for altruistic preferences, separately for physicians with patient pools in the lowest/highest quartile of a characteristic. Each panel represents OLS regression results, with observations separated by a different characteristic. All regressions include individual controls, institutional controls, patient pool quartiles, state controls, and calendar years. Lines represent the 95% confidence intervals. Robust standard errors are clustered on the physician-level.