No. 102

UNIVERSITY OF COLOGNE

WORKING PAPER SERIES IN ECONOMICS

INEFFICIENCY AND REGULATION IN CREDENCE GOODS MARKETS WITH ALTRUISTIC EXPERTS

RAZI FARUKH
ANNA KERKHOF
JONAS LOEBBING

Department of Economics
University of Cologne
Albertus-Magnus-Platz
D-50923 Köln
Germany

http://www.wiso.uni-koeln.de

Inefficiency and Regulation in Credence Goods Markets with Altruistic Experts

Razi Farukh* Anna Kerkhof† Jonas Loebbing‡

April 2020

Abstract

We study a credence goods problem – that is, a moral hazard problem with non-contractible outcome – where altruistic experts (the agents) care both about their income and the utility of consumers (the principals). Experts' marginal rate of substitution between income and consumer utility declines in income, such that experts care less for consumers when their financial situation is bad. In a market setting with multiple consumers per expert, a cross-consumer externality arises: one consumer's payment raises the expert's income, which makes the non-selfish part of preferences more important and thereby induces the expert to provide higher quality services to all consumers. The externality renders the market outcome inefficient. Price regulation partially overcomes this inefficiency and Pareto-improves upon the market outcome. If market entry of experts is endogenous, price regulation should be accompanied by entry restrictions. Our theory provides a novel rationale for the widespread use of price and entry regulation in real-world markets for expert services.

JEL: D62, D82, D86, L15, L51

Keywords: asymmetric information, common agency, credence goods, expert services, externality, inefficiency, moral hazard, regulation, social preferences

1. Introduction

Market regulation is a pervasive feature of the economy in virtually all countries. In general, it appears to be more prevalent in developing countries and has consequently been associated with poor economic performance (e.g. Djankov, La Porta, de Silanes and Shleifer, 2002).

Yet, even in highly developed countries, a certain set of service sector industries exhibits a particularly high degree of regulation. In these industries, often highly qualified experts

*Department of Economics, University of Cologne. Website: https://www.strategy-wiso.uni-koeln.de/de/team/doktorandinnen-und-doktoranden/razi-farukh/. E-mail: razi.farukh[at]uni-koeln.de.

†Department of Economics, University of Cologne. Website: https://annakerkhof.weebly.com/. E-mail: anna.kerkhof[at]wiso.uni-koeln.de.

‡Center for Macroeconomic Research, University of Cologne. Website: https://cmr.uni-koeln.de/en/team/phd-students/research-teaching-assistant/loebbing/. E-mail: loebbing[at]wiso.uni-koeln.de.

provide specialized services to consumers, who are unable to reliably assess the quality of the service provided. In its purest form, the resulting information asymmetry requires that the consumer trusts the expert to provide an appropriate service. Hence, such services have been termed credence goods (e.g. Darby and Karni, 1973; Dulleck and Kerschbamer, 2006). Existing regulation of credence goods markets often entails a combination of price controls and entry restrictions.[1] Given their potentially detrimental effect on efficiency, it is important to understand whether such regulations can be justified by the specific features of credence goods markets.[2]

Addressing this issue, we provide a novel rationale for price and entry regulation on markets for credence goods, based on considerations of economic efficiency.

In particular, we consider a setting where consumers demand a good of variable quality and cannot write contracts contingent on quality or on a signal thereof. Producers (experts, henceforth) are altruistic in the sense that they value both their own monetary income and their consumers' well-being.

We impose two key assumptions. First, experts' preferences are convex in a way that makes their marginal rate of substitution between income and consumer utility decline in income. Put differently, experts' valuation of additional money relative to their consumers' utility decreases in the amount of income already earned. Second, there is a common agency structure, whereby many consumers (the principals) are served by a single expert (the agent).

In combination, these two assumptions give rise to an externality across consumers: the payment of a given consumer raises the expert's income, which in turn increases the relative importance of the other-regarding part of the expert's preferences. This improves the service quality received by all consumers served by the expert.

We study the implications of this externality in the setting that allows to expose our main results in the most transparent way. In particular, we assume that consumers are matched randomly to experts (in a many-to-one fashion) and make a take-it-or-leave-it price offer to the matched expert. Experts then decide whether to accept the offers and, in case of acceptance, covertly choose the quality of the good supplied to the respective consumer.[3]

Our first set of results shows that consumers' equilibrium price offers are inefficiently low. When making offers, consumers do not internalize the positive effect of their payment on the quality received by other consumers. Consequently, raising prices above the (unregulated) equilibrium level can make all consumers better off. Since experts are trivially better off when prices increase, introducing a fixed price or a price floor above the equilibrium price can achieve a Pareto improvement. We also show that there is no need to consider policies other than the regulation of prices in our baseline setting. Price regulation can implement all

[1] The European Economic and Social Committee (2014) provides a comprehensive description of the various types of regulations imposed on credence goods markets in the European Union. For a detailed overview of the regulation of health care markets (arguably one of the most important credence goods markets) in OECD countries, see Paris, Devaux and Wei (2010).

[2] The professions related to credence goods markets, such as physicians or lawyers, consistently rank among the top-earning occupations in most advanced economies. Arguably, their high incomes partly reflect the regulations imposed on their markets. See, for example, Kleiner and Krueger (2013) for evidence supporting that occupational-level entry restrictions substantially increase earnings of incumbent workers. The question for justification of these regulations is therefore also relevant from a distributional perspective.

[3] In Appendix B, we show that our main results are unchanged in a setting where experts post prices and consumers subsequently choose between experts.

allocations that are constrained efficient in an appropriate sense.

Next, we endogenize the entry decisions of experts. We introduce a fixed cost of entry and decreasing returns in experts' technology, such that entry costs are financed out of inframarginal rents. The unregulated equilibrium is still (constrained) inefficient. With endogenous entry, however, price regulation alone does not suffice to overcome this inefficiency. Indeed, price regulation alone can lead to a Pareto deterioration: Elevated prices draw additional experts into the market until profits (net of the cost of entry) are close to zero again. Thus, the desirable effect of a price floor on profits, and thereby on experts' social behavior, vanishes. This leaves the increase in price and a congruent increase in total entry costs as the only essential allocation changes. Yet, when price regulation is combined with entry restrictions, its efficiency-enhancing effect is re-established. A cap on the number of active experts prevents the dilution of profits through entry after prices have been raised, such that profits and the extent of experts' prosociality increase as desired.

Key to our results is the assumption that experts' preferences give rise to income effects on social behavior. We discuss evidence for this assumption in Section 8 at length. In a nutshell, we describe three types of evidence from existing work that support our assumption. First, results from numerous dictator games show that the level of giving strongly increases in the overall amount of money to be distributed (e.g. Engel, 2011). Second, Bartling, Valero and Weber (2019) present results from a more focused experiment, showing that increases in (experimental) income raise participants' willingness to forgo additional income to the benefit of others. Finally, various forms of correlational evidence on real-world giving behavior support the notion that giving increases with income (e.g. List, 2011).

In addition to that, we provide an empirical analysis that demonstrates the causal effect of income on prosocial behavior. Arguing that financial donations indicate prosocial behavior, we use data from the German Socio-Economic Panel (SOEP) to show that income has a positive effect on financial donations on the extensive and on the intensive margin. To isolate the causal channel, we use intertemporal changes in average net income within occupation groups to instrument for individual net income. The idea is that income changes within occupation groups are strongly correlated to the individuals' income, but otherwise exogenous to any of their decisions; in particular, they have no effect on individual financial donations except through individual income. The results strongly support the plausibility of our key theoretical assumption: A 100 Euro increase in net income leads to a 2.4 percentage point increase in the probability to donate and a 13 Euro increase in the amount donated; moreover, a one standard deviation increase in net income leads to a 40% standard deviation increase on the extensive and a 30% standard deviation increase on the intensive margin of financial donations.

We contribute to the existing literature by providing a novel rationale for price and entry regulation in credence goods markets. This complements Pesendorfer and Wolinsky (2003) who provide an alternative argument for price (but not entry) regulation in markets for credence goods. Other theoretical analyses of quality-related entry or price regulation, such as Atkeson, Hellwig and Ordonez (2015), deviate more strongly from the pure credence goods case and thus have different applications. Existing studies of credence goods markets with socially motivated experts (e.g. Kerschbamer, Sutter and Dulleck, 2017) and, more generally, in behavioral contract theory have not discovered the cross-consumer externality central to our results, because they either lack the common agency structure or the non-linear structure of (social) preferences.

The relation of our work to the existing literature is discussed in more detail in the next section. Section 3 introduces our model. In Section 4, we discuss a benchmark without common agency to clearly lay out the key mechanism in the model. Section 5 analyzes a market setting with common agency and Section 6 analyzes regulatory intervention. In Section 7, we extend the analysis to include endogenous market entry of experts and, correspondingly, study the effects of entry regulation. In Section 8, we describe evidence from existing work that supports our assumption that social behavior depends on income. Finally, Section 9 concludes.

2. Related Literature

In studying the regulation of credence goods markets, our work is closely related to Pesendorfer and Wolinsky (2003). They also provide a rationale for the introduction of price floors on credence goods markets. Their argument is based on a setting where consumers can consult multiple experts sequentially to learn about the service most appropriate to their needs. In this setting, an externality arises from experts' efforts to identify the need of a consumer: if other experts identify the consumer's need with high probability, the consumer can verify any given expert's recommendation with high precision by consulting a second expert. Price competition then leads any given expert to reduce price and effort, which erodes effort incentives for all other experts. A price floor stops this process and sustains high diagnostic effort by all. Our rationale for regulation is different, building on experts' social preferences. It is complementary to Pesendorfer and Wolinsky (2003) in the sense that, incorporating non-linear social preferences into their setup would give rise to the same considerations as in our analysis. In particular, this would arguably strengthen the case for a price floor and introduce benefits from entry restrictions.[4]

Other theoretical work on market regulation with the goal to promote quality deviates more strongly from the pure credence goods case analyzed here. Atkeson et al. (2015), for example, assume that consumers receive an imperfect signal of quality after their purchase, which allows for reputation building by suppliers. They also find a rationale for joint entry and price regulation, as this incentivizes sellers to undertake ex-ante investments into their quality. But again, if experts had social preferences as in our analysis, the cross-consumer externality from our setting would also arise in theirs and our implications for regulation would complement their results.

More generally, whenever the monitoring of quality is imperfect and experts have non-linear social preferences, our reasoning applies and creates a rationale for regulation. Yet, it is arguably most relevant in the pure credence goods case, where social behavior of suppliers

[4]Note that the reason for price regulation identified by Pesendorfer and Wolinsky (2003) critically depends on consumers being able to consult multiple experts. This excludes a variety of settings, in which our analysis remains applicable. These are (i) settings with a need for immediate service delivery, such as medical emergencies; (ii) situations where recommendation and execution of the service cannot be well separated; and (iii) situations where separation is feasible but the execution cannot be monitored.

becomes crucial because other mechanisms, such as reputation building or explicit monetary incentives, are not available.[5]

The theoretical literature on credence goods mainly focuses on relaxing the informational restrictions of the pure credence goods case in various ways and studies how this affects the ability of private contracts to overcome the remaining informational problems. Dulleck and Kerschbamer (2006) provide a useful taxonomy of informational assumptions and the associated results, giving a comprehensive overview of the corresponding studies.[6] With the exception of Pesendorfer and Wolinsky (2003) (see above), these studies do not analyze the scope for public regulation. In contrast, Mimra, Rasch and Waibel (2016) study the effects of price regulation on quality in an experiment on credence goods provision. They find that fixed prices lead to higher quality than price competition, but do not offer a theoretical explanation for their results.

Kerschbamer et al. (2017) propose social preferences as an explanation for deviations from theoretical predictions identified in experimental work by Dulleck, Kerschbamer and Sutter (2011). Yet, neither these authors nor subsequent work studies (non-linear) social preferences in a market setting with common agency. Hence, they do not discover the externality that is at the core of our results.

The same holds, more generally, for the entire literature on behavioral contract theory (see Kőszegi (2014) for a survey). Englmaier and Wambach (2010), for example, study moral hazard with inequity-averse agents, but they do not embed their analysis in a common agency framework. Therefore, they do not obtain externalities across principals.

Studies of common agency, in contrast, have identified externalities across principals in various settings (e.g. Dixit, Grossman and Helpman, 1997). Yet, these papers do not consider non-linear social preferences. Hence, their externalities are different from the one in our analysis.

3. Setup

We set up a model with many consumers who need a service and many experts who can provide this service. Experts covertly choose the quality of the service, which creates moral hazard. Moreover, consumer utility is not contractible, which makes the service a credence good (e.g., Dulleck and Kerschbamer, 2006).

[5] It is, however, important for our results that consumers have a restricted set of contracts at their disposal. Prescott and Townsend (1984) show that unrestricted private contracts achieve a constrained efficient outcome in a wide range of moral hazard settings. Their results do not apply in our case because we do not allow consumers to propose contracts contingent on experts' interaction with other consumers. For example, consumers might overcome the inefficiency in our setting by offering prices conditional on experts not accepting lower prices by other consumers. We consider this less realistic than the analyzed regulatory interventions. See Arnott, Greenwald and Stiglitz (1994) for a similar view.

[6] For examples, see Pitchik and Schotter (1987), Wolinsky (1993), and Emons (1997). An important more recent contribution to this line of research is Bester and Dahm (2018).

3.1. Consumers

There is a continuum of consumers (or, buyers) indexed by $b \in B$. The mass of consumers $|B|$ is denoted M. Consumer b's utility is

$$u_b = v(a_b) - p_b \tag{1}$$

if the consumer receives a service of quality a_b and pays p_b in return. If the consumer receives no service, he gets outside utility $\underline{v}$.[7]

We assume that v is C^2, with $v' > 0$ and $v'' < 0$ everywhere. For interior solutions, let $v'(a) \to 0$ as $a \to \infty$.

3.2. Experts

There is a finite set of experts indexed by $e \in E := \{1, 2, ..., N\}$. To reduce notation, let the number of experts equal the mass of consumers, $N = M$. Expert e earns an income of

$$y_e = \int_{B_e} [p_b - c(a_b)] \; db \; ,$$

where $B_e \subset B$ is the set of consumers served by expert e and $c(a_b)$ denotes the cost of providing a service of quality a_b. The cost function is C^2 with $c > 0$, $c' > 0$, and $c'' > 0$ everywhere. We restrict the quality variable to take positive values, such that 0 is the minimum quality an expert can provide.[8]

Note that we do not explicitly model the expert's opportunity cost of service provision. Hence, the cost function c is best thought of as including this opportunity cost. Income is then measured net of opportunity costs. If $y_e = 0$, the expert does therefore not literally earn nothing, but she earns the same amount she could earn from alternative uses of her time.

Expert e's utility is given by

$$u_e = W(y_e) + \int_{B_e} [v(a_b) - p_b] \; db \; . \tag{2}$$

Hence, experts care about their material payoff y_e but also about the utility of their clients. The function W is C^2 with $W' > 1$. This ensures that the expert always values her own income more than her clients' incomes at the margin. Crucially, we also assume that the marginal utility from income is decreasing, that is, $W'' < 0$ everywhere. This makes the expert's degree of selfishness contingent on her income level. If the expert earns little, she will focus on increasing her income with little regard to consumers' utility. If in contrast the expert is financially well situated, she will pay more attention to her clients' needs.

We impose two further sensible assumptions on preferences to simplify the analysis. Our main results do not depend on these assumptions. First, we transform consumers' utility

[7] We use 'he' when we speak of a consumer and 'she' when we speak of an expert.

[8] We interpret 0 as a quality threshold such that consumers can observe whether the quality they receive exceeds 0 or not. Consumers can then condition payments on this, making experts always provide at least 0 quality. Alternatively, take 0 as a minimum service that is costless to the expert, such that she is always willing to provide this minimum.

function such that $v(0) - c(0) = 0$. This implies that experts do not derive moral satisfaction (i.e., utility through the non-selfish part of their preferences) by serving consumers the minimum quality 0 at the price of its cost. Second, let consumers' outside utility be small, $\underline{v} \leq 0$. This excludes uninteresting cases where consumers refuse to participate in the market.

3.3. Information

We assume throughout the paper that only experts themselves observe the quality of their services. Thus, consumers cannot enforce contracts that make payments contingent on quality. Moreover, we assume that consumer utility is not contractible either.[9] This precludes standard approaches to moral hazard problems.

With purely selfish preferences, these assumptions would make the case for consumers hopeless. Experts would never have an incentive to provide more than the minimum level of quality. Non-selfish experts, however, may provide higher quality services because they care for their clients. This makes our setup well-suited to study the impact of non-selfish preferences on credence goods provision in isolation from other considerations.

Note at this point that, in contrast to standard moral hazard and credence goods problems, our setting does not include a stochastic, potentially unobservable state. We can easily incorporate such a state in the analysis, but this does not add any relevant insights.

4. Bilateral Trade

To prepare the analysis of trading mechanisms for many consumers and many experts, consider first a bilateral setting with a single expert e and a single consumer b. The consumer is as described above. The expert, however, does not perceive the consumer as atomistic, because he is her only client. Hence the expert's utility is

$$\tilde{u}_e = W(p_b - c(a_b)) + v(a_b) - p_b$$

if she provides her service to the consumer, and $W(0)$ otherwise. In relation to the common agency setting studied in the remainder of the paper, this may best be thought of as a situation where all consumers perfectly cooperate and are replaced by a representative consumer who follows their jointly optimal strategy.

Suppose now the consumer offers a payment p_b to the expert, who can then accept or reject the offer. If the expert accepts the offer, she chooses the quality a_b and provides the service.

If the expert accepts an offer p_b, she will choose the quality a_b of her service to maximize utility. Expert utility is strictly concave in a_b and a_b must be non-negative by assumption, so

[9] In the jargon of the credence goods literature, we consider a setting without verifiability (of treatments) and liability (e.g., Dulleck and Kerschbamer, 2006).

the following Kuhn-Tucker conditions uniquely determine the optimal quality $\tilde{a}^{IC}(p_b)$:

$$\begin{aligned} \left[W'(p_b - c(\tilde{a}_b^{IC}))c'(\tilde{a}_b^{IC}) - v'(\tilde{a}_b^{IC})\right] \tilde{a}_b^{IC} &= 0 \\ W'(p_b - c(\tilde{a}_b^{IC}))c'(\tilde{a}_b^{IC}) - v'(\tilde{a}_b^{IC}) &\geq 0 \\ \tilde{a}_b^{IC} &\geq 0 \, . \end{aligned} \tag{3}$$

For concreteness, assume now that

$$W'(0)c'(0) \geq v'(0) \, . \tag{4}$$

This implies that the expert chooses the minimum quality of 0 if her income is zero. In particular, she will not incur monetary losses (relative to her outside option) to provide a quality higher than necessary.

Consider now the expert's acceptance decision. Suppose the offer is $p_b = c(0)$. If accepting this offer, the expert will choose a quality of 0 and obtain utility $W(0)$, equal to her outside option. For simplicity we assume throughout the paper that, when indifferent between two actions one of which leads to the outside option, all individuals decide against the outside option. Hence, the expert accepts the payment $c(0)$. Moreover, her utility strictly increases in p_b (recall that $W' > 1$), so she accepts all offers above $c(0)$ and rejects all offers below.

Anticipating these decisions of the expert, the consumer chooses his payment offer. In particular, he takes into account the effect of his payment on service quality. By condition (3), this effect is positive: a higher payment raises the expert's income, which reduces the marginal utility of income and makes the expert pay more attention to consumer utility. Thus, the consumer's offer choice is non-trivial; he may well choose a payment above $c(0)$ to receive a service of higher quality.

Let p^* denote the optimal offer for the consumer, that is,

$$p^* \in \underset{p_b \geq c(0)}{\operatorname{argmax}} \left\{ v\left(\tilde{a}_b^{IC}(p_b)\right) - p_b \right\} \, . \tag{5}$$

To focus on the most interesting case, we assume henceforth that v, W, and c indeed leave some scope for mutually beneficial exchange above the minimum quality 0. Formally, the minimum offer $c(0)$ (and the resulting minimum quality service) shall not maximize consumer utility:

$$c(0) \notin \underset{p_b \geq c(0)}{\operatorname{argmax}} \left\{ v\left(\tilde{a}_b^{IC}(p_b)\right) - p_b \right\} \, . \tag{6}$$

In Appendix A.1, we provide an exact condition showing that assumption (6) holds if the expert's marginal cost does not increase too quickly in quality at $a_b = 0$.

Figure 1 illustrates the results of the bilateral setting. The curve $\tilde{a}_b^{IC}$ marks the set of feasible allocations from the consumer's perspective. The consumer chooses the point $\left(p^*, \tilde{a}_b^{IC}(p^*)\right)$ on the curve, where his indifference curve I_b is tangent to the graph of $\tilde{a}_b^{IC}$. The expert's indifference curves I_e are such that expert utility is maximized at $\tilde{a}_b^{IC}(p_b)$ for any p_b. Hence they have slope infinity at any point $\left(p_b, \tilde{a}_b^{IC}\right)$.

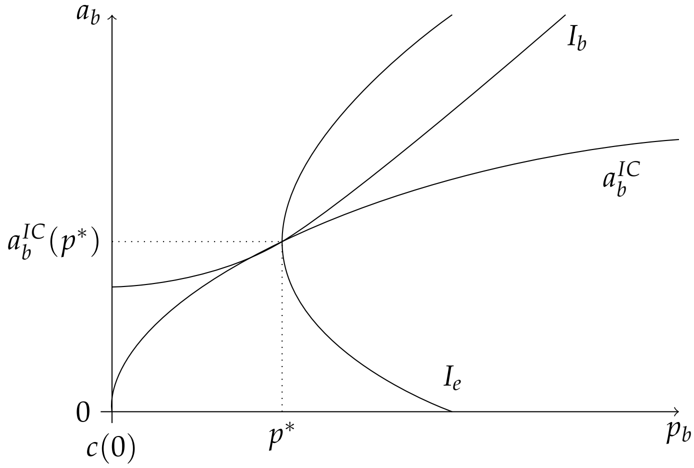

Figure 1. The figure displays indifference curves of the expert, I_e, and of the consumer, I_b, together with the graph of expert's quality choices $\tilde{a}_b^{IC}$. The point $(p^*, \tilde{a}_b^{IC}(p^*))$ maximizes consumer utility on the curve $\tilde{a}_b^{IC}$.

5. Market Trade

Consider now again the setup with a finite number of experts and a continuum of consumers. As in the bilateral setting we study a trading mechanism in which consumers offer payments in exchange for the expert service and experts accept or reject.

In Appendix B we analyze a mechanism where experts offer prices and consumers decide which offer to accept. This mechanism yields essentially the same outcome as the consumer-proposing mechanism studied here. The only difference is that the expert-proposing mechanism gives rise to additional equilibria (with different outcomes), which heavily rely on coordination across consumers. We argue in the appendix that these equilibria are not very plausible and provide two selection criteria, restricting consumers' ability to coordinate. Both criteria leave only the equilibrium that replicates the outcome of the consumer-proposing mechanism. To avoid these complications here, we focus directly on the consumer-proposing mechanism.

In particular, consider the following mechanism.

Stage 1 Each consumer b is matched randomly to an expert e and offers a payment p_b to the expert.[10]

Stage 2 Experts accept or reject the payments offered to them. If a consumer b's offer is rejected, he obtains outside utility $\underline{v}$. If b's offer is accepted, the accepting expert chooses a quality level a_b, and consumer b receives utility (1). Each expert e receives utility (2), where B_e is the set of consumers whose offers the expert accepted.[11]

Stages 1 and 2 describe a sequential game with complete information. We study its subgame perfect equilibria by backward induction. For that, suppose payments $\{p_b\}_{b \in B}$ and acceptance

[10]We assume that for each consumer the matching probability is uniform across experts. Thus, each expert will be matched to a mass M/N of consumers.

[11]Note that consumers cannot condition their payments on the service quality they receive. This follows from our assumption that quality is hidden to consumers and final outcomes are not contractible.

sets B_e are given. Then, experts choose quality levels a_b to maximize utility subject to the non-negativity constraint $a_b \geq 0$ for all b. Let a_b^{IC} denote the optimal quality choice of expert e for consumer $b \in B_e$. As in the bilateral setting, this quality is uniquely determined by the following Kuhn-Tucker conditions:[12]

$$\begin{aligned} \left[W'(y_e)c'(a_b^{IC}) - v'(a_b^{IC})\right] a_b^{IC} &= 0 \\ W'(y_e)c'(a_b^{IC}) - v'(a_b^{IC}) &\geq 0 \\ a_b^{IC} &\geq 0\,. \end{aligned} \tag{7}$$

Before choosing quality, experts decide which offers to accept. Formally, each expert e assesses for each of her offers the marginal utility of adding the offer to her acceptance set B_e. The set B_e must therefore satisfy the following conditions:

$$W'(y_e)\left(p_b - c(a_b^{IC})\right) + v\left(a_b^{IC}\right) - p_b \begin{cases} \geq 0 & \forall\, b \in B_e \\ < 0 & \text{for all } b \text{ whose offer } e \text{ rejects.} \end{cases} \tag{8}$$

Using experts' quality choices, these conditions lead to a simple characterization of acceptance decisions contingent on an expert's income.

Lemma 1. *Given payment offers $\{p_b\}_{b\in B}$, any expert e's acceptance set B_e and income y_e must satisfy, for any b matched to e on stage 1,*

$$b \in B_e \quad \Leftrightarrow \quad p_b \geq \begin{cases} c(0) & \text{if } y_e \leq 0 \\ \tilde{p}(y_e) & \text{if } y_e > 0 \end{cases}$$

with $\tilde{p} : y_e \mapsto \tilde{p}(y_e)$ decreasing in y_e and $\tilde{p}(y_e) \leq c(0)$ for all $y_e > 0$.

Proof. See Appendix A.2. □

Lemma 1 provides an acceptance threshold for consumers' offers. Anticipating this threshold and experts' subsequent quality choices, consumers decide about their offers.

Importantly, here the quality provided by expert e does not depend on any individual payment p_b. In particular, by condition (7) the quality an expert provides is fully determined by her income. But since consumers are atomistic, they perceive their contribution to the expert's income as negligible. Hence, in contrast to the bilateral setting, consumers have no incentive to raise their payment above the acceptance threshold. The following proposition shows that the relevant piece of the threshold then becomes $c(0)$.

Proposition 1. *Consider the game described by stages 1 and 2. In any subgame perfect equilibrium all consumers offer $c(0)$ and receive the minimum quality, that is, $p_b = c(0)$ and $a_b = 0$ for all $b \in B$.*[13,14]

[12] Expert utility is strictly concave in $\{a_b\}_{b\in B_e}$, such that the Kuhn-Tucker conditions identify a unique maximizer.

[13] Our propositions focus on equilibrium outcomes instead of on the equilibria themselves, because there may be multiplicity in the latter. This multiplicity, however, purely arises from off-equilibrium actions.

[14] A formal complication arises from the assumption of a consumer continuum: If experts change their actions towards a measure zero of consumers, this does not affect experts' utilities. We ignore this uninteresting issue throughout the paper. Specifically, we dismiss any equilibrium in which some expert chooses a special action for a measure zero subset of consumers.

Proof. See Appendix A.3. □

Proposition 1 stands in stark contrast to the result from the bilateral setting. Intuitively, this discrepancy stems from an externality across buyers. If other buyers raised their payments, experts' incomes would increase and so would the service quality that any given buyer receives.

Note that the key assumption for this result is that experts' preferences over income and consumer utility are convex in a way that makes the marginal rate of substitution between the two goods decreases in income. This induces experts to care more for their consumers and provide higher quality services when their income is high.

6. Regulation and Efficiency

The cross-buyer externality suggests to study regulation policy. We study price regulation that fixes consumers' payments at a prescribed level.[15]

In particular, consider the game described by stages 1 and 2 but with buyers' offers p_b fixed at the level $\overline{p}$. Since buyers then have no decisions left, the game collapses to experts' acceptance and quality decisions. These must again satisfy conditions (7) and (8).

From Lemma 1 we already know that experts accept all offers if the regulation $\overline{p}$ is greater or equal to $c(0)$. Otherwise, they reject all offers. We can therefore implement an allocation $\{p_b\}_{b\in B}$, $\{B_e\}_{e\in E}$, $\{a_b\}_{b\in \cup_{e\in E} B_e}$ via price regulation if and only if it satisfies the following conditions.[16]

(i) Payments are uniform across buyers, $p_b = p_{b'}$ for all $b, b' \in B$, and $p_b \geq c(0)$ for all $b \in B$.

(ii) The sets B_e have equal size, $|B_e| = 1$ for all $e \in E$, and they are disjoint, $B_e \cap B_{e'} = \emptyset$ for all $e \neq e'$.

(iii) Service quality is uniform across buyers, $a_b = a_{b'}$ for all $b, b' \in B$, and satisfies the Kuhn-Tucker conditions (7).

We call such allocations implementable. In an implementable allocation, consumer utility is given by

$$v\left(\overline{a}^{IC}(\overline{p})\right) - \overline{p}\,,$$

where the quality level $\overline{a}^{IC}(\overline{p})$ follows from the Kuhn-Tucker conditions (7). Using the symmetry of implementable allocations implied by (i) and (ii), the Kuhn-Tucker conditions simplify

[15] If payments were restricted by a lower bound instead of fixed, consumers would set their offers at the lower bound as long as the lower bound does not fall short of the competitive level $c(0)$. Hence, a price floor yields essentially the same results as a fixed price.

[16] Via $\overline{p} < c(0)$ we can also implement the trivial allocation where $B_e = \emptyset$ for all $e \in E$. We ignore this allocation here.

to

$$\begin{aligned} \left[W'\left(\overline{p}-c(\overline{a}^{IC})\right)c'(\overline{a}^{IC})-v'(\overline{a}^{IC})\right]\overline{a}^{IC}&=0\\ W'\left(\overline{p}-c(\overline{a}^{IC})\right)c'(\overline{a}^{IC})-v'(\overline{a}^{IC})&\geq 0\\ \overline{a}^{IC}&\geq 0\,. \end{aligned}$$

The thus defined quality $\overline{a}^{IC}$ is identical to the quality $\tilde{a}^{IC}$ from the bilateral setting. Hence, consumer utility as a function of the regulated price $\overline{p}$ is identical to consumer utility as a function of the consumer's payment offer in the bilateral setting. This identity implies that the price p^* (as defined by equation (5)) maximizes consumer utility among all implementable allocations.

Turning to experts' utility under regulation $\overline{p}$, we obtain

$$\max_{a\geq 0}\left\{W(\overline{p}-c(a))+v(a)-\overline{p}\right\}\ .$$

This is strictly increasing in $\overline{p}$. Since $p^*>c(0)$ by assumption (6), experts prefer the regulation p^* to the competitive equilibrium outcome (described in Proposition 1).[17] We have therefore established that price regulation at p^* Pareto-improves upon the competitive outcome.[18]

Proposition 2. *The allocation implemented by price regulation p^* (defined in equation (5)) Pareto-dominates the competitive equilibrium outcome described in Proposition 1.*

Intuitively, price regulation forces consumers to raise their payments as if internalizing the externality they impose on other consumers. This counteracts the inefficiency that arises in the competitive equilibrium.

Note at this point that a subsidy could not achieve such efficiency gains. A subsidy would lower experts' acceptance thresholds. Anticipating this, consumers would reduce their offers, leaving producer prices at $c(0)$. The incidence of the subsidy therefore falls completely on consumers. It thereby fails to raise experts' profits such that service quality remains unchanged.

To understand the potential of price regulation more completely, consider the set of constrained efficient allocations. This is the set of implementable allocations that are not Pareto-dominated by any other implementable allocation.

Since the regulation p^* maximizes consumer utility, the allocation induced by p^* is constrained efficient. When raising the price above p^*, experts gain and consumers lose. Hence, regulation levels $\overline{p}>p^*$ are constrained efficient as well. Any allocation implemented by $\overline{p}<p^*$ in contrast is not constrained efficient, as both consumers and experts prefer the allocation under p^*. The set of contrained efficient allocations is therefore the set of allocations implementable by a fixed price $\overline{p}\geq p^*$.[19]

[17]We use the term competitive (equilibrium) outcome for the allocation described in Proposition 1, because it is identical to the outcome obtained under (perfect) price competition between experts in Appendix B.

[18]We say that an allocation Pareto-dominates another allocation, if no agent is worse off and a non-zero measure of agents is strictly better off in the first allocation.

[19]By the way we set up the analysis of price regulation, we ignore participation constraints of consumers. If we were to include such constraints, they would imply an upper bound on the regulation $\overline{p}$, beyond which consumers no longer participate. Otherwise, the results would remain unchanged.

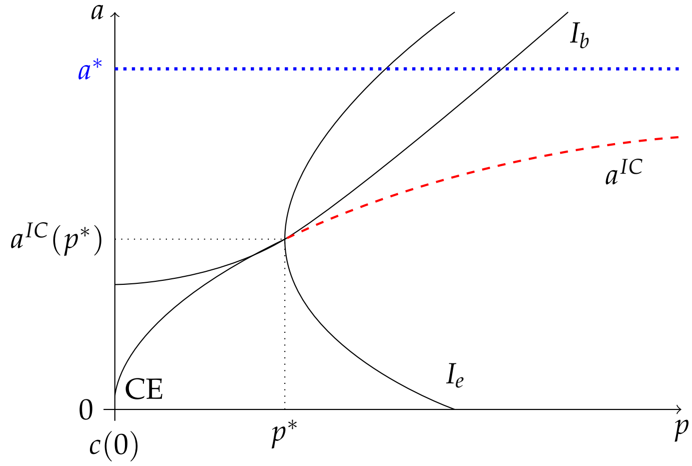

Figure 2. The figure displays indifference curves of experts, I_e, and of consumers, I_b, among symmetric allocations represented by a common payment p and a common service quality a. The function $\overline{a}^{IC}$ returns experts' optimal quality choice given a common payment offer p. The point CE marks the competitive equilibrium outcome from Proposition 1, the red dashed segment of $\overline{a}^{IC}$ is the set of symmetric constrained efficient allocations, and the blue dotted line is the set of symmetric fully efficient allocations.

Compare now the set of constrained efficient allocations to the set of fully efficient allocations. An allocation is fully efficient if and only if it is not Pareto-dominated by any other allocation. In the proof of Proposition 3 below, we show that an allocation is fully efficient if and only if $a_b = a^{**}$ for all consumers b, where the (fully) efficient quality a^{**} is given by

$$v'(a^{**}) = c'(a^{**}) \ .$$

Intuitively, fully efficient allocations maximize surplus, defined as $\int_B (v(a_b) - c(a_b))\ db$. Starting from an allocation that does not maximize surplus, we can move to a surplus-maximizing allocation and redistribute the gains over experts and consumers to make everyone better off.

Inspecting the Kuhn-Tucker conditions for experts' quality choices, we find that expert e chooses the fully efficient quality a^{**} if and only if $W'(y_e) = 1$. In words, to provide fully efficient quality, experts must be indifferent regarding marginal redistribution of money between them and their consumers. Since we excluded this by assumption ($W' > 1$), we can never achieve fully efficient service quality without interfering with experts' quality choices directly. So, the sets of constrained efficient and fully efficient allocations are disjoint; price regulation never achieves full efficiency.

We summarize our findings on the structure of efficient allocations as follows.

Proposition 3. *The set of constrained efficient allocations equals the set of allocations implementable by price regulation $\overline{p} \geq p^*$, where p^* is given by equation (5).*

The regulation p^* maximizes consumer utility. Expert utility increases strictly in the regulation $\overline{p}$. Moreover, the sets of constrained efficient and fully efficient allocations are disjoint.

Proof. See Appendix A. □

Proposition 3 is illustrated by Figure 2. The figure focuses on symmetric allocations, represented by a common payment p and a common quality level a across consumers.

The curve $\overline{a}^{IC}$ marks all allocations implementable via price regulation. Of these, all allocations on the red (dashed) part of the curve are constrained efficient, as they have $p \geq p^*$. There is no intersection with the set of fully efficient symmetric allocations marked by the blue (dotted) line. The competitive outcome CE at $(0, c(0))$ is neither constrained nor fully efficient.

In short, raising prices up to p^* is Pareto-improving. Raising prices further benefits experts and hurts consumers.

7. Endogenous Entry

When price regulation raises experts' profits it may incentivize new experts to enter the market. This may dilute profits and thereby undermine the desired consequences of regulation. To address this concern we extend the analysis to a setting with endogenous entry.

In particular, suppose now that there is a (countably) infinite set of experts who initially decide whether to enter the market at a fixed cost $F > 0$ or not. To finance the entry cost even in a situation where prices equal marginal cost, suppose that experts operate decreasing returns to scale technologies. Formally, let the income of an expert e who entered the market be

$$\hat{y}_e = \int_{B_e} [p_b - c(a_b)] \, db - k(|B_e|) - F \, , \tag{9}$$

where all recurrent variables have the same meaning as before. The new cost function k is C^2 and satisfies $k(0) = 0$, $k' > 0$, and $k'' > 0$. Without loss of generality we can now impose the normalization $c(0) = 0$. The function k then measures a fixed cost per consumer served that is independent of service quality. It is convex in the mass of consumers served to capture decreasing returns to scale.[20]

Expert e's utility becomes

$$\hat{u}_e = W(\hat{y}_e) + \int_{B_e} \left(v(a_b) - p_b - v(0) + k'(|B_e|) \right) db \, . \tag{10}$$

Compared to the previous sections we adjust the other-regarding part of experts' utility by $|B_e| \left(-v(0) + k'(|B_e|) \right)$. This adjustment ensures that experts do not derive immaterial benefits or losses from serving a consumer the minimal quality at marginal cost. It mirrors our assumption of $v(0) - c(0) = 0$ from the previous sections. As in the previous sections, the assumption serves to simplify the analysis without substantively changing the results.

Consumers are modeled exactly as before (see section 3), except for that we replace the assumption $\underline{v} \leq 0$ by

$$\underline{v} \leq v(0) - k'(M) \, .$$

This again ensures that consumers' outside utility is small enough to exclude uninteresting

[20]Decreasing returns to scale may for example stem from increasing difficulties to coordinate appointments with consumers, frictional interaction with a growing number of employees, or disproportional wear and tear of equipment.

cases where consumers refuse to participate in the market.

7.1. Market Trade with Endogenous Entry

We consider now the following timing of events.

Stage 1' Experts decide whether to enter the market or not. If they do not enter, they receive utility $W(0)$.

Stage 2' Denote by $E = \{1, 2, ..., N\}$ the set of experts who enter the market. Each consumer $b \in B$ is matched randomly to an expert $e \in E$ and offers a payment p_b to the expert.[21]

Stage 3' Experts accept or reject offers. If an offer p_b is rejected, consumer b receives the outside option $\underline{v}$. If p_b is accepted, the corresponding expert chooses a_b and the consumer receives utility (1). Finally, each expert $e \in E$ receives utility according to (10), where B_e is the set of consumers whose offers e accepts.

This defines a sequential game with complete information and we again study its subgame perfect equilibria by backward induction.

Given a set of active experts E, payment offers $\{p_b\}_{b\in B}$ and a matching $\{B_e\}_{e\in E}$, experts' quality choices $\hat{a}_b^{IC}$ are determined by the Kuhn-Tucker conditions (7) as in Section 5. The only difference is that income y_e is replaced by $\hat{y}_e$ as given by equation (9).

Moving backwards, the acceptance decisions of each expert $e \in E$ must satisfy

$$W'(\hat{y}_e)\left(p_b - c(\hat{a}_b^{IC}) - k'(|B_e|)\right) + v(\hat{a}_b^{IC}) - p_b - v(0) + k'(|B_e|) \begin{cases} \geq 0 & \forall\, b \in B_e \\ < 0 & \text{for all } b \text{ whose offer } e \text{ rejects.} \end{cases}$$

The condition computes the marginal benefit from expanding the set B_e by consumer b. If this marginal benefit is positive, the expert accepts b's offer, otherwise not. The condition leads to the following intermediate result.

Lemma 2. *Given payment offers $\{p_b\}_{b\in B}$, each active expert e's acceptance decisions B_e and income $\hat{y}_e$ must satisfy, for any consumer b matched to e on stage 2',*

$$b \in B_e \quad \Leftrightarrow \quad p_b \geq \begin{cases} k'(|B_e|) & \text{if } \hat{y}_e \leq 0 \\ \hat{p}(y_e, B_e) & \text{if } \hat{y}_e > 0 \end{cases}$$

with $\hat{p} : (\hat{y}_e, B_e) \mapsto \hat{p}(\hat{y}_e, B_e)$ decreasing in $\hat{y}_e$ and $\hat{p}(\hat{y}_e, B_e) \leq k'(|B_e|)$ for all $\hat{y}_e > 0$ and all B_e.

Proof. See Appendix A. □

Lemma 2 provides an acceptance threshold, which consumers anticipate when making their offers on stage 2'. Determining equilibrium offers is now complicated by inframarginal rents, which may induce positive profits. We therefore proceed with a case distinction.

[21] Let the matching probability again be uniform, such that each expert is matched to mass M/N of consumers.

Lemma 3. *Take a non-empty set of active experts E and consider the subgame after E described by stages 2′ and 3′. Distinguish the following cases.*

1. *If*

$$\frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F > 0\,,$$

payment offers and expert utilities must satisfy

$$p_b \leq k'\left(\frac{M}{N}\right) \quad \textit{and} \quad \hat{u}_e > W(0)$$

for all $b \in B$ and $e \in E$.

2. *If*

$$\frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F = 0\,,$$

payment offers and expert utilities must satisfy

$$p_b = k'\left(\frac{M}{N}\right) \quad \textit{and} \quad \hat{u}_e = W(0)$$

for all $b \in B$ and $e \in E$.

3. *If*

$$\frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F < 0\,,$$

payment offers and expert utilities must satisfy

$$p_b = k'\left(\frac{M}{N}\right) \quad \textit{and} \quad \hat{u}_e < W(0)$$

for all $b \in B$ and $e \in E$.

Proof. See Appendix A. □

Case 3 is not compatible with entry decisions on stage 1′, as experts' utility falls short of their outside option. Hence, the equilibrium number of experts $\hat{N}$ must satisfy the conditions of cases 1 or 2. At $\hat{N}+1$, however, we need case 3, such that expert $\hat{N}+1$ finds it unprofitable to enter:

$$\frac{M}{\hat{N}}k'\left(\frac{M}{\hat{N}}\right) - k\left(\frac{M}{\hat{N}}\right) - F \geq 0 \tag{11}$$

$$\frac{M}{\hat{N}+1}k'\left(\frac{M}{\hat{N}+1}\right) - k\left(\frac{M}{\hat{N}+1}\right) - F < 0\,. \tag{12}$$

To resolve the cumbersome case distinction, suppose now that the mass of consumers is large, $M \to \infty$. Then, conditions (11) and (12) imply $M/\hat{N} \to m$, where m satisfies

$$mk'(m) - k(m) - F = 0\,. \tag{13}$$

Hence,

$$\frac{M}{\hat{N}}k'\left(\frac{M}{\hat{N}}\right)-k\left(\frac{M}{\hat{N}}\right)-F\to 0$$

as $M\to 0$. In words, when we get rid of the integer problem with finite N, we approach case 2 of Lemma 3, where experts make zero profits and payments equal marginal cost.

Proposition 4. *Consider the game described by stages 1′ to 3′. Suppose $M\to\infty$. Then, in any subgame perfect equilibrium consumers' offers approach marginal cost and quality levels approach zero, that is, $p_b\to k'(m)$ and $a_b\to 0$ for all $b\in B$, where m is defined by equation (13).*

Proof. See Appendix A. □

Proposition 4 shows that for large M the equilibrium allocation with market entry approaches the competitive outcome of minimal quality and marginal cost pricing familiar from Section 5. The only difference is that here marginal cost is given by $k'(m)$ instead of $c(0)$.

7.2. Regulation with Endogenous Entry

We consider now a joint regulation of prices and entry, represented by the tuple $(\overline{p},\overline{N})$. Such a regulation induces a game described by stages 1′ to 3′ with two modifications. First, only a number of $\overline{N}$ experts decides whether to enter the market on stage 1′. This caps the number of active experts at $\overline{N}$. Second, as in Section 6 price regulation fixes buyers' offers at $\overline{p}$.

Hence under regulation $(\overline{p},\overline{N})$, experts decide whether to enter the market, whether to accept the fixed payment offers, and which quality to provide. Consumers have no choices. In the following we construct a regulation that Pareto-improves upon the competitive outcome of Proposition 4.

Note first that for a given number of active experts $\tilde{N}$, experts accept all offers if $\overline{p}\geq k'(M/\tilde{N})$. In such a situation, condition (7) for experts' quality choices simplifies to

$$\left[W'\left(\frac{M}{\tilde{N}}\overline{p}-\frac{M}{\tilde{N}}c(\hat{\bar{a}}^{IC})-k\left(\frac{M}{\tilde{N}}\right)-F\right)c'(\hat{\bar{a}}^{IC})-v'(\hat{\bar{a}}^{IC})\right]\hat{\bar{a}}^{IC}=0$$
$$W'\left(\frac{M}{\tilde{N}}\overline{p}-\frac{M}{\tilde{N}}c(\hat{\bar{a}}^{IC})-k\left(\frac{M}{\tilde{N}}\right)-F\right)c'(\hat{\bar{a}}^{IC})-v'(\hat{\bar{a}}^{IC})\geq 0$$
$$\hat{\bar{a}}^{IC}\geq 0\,.$$

This defines the quality $\hat{\bar{a}}^{IC}(M/\tilde{N},\overline{p})$ as a function of the consumer to expert ratio $M/\tilde{N}$ and the price level $\overline{p}$. Consumer utility then also becomes a function of $M/\tilde{N}$ and $\overline{p}$. We denote the price that maximizes consumer utility at a given consumer to expert ratio by $\hat{p}^*(M/\tilde{N})$:

$$\hat{p}^*\left(\frac{M}{\tilde{N}}\right)\in\max_{\overline{p}\geq k'\left(\frac{M}{\tilde{N}}\right)}\left\{v\left(\hat{\bar{a}}^{IC}\left(\frac{M}{\tilde{N}},\overline{p}\right)\right)-\overline{p}\right\}\,. \tag{14}$$

Assume now that for large M and at the unregulated expert number $\hat{N}$ (as given by conditions (11) and (12)), there is scope for trade above the minimum quality level of zero. Formally, if the expert to consumer ratio approaches its limit value m from the unregulated case (as given by equation (13)), marginal cost pricing is not collectively optimal for consumers:

$$k'(m) \notin \max_{\overline{p} \geq k'(m)} \left\{ v\left(\hat{\overline{a}}^{IC}(m, \overline{p})\right) - \overline{p} \right\} . \tag{15}$$

This assumption is analogous to assumption (6) in the setting without entry.

As a consequence of assumption (15), if we can regulate entry such that the number of active experts remains the same as in the unregulated equilibrium, we can Pareto-improve upon the unregulated outcome by raising prices to $\hat{p}^*(m)$ when M is large. Proposition 5 shows that capping entry at the number of experts from the unregulated outcome, $\overline{N} = \hat{N}$, yields the desired result.[22] In addition, Proposition 5 shows that the entry-related component of the regulation is important.

Proposition 5. *Consider the regulation* $(\hat{p}^*(m), \hat{N})$, *where* $\hat{p}^*$ *is the consumer-optimal price given by equation* (14) *and* $\hat{N}$ *is the number of active experts in the unregulated equilibrium given by conditions* (11) *and* (12). *There exists a value* $\overline{M}$ *such that for all* $M > \overline{M}$, *the allocation implemented by the described regulation Pareto-dominates the unregulated equilibrium outcome described in Proposition 4.*

Consider in contrast the pure price regulation $(\hat{p}^*(m), \infty)$. *There exists a value* $\overline{M}'$ *such that for all* $M > \overline{M}'$, *the allocation implemented by the pure price regulation is Pareto-dominated by the allocation implemented by the joint price and entry regulation described above.*

Proof. See Appendix A. □

Proposition 5 shows that price regulation should be accompanied by entry regulation when entry is endogenous. Adding the entry regulation $\hat{N}$ to the pure price regulation $(\hat{p}^*(m), \infty)$ yields a Pareto-improvement.

To understand this result, note that the purpose of price regulation is to make experts behave less selfishly by raising their profits. But with endogenous entry, any attempt to raise profits via price regulation attracts new entrants, which counteracts the increase in profits. The desired effect on service quality is therefore mitigated. Entry regulation solves this problem by capping the number of active experts. Those who are still allowed to enter benefit from the increased prices and decide, non-selfishly, to provide higher quality services. Thus, entry regulation restores the effectiveness of price regulation.

Whether the price regulation alone already achieves a Pareto-improvement over the competitive outcome is unclear. For large M, experts' utility is approximately unaffected by pure price regulation, because entry drives down experts' utility to their outside option. For consumers the effect is ambiguous. On the one hand, increased prices reduce utility. On the other hand, although mitigated by entry, the pure price regulation can still have a positive effect on service quality. This is because the regulation raises prices above marginal cost, which has a negative effect on experts' utility through the non-selfish part of their preferences: experts feel bad because consumers pay "too much" for what they receive. This immaterial utility loss must be compensated by material gains to make experts enter the market. Hence, entry stops before the income level drops to zero. Since income is positive, service quality can be positive as well.

[22] Intuitively, raising prices above the marginal cost $k'(m)$ makes entry more attractive, such that the cap at $\hat{N}$ is binding and therefore equal to the actual number of active experts.

8. Does Social Behavior Depend on Income?

Our theory builds on the assumption that there are positive income effects on social behavior. To support the plausibility of this assumption, this section provides a broad range of experimental and empirical evidence on the relationship between income and prosocial behavior. To this end, we first review the existing literature and, second, present the results of our own empirical analysis.

8.1. Evidence from the literature

In the experimental and empirical literature, there are three types of evidence that support our key assumption.

First, experimental evidence from dictator games consistently shows that individuals give more to others when their endowment increases.[23] Hence, as individuals' income in the experiment goes up, so does their willingness to forgo additional income to the benefit of others. This exactly replicates the crucial behavioral property implied by our assumption on experts' preferences. The finding that the absolute level of giving in dictator games increases in the endowment is uncontroversial in the experimental literature and therefore typically receives little attention. We view this as an indication that, at least qualitatively, our preference assumption is quite modest.

Bartling et al. (2019) question the informativeness of dictator games for whether social behavior is income-dependent or not, based on the assertion that there are strong social norms regarding the share of income to be kept in the dictator game.[24] They propose an alternative experiment, mimicking a market situation where participants decide between buying a good that inflicts externalities on others and one that does not. They find that the premium individuals are willing to pay for the externality-free good increases in their experimental income, in line with our preference assumption.

Finally, there is correlational evidence from the field. Many studies find that charitable giving significantly increases in household income (e.g. Smith, Kehoe and Cremer, 1995; List, 2011). Wiepking and Bekkers (2012) review over 50 studies showing that income and wealth have a positive effect on the level of philantrophic donations.[25] Moreover, Andreoni, Nikiforakis and Stoop (2017) demonstrate that rich households are more likely to return misdelivered envelopes with money than poor households.

Particularly insightful in our context is a study by Rasch and Waibel (2018). Using data on car repairs – i.e., expert services – in Germany, they find that a critical financial situation of a car garage is associated with a higher amount of overcharging incidences.

[23] See, for example, Carpenter, Verhoogen and Burks (2005), Chowdhury and Jeon (2014), Korenok, Millner and Razzolini (2012), and the comprehensive meta study on dictator games by Engel (2011).

[24] They argue that many individuals adhere to the norm that the money should be divided equally between dictator and recipient. Indeed, many individuals seem to follow this norm.

[25] Conducting dictator games with millionaires, Smeets, Bauer and Gneezy (2015) find that the level of giving by millionaires is "much higher than in other experiments we are aware of" (p. 10641).

8.2. Empirical analysis

Next, we present the results of an empirical analysis based on data from the German Socio-Economic Panel (SOEP); a detailed description of the procedure and robustness checks can be found in Appendix C. Following Section 8.1, we argue that financial donations indicate social behavior and show that net income has a positive effect on financial donations on the extensive and on the intensive margin.

A major challenge in the analysis is that a naive regression of financial donations on income is unlikely to yield a causal effect. As argued above, correlational studies typically document a positive relationship, but self-selection and reverse causality could lead to over- or under-estimation of the effect. E.g., low-earning individuals could be more social per se; similarly, individuals who exhibit a strong prosocial attitude might self-select into occupations that are poorly paid, which would entail downward biased coefficients.

To eliminate endogeneity in income, we proceed in two steps. First, we exploit the panel structure of our data to erase individual fixed effects from the regression. Thus, we consider each individual's intertemporal *change* in income and financial donations and estimate

$$\Delta fdon_i = \beta_0 + \beta_1 \Delta netinc_i + \beta_2 \Delta \mathbf{X_i} + \varepsilon_i, \tag{16}$$

where $\Delta fdon_i$ corresponds to individual i's change in financial donations and $\Delta netinc_i$ refers to i's change in net income. We also consider a broad range of control variables $\Delta \mathbf{X_i}$, including i's change in bonus payments (Christmas, vacation, and annual bonus), employment circumstances (weekly working hours, side job, activity status), marital and health status, and life satisfaction. The parameter of interest is β_1: it measures the marginal effect of an absolute change in $\Delta netinc_i$ on $\Delta fdon_i$. Following our theory, we expect that an increase in $\Delta netinc_i$ has a positive effect on $\Delta fdon_i$, i.e., $\hat{\beta}_1 > 0$.

Second, we use the intertemporal *change in the average net income within occupation groups*, denoted by $\Delta avinc_i$, to instrument for $\Delta netinc_i$. We argue that $\Delta avinc_i$ meets the requirements of a valid instrument: it is strongly correlated to $\Delta netinc_i$, but otherwise exogenous to any of i's decisions. In particular, the change in the average net income within her occupation group does not affect an individual's financial donations except through $\Delta netinc_i$. Thus, we augment the model with the first stage

$$\Delta netinc_i = \pi_0 + \pi_1 \Delta avinc_i + \pi_2 \Delta \mathbf{X_i} + u_i \tag{17}$$

and estimate equations (16) and (17) by 2SLS.

Table 1 summarizes our findings; see Appendix C.2 for the complete set of results. Columns 1 to 4 show the OLS and the 2SLS estimates of regressing an individual's change in net income on the change in her financial donations on the extensive margin, with and without controls. To enhance readabilty of the estimates, $\Delta netinc_i$ is scaled with the factor 100. All estimates are positive, but the 2SLS estimates in columns 3 and 4 are several times larger and more statistically significant than the OLS estimates in columns 1 and 2, which is in line with our concerns about a downward biased OLS estimation. According to the 2SLS estimates, a 100 Euro increase in $\Delta netinc_i$ leads to a 2.4 percentage point change in the probability to donate;

a one standard deviation increase in $\Delta netinc_i$ leads to about a 40% increase in the dependent variable.

Analogously, columns 5 to 8 show the OLS and the 2SLS estimates of regressing an individual's change in net income on the change in her financial donations on the intensive margin, with and without controls. All estimates are positive, but the OLS estimates are not statistically significant. Moreover, the 2SLS estimates are again several times larger than their OLS counterparts. Following the 2SLS estimates, a 1 Euro increase in $\Delta netinc_i$ leads to a 0.13 Euro increase in the change in the amount donated; a one standard deviation increase in $\Delta netinc_i$ leads to about a 30% increase in the dependent variable. We conclude that income has a causal positive effect on the extensive and on the intensive margin of financial donations.

Table 1. The effect of net income on financial donations

	Extensive margin				Intensive margin			
	OLS		2SLS		OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta netinc_i$	0.0018*	0.0015*	0.0241***	0.0222**	0.0130	0.0127	0.132**	0.134***
	(0.0009)	(0.0009)	(0.0091)	(0.0093)	(0.0205)	(0.0210)	(0.0521)	(0.0511)
ΔX_{1i}		X		X		X		X
ΔX_{2i}		X		X		X		X
ΔX_{3i}		X		X		X		X
Intercept	0.044***	0.041***	-0.008	-0.053	33.84***	31.33***	5.86	3.55
	(0.007)	(0.008)	(0.022)	(0.022)	(7.22)	(7.25)	(12.17)	(11.86)
			First Stage				First Stage	
$\Delta avinc_i$			0.021***	0.020***			2.06***	2.03***
			(0.004)	(0.003)			(0.36)	(0.35)
F-statistic			33.74	33.22			33.50	32.98
N	5,496	5,390	5,496	5,390	5,449	5,347	5,449	5,347

Notes: Robust standard errors in parentheses. The dependent variable in columns 1 to 4 is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The dependent variable in columns 5 to 8 is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The estimates in columns 1, 2, 5, and 6 are OLS estimates. The estimates in columns 3, 4, 7, and 8 are 2SLS estimates. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100 in columns 1 to 4. See Section C for details on data and empirical strategy.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

9. Conclusion

We propose that income-dependence of social behavior creates an externality across principals in a common agency framework. This externality is most relevant in environments where the scope for monetary incentives is limited and social behavior plays a critical role. The propotypical case of such an environment is a market for credence goods.

We show that the externality creates a rationale for regulatory intervention in credence goods markets. Regulation that raises producer prices above their competitive level can achieve Pareto improvements. Examples are price floors and fixed prices. When market entry of experts is endogenous, price regulation must be accompanied by entry restrictions to seize Pareto gains.

Regarding their practical implications, our results provide a novel perspective on discussions about the dismissal of existing regulations in markets for expert services. While we believe that decisions about such deregulation must be made on a case-by-case basis, accounting for the idiosyncrasies of each market, our results should be considered as an input into these decisions.

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A. Omitted Proofs

This section collects all proofs omitted from the main text.

A.1. Discussion of Assumption (6)

To gain insights about the properties of W, v, and c, under which assumption (6) holds, we rewrite the expert's quality choice as a direct choice of consumer utility. In particular, using

$$u_b = v(a_b) - p_b ,$$

we can write expert utility as (in the bilateral setting of Section 4)

$$\overline{u}_e = W(p_b - \tilde{c}(u_b + p_b)) + u_b .$$

Here, $\tilde{c}(x) \equiv c(v^{-1}(x))$ measures the cost of providing utility-from-treatment (i.e., utility gross of the price) of x to the consumer.

Given a price offer p_b, expert e now chooses u_b to maximize her utility $\overline{u}_e$. The derivative of $\overline{u}_e$ with respect to u_b is

$$-W'(p_b - \tilde{c}(u_b + p_b))\tilde{c}'(u_b + p_b) + 1 .$$

By assumption (4), this derivative is weakly negative at $p_b = \tilde{c}(v(0))$ and $u_b = v(0) - \tilde{c}(v(0))$. For concreteness, suppose now that this assumption indeed holds exactly, that is,

$$W'(0)\tilde{c}'(v(0)) = 1 .$$

Then, since the second derivative of $\overline{u}_e$ with respect to u_b is strictly negative everywhere, the effect of raising p_b on the optimal choice u_b is qualitatively given by the sign of

$$\frac{\partial^2 \overline{u}_e}{\partial u_b \partial p_b} = -W''(p_b - \tilde{c}(u_b + p_b))(1 - \tilde{c}(u_b + p_b))\tilde{c}'(u_b + p_b) - W'(p_b - \tilde{c}(u_b + p_b))\tilde{c}''(u_b + p_b) .$$

At the competitive equilibrium values $p_b = \tilde{c}(v(0))$ and $u_b = v(0) - \tilde{c}(v(0))$, the cross-derivative is positive if and only if

$$-\frac{W''(0)}{W'(0)}(1 - \tilde{c}'(v(0))) > \frac{\tilde{c}''(v(0))}{\tilde{c}(v(0))} .$$

If and only if this is satisfied, assumption (6) holds and the collectively optimal price offer of consumers exceeds the competitive price $\tilde{c}(v(0))$. Hence, for this to be true, the cost function $\tilde{c}$ must have sufficiently small curvature at $v(0)$. Put differently, the marginal cost of providing additional utility-from-treatment to consumers must not increase too quickly around the competitive equilibrium.

A.2. Proof of Lemma 1

Let

$$A(p_b, y_e, a_b) := W'(y_e)\,[p_b - c(a_b)] + v(a_b) - p_b$$

denote the marginal utility for expert e of adding consumer b to her set of clients B_e if she provides quality a_b to b.

Expert e's actual quality choice for consumer b follows from conditions (7) as a function of the expert's income y_e. Denote this quality by $a_b^{IC}(y_e)$. Then, the expert's actual marginal utility from serving consumer b, taking into account her quality choice $a_b^{IC}(y_e)$, becomes

$$A^{IC}(p_b, y_e) := A(p_b, y_e, a_b^{IC}(y_e))\,.$$

Expert e will accept an offer p_b if and only if $A^{IC}(p_b, y_e) \geq 0$. Hence, the equality $A^{IC} = 0$ defines the acceptance threshold described by Lemma 1.

Before deriving the claimed properties of the threshold, note that

$$A^{IC}(p_b, y_e) = \max_{a \geq 0} A(p_b, y_e, a) \tag{18}$$

by definition of $a_b^{IC}(y_e)$. In words, the expert chooses the service quality for b such as to maximize her utility from serving b.

Case 1: $y_e \leq 0$**.** By assumption (4), we have $a_b^{IC}(y_e) = 0$ for all $y_e \leq 0$. Hence, $A^{IC}(c(0), y_e) = 0$ for all $y_e \leq 0$. That is, if the expert has negative income, she just accepts an offer at $c(0)$. Since A^{IC} is strictly increasing in p_b, we have that for all $y_e \leq 0$, $A^{IC}(p_b, y_e) \geq 0$ if and only if $p_b \geq c(0)$. This proves the first piece of the acceptance threshold in Lemma 1.

Case 2: $y_e > 0$**.** As in Lemma 1, denote the acceptance threshold for $y_e > 0$ by $\tilde{p}(y_e)$, that is, $A^{IC}(\tilde{p}(y_e), y_e) = 0$.

First note that $A(c(0), y_e, 0) = 0$ for all y_e. Hence, $A^{IC}(c(0), y_e) \geq 0$ for all y_e. Therefore, the acceptance threshold satisfies $\tilde{p}(y_e) \leq c(0)$ for all y_e.

It remains to show that $\tilde{p}(y_e)$ is decreasing in y_e. For that, consider $y_e^{(2)} > y_e^{(1)} > 0$. From the definition of A we see that A is increasing in y_e if $p_b \leq c(0)$. Since $\tilde{p}(y_e^{(1)}) \leq c(0)$, we obtain the following inequalities:

$$\begin{aligned}
A^{IC}\left(\tilde{p}\left(y_e^{(2)}\right), y_e^{(2)}\right) &= 0 \\
&= A\left(\tilde{p}\left(y_e^{(1)}\right), y_e^{(1)}, a_b^{IC}\left(y_e^{(1)}\right)\right) \\
&\leq A\left(\tilde{p}\left(y_e^{(1)}\right), y_e^{(2)}, a_b^{IC}\left(y_e^{(1)}\right)\right) \\
&\overset{\text{by (18)}}{\leq} A\left(\tilde{p}\left(y_e^{(1)}\right), y_e^{(2)}, a_b^{IC}\left(y_e^{(2)}\right)\right) \\
&= A^{IC}\left(\tilde{p}\left(y_e^{(1)}\right), y_e^{(2)}\right)\,.
\end{aligned}$$

Using that A^{IC} is always increasing in p_b, the inequality between the first and the last expression implies $\tilde{p}(y_e^{(2)}) \leq \tilde{p}(y_e^{(1)})$.

A.3. Proof of Proposition 1

We prove Proposition 1 via the following lemma.

Lemma 4. *Consider the game described by stages 1 and 2. In any subgame perfect equilibrium all offers are symmetric, $p_b = p_{b'}$ for all $b, b' \in B$, all offers are accepted, and all quality levels are symmetric, $a_b = a_{b'}$ for all $b, b' \in B$.*

Proof. **Step 1.** The thresholds in Lemma 1 imply that an offer $p_b = c(0)$ is always accepted. Since $v(0) - c(0) \geq \underline{v}$ and agents always opt against their outside option in case of indifference, consumers always prefer to make the offer $c(0)$ over any offer that is not accepted. Hence, offers that are not accepted are strictly dominated and cannot be part of a subgame perfect equilibrium.

Step 2. Consider now all consumers $b \in B_e$ for a given expert e. By the Kuhn-Tucker conditions (7), these consumers all receive the same quality level. Moreover, they face the same acceptance threshold. Since all consumers take expert e's income as given, they anticipate the quality they receive to be independent of their offers. Hence, they offer exactly the acceptance threshold, which is the same across all consumers.

Step 3. By Step 2, any expert e receives the same offers from all consumers matched to her. Suppose now that these offers are strictly higher for some expert e than for another expert e'. Denote the offer level for e by p and for e' by p'. By Step 1, all offers are accepted. So, experts' revenue equals their offer level,

$$\int_{B_e} p_b \, db = p > \int_{B_{e'}} p_b \, db = p' .$$

Using this in the Kuhn-Tucker conditions (7), it is easy to show that expert e will also have greater income than expert e', $y_e \geq y_{e'}$. But then, by Lemma 1, the acceptance threshold of expert e is smaller than that of expert e'. Hence, consumers matched to e offer lower payments than consumers matched to e'. This contradicts the initial assumption of $p > p'$.

We have therefore established that all consumers offer the same payments and all offers are accepted in any subgame perfect equilibrium. The Kuhn-Tucker conditions (7) then immediately imply that quality levels are the same for all consumers in any subgame perfect equilibrium as well. □

Proposition 1 is now proven as follows. By Lemma 4, there is a common offer level $p = p_b$ for all $b \in B$. By Lemma 1, offers $p_b = c(0)$ are always accepted. Moreover, consumers always offer payments exactly equal to the expert's acceptance threshold. So, the common offer level p can be at most $c(0)$.

Suppose that $p < c(0)$. Then, any expert e has negative income, $y_e \leq 0$. But for $y_e \leq 0$, Lemma 1 says that offers below $c(0)$ are rejected. Hence, we must have $p = c(0)$ in any subgame perfect equilibrium. The Kuhn-Tucker conditions (7) then imply $a_b = 0$ for all $b \in B$ in any subgame perfect equilibrium.

A.4. Proof of Proposition 3

The only part of the proposition that remains to be shown is that an allocation is fully efficient if and only if $a_b = a^{**}$ for almost all $b \in B$.

(⇒) We first prove the "only if" part of the claim. To show that no allocation other than those described above is fully efficient, take an arbitrary allocation q, $\{p_b^q\}_{b\in B}$, $\{B_e\}_{e\in E}$, $\{a_b^q\}_{b\in B}$, with $a_b^q \neq a^{**}$ for some non-zero measure of consumers. Construct a new allocation r with $a_b^r = a^{**}$ for all $b \in B$, $B_e^r = B_e^q$ for all $e \in E$, and

$$p_b^r = p_b^q + v(a_b^r) - v(a_b^q) \; .$$

Comparing r to q, the utility of consumers is unchanged by construction of r. For an expert e the utility change is $W(y_e^r) - W(y_e^q)$. Its sign depends on the difference in incomes $y_e^r - y_e^q$. Using the construction of payments p_b^r in allocation r, this income difference becomes

$$y_e^r - y_e^q = \int_{B_e^q} \left[v(a_b^r) - c(a_b^r) - v(a_b^q) + c(a_b^q) \right] \, db \; .$$

Since a^{**} uniquely maximizes $v(a) - c(a)$, the income difference is positive, $y_e^r - y_e^q > 0$. Hence, experts strictly prefer allocation r to q. Since consumers are indifferent between the two, allocation r Pareto-dominates q. Allocation q can therefore not be fully efficient.

(⇐) To see that any allocation with $a_b = a^{**}$ for almost all b is fully efficient, suppose such an allocation (call it s) is Pareto-dominated by some other allocation (call it t). If t has $a_b \neq a^{**}$ for a non-zero measure of consumers, part (⇒) above implies that there exists an allocation t' with $a_b^{t'} = a^{**}$ almost everywhere that Pareto-dominates t. By transitivity, t' will then also Pareto-dominate s. Hence, we can focus on allocations t that feature $a_b^t = a^{**}$ for almost all b.

Allocations s and t then only differ in the distribution of payments over experts and consumers. Since this distribution is zero-sum, none of the allocations can Pareto-dominate the other. We have thereby established that any allocation with $a_b = a^{**}$ almost everywhere is fully efficient.

A.5. Proof of Lemma 2

Given a non-empty set of active experts E, the subgame described by stages 2′ and 3′ is very similar to the game with exogenous entry described by stages 1 and 2 in Section 5. The main difference is that expert e's marginal cost of serving an additional consumer b is $c(a_b) + k'(|B_e|)$ instead of $c(a_b)$ only. The proof of the acceptance threshold in Lemma 2 therefore proceeds in close analogy to the proof of the acceptance threshold from the exogenous entry setting in Lemma 1.

Let

$$\hat{A}(p_b, B_e, \hat{y}_e, a_b) := W'(\hat{y}_e) \left[p_b - c(a_b) - k'(|B_e|) \right] + v(a_b) - p_b - v(0) + k'(|B_e|)$$

denote expert e's marginal utility from adding consumer b to her set of clients B_e if she provides quality a_b to the consumer.

Expert e's actual quality choice follows from the Kuhn-Tucker conditions (7) as a function of $\hat{y}_e$. Denote this quality by $\hat{a}_b^{IC}(\hat{y}_e)$. Then, the expert's actual marginal utility from accepting the offer p_b, taking into account her quality choice $\hat{a}_b^{IC}(\hat{y}_e)$, becomes

$$\hat{A}^{IC}(p_b, B_e, \hat{y}_e) := \hat{A}(p_b, B_e, \hat{y}_e, \hat{a}_b^{IC}(\hat{y}_e)) .$$

Expert e will accept p_b if and only if $\hat{A}^{IC}(p_b, B_e, \hat{y}_e) \geq 0$. The equality $\hat{A}^{IC} = 0$ therefore defines the acceptance threshold from Lemma 2.

Note at this point that

$$\hat{A}^{IC}(p_b, B_e, \hat{y}_e) = \max_{a \geq 0} A(p_b, B_e, \hat{y}_e, a) \tag{19}$$

by definition of $\hat{a}_b^{IC}(\hat{y}_e)$.

Case 1: $\hat{y}_e \leq 0$. Assumption (4) implies $\hat{a}_b^{IC}(\hat{y}_e) = 0$ for all $\hat{y}_e \leq 0$. So, $\hat{A}^{IC}(k'(|B_e|), \hat{y}_e) = 0$ for all $\hat{y}_e \leq 0$. That is, at negative income the expert just accepts an offer at marginal cost $k'(|B_e|)$. Since $\hat{A}^{IC}$ is strictly increasing in p_b, it holds for all $\hat{y}_e \leq 0$ that $\hat{A}^{IC}(p_b, B_e, \hat{y}_e) \geq 0$ if and only if $p_b \geq k'(|B_e|)$. We have thus proven the first piece of the acceptance threshold in Lemma 2.

Case 2: $\hat{y}_e > 0$. Denote the acceptance threshold for $\hat{y}_e > 0$ by $\hat{p}(\hat{y}_e, B_e)$, that is, $\hat{A}^{IC}(\hat{p}(\hat{y}_e, B_e), B_e, \hat{y}_e) = 0$.

Note that $\hat{A}(k'(|B_e|), B_e, \hat{y}_e, 0) = 0$ for all $\hat{y}_e$ and B_e. Thus, $\hat{A}^{IC}(k'(|B_e|), B_e, \hat{y}_e) \geq 0$ for all $\hat{y}_e$ and B_e. Hence, we have $\hat{p}(\hat{y}_e, B_e) \leq k'(|B_e|)$ for all $\hat{y}_e$ and B_e.

It remains to prove that $\hat{p}(\hat{y}_e, B_e)$ is decreasing in $\hat{y}_e$. Take any B_e and any two income levels $\hat{y}_e^{(2)} > \hat{y}_e^{(1)} > 0$. From the definition of $\hat{A}$, it is clear that $\hat{A}$ increases in $\hat{y}_e$ if $p_b \leq k'(|B_e|)$. Since $\hat{p}(\hat{y}_e^{(1)}, B_e) \leq k'(|B_e|)$, the following applies:

$$\begin{aligned}
\hat{A}^{IC}\left(\hat{p}\left(\hat{y}_e^{(2)}, B_e\right), B_e, \hat{y}_e^{(2)}\right) &= 0 \\
&= A\left(\hat{p}\left(\hat{y}_e^{(1)}, B_e\right), B_e, y_e^{(1)}, \hat{a}_b^{IC}\left(\hat{y}_e^{(1)}\right)\right) \\
&\leq \hat{A}\left(\hat{p}\left(\hat{y}_e^{(1)}, B_e\right), B_e, \hat{y}_e^{(2)}, \hat{a}_b^{IC}\left(\hat{y}_e^{(1)}\right)\right) \\
&\overset{\text{by (19)}}{\leq} \hat{A}\left(\hat{p}\left(\hat{y}_e^{(1)}, B_e\right), B_e, \hat{y}_e^{(2)}, \hat{a}_b^{IC}\left(\hat{y}_e^{(2)}\right)\right) \\
&= \hat{A}^{IC}\left(\hat{p}\left(\hat{y}_e^{(1)}, B_e\right), B_e, \hat{y}_e^{(2)}\right) .
\end{aligned}$$

Since $\hat{A}^{IC}$ always increases in p_b, the inequality between the first and the last expression implies $\hat{p}(\hat{y}_e^{(2)}, B_e) \leq \hat{p}(\hat{y}_e^{(1)}, B_e)$.

A.6. Proof of Lemma 3

To prepare the proofs of Lemma 3 and Proposition 4, we prove the following lemma.

Lemma 5. *Take any non-empty set of active experts E and consider the subgame after E described by stages 2′ and 3′. In any subgame perfect equilibrium of this subgame all offers are symmetric, $p_b = p_{b'}$ for all $b, b' \in B$, all offers are accepted, and all quality levels are symmetric, $a_b = a_{b'}$ for all $b, b' \in B$.*

Proof. Take a non-empty set of active experts E and consider the subgame after E described by stages 2′ and 3′. This subgame is almost equivalent to the game with exogenous entry described by stages 1 and 2 in Section 5. Hence, the proof of Lemma 5 closely follows the proof of Lemma 4.

Step 1. The maximum size of B_e for any expert e is M. Hence, Lemma 2 implies that experts always accept an offer $p_b \geq k'(M)$. Since $v(0) - k'(M) \geq \underline{v}$ and agents always decide against their outside option in case of indifference, any consumer b prefers the offer $p_b = k'(M)$ over any offer that is not accepted. So, consumers only make offers that are accepted in equilibrium.

Step 2. This step is identical to step 2 in the proof of Lemma 4. We repeat it here for convenience. Consider all consumers $b \in B_e$ for a given expert e. By the Kuhn-Tucker conditions (7) (using $\hat{y}_e$ instead of y_e in the conditions), these consumers all receive the same quality level. Moreover, they face the same acceptance threshold. Since all consumers take expert e's income as given, they anticipate the quality they receive to be independent of their offers. Hence, they offer exactly the acceptance threshold, which is the same across all consumers.

Step 3. By Step 2, any expert e receives the same offers from all consumers matched to her. To derive a contradiction, suppose that these offers are strictly higher for some expert e than for another expert e'. Denote the offer level for e by p and for e' by p'. By Step 1, all offers are accepted. So, the revenues of e and e' are given by

$$\int_{B_e} p_b \, db = \frac{M}{N} p > \frac{M}{N} p' = \int_{B_{e'}} p_b \, db \,.$$

Using this together with the fact that $|B_e| = |B_{e'}|$, the Kuhn-Tucker conditions (7) imply that expert e will have a greater income than e', $\hat{y}_e \geq \hat{y}_{e'}$. Then, again because $|B_e| = |B_{e'}|$, Lemma 2 implies that the acceptance threshold of expert e is smaller than that of e'. So, consumers matched to e make smaller offers than those matched to e', contradicting the initial assumption $p > p'$.

We have therefore established that all consumers offer the same payments and all offers are accepted in any subgame perfect equilibrium. The Kuhn-Tucker conditions (7) then immediately imply that quality levels are the same for all consumers in any subgame perfect equilibrium as well. □

We prove now each of the three cases of Lemma 3. Since by Lemma 5 all offers are accepted, we can set $|B_e| = M/N$ for all active experts $e \in E$ throughout the proof.

1. We first show that $\hat{y}_e > 0$ for all $e \in E$. To derive a contradiction, suppose that $\hat{y}_e \leq 0$ for some $e \in E$. Using Lemma 2, this implies that all consumers $b \in B_e$ offer $p_b = k'(M/N)$. Moreover, the Kuhn-Tucker conditions (7) imply that $a_b = 0$ for all $b \in B_e$. But then we obtain for expert e's income:

$$\hat{y}_e = \frac{M}{N} k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F > 0 \,,$$

a contradiction.

So, $\hat{y}_e > 0$ for all $e \in E$. From Lemma 2 we then obtain $p_b \leq k'(M/N)$ for all $b \in B$.

For experts' utility, note that $a_b \geq 0$ and $p_b \leq k'(M/N)$ for all b imply

$$v(a_b) - p_b - v(0) + k'\left(\frac{M}{N}\right) > 0\,.$$

Hence, using $\hat{y}_e > 0$,

$$W(\hat{y}_E) + \int_{B_e} \left[v(a_b) - p_b - v(0) + k'\left(\frac{M}{N}\right)\right]\,db > W(0)$$

for all $e \in E$.

2. We show that $\hat{y}_e = 0$ for all $e \in E$. To derive a contradiction, suppose first that $\hat{y}_e > 0$ for some $e \in E$. But then $p_b \leq k'(M/N)$ for all $b \in B_e$ by Lemma 2. Together with $a_b \geq 0$ for all b, this implies

$$\hat{y}_e \leq \frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F = 0\,,$$

a contradiction. Suppose now that $\hat{y}_e < 0$ for some $e \in E$. Then, $p_b = k'(M/N)$ for all $b \in B$ by Lemma 2. Moreover, expert e's quality choice yields $a_b = 0$ for all $b \in B_e$ by conditions (7). Hence we obtain for expert e's income:

$$\hat{y}_e = \frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F = 0\,,$$

a contradiction.

So, $\hat{y}_e = 0$ for all $e \in E$. Using Lemma 2, we obtain $p_b = k'(M/N)$ for all $b \in B$.

Moreover, $\hat{y}_e = 0$ for all $e \in E$ implies $a_b = 0$ for all $b \in B$. So,

$$v(a_b) - p_b - v(0) + k'(M/N) = 0$$

for all $b \in B$. Experts' utility thus becomes

$$W(0) + \int_{B_e} \left[v(0) - k'\left(\frac{M}{N}\right) - v(0) + k'\left(\frac{M}{N}\right)\right]\,db = W(0)$$

for all $e \in E$.

3. We first show that $\hat{y}_e < 0$ for all $e \in E$. To derive a contradiction, suppose $\hat{y}_e \geq 0$ for some $e \in E$. Then, $p_b \leq k'(M/N)$ for all $b \in B_e$ by Lemma 2. Using $a_b \geq 0$ for all b, we obtain

$$\hat{y}_e \leq \frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F < 0\,,$$

a contradiction.

So, $\hat{y}_e < 0$ for all $e \in E$. With Lemma 2 we then obtain $p_b = k'(M/N)$ for all $b \in B$.

Moreover, $\hat{y}_e < 0$ for all e implies $a_b = 0$ for all b. Experts' utility hence satisfies

$$W(\hat{y}_e) + \int_{B_e} \left[v(0) - k'\left(\frac{M}{N}\right) - v(0) + k'\left(\frac{M}{N}\right)\right]\,db < W(0)$$

for all $e \in E$.

A.7. Proof of Proposition 4

Since all offers are accepted by Lemma 5, we can again set $|B_e| = M/N$ throughout the proof.

From conditions (11) and (12), we have $M/N \to m$ as $M \to \infty$. Moreover,

$$\frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F \to 0\,.$$

We first show that $\hat{y}_e \to 0$ for all $e \in E$ as $M \to \infty$. For that, take any unbounded sequence of consumer masses M. To derive a contradiction, suppose first that there exists a subsequence such that $\hat{y}_e$ is positive and bounded away from zero along this subsequence. Since $p_b \leq k'(M/N)$ for all $b \in B$ by Lemma 2 and because $a_b \geq 0$ for all b, we have

$$\hat{y}_e \leq \frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F\,.$$

But the right-hand-side of the inequality converges to zero along the subsequence. Hence, $\hat{y}_e$ cannot be positive and bounded away from zero.

Suppose now that there is a subsequence of consumer masses along which $\hat{y}_e$ remains negative and bounded away from zero for some $e \in E$. Then by Lemma 2, $p_b = k'(M/N)$ along the subsequence. Moreover, $a_b = 0$ for all $b \in B_e$ along the subsequence by conditions (7). Thus,

$$\hat{y}_e = \frac{M}{N}k'\left(\frac{M}{N}\right) - k\left(\frac{M}{N}\right) - F \to 0\,,$$

a contradiction.

We have therefore established that $\hat{y}_e \to 0$ for all $e \in E$ as $M \to \infty$. From conditions (7), we then immediately obtain $a_b \to 0$ for all $b \in B$.

Finally by Lemma 5, there is a common payment level p and a common quality level a for all consumers. Income of expert e thus becomes

$$\hat{y}_e = \frac{M}{N}p - \frac{M}{N}c(a) - k\left(\frac{M}{N}\right) - F\,,$$

and hence

$$p = \frac{N}{M}\hat{y}_e + c(a) + \frac{N}{M}k\left(\frac{M}{N}\right) + \frac{N}{M}F\,.$$

Since $M/N \to m$, $a \to 0$, and $\hat{y}_e \to 0$, we can use the definition of m to show that the right-hand-side of the equation goes to $k'(m)$ as $M \to \infty$. Therefore, $p_b \to k'(m)$ for all $b \in B$.

A.8. Proof of Proposition 5

Part 1. Consider first the regulation $(\hat{p}^*, \hat{N})$. In the main text we have already shown that the proposed regulation Pareto-dominates the unregulated (or, competitive) outcome for sufficiently large M if the actual number of active experts $\tilde{N}$ equals the cap $\hat{N}$. To see that we will indeed have $\tilde{N} = \hat{N}$, consider the competitive outcome at a given M. From Proposition 4, it is easy to see that experts' utility in the competitive outcome approaches $W(0)$ as $M \to \infty$. Again from Proposition 4, we know that $p_b \to k'(m)$ for all b as $M \to \infty$. Hence, for sufficiently large M the regulated price $\hat{p}^*$ strictly exceeds the competitive price. Holding the number of active exerts constant at $\hat{N}$, an increase in the level of payments strictly increases experts' utility. So for large M and holding the number of experts at $\hat{N}$, experts' utility from the regulated price $\hat{p}^*$ strictly exceeds $W(0)$. But that means that all $\hat{N}$ experts indeed choose to enter the market under the regulation $(\hat{p}^*, \hat{N})$ for sufficiently large M. Hence, the cap of $\hat{N}$ is binding, $\tilde{N} = \hat{N}$.

Part 2. Consider next the pure price regulation $(\hat{p}^*, \infty)$. Denote the number of active experts under this regulation by $\tilde{N}$ and compare it to the regulated number of experts $\hat{N}$ from Part 1. By Part 1, experts' utility under the joint regulation $(\hat{p}^*, \hat{N})$ converges to a level strictly above $W(0)$. Moreover as $M \to \infty$, the impact of an additional entrant on experts' utility approaches zero. Hence, without entry regulation the expert $\hat{N} + 1$ finds it beneficial to enter the market. So, $\tilde{N} > \hat{N}$. Since experts' utility declines in the number of active experts for given prices, experts' utility is strictly smaller under the pure price regulation than under the joint regulation of Part 1.

Moreover, suppose that experts' income $\hat{y}_e$ is greater under the pure price regulation than under the joint regulation. This would imply that service quality is higher under the pure price regulation as well. But with a higher service quality and a larger number of active experts, income must be strictly smaller under the pure price regulation than under joint regulation. Hence, experts' income is indeed strictly smaller under the pure price than under the joint regulation.

Finally, under the joint regulation we have $a_b > 0$ for all consumers. So experts' quality choice problem has an interior solution. In the neighborhood of such an interior solution, quality strictly decreases in income. So, service quality must be strictly smaller under the pure price regulation than under the joint regulation. Since the payments p_b are the same in both cases, we obtain that consumers' utility is strictly smaller under the pure price regulation than under the joint regulation. This establishes that the joint regulation Pareto-dominates the pure price regulation.

B. Price Competition

In this section we present an alternative trading mechanism where experts instead of consumers make price offers. The environment is the same as in the main text, that is, the one introduced in Section 3. The mechanism works as follows.

Stage 1” Each expert $e \in E$ makes price offers $\{p_{e,b}\}_{b \in B}$ to all consumers.

Stage 2” Each consumer $b \in B$ observes his offers $\{p_{e,b}\}_{e \in E}$ but not the offers received by other consumers. Consumer b then accepts or rejects each of his offers. Each consumer can accept at most one offer.

Stage 3” For each expert e, let $B_e \subset B$ denote the set of consumers who accepted e's offers. Expert e observes consumers' acceptance decisions and chooses the service quality a_b for each consumer $b \in B_e$.[26]

For each consumer $b \in \cup_{e \in E} B_e$, set p_b equal to the offer consumer b accepted, that is, $p_b = p_{e,b}$ for e such that $b \in B_e$. Then, each expert receives utility 2. Each consumer $b \in \cup_{e \in E} B_e$ receives utility 1, and all other consumers receive the outside option $\underline{v}$.

Note that in contrast to the consumer-proposing mechanism from the main text, consumers receive offers from all experts instead of being matched to only one expert each. Our results are robust to adding a matching stage where consumers are matched to only a few, but at least two, experts whom they receive offers from. The minimum number of two experts per consumer is necessary to initiate price competition.

The second noteworthy assumption is that consumers do not observe the offers received by other consumers. This seems appropriate in the context of service provision, where sellers interact directly, and often privately, with each buyer to deliver the service. The assumption is not relevant for our first result on the existence of an equilibrium that replicates the outcome of the consumer-proposing mechanism from the main text. The structure of other equilibria however may change when making a different informational assumption.

B.1. Competitive Outcome

Stages 1″ to 3″ describe a sequential game of (complete, but) imperfect information. We study its perfect Bayesian equilibria (PBE) in the following. We start by constructing a PBE that replicates the competitive outcome of the consumer-proposing mechanism from Proposition 1.

Proposition 6. *Consider the game described by stages 1″ to 3″. There exists a PBE in which all consumers accept offers at marginal cost, $p_b = c(0)$ for all $b \in B$, and receive a service of zero quality, $a_b = 0$ for all $b \in B$.*

Proof. We construct a PBE with the desired properties. The PBE consists of the following elements.

[26] Whether experts observe only the acceptance decisions on their own offers or on all experts' offers does not matter for our results. For concreteness we assume here that experts observe all acceptance decisions of all consumers.

- Expert strategies (for all $e \in E$): for any set B_e, expert e's quality choices on stage 3″ are determined by the Kuhn-Tucker conditions (7). Moreover, expert e's price offers on stage 1 are $p_{e,b} = c(0)$ for all $b \in B$.

- Consumer strategies (for all $b \in B$): for any set of offers $\{p_{e,b}\}_{e \in E}$, consumer b accepts the smallest offer if

$$\min_{e \in E} p_{e,b} \leq v(0) - \underline{v} \,. \tag{20}$$

  Otherwise, b rejects all offers. If there are multiple smallest offers satisfying equation (20), b chooses one of them randomly (the exact distribution of the randomization does not matter).

- Expert beliefs: experts' beliefs about the history at any of their information sets is consistent with their observations. Since they observe all events, this uniquely identifies experts' beliefs.

- Consumer beliefs: at any of his information sets, any consumer $b \in B$ believes that all experts $e \in E$ offered $p_{e,b'} = c(0)$ to all other consumers $b' \in B \setminus \{b\}$.

Note first that the proposed beliefs are consistent with equilibrium strategies.

Second, strategies strategies are sequentially rational. To see this, start with experts' quality choices given B_e. Since experts' problem of choosing quality levels to maximize utility is (strictly differentially) concave, the Kuhn-Tucker conditions (7) identify the unique solution to this problem. Moreover, given that consumers always accept the lowest price if it does not exceed the threshold $v(0) - \underline{v}$ and given that all other experts make offers at $c(0)$, there is no profitable deviation from the proposed equilibrium offers. Hence, offers $p_{e,b} = c(0)$ for all $b \in B$ are rational for all experts $e \in E$.

Turning to consumers, note that any consumer b's belief together with other consumers' equilibrium strategies implies $y_e = 0$ for all experts $e \in E$ and at any information set of b. Hence, consumers believe to receive zero quality at all of their information sets. So, choosing any of the lowest offers if they are below $v(0) - \underline{v}$ and rejecting all offers otherwise is rational for consumers given their belief. □

The intuition behind Proposition 6 is standard. Consumers accept the lowest prices and experts undercut each other's prices until they hit marginal cost.

In contrast to standard price competition à la Bertrand, however, equilibria with other outcomes exist. Such equilibria are of two types. In the first type, consumers coordinate to buy only from certain sellers but not from others. Suppose for example that all consumers accept the offer of expert 1 as long as it does not exceed a certain threshold level. Expert 1 will then offer the threshold price and all other experts' offers become irrelevant. Consumers may act rationally in this situation because all experts except for expert 1 have zero income and would therefore provide low quality services.

In the second type of equilibrium, consumers coordinate to buy only from those experts who offer a specific price. As soon as some expert deviates from this offer, consumers believe her profits to be zero, because they believe that no other consumer buys from this expert anymore. So, consumers believe that such a deviating expert provides zero quality and may thus indeed shun her rationally.

Both types of equilibria require a high degree of coordination between consumers. For the first type, consumers must believe all other consumers to accept offers only from a certain, arbitrary set of experts. For the second type, they must believe all other consumers to accept only offers at a certain, arbitrary price. We consider such coordination among consumers implausible as a description of many real-world credence goods markets.

To make this reasoning precise, we propose two criteria for equilibrium selection tailored to our environment.The criteria restrict consumers' ability to coordinate. Both of them leave only those equilibria that lead to the competitive outcome described in Proposition 6.

B.2. Equilibrium Selection by Insufficient Reason

Any consumer's decision problem is affected by other consumers' actions exclusively via experts' income levels. Beliefs about experts' incomes are hence crucial for sustaining coordination among consumers. In particular, the types of coordination described above require consumers to entertain different beliefs about different experts' incomes at some of their information sets. To curb such coordination we therefore require consumers' strategies to be optimal even under a belief that treats all experts' incomes identically.

A belief that treats all experts' incomes identically is reminiscent of the Principle of Insufficient Reason. Facing a set of events and no particular reason to believe that one of them is more likely than the others, the Principle of Insufficient Reason advises to assign equal probability to all events. Here, from the perspective of a given consumer, differences in experts' incomes can only stem from other consumers' strategies. Since many such strategies are compatible with PBE, a given consumer has little reason to perceive one set of other consumers' strategies as more likely than another. Hence, according to the Principle of Insufficient Reason, he entertains a belief that does not discriminate between experts.[27]

Definition 1. A PBE is robust to insufficient reason if and only if consumer strategies satisfy the following. Take any set of offers $\{p_{e,b}\}_{e\in E}$ for any consumer b. Let $\infty_{(e,b)}$ be an indicator function equal to one if b accepts $p_{e,b}$ and zero otherwise, and let $a^{IC}(y_e)$ denote the solution to the Kuhn-Tucker conditions (7) given y_e. Then, consumer b's acceptance decision following the offers $\{p_{e,b}\}_{e\in E}$ must maximize

$$\int_{\mathbb{R}^N}\left[\sum_{e\in E}\infty_{(e,b)}\left(v(a^{IC}(y_e))-p_{e,b}\right)\right]\pi(y_1,y_2,...,y_N)\,d(y_1,y_2,...,y_N)+\left(1-\sum_{e\in E}\infty_{(e,b)}\right)\underline{v} \quad (21)$$

for some probability density function ϕ such that the marginal distributions of the y_e are identical for all e, that is,

$$\tilde{\pi}_e=\tilde{\pi}_{e'} \quad \text{for all } e,e'\in E\,,$$

[27]The Principle of Insufficient Reason is known to fail as a positive theory of choice under uncertainty when individuals face a decision between a risky (with known probabilities) and an uncertain option (with unknown probabilities). See the Ellsberg Paradox (Ellsberg, 1961). Here, there is no way for consumers to escape the uncertainty about other consumers' choices (and hence experts' incomes). So, the critique based on the Ellsberg Paradox does not apply.

where $\tilde{\pi} : y_e \mapsto \mathbb{R}_+$,

$$\tilde{\pi}_e(y_e) := \int_{\mathbb{R}^{N-1}} \pi(y_1, y_2, ..., y_N) \, d(y_1, ..., y_{e-1}, y_{e+1}, ..., y_N) \, ,$$

is the marginal density for y_e.

Robustness to insufficient reason rules out all PBE with consumer strategies that are optimal only under beliefs that discriminate between experts. Since consumer coordination as described above requires such discriminatory beliefs, the robustness criterion excludes all PBE that rely on consumer coordination.

It turns out that only those PBE survive the selection that lead to the competitive outcome of Proposition 6.

Proposition 7. *Consider the game described by stages 1″ to 3″. In any PBE that is robust to insufficient reason (see Definition 1), all consumers accept offers at marginal cost, $p_b = c(0)$ for all $b \in B$, and receive services of zero quality, $a_b = 0$ for all $b \in B$.*

Proof. **Step 1.** Robustness to insufficient reason imposes a clear structure on consumer strategies. In particular, since the marginal distributions of experts' incomes are identical under π, maximizing (21) is equivalent to choosing the least price offer if

$$\min_{e \in E} p_{e,b} \leq \int_{\mathbb{R}} v(a^{IC}(y_e)) \tilde{\pi}(y_e) \, dy_e - \underline{v}$$

and rejecting all offers otherwise. Since $a^{IC} \geq 0$,

$$\int_{\mathbb{R}} v(a^{IC}(y_e)) \tilde{\pi}(y_e) \, dy_e \geq v(0) \, .$$

So, if the minimal offer is unique and equal to $c(0)$, it is accepted with certainty.

Step 2. Given the consumer strategies from step 1 the standard logic of Bertrand competition implies that we can never have a situation where consumers accept offers strictly greater than $c(0)$. Moreover, suppose some consumer b accepts no offer. Then, some expert e could offer $p_{e,b} = c(0)$ and consumer b would accept. Both e and b would decide for this deviation, because we assumed that all agents decide against their outside option in case of indifference. So, the only PBE that are robust to insufficient reason have all consumers accept offers at marginal cost $c(0)$.

Step 3. Finally by step 2, we have $y_e = 0$ for all $e \in E$ while all consumers accept some offer. The Kuhn-Tucker conditions (7) then imply $a_b = 0$ for all $b \in B$. This must again hold in any PBE that is robust to insufficient reason. □

B.3. Equilibrium Selection by Ambiguity Aversion

A critique of robustness to insufficient reason is that consumer strategies must be optimal only under a specific belief π. If consumers cannot coordinate and there are many different equilibrium strategies for consumers, where should such a specific belief come from?

Our second criterion allows consumers to entertain many beliefs and perceive experts' incomes as ambiguous, or uncertain in the Knightian sense. If we additionally assume that consumers are ambiguity averse in the sense of Gilboa and Schmeidler (1989), we obtain the following robustness criterion.

Definition 2. A PBE is robust to strategic ambiguity if and only if consumer strategies satisfy the following. Take any set of offers $\{p_{e,b}\}_{e\in E}$ for any consumer b. Let $\infty_{(e,b)}$ be an indicator function equal to one if b accepts $p_{e,b}$ and zero otherwise, and let $a^{IC}(y_e)$ denote the solution to the Kuhn-Tucker conditions (7) given y_e. Then, consumer b's acceptance decision following the offers $\{p_{e,b}\}_{e\in E}$ must maximize

$$\min_{(y_1,y_2,\dots,y_N)\in\mathbb{R}^N} \sum_{e\in E} \infty_{(e,b)} \left(v(a^{IC}(y_e)) - p_{e,b} \right) + \left(1 - \sum_{e\in E} \infty_{(e,b)} \right) \underline{v} \,. \tag{22}$$

In a PBE that is robust to strategic ambiguity, consumer strategies are supported by two considerations. First, as is usual in a PBE, consumers can anticipate other agents' strategies, form beliefs about unobserved events accordingly, and choose their strategies as a best response to the anticipated behavior of others. Second, consumers may perceive the behavior of others as ambiguous and choose the strategies that optimize the worst-case outcome.[28]

The only PBE that are robust to strategic ambiguity are those leading to the competitive outcome of Proposition 6.

Proposition 8. *Consider the game described by stages 1″ to 3″. In any PBE that is robust to strategic ambiguity (see Definition 2), all consumers accept offers at marginal cost, $p_b = c(0)$ for all $b \in B$, and receive services of zero quality, $a_b = 0$ for all $b \in B$.*

Proof. In analogy to the proof of Proposition 7, robustness to strategic ambiguity has clear implications for consumer strategies. In particular, the worst-case outcome for consumers for any acceptance decision they make is when $y_e \le 0$ for all $e \in E$. So, maximizing (22) is equivalent to maximizing

$$\sum_{e\in E} \infty_{(e,b)} \left(v(0) - p_{e,b} \right) + \left(1 - \sum_{e\in E} \infty_{(e,b)} \right) \underline{v} \,.$$

This expression is maximized by accepting the least price offer if

$$\min_{e\in E} p_{e,b} \le v(0) - \underline{v}$$

and rejecting all offers otherwise. This is essentially the same result as obtained from step 1 in the proof of Proposition 7. The remainder of the proof is then analogous to steps 2 and 3 of the proof of Proposition 7. □

B.4. Special Case: Two Experts

As a final remark, for $N = 2$ experts the selection criteria can be relaxed substantially. In particular, with two experts it is sufficient to restrict the off-equilibrium part of consumers'

[28]Moreover, the combination of the usual PBE requirements with robustness to strategic ambiguity allows consumers to engage in considerations of the following type in equilibrium. Any given consumer anticipates that all other consumers perceive others' behavior as ambiguous and optimize their worst-case outcomes. The given consumer then chooses his strategy as a best response to this anticipated behavior of others.

strategies. For expositional reasons we focus on robustness to strategic ambiguity here.

Definition 3. A PBE is weakly robust to strategic ambiguity if and only if any consumer b's actions following any off-equilibrium set of offers $\{p_{e,b}\}_{e \in E}$ satisfy the requirements of robustness to strategic ambiguity described in Definition 2.

The reduction to off-equilibrium actions is substantial. The weakened criterion allows consumers to believe in coordination on any arbitrary set of strategies. Only once they observe an event that is incompatible with the strategies they believed in, consumers revert to ambiguity-averse behavior without committing to any specific new belief about other agents' actions.

For two experts, the weak robustness criterion is sufficient to exclude all outcomes except for the competitive one.

Proposition 9. *Consider the game described by stages 1″ to 3″ and suppose that $N = 2$. Then in any PBE that is weakly robust to strategic ambiguity (see Definition 2) and has experts play pure strategies, all consumers accept offers at marginal cost, $p_b = c(0)$ for all $b \in B$, and receive services of zero quality, $a_b = 0$ for all $b \in B$.*

Proof. Note first that all consumers under all circumstances prefer to accept an offer smaller or equal to $v(0) - \underline{v}$ to rejecting all offers.

Suppose now that in some PBE as described in the proposition, some consumer b accepts no offer. Then in such a PBE, all offers for consumer b must be strictly above $v(0) - \underline{v}$. But then, expert 1 could deviate to offer $p_{1,b} = v(0) - \underline{v}$. This deviation makes consumer b optimize his worst-case outcome according to weak robustness to strategic ambiguity. Thus, b accepts the least price offer if it does not strictly exceed $v(0) - \underline{v}$. Hence, b accepts $p_{1,b}$. But since $p_{1,b} = v(0) - \underline{v} \geq c(0)$, expert 1 is better off through her initial deviation. So there cannot be a PBE as described in the proposition where some consumer rejects all offers.

Next suppose that in some PBE as described in the proposition, some consumer b accepts an offer $p_{2,b} > c(0)$. Then, expert 1 can deviate to some offer $p_{1,b}$ such that $p_{1,b} < p_{2,b}$ and $p_{1,b} \in [c(0), v(0) - \underline{v}]$. The deviation again makes b optimize his worst-case outcome, so b accepts $p_{1,b}$. This makes expert 1 better off, so the deviation is profitable for expert 1. Thus, there cannot be a PBE as described in the proposition where some consumer accepts an offer above marginal cost.

Hence we have shown that in any PBE as described in the proposition, all consumers accept offers at marginal cost $c(0)$. This immediately implies $y_e = 0$ for all experts and, by conditions (7), $a_b = 0$ for all consumers. □

C. Empirical analysis

Our theoretical model builds on the assumption that prosocial behavior increases in income. Complementing the discussion from Section 8, this section provides further empirical evidence that supports the plausibility of this assumption. In particular, we use data from the German Socio-Economic Panel to demonstrate that income has a causal positive effect on the extensive and on the intensive margin of financial donations, which we use as an indicator of prosocial behavior. As far as we know, we are the first to unveil a causal effect of income on prosocial behavior from survey data.

C.1. Data and empirical strategy

Our empirical analysis is based on data from the German Socio-Economic Panel (SOEP). The SOEP provides nationally representative longitudinal data on several thousand private individuals and households in Germany, including their economic and social circumstances, behavior, attitudes, and subjective well-being.[29] There are two types of questions: basic questions that are raised in each wave of the survey (e.g., on the individuals' current occupation and income), and specialized questions that are raised every few years. In 2010 and 2015, individuals were asked two questions on their financial donations:

1. Did you donate money last year, not counting membership fees?
2. How high was the total amount of money that you donated last year?

Following the literature (see Section 8 for a discussion), we argue that financial donations indicate prosocial behavior. Thus, to support the plausibility of our key theoretical assumption, we demonstrate that income has a causal positive effect on individual financial donations.

A major challenge in the analysis is that a naive regression of financial donations on income is unlikely to yield a causal effect. As argued in Section 8, correlational studies typically document a positive relationship, but self-selection and reverse causality could lead to over- or underestimation of the effect. For instance, low-earning individuals could be more social per se; similarly, individuals who exhibit a strong prosocial attitude might self-select into occupations that are poorly paid. Both scenarios would entail downward biased coefficients.

To eliminate endogeneity in income, we proceed in two steps. First, we exploit the panel structure of our data to erase individual fixed effects from the regression. In other words, we consider each individual's *change* in income and financial donations between 2010 and 2015 and estimate equation (16) from Section 8

$$\Delta fdon_i = \beta_0 + \beta_1 \Delta netinc_i + \beta_2 \Delta \mathbf{X_i} + \varepsilon_i, \tag{23}$$

where $\Delta fdon_i$ corresponds to individual i's change in financial donations on the extensive (denoted by $\Delta ddonate_i$) or on the intensive margin (denoted by $\Delta donation_i$). Note that $\Delta ddonate_i \in \{-1, 0, 1\}$, while $\Delta donation_i$ can take on all values. Furthermore, $\Delta netinc_i$ refers to i's change

[29] See https://www.diw.de/en/diw_01.c.600489.en/about.html. Viewed: April 2020.

in net income; for retirees, $\Delta netinc_i$ is i's change in retirement pay.[30] We also consider a broad range of control variables $\Delta \mathbf{X_i}$, including i's change in bonus payments (Christmas, vacation, and annual bonus), employment circumstances (weekly working hours, side job, activity status, tenure, temporal employment), marital and health status, and life satisfaction.[31] The parameter of interest is β_1: it measures the marginal effect of an absolute change in $\Delta netinc_i$ on $\Delta fdon_i$. Following our theory, we expect that an increase in $\Delta netinc_i$ has a positive effect on $\Delta fdon_i$, i.e., $\hat{\beta}_1 > 0$.

Although equation (16) controls for many confounding factors, omitted variables may affect i's change in financial donations and her change in net income at the same time. For instance, if i became more selfish over time, she might self-select into an occupation that yields higher earnings and simultaneously decrease her monetary donations, leading to downward biased coefficients. Thus, as a second step, we use the *change in the average net income within occupation groups* between 2010 and 2015, denoted by $\Delta avinc_i$, to instrument for $\Delta netinc_i$. We argue that $\Delta avinc_i$ meets the requirements of a valid instrument: it is strongly correlated with $\Delta netinc_i$, but otherwise exogenous to any of i's decisions. In particular, the change in the average net income within her occupation group does not affect an individual's financial donations except through $\Delta netinc_i$.

The instrument $\Delta avinc_i$ is computed directly from the SOEP data. Based on the International Standard Classification of Occupations 88 (ISCO-88), the SOEP classifies individuals' occupations into one out of ten groups.[32] We augment this classification with an eleventh group for retirees; see Table 2 for an overview.[33] Then, we compute the change in average net income between 2010 and 2015 for each occupation group and set up the first stage equation (17) from Section 8

$$\Delta netinc_i = \pi_0 + \pi_1 \Delta avinc_i + \pi_2 \Delta \mathbf{X_i} + u_i. \tag{24}$$

Equation (17) initiates a causal chain: exogenous variation in $\Delta avinc_i$ generates exogenous variation in $\Delta netinc_i$, which is isolated by the first stage. Using this variation, we can consistently estimate $\hat{\beta}_1$ in equation (16) by Two Stage Least Squares (2SLS).

Crucially, we can only assume that $\Delta avinc_i$ is exogenous to any of i's decisions if i did not change her occupation group between 2010 and 2015. In particular, if selecting into a better paid occupation group was driven by omitted variables that also affect i's financial donations, our instrument would be invalid. To avoid such confounds, we exclude all individuals who changed their occupation group between 2010 and 2015 from the analysis. Moreover, we consider only individuals for whom we observe net income and at least one of the dependent variables, $\Delta ddonate_i$ or $\Delta donation_i$. In sum, we are left with 5,490 observations; see Table 3 for

[30]See Section C.3.2 for a robustness check where we consider the individuals' difference in gross income instead of net income, and Section C.3.3 for a robustness check where we exclude retirees from the analysis.

[31]Note that we are limited to variables that exist in the 2010 *and* the 2015 version of the survey.

[32]The ISCO-88 is an International Labour Organization (ILO) classification structure for organizing information on labor and jobs. It groups occupations based on the similarity of skills required to fulfill the tasks and duties of the jobs; see `https://www.ilo.org/public/english/bureau/stat/isco/isco88/index.htm`. Viewed: April 2020.

[33]Data on the current occupation is missing for some individuals for some years. In our main analysis, we assume that an individual's occupation has not changed unless the individuals states a different occupation or states to have changed its activity status (e.g., retired or lost her job). Section C.3.5 proves the robustness of our results when we exclude all observations for whom we lack data on their current occupation.

an overview of all variables used in the analysis.

C.2. Results

Extensive margin Table 4 shows the results on the extensive margin of financial donations. To enhance readability of the estimates, we have scaled $\Delta netinc_i$ with the factor 100, i.e., a one unit increase in $\Delta netinc_i$ corresponds to a 100 Euro increase in net income between 2010 and 2015.

Columns 1 to 6 show the results of the potentially biased OLS estimation of equation (16). In column 1, we run the regression without any control variables; in columns 2 to 5, we add controls for the change in (i) bonus payments, (ii) life circumstances, and (iii) employment circumstances. In column 6, we also control for temporal employment and tenure; since this information is missing for about half of our observations, we include these variables only into the last specification. The estimates for β_1 are positive throughout all specifications, thus, there is a positive correlation between the change in i's net income and the change in her probability to donate. The estimates are statistically significant at the 5% level in columns 1 to 3, and weakly statistically significant at the 10% level in columns 4 and 5. The magnitude of the estimates is small: according to column 1, a 100 Euro increase in i's change in net income is associated with a 0.18 percentage point increase in the change of i's probability to donate. A one standard deviation increase in $\Delta netinc_i$ is associated with a 1.6 percentage point increase in the change of her probability to donate, which corresponds to 3.1 of a standard deviation in the dependent variable.

Columns 7 to 12 show the results of the 2SLS estimation of equations (16) and (17). Again, the estimates for β_1 are positive throughout all specifications. Moreover, they are statistically significant at the 1% level (columns 7, 8, and 10) or at the 5% level (columns 9, 11, and 12). In line with the concerns about downward biased OLS estimates, the 2SLS estimates are more than ten times larger than their OLS counterparts. E.g., according to column 7, a 100 Euro increase in i's change in net income leads to a 2.4 percentage point increase in the change of her probability to donate. A one standard deviation increase in $\Delta netinc_i$ leads to a 20.9 percentage point increase in the change of her probability to donate, which corresponds to about 41% of a standard deviation in the dependent variable. The first stage diagnostics support the validity of our empirical strategy: the estimate for π_1 in equation (17) is highly statistically significant throughout all specifications, and $F > 30$ in all columns. Thus, we conclude that net income has a causal positive effect on the extensive margin of donation behavior.[34]

Intensive margin Table 5 shows the results on the intensive margin of donation behavior. Columns 1 to 6 show the results of the potentially biased OLS estimation of equation (16). Analogous to Table 4, we run the regression without any control variables in column 1. In columns 2 to 5, we add controls for the change in (i) bonus payments, (ii) life circumstances, and (iii) employment circumstances; in column 6, we also control for temporal employment and tenure. The estimates for β_1 are positive throughout all specifications, but not statistically

[34] See Section C.3.1 for a robustness check where we use an ordered probit instead of a linear model.

significant. Their magnitude is small: a 1 Euro increase in i's change in net income is associated with a 0.01 Euro increase in the change of the amount of money donated. A one standard deviation increase in $\Delta netinc_i$ is associated with a 8.72 Euro increase in the amount donated, which corresponds to 2.4% of a standard deviation in the dependent variable.

Columns 7 to 12 show the results of the 2SLS estimation of equations 16 and 17. Again, the estimates for β_1 are positive throughout all specifications. Moreover, they are statistically significant at the 1% level (columns 10 and 11) or at the 5% level (columns 7, 8, 9, and 12). The 2SLS estimates are several times larger than their OLS counterparts: e.g., according to column 7, a 1 Euro increase in i's change in net income leads to a 0.13 Euro increase in the change of the amount of money donated. A one standard deviation increase in $\Delta netinc_i$ leads to a 115.21 Euro increase in the change in the amount donated, which corresponds to about 31.7% of a standard deviation in the dependent variable. Again, the first stage diagnostics support the validity of our empirical strategy: the estimate for π_1 in equation (17) is highly statistically significant throughout all specifications, and $F > 30$ in all columns. Thus, we conclude that net income has a causal positive effect on the intensive margin of donation behavior, too.

C.3. Robustness checks

This section probes the robustness of our results with respect to functional form, using gross instead of net income, and excluding retirees, occupation groups with few observations, and observations for whom we lack data on their current occupation from the analysis.

C.3.1. Ordered probit model

The dependent variable $\Delta ddonate_i$ can only take on three distinct values $\in \{-1, 0, 1\}$, yet, we estimate a linear model in Section C.2. The main advantage is that the coefficients of a linear model are straightforward to interpret. On the other hand, if the partial effect of $\Delta netinc_i$ was non-linear or if one wants to avoid that certain combinations of independent variables lead to predicted outcomes below -1 or above 1, estimating an ordered choice model would be more appropriate.

To demonstrate that the findings from Section C.2 do not hinge on the functional form of the model, this section presents the results from a maximum likelihood estimation of an ordered probit model with three outcome categories. Again, to account for endogeneity in $\Delta netinc_i$, we augment the procedure by estimating the first stage equation (17). Moreover, analogous to Table 4, we scale $\Delta netinc_i$ with the factor 100 to enhance readability and comparability of the coefficients.

Table 6 shows the results. Columns 1 to 6 show the potentially biased coefficients of a maximum likelihood estimation of the ordered probit model without the first stage. As in Table 4, we do not include control variables in column 1, add controls for the change in (i) bonus payments, (ii) life circumstances, and (iii) employment circumstances in columns 2 to 5, and also control for temporal employment and tenure in column 6. Just as their counterparts in Table 4, the coefficients are positive and statistically significant at the 5% level in columns 1 to 3, and at the 10% level in columns 4 and 5.

One disadvantage of estimating an ordered choice model is that the magnitudes of the coefficients are not meaningful by themselves. Also, in contrast to binary choice models, the partial effects do not always have the same sign as the coefficients, but must be evaluated separately for each outcome category. Thus, Table 6 also reports the average partial effects (APE) of $\Delta netinc_i$ for the three outcome categories $\Pr(\Delta ddonate_i = -1)$, $\Pr(\Delta ddonate_i = 0)$, and $\Pr(\Delta ddonate_i = 1)$. For all specifications, the APE of $\Delta netinc_i$ is negative for $\Pr(\Delta ddonate_i = -1)$ and positive for $\Pr(\Delta ddonate_i = 1)$. In other words, we find a positive correlation between $\Delta netinc_i$ and $\Delta ddonate_i$, which is in line with our theory and our findings from Section C.2.

In columns 7 to 12, we take the first stage 17 into account. Just as their counterparts in Table 4, the coefficients are positive throughout all specifications and statistically significant at the 1% level (columns 7, 8, and 10) or at the 5% level (columns 9, 11, and 12). The APEs have the same signs as in columns 1 to 6, but several times larger, in line with the concern that endogeneity in $\Delta netinc_i$ may lead to downward biased estimates if not taken into account. We conclude that the ordered probit, too, provides evidence of a causal positive effect of $\Delta netinc_i$ and $\Delta ddonate_i$. Yet, since the coefficients of an ordered probit model cannot be interpreted without a fair amount of extra calculation, we limit our attention to estimating the linear model consisting of equations (16) and 17 in the robustness checks below.

C.3.2. Gross income

Next, we show that our results are robust to considering the effect of gross income instead of net income. To this end, we replace $\Delta netinc_i$ in equations (16) and (17) with $\Delta grossinc_i$, which corresponds to the change in i's gross income. Moreover, we use $\Delta avincgross_i$ – the change in the average gross income of i's occupation group – as an instrument for $\Delta grossinc_i$ in equation (17).

Extensive margin Table 7 shows the results on the extensive margin on financial donations. Analogous to Table 4, we have scaled $\Delta grossinc_i$ with the factor 100 to enhance the readability of the results.

The 2SLS estimates for β_1 are positive for all specifications. Moreover, the estimates are statistically significant at the 1% level in columns 1, 2, 4, and 6, and at the 5% level in columns 3 and 5. Although the magnitude of the estimates is smaller than in Table 4, the effect sizes are comparable: e.g., according to column 1, a 100 Euro increase in i's change in gross income leads to a 1.4 percentage point change in $\Delta ddonate_i$. A one standard deviation increase in $\Delta grossinc_i$ leads to a 21 percentage point increase in $\Delta ddonate_i$, which corresponds to 41% of a standard deviation in the dependent variable. The first stage diagnostics support the validity of our empirical strategy based on gross income: the estimate for π_1 in equation (17) is highly statistically significant throughout all specifications, and $F > 15$ in all columns.

Intensive margin Table 8 shows the results on the intensive margin on financial donations. As in Table 5, the 2SLS estimates for β_1 are positive for all specifications. Moreover, the estimates are statistically significant at the 5% level in columns 1, 3, and 5, and at the 10% level in columns 2, 4, and 6. As for the extensive margin, the magnitude of the estimates is smaller than in Section C.2, while the effect size is comparable: e.g., according to column 1, a 1 Euro increase in $\Delta grossinc_i$ leads to 0.09 Euro increase in $\Delta donation_i$. A one standard deviation increase in $\Delta grossinc_i$ leads to a 133.14 Euro increase in $\Delta donation_i$, which corresponds to 36.7% of a standard deviation in the dependent variable. Again, the first stage diagnostics support the validity of our empirical strategy based on gross income: the estimate for π_1 in equation (17) is highly statistically significant throughout all specifications, and $F > 15$ in all columns.

C.3.3. Exclude retirees

Our main analysis considers retirees alongside individuals who still participate in the labor market. To rule out that retirees – whose donation behavior might be very different from the working population – drive our results, this section demonstrates that the findings from Section C.2 are robust to excluding them from the analysis.

Extensive margin Table 9 shows the 2SLS results on the extensive margin on financial donations without retirees. Just as their counterparts in Table 4, all estimates are positive. Due to the reduced number of observations, the standard errors are larger than in Table 4, but all estimates are statistically significant at the 5% level. Moreover, the magnitude of the estimates increases: e.g., according to column 1, a 100 Euro increase leads to a 3 percentage point increase in $\Delta ddonate_i$ and a one standard deviation increase in $\Delta netinc_i$ leads to a 26 percentage point increase in $\Delta ddonate_i$, which corresponds to 51% of a standard deviation in the dependent variable. The first stage diagnostics support the validity of our empirical strategy when we exclude retirees: the estimate for π_1 in equation (17) is highly statistically significant throughout all specifications, and $F > 20$ in all columns.

Intensive margin Table 9 shows the 2SLS results on the intensive margin on financial donations without retirees. As in Table 5, all estimates are positive. Similar to the extensive margin, the standard errors increase due to the reduced number of observations, but all estimates are statistically significant at the 5% level. Moreover, they are slightly larger than their counterparts in Table 5: e.g., according to column 1, a 1 Euro increase in $\Delta netinc_i$ leads to a 0.16 Euro increase in $\Delta donation_i$ and a one standard deviation increase in $\Delta netinc_i$ leads to a 139.52 Euro increase in $\Delta donation_i$, which corresponds to 38.4% of a standard deviation in the dependent variable.

C.3.4. Exclude occupation groups 06 and 10

Next, we exclude occupation groups 06 and 10 – i.e., skilled agricultural, forestry and fishery workers and armed forces occupations – from the analysis, because the number of observations for each group is small (see also Table 2). Thus, each individual could have a sizable impact on $\Delta avinc_i$, rendering it unclear if the exclusion restriction holds. This section shows that our main results are robust to excluding these observations.

Extensive margin Table 11 shows the 2SLS results on the extensive margin of financial donations when we exclude occupation groups 06 and 10. The estimates are positive, but slightly smaller than their counterparts in Table 4. Moreover, the standard errors are larger than in Table 4, but all estimates are statistically significant at the 5% level (columns 1, 2, 4, and 5) or at the 10% level. The first stage diagnostics, too, are similar to Table 4: all first stage estimates are highly statistically significant, and $F > 25$ in all columns.

Intensive margin Table 12 shows the 2SLS results on the intensive margin of financial donations when we exclude occupation groups 06 and 10. The estimates are positive and slightly smaller than their counterparts in Table 5; the relative magnitude of the standard errors remains nearly unchanged. The first stage diagnostics are similar to Table 5, too: all first stage estimates are highly statistically significant, and $F > 25$ in all columns.

C.3.5. Reported profession

As a final robustness check, we exclude all individuals who do not report their current occupation in 2010 or 2015, but have done so in a preceding wave of the survey and did not state to have changed their occupation or activity status. Tables 13 and 14 show the results: they are nearly equivalent to our main results in Section C.2.

Table 2. Occupation groups

Group	Label	Obs.	Percent
01	Managers	146	2.66
02	Professionals	781	14.21
03	Technicians and associate professionals	852	15.50
04	Clerical support workers	297	5.40
05	Service and sales workers	331	6.02
06	Skilled agricultural, forestry and fishery workers	23	0.42
07	Craft and related trades workers	364	6.62
08	Plant and machine operators and assemblers	175	3.18
09	Elementary occupations	140	2.55
10	Armed forces occupations	12	0.22
11	Retirees	2,375	43.21
Total		5,496	100.00

Notes: Table 2 gives an overview of all occupation groups considered in the analysis. Groups 01 to 10 are based on the ISCO 88 classification by the International Labor Organization; Group 11 classifies retirees.

Table 3. Summary statistics

Variable	Label	Obs	Mean	Std. Dev.	Min	Max	Median
Main analysis:							
$\Delta ddonate_i$	Change in fin. donations, extensive margin	5,496	0.048	0.509	-1	1	0
$\Delta donation_i$	Change in fin. donations, intensive margin	5,449	36.883	363.122	-5,000	5,000	0
$\Delta netinc_i$	Change in net income	5,496	233.889	872.849	-14,210	24,000	135
$\Delta avinc_i$	Change in av. net income of occupation group	5,496	121.474	35.332	57.671	668.247	113.631
ΔX_{1i} :							
$\Delta bonus_i$	Change in annual bonus	5,496	18.759	919.527	-20,000	10,000	0
$\Delta vacbonus_i$	Change in vacation	5,496	10.873	515.246	-8,200	10,000	0
$\Delta xmasbonus_i$	Change in Christmas bonus	5,496	35.151	726.756	-6,000	10,000	0
ΔX_{2i} :							
$\Delta sidejob_i$	Change in having a side job	5,496	-0.002	0.2	-1	1	0
$\Delta workhours_i$	Change in weekly working hours	5,413	-0.593	8.513	-70	55	0
$\Delta activstatus_i$	Change in activity status	5,496	0.12	0.325	0	1	0
ΔX_{3i} :							
$\Delta happiness_i$	Change in self-reported life satisfaction	5,480	-0.015	1.593	-8	10	0
$\Delta health_i$	Change in self-reported health status	5,485	0.12	0.838	-3	3	0
$\Delta married_i$	Change in marital status	5,496	-0.001	0.294	-1	1	0
ΔX_{4i} :							
$\Delta tenure_i$	Change in being tenured	2,818	0.073	0.38	-1	1	0
$\Delta tempemp_i$	Change in being temporally employed	2,811	-0.01	0.147	-1	1	0
Robustness checks:							
$\Delta grossinc_i$	Change in gross income	5,258	311.763	1496.684	-58,723	30,000	150
$\Delta avincgross_i$	Change in av. gross income of occupation group	5,496	161.31	68.098	55.912	760.509	127.26

Notes: Table 3 lists all variables used in the analysis. The underlying variables for $\Delta ddonate_i$, $\Delta sidejob_i$, $\Delta activstatus_i$, $\Delta married_i$, $\Delta tenure_i$, and $\Delta tempemp_i$ are dummy variables, hence, the corresponding differences can take on the values -1, 0, and 1. The underlying variables for $\Delta happiness_i$ and $\Delta health_i$ are originally measured on a scale from 0 to 10, where 0 indicates the worst and 10 the best outcome. Hence, the corresponding differences can take on all integer values from the interval $[-10, 10]$. The underlying variables for the remaining variables are continuous, hence, their corresponding differences can take on all values.

Table 4. The effect of net income on the extensive margin of financial donations

	OLS						2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta netinc_i$	0.0018**	0.0018**	0.0017**	0.0016*	0.0015*	0.0013	0.0241***	0.0239***	0.0232**	0.0233***	0.0222**	0.0296**
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0022)	(0.0091)	(0.0092)	(0.0094)	(0.0089)	(0.0093)	(0.0119)
ΔX_{1i}		X			X	X		X			X	X
ΔX_{2i}			X		X	X			X		X	X
ΔX_{3i}				X	X	X				X	X	X
ΔX_{4i}						X						X
Intercept	0.044***	0.044***	0.045***	0.041***	0.041***	0.027**	-0.008	-0.005	-0.009	-0.007	-0.053	-0.053
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.013)	(0.022)	(0.023)	(0.023)	(0.022)	(0.022)	(0.036)
							First stage					
$\Delta avinc_i$							0.021***	0.020***	0.020***	0.021***	0.020***	0.016***
							(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
F-statistic							33.74	32.86	32.53	35.22	33.22	39.94
N	5,496	5,496	5,470	5,413	5,390	2,749	5,496	5,496	5,470	5,413	5,390	2,749

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5. The effect of net income on the intensive margin of financial donations

	OLS						2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta netinc_i$	0.0130	0.0130	0.0125	0.0131	0.0127	0.0444*	0.132**	0.134**	0.134**	0.130***	0.134***	0.113**
	(0.0205)	(0.0206)	(0.0207)	(0.0208)	(0.0210)	(0.0267)	(0.0521)	(0.0530)	(0.0524)	(0.0502)	(0.0511)	(0.0476)
ΔX_{1i}		X			X	X		X			X	X
ΔX_{2i}			X		X	X			X		X	X
ΔX_{3i}				X	X	X				X	X	X
ΔX_{4i}						X						X
Intercept	33.84***	33.49***	33.83***	31.85***	31.33***	19.38**	5.86	5.34	5.36	4.56	3.55	-0.24
	(7.22)	(7.21)	(7.09)	(7.35)	(7.25)	(9.40)	(12.17)	(12.25)	(12.41)	(11.61)	(11.86)	(13.70)
							First stage					
$\Delta avinc_i$							2.06***	2.03***	1.97***	2.12***	2.03***	1.60***
							(0.36)	(0.36)	(0.35)	(0.36)	(0.35)	(0.25)
F-statistic							33.50	32.62	32.31	34.97	32.98	39.55
N	5,449	5,449	5,424	5,369	5,347	2,731	5,449	5,449	5,424	5,369	5,347	2,731

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Ordered probit: The effect of net income on the extensive margin of financial donations

	Ordered Probit						Ordered Probit with IV					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta netinc_i$	0.004**	0.004**	0.004**	0.004*	0.003*	0.003	0.052***	0.052***	0.050**	0.050***	0.049***	0.064***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)	(0.022)
Av. partial effects of $\Delta netinc_i$:												
$\Pr(\Delta ddonate_i = -1)$	-0.0008**	-0.0008**	-0.0007**	-0.0007*	-0.0006*	-0.0005	-0.011***	-0.011***	-0.011**	-0.011***	-0.010**	-0.014**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0010)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)
$\Pr(\Delta ddonate_i = 0)$	-0.0002**	-0.0002**	-0.0002*	-0.0002*	-0.0002*	-0.0001	-0.0022***	-0.0022***	-0.0021***	-0.0021***	-0.0020***	-0.0024***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0007)
$\Pr(\Delta ddonate_i = 1)$	0.0010**	0.0010**	0.0010**	0.0009*	0.0008*	0.0007	0.0132***	0.0131***	0.0127***	0.0128***	0.0122**	0.0161***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0012)	(0.0046)	(0.0047)	(0.0048)	(0.0045)	(0.0048)	(0.0060)
ΔX_{1i}		X			X	X		X			X	X
ΔX_{2i}			X		X	X			X		X	X
ΔX_{3i}				X	X	X				X	X	X
ΔX_{4i}						X						X
							First stage					
$\Delta avinc_i$							0.021***	0.020***	0.020***	0.021***	0.020***	0.016***
							(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
F-statistic							33.74	32.86	32.53	35.22	33.22	39.94
N	5,496	5,496	5,470	5,413	5,390	2,749	5,496	5,496	5,470	5,413	5,390	2,749

Notes: Robust standard errors in parentheses. The outcome categories of the ordered probit are $\Pr(\Delta ddonate_i = -1)$, $\Pr(\Delta ddonate_i = 0)$, and $\Pr(\Delta ddonate_i = 1)$, where $\Delta ddonate_i$ is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Robustness check: The effect of gross income on the extensive margin of financial donations

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta grossinc_i$	0.014***	0.014***	0.013**	0.013***	0.013**	0.019***
	(0.0052)	(0.0053)	(0.0052)	(0.0051)	(0.0052)	(0.0064)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	0.004	0.004	0.006	0.003	0.005	-0.243
	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.036)
	First stage					
$\Delta avincgross_i$	0.025***	0.025***	0.024***	0.026***	0.024***	0.021***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
F-statistic	17.43	16.62	19.29	17.58	18.56	51.99
N	5,258	5,258	5,232	5,190	5,167	2,555

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8. Robustness check: The effect of gross income on the intensive margin of financial donations

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta grossinc_i$	0.089**	0.090***	0.091**	0.088***	0.090**	0.090***
	(0.044)	(0.045)	(0.043)	(0.043)	(0.043)	(0.033)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	8.20	7.786	7.426	6.376	5.30	-7.132
	(13.03)	(13.17)	(13.11)	(12.69)	(12.80)	(12.520)
	First stage					
$\Delta avincgross_i$	2.516***	2.468***	2.439***	2.574***	2.451***	2.118***
	(0.604)	(0.606)	(0.556)	(0.614)	(0.569)	(0.295)
F-statistic	17.37	16.57	19.27	17.59	18.57	51.52
N	5,215	5,215	5,190	5,149	5,127	2,540

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9. Robustness check: The effect of net income on the extensive margin of financial donations, no retirees

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.030**	0.030**	0.030**	0.029**	0.029**	0.029**
	(0.0125)	(0.0126)	(0.0131)	(0.0120)	(0.0128)	(0.0120)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	-0.043	-0.043	-0.043	-0.046	-0.048	-0.051
	(0.041)	(0.041)	(0.042)	(0.041)	(0.043)	(0.037)
	First stage					
$\Delta avinc_i$	0.015***	0.015***	0.015***	0.016***	0.015***	0.016***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
F-statistic	24.02	23.58	22.68	26.38	24.26	39.24
N	3,121	3,121	3,106	3,048	3,035	2,686

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude retirees from the analysis. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10. Robustness check: The effect of net income on the intensive margin of financial donations, no retirees

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.160**	0.163**	0.165**	0.151***	0.158**	0.110**
	(0.067)	(0.068)	(0.068)	(0.062)	(0.064)	(0.048)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	-9.735	-10.82	-11.53	-6.55	-9.95	1.050
	(19.80)	(19.86)	(20.33)	(19.17)	(19.82)	(14.036)
	First stage					
$\Delta avinc_i$	1.553***	1.536***	1.479***	1.614***	1.511***	1.578***
	(0.319)	(0.318)	(0.312)	(0.316)	(0.308)	(0.253)
F-statistic	23.77	23.34	22.46	26.11	24.03	38.84
N	3,096	3,096	3,082	3,026	3,014	2,668

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude retirees from the analysis.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11. Robustness check: The effect of net income on the extensive margin of financial donations, no occupation groups 06 and 10

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.020**	0.019**	0.019*	0.018**	0.018**	0.023*
	(0.0095)	(0.0097)	(0.0099)	(0.0091)	(0.0096)	(0.0124)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	0.001	0.002	0.005	0.001	0.005	-0.035
	(0.023)	(0.023)	(0.024)	(0.022)	(0.023)	(0.037)
	First stage					
$\Delta avinc_i$	0.032***	0.032***	0.031***	0.034***	0.032***	0.027***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
F-statistic	29.40	27.84	28.06	29.84	32.73	56.94
N	5,461	5,461	5,436	5,380	5,358	2,724

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude occupation groups 06 and 10 from the analysis. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12. Robustness check: The effect of net income on the intensive margin of financial donations, no occupation groups 06 and 10

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.191***	0.195**	0.197***	0.184***	0.191***	0.173***
	(0.074)	(0.076)	(0.075)	(0.069)	(0.072)	(0.067)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	-8.30	-9.07	-9.57	-8.18	-10.09	-17.84
	(16.52)	(16.77)	(17.03)	(15.28)	(15.87)	(18.025)
	First stage					
$\Delta avinc_i$	3.226***	3.160***	3.105***	3.422***	3.232***	2.641***
	(0.598)	(0.602)	(0.589)	(0.601)	(0.595)	(0.354)
F-statistic	29.10	27.56	27.80	32.38	29.52	55.79
N	5,414	5,414	5,390	5,336	5,315	2,706

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude occupation groups 06 and 10 from the analysis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13. Robustness check: The effect of net income on the extensive margin of financial donations, reported occupations

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.024***	0.024***	0.023**	0.023***	0.022**	0.030**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.012)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	-0.009	-0.008	-0.006	-0.009	-0.007	-0.053
	(0.022)	(0.022)	(0.023)	(0.022)	(0.023)	(0.036)
	First stage					
$\Delta avinc_i$	0.021***	0.021***	0.020***	0.021***	0.020***	0.016***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
F-statistic	34.12	33.20	32.92	34.45	32.43	40.00
N	5,428	5,428	5,402	5,346	5,323	2,745

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta ddonate_i$, which is the change in financial donations on the extensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude observations on whom we lack data on the current occupation from the analysis. To enhance readability of the estimates, $\Delta netinc_i$ is scaled with the factor 100.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14. Robustness check: The effect of net income on the intensive margin of financial donations, reported occupations

	2SLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta netinc_i$	0.128**	0.131**	0.130**	0.129**	0.133**	0.113**
	(0.051)	(0.052)	(0.051)	(0.051)	(0.051)	(0.047)
ΔX_{1i}		X			X	X
ΔX_{2i}			X		X	X
ΔX_{3i}				X	X	X
ΔX_{4i}						X
Intercept	6.093	5.540	5.76	4.85	3.92	-0.111
	(12.15)	(12.23)	(12.41)	(11.71)	(12.01)	(13.67)
	First stage					
$\Delta avinc_i$	2.113***	2.081***	2.023***	2.128***	2.004***	1.605***
	(0.363)	(0.362)	(0.354)	(0.364)	(0.353)	(0.255)
F-statistic	33.87	32.97	32.69	34.23	32.22	39.61
N	5,381	5,381	5,356	5,302	5,280	2,727

Notes: Robust standard errors in parentheses. The dependent variable is $\Delta donation_i$, which is the change in financial donations on the intensive margin. The F-statistic corresponds to the first stage F-statistic of the excluded instrument. The results are based on estimations that exclude observations on whom we lack data on the current occupation from the analysis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$