(Non)exclusive Contracting under Adverse Selection: An Experiment*

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Abstract

The performance of markets with hidden information is of central importance in microeconomic theory. We present the results of a comprehensive experiment that distinguishes between the two fundamental forms of hidden information, private and common values, in different contracting environments. Contracting environments vary in terms of the market power that the screening market side has over the trades of its privately informed customers, ranging from monopoly to nonexclusive competition. The degree of equilibrium play is striking, particularly in the complex cases of common values. Under private values, competition ensures efficient trades. Under common values, low-type buyers are to a large extent excluded under nonexclusive competition, whereas such types' trades are only distorted under exclusive competition. This leads to a significantly higher market surplus under exclusive competition in comparison to nonexclusive competition under common values.

JEL classification: D82; L10; C92.

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1 Introduction

The functioning of markets with hidden information has been a major focus of microeconomic theory since Akerlof's (1970) lemons model. For instance, the Rothschild and Stiglitz (1976) model of a competitive insurance market with privately known risk types has motivated a sizeable literature on the question of whether competitive markets can implement second-best efficient allocations. While theoretical models have made significant progress at understanding how markets operate under asymmetric information, empirical analyses are relatively scarce. In particular, while there is by now a substantial empirical body of work based on observational data testing for the presence of asymmetric information in general,[1] there is a striking lack of empirical results on whether markets work as theoretically put forward in terms of strategic interaction and efficiency. One problem explaining this gap is simply—but importantly—the lack of availability of the relevant market-wide data.[2] For instance, when there is nonexclusive competition in the market, i.e. when the uninformed market side cannot enforce exclusive contracts such that market participants with hidden information can contract with several market participants from the uninformed market side, unambiguous inferences can only be made when data on the contract menus offered and the contracts accepted of *all* market participants is available.

The nonexclusivity of contracts is a reality in many important markets with information problems. For instance, the life insurance market is characterized by nonexclusivity: In the US, about 20-25% of people with life insurance have multiple coverage. In health insurance, more of this form of competition will become relevant, with basic health insurance contracts excluding treatments for some conditions, such that individuals might have to supplement the plan with other forms of insurance. In financial markets, information problems combined with nonexclusivity is increasing in importance. The designers of structured financial products such as collateralized debt obligations, e.g., are likely to hold private information about their quality, and most of these securities are traded outside of organized exchanges on over-the-counter markets, with little information on the trading volumes or on the net positions of traders.

Is nonexclusivity a problem? Do markets with nonexclusive competition perform differently than markets in which contracting is exclusive? A systematic analysis of the implications of different contracting environments under information problems with observational data is virtually impossible, both from a lack of data and other important

[1] See, for instance, Cohen and Siegelman (2010).
[2] See, e.g., Salanié (2017).

heterogeneity across markets for which some data is available.

Against this backdrop, we chose to take the problem to the lab: This paper provides a systematic experimental study of contracting under asymmetric information. We analyze and compare different market environments from monopoly to exclusive competition and nonexclusive competition, with a particular focus on the latter. Our experiment allows us to generate complete datasets for markets under asymmetric information and thus to test for the crucial strategic mechanisms and implications and compare across market environments.

In a 3×2 design (see *Table 1*), we do not only vary the market environments (monopoly, exclusive competition and nonexclusive competition), but also distinguish between the two types of hidden information: private and common values. The crucial difference between hidden information of the private and common values form is that in case of the former, an uninformed party's payoff and therefore incentives do not depend on the hidden information *given* a contract. In contrast to that, with common values, even given a contract, the hidden information is payoff-relevant for the uninformed party, which is the case e.g. in Akerlof (1970) and Rothschild and Stiglitz (1976). This difference leads to dramatically different implications in terms of market outcomes, in particular under competition. While competition should implement efficient outcomes when hidden information takes the form of private values, it leads to serious problems under common values.

Table 1: Experimental set-up – Conditions.

		Form of hidden information	
		Private values	Common values
Contracting environment	Monopoly/Bilateral	PV Mon	CV Mon
	Exclusive competition	PV CompE	CV CompE
	Nonexclusive competition	PV CompNE	CV CompNE
			CV CompNE - Control

Our design allows us to study market outcomes across the two variations within one parsimonious framework. The parametrization ensures that unique equilibria exist in each of the six conditions and that private and common value markets are comparable in terms of surplus generation. The theoretical predictions are, in more detail, as follows:

In the standard model of adverse selection of the private values form, some types' trade may be distorted or the types may be excluded for rent extraction purposes under monopoly settings. Competition—either exclusive or nonexclusive— however restores the efficiency of the equilibrium allocation. Under common values, although the principal's incentives are similar to those under private values in the monopoly case, competition in contrast may lead to problems of existence of a pure-strategy equilibrium; moreover, if a pure-strategy equilibrium exists, some types' trade may be distorted compared to the First Best allocation under exclusive competition and some types may even be excluded from trading under nonexclusive competition. In our experiment, we test these predictions by considering a market with sellers and buyers in which privately informed buyers are either of high or low type. *Table 2* below summarizes the main theoretical predictions for our chosen parametrization.

Table 2: Experimental set-up – Predictions.

	Private Values	Common Values
Monopoly	Low type **excluded**	Low type **excluded**
Exclusive Competition	**Efficient** trade	Equilibrium exists Low type's trade is **distorted**
Nonexclusive Competition	**Efficient** trade	Equilibrium exists Low type **excluded**

We analyze whether behavior in the lab reflects the theoretical redictions with regard to the changes in allocations implied by changes in the market environment. Our experimental results largely confirm theoretical predictions, which is particularly striking in the complex cases of common values. Under private values, monopolistic sellers partially try to exclude low-type buyers, but seller competition leads to the efficient allocation. Under common values and exclusive competition, buyer types frequently self-select into contracts and the low-type buyers' trades are distorted downward as predicted. Furthermore, low-type buyers' trade rates are significantly higher under exclusive competition than under nonexclusive competition or monopoly since the contract menus offered exclude these types less often under exclusive competition than under nonexclusive competition. This leads to a significantly higher surplus under exclusive competition than under nonexclusive competition and monopoly for the common value treatments. Thus, our results confirm that nonexclusive competition may be detrimental to surplus generation in common value adverse selection markets.

Literature

The market framework and theoretical results upon which our experimental set-up and treatments are based are Mussa and Rosen (1978), Fagart (1996), and Pouyet et al. (2008) for private values. For common values, it is based on Rothschild and Stiglitz (1976) for exclusive competition and the recent work of Attar et al. (2014) for nonexclusive competition.[3] For the summary of the theoretical results from the literature, the overall market set-up presented is based on the framework in Attar et al. (2014).

The experimental literature on markets with adverse selection is scarce and scattered. We will discuss this literature below, *Table 3* provides an overview of experimental studies. Under private values, the seminal experimental paper is Smith (1962), who investigates trading prices in a competitive market in which prices are set by a double oral auction. Sellers have hidden information about their production costs and buyers about their valuation of the good. Smith (1962) shows that despite the hidden information on both market sides, trading prices converge to the equilibrium price over time. In a labor market setting, Cabrales et al. (2011) examine how differing degrees of relative bargaining power between principals and agents affect outcomes and efficiency under private values. A firm needs exactly one worker. A one-to-one-matching with full bargaining power of the principal is compared to settings with excess agents and excess principals. Cabrales et al. (2011) find that the highest efficiency in terms of actual matches is achieved in the treatment with competition among the informed agents. In contrast to their set-up in which principals can only choose among six predetermined menus, prices in our experiment are endogenous and our design facilitates an efficiency comparison across market environments.[4]

Monopoly under private values is experimentally examined in Hoppe and Schmitz (2013) and Hoppe and Schmitz (2015). In Hoppe and Schmitz (2013), a principal makes a take-it-or-leave-it (TIOLI) wage offer to an agent who is privately informed about his production costs. However, production costs are private values in the sense that given

[3]Theoretical analyses of nonexclusive competition in slightly different set-ups are provided in Attar et al. (2011), Rothschild (2015) and Attar et al. (2016).

[4]A welfare comparison in Cabrales et al. (2011) is difficult because there are unbalanced principal/agent structures across the treatments, which also renders a comparison to our private values monopoly and exclusive competition treatments impossible.

a wage offer, the principals payoff does not depend on the agent's production costs. Hoppe and Schmitz (2013) find that sellers choose a wage that excludes high cost types when it is profitable to do so, and that social preferences are less pronounced than in conventional ultimatum games. In Hoppe and Schmitz (2013), sellers can only make single contract offers, in contrast, in Hoppe and Schmitz (2015), the authors analyze whether separating menus are offered when it is profitable to separate types. Their experimental results largely confirm theory, i.e. most sellers offer separating contracts when theory would predict. However, buyers reject offers because of inequity aversion, but less often than in standard ultimatum games under incomplete information.

Several experimental papers have analyzed exclusive competition under common values in markets that feature the preference and contracting structure of the Rothschild and Stiglitz (1976) model; however, these experiments are highly heterogeneous in terms of experimental set-up and research focus. Asparouhova (2006) analyzes lending where sellers can offer menus of contracts from a given set of contracts. The set of available contracts is varied such that an equilibrium in pure strategies exists in one treatment but not the other. Asparouhova (2006) finds that in the treatment in which an equilibrium theoretically exists, sellers offer menus that induce buyers to self-select into contracts. In the treatment in which an equilibrium does not exist, there is temporary cross-subsidization, but markets do not settle down. In a labor market framing, Kübler et al. (2008) compare screening with signaling, concluding that the single contract wage offer is more often separating under signaling than under screening.

Shapira and Veneyia (1999), Posey and Yavas (2007) and Riahi et al. (2013) conduct experiments with insurance set-ups. Shapira and Veneyia (1999) analyze the demand and supply side separately without market interaction, finding that sellers try to screen only after several periods and buyers tend to self-select into contracts, albeit not extensively. Posey and Yavas (2007), who consider seller behavior with simulated buyers, find that when the share of high risks is high (low), sellers tend to offer a separating (pooling) menu as predicted by theory. Riahi et al. (2013) analyze market interactions in which sellers can only offer a single contract in one treatment but may offer a separating menu in another treatment. The parametrization is such that the pricing in the single contract case would be expected to crowd out low risks as in Akerlof's lemons model, but a separating menu in which each type buys her respective contract as in Rothschild/Stiglitz would theoretically be offered in the treatment that allows for menu offers. Riahi et al. (2013) find only partial crowding out in the single-contract case and no reduction in crowding out when contract menus can be offered. Furthermore, their results indicate the existence of pooling rather than separating equilibria.

Table 3: Overview of experimental literature.

Contracting environment	Form of hidden information: **Private Values**	Form of hidden information: **Common Values**
Monopoly / Bilateral contracting	Hoppe and Schmitz (2013) - Rent extraction versus efficiency with single contract offers by principal - *Results:* Qualitative results as predicted by theory, social preferences (Fehr-Schmidt) play a role, but less pronounced than, e.g., in ultimatum games Hoppe and Schmitz (2015) - Separation versus pooling when principal can offer a contract menu - *Results:* (Most) principals offer separating contracts when theory would predict	**none with hidden, heterogeneous types***
Exclusive competition	Smith (1962) - Classroom experiment with oral double auction for unique good, buyers have hidden information about their valuation and sellers about their costs - *Results:* Trades converge quickly towards competitive equilibrium Cabrales et al. (2011) - job market setting, one-to-one matching versus principal competition versus agent competition - *Results:* highest efficiency with agent competition	Asparouhova (2006) - Lending, equilibrium nonexistence problem - *Results:* Separation of types when equilibrium exists, same outcome in some markets when equilibrium does not exist, other markets do not settle, exhibit temporary cross-subsidization Kübler et al. (2008) - Screening versus signaling in labor market - *Results:* More separating outcomes under signaling than under screening Specific insurance set-ups - Shapira and Veneyia (1999), Posey and Yavas (2007), Riahi et al. (2013)
Non-exclusive competition	**none**	**none**

* **Related**: Kagel et al. (1996) and Harstad and Nagel (2004). Ultimatum games in which a responder may have private information about the size of a cake.

A large empirical literature has emerged in the past two decades testing for the presence of asymmetric information, in particular in insurance markets.[5] On the basis of the positive correlation test suggested by Chiappori and Salanié (2000), a positive correlation between ex post risk and level of coverage has e.g. been found in the market for annuities (Finkelstein and Poterba, 2002, 2004; McCarthy and Mitchell, 2010) and the health insurance market (Cutler and Reber, 1998; Cutler et al., 2000). Yet, a negative correlation, indicating advantageous selection, has been found in the market for life insurance (Cawley and Philipson, 1999; McCarthy and Mitchell, 2010) as well as for Medigap (Fang et al., 2008). While the result regarding life insurance can be explained with a positive relation between insurance purchase and income/wealth on the one hand and a negative one between risk and income/wealth on the other, a problem for identification is that nonexclusive competition is present in life insurance markets. Showing that there is no positive correlation in long term care, Finkelstein and McGarry (2006) suggest that different results emerge in the literature because unobservable heterogeneity in individual preferences such as risk aversion confound the analysis. While this heterogeneity cannot be fully eliminated in experiments, it can be better controlled for in the lab, a further advantage of using a lab experiment to test market outcomes under asymmetric information.

2 Adverse selection markets

In this section, we summarize the theoretical results from the adverse selection literature upon which the experiment will be based.[6] The exposition follows, with minor modifications, the common value framework in Attar et al. (2014), to which the private values case is added. We consider a market for a good with sellers and buyers in which buyers are privately informed about their type and uninformed sellers make contract offers to buyers.[7] All parameters are common knowledge with the exception of a buyer's type.

[5] For an overview of empirical work on contract theory, see Chiappori and Salanié (2003). For overviews on how to test predictions in markets with asymmetric information, in particular in insurance markets, see e.g. Chiappori and Salanié (2008), Chiappori and Salanié (2013) and Salanié (2017). A recent review of empirical findings on asymmetric information in insurance markets is given in Cohen and Siegelman (2010).

[6] While adverse selection is often understood as a phenomenon under common values and single crossing, we follow the standard contract theory terminology and write adverse selection as synonymous with hidden information.

[7] Note that this is reversed from Attar et al. (2014), in which the labeling is such that sellers are privately informed about their preferences.

2.1 The market set-up

2.1.1 The buyers

There are $n \geq 2$ buyers. A buyer is of type $\theta \in \{L, H\}$, and the share of H-type buyers among all buyers is γ. When trading, a buyer cares only about the aggregate quantity she purchases from sellers and the aggregate price she must pay in return. Type θ's preferences over aggregate quantity-price bundles (Q, P) are represented by the utility function $u_\theta(Q, P) = v_\theta(Q) - P$ with $v'_\theta(Q) > 0$ and $v''_\theta(Q) < 0$, and $v_H(0) = v_L(0)$. For each Q, $v'_H(Q) > v'_L(Q)$, i.e. a strict single-crossing property: Type H is more eager to buy a higher quantity than type L is. Thus, in the (Q, P) plane, an H-type indifference curve crosses an L-type indifference curve only once, from below.

2.1.2 The sellers

There are $m \geq 1$ sellers. A seller's preferences over trades are represented by a linear profit function: If a seller sells quantity q to a buyer who is of type θ at price p, he earns a profit of $p - c_\theta q$ with this trade. A seller's total profit is then given by the sum of the profits of all trades. In the following analysis, we will consider two different forms of hidden information on the part of buyers that impact a seller's profit:

Private Info I: Private Values
$c_H = c_L = c > 0.$

To consider the standard case in which th trading of a positive quantity is efficient for both type, we assume that $v'_L(0) > c$.

Private Info II: Common Values
$c_H > c_L > 0.$

Let Q^e_θ denote buyer type θ's efficient quantity. Efficient quantities in the above set-up with linear costs are then given by $v'_\theta(Q^e_\theta) = c_\theta$. To ensure that despite the higher marginal cost of serving the H-type, the H-type's higher marginal willingness to pay translates into a larger efficient quantity of H-types under common values, we assume that $c_H < v'_H(Q^e_L)$.

In adverse selection models in which the buyer's preferences are such that the efficient quantity is the same for both types of buyers, as in the Rothschild and Stiglitz (1976) model, $c_H > c_L$ is already sufficient to modify the sellers' strategic incentives under common values in comparison to private values. For the set-up considered here, we must further assume that, for given valuations of quantity $v_\theta(Q)$, the difference between c_H and c_L is large enough such that the H-type will prefer to purchase the L-type's efficient quantity if it were offered at the unit price of c_L. This crucial difference between private and common values is made explicit in the following assumption: $c_H > \frac{v_H(Q_H^e)-v_H(Q_L^e)+c_L Q_L^e}{Q_H^e}$.

2.1.3 Contracting environments

Monopoly/Bilateral Contracting
$m = 1$. The seller proposes a menu of contracts, that is, a set $C \subset \mathbb{R}^2$ of quantity-price bundles that contains at least the no-trade contract $(0, 0)$. A buyer selects one contract from the menu.

Exclusive Competition
Each seller k proposes a menu of contracts as above. A buyer selects one contract from one of the menus C^k offered by the sellers.

Nonexclusive Competition
Each seller k proposes a menu of contracts as above. A buyer selects one contract from up to two of the menus C^k offered by the sellers.

2.2 Equilibrium allocations

For the experiment, we are not primarily interested in the model set-up presented above per se, but rather in the fundamental strategic incentives and the resulting properties of equilibrium allocations in the different contracting environments. For this reason, we review these properties explicitly below.

Definition 1. ***Equilibrium allocation*** *A menu of quantity-price bundles* $((Q_H, P_H), (Q_L, P_L))$ *is an equilibrium allocation if an equilibrium of the contracting game exists in which buyers of type* $H(L)$ *receive a aggregate quantity* $Q_H(Q_L)$ *at aggregate price* $P_H(P_L)$.

Definition 2. ***Properties of equilibrium allocations***

- *Efficiency: A buyer of type* θ *trades her efficient quantity* Q_θ^e.
- *Distortion: A buyer of type* θ *trades a quantity* Q_θ *with* $0 < Q_\theta < Q_\theta^e$.
- *Exclusion: A buyer of type* θ *does not trade, i.e. receives quantity* $Q_\theta = 0$.

Note that we refer to "distortion" only in the case of downward distortions.

2.2.1 Private values

With private values and linear costs, the problem under monopoly is simply the classic problem of monopolistic second-degree price discrimination. There is no distortion at the top, i.e. H-type buyers will receive their efficient quantity, but in order to reduce the information rent of H-type buyers, L-type buyers will not receive their efficient quantity. Thus, for rent extraction purposes, the L-type buyers' trade will be distorted or the L-type buyers even excluded.[8]

When there is competition between sellers, the fact that values are private (i.e., that the constant marginal cost of supply c is independent of the buyers' types), leads to classic price competition on quantity-price bundles. In equilibrium, the buyers' efficient quantities are offered at a unit price of c. Each buyer type optimally chooses his efficient quantity, since buyers maximize the respective utility when the unit price is c, i.e. incentive constraints are satisfied. Hence, when values are private, competitive equilibria are efficient.[9] Note that this holds for both exclusive and nonexclusive competition. Under nonexclusive competition, a seller may try to pivot on a competitor's offer, i.e., to offer a contract to a buyer that is attractive to the buyer if the buyer combines it with the competitor's offer and profitable for the seller. The possibility to pivot on a competitor's offer has, however, no impact: Given efficient quantities, no buyer type has an incentive to purchase further units at the lowest possible unit price c.[10] *Result I* below summarizes these results from the adverse selection literature on equilibrium allocations under private values and linear costs.

Result I. ***Private values - Theory***

(i) Under monopoly, H-type buyers receive their efficient quantity and L-type buyers' trade is distorted or L-type buyers are excluded. If L-type buyers are excluded, H-type buyers do not receive a rent; otherwise, H-type buyers receive a positive rent from trade.

[8]See, e.g., the seminal work of Mussa and Rosen (1978) or standard contract theory textbooks.

[9]For a general proof of the result that adverse selection does not change the set of competitive equilibria when values are private, there are constant returns to scale, and contracting is exclusive, see Pouyet et al. (2008).

[10]To our knowledge, there is no work showing explicitly that, in this model set-up with private values and linear costs, the unique equilibrium allocation under nonexclusive competition is efficient and coincides with that under exclusive competition. However, since the argument is straightforward, we do not provide a proof.

(ii) Under both exclusive and nonexclusive competition, in the unique equilibrium allocation, a buyer of type θ receives his efficient quantity Q^e_θ at unit price c.

2.2.2 Common values

Under common values, given that a buyer has chosen a particular contract, a seller's profit depends on the buyer's type. Under monopoly, a seller's profit-maximizing offer has the same features as under private values: The H-type is not distorted, but the L-type might be distorted downward or excluded in order to reduce the information rent of the H-type.

The crucial difference between private and common values appears when sellers compete: Under private values, competition leads to the efficient allocation. Under common values, the L-type cannot be offered his efficient quantity at marginal cost pricing (i.e., at unit price c_L), since the H-type would prefer it to his own efficient quantity at a unit price of c_H. Under exclusive competition, competition still drives unit prices down to marginal costs, which are now type-dependent. However, the efficient allocation is not incentive compatible. Cross-subsidization cannot occur because, due to single-crossing, there is always a cream-skimming deviation available. The only candidate equilibrium allocation under exclusive competition is thus the Rothschild-Stiglitz (RS) allocation, i.e. the menu in which H-types receives their efficient quantity at a unit price of c_H (H-type RS contract) and the L-types' quantity is, at a unit price of c_L, distorted such that the menu is incentive compatible (L-type RS contract). If the share of H-type buyers γ is high enough such that a pooling deviation is unattractive to L-types compared to their Rothschild-Stiglitz contract, this allocation is the unique equilibrium allocation. However, if the share of H-type buyers is not sufficiently large, an equilibrium in pure strategies in the simple screening game may not exist under exclusive competition.[11] The RS allocation is shown in *Figure 1* in a (Q,T)-diagram in which the H-type and L-type RS quantities are denoted by Q_H^{RS} and Q_L^{RS} respectively.

When competition is nonexclusive, Attar et al. (2011) and Attar et al. (2014) show that further strategic intricacy arises: The possibility to pivot on a competitor's offer now has a bite—contrary to the case of private values. In particular, the fact that a seller can offer a profitable contract to a buyer that is attractive to the buyer if the buyer combines it with the competitor's offer implies that the L-type RS contract cannot be offered in equilibrium: From the binding H-type's incentive constraint in the RS contracts, combining the L-type's RS contract with a contract with quantity

[11] See Rothschild and Stiglitz (1976).

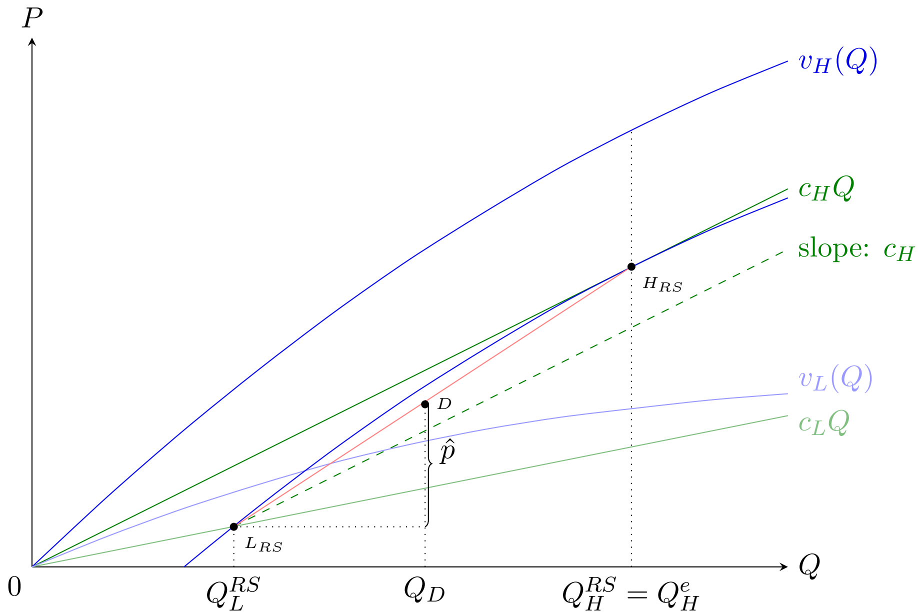


Figure 1: Common Values.

$Q_H^{RS} - Q_L^{RS}$ at a unit price that is slightly higher than c_H – and thus profitable if taken out by H-types – is preferred by H-types over their RS contract alone. This possibility whereby sellers can profitably pivot on competitor's offers of the L-type RS contract is illustrated by the line segment connecting the L-type and H-type RS contracts in *Figure 1*, which has a steeper slope than the cost curve for H-types.[12] In *Figure 1*, if the L-type RS contract is offered by a seller, another seller can offer a contract with quantity $Q^D - Q_L^{RS}$ at price $\hat{p}$. Since $\hat{p} > c_H(Q^D - Q_L^{RS})$, this contract is profitable when taken out by H-types (and, of course, also when taken out by L-types). H-types prefer to combine this contract with the L-type RS contract, reaching point D in *Figure 1*, over their RS contract. However, the seller offering the L-type RS contract would be incurring losses on this contract, since it would be taken out by H-types in combination with other contracts. By similar reasoning, no other quantity intended for L-types can be offered.

Attar et al. (2014) show that the only candidate equilibrium allocation is the one in which H-types receive their efficient quantity but L-types are excluded.[13] An equilibrium with this allocation exists if L-types are unwilling to cross-subsidize H-types

[12]Rothschild (2015) provides an analysis of constrained efficient allocations in nonexclusive linearly priced compulsory insurance markets. Rothschild (2015) shows that, due to the ability to 'convexify' across contracts under linear pricing, feasible allocations have to safisfy 'convexification' constraints. These replace the standard incentive compatibility constraints from exclusive contracting settings.

[13]This corresponds to a degenerate Jaynes-Hellwig-Glosten JHG) allocation. For an analysis of the JHG allocation in an insurance context, see Attar et al. (2016).

for any positive quantity, i.e. if $v'_L(0) \leq \gamma c_H + (1-\gamma)c_L \leq v'_H(0)$.[14] *Result II* below summarizes these results from the adverse selection literature on equilibrium allocations under common values with convex preferences and linear costs.

Result II. ***Common values - Theory***

(i) Under monopoly, H-type buyers receive their efficient quantity and L-type buyers' trade is distorted or L-type buyers are excluded. If L-type buyers are excluded, H-type buyers do not receive a rent, otherwise, H-type buyers receive a positive rent from trade.

(ii) Under exclusive competition, an equilibrium in pure strategies may fail to exist. If an equilibrium exists, H-type buyers receive their efficient quantity Q^e_θ and L-type buyers' trade is distorted. Sellers make zero profits on each trade.

(iii) Under nonexclusive competition, an equilibrium in pure strategies may fail to exist. If an equilibrium exists, H-type buyers receive their efficient quantity Q^e_θ and L-type buyers are excluded. Sellers make zero profits.

3 Experiment

3.1 Experimental design

We apply a 3x2 factorial between-subjects design, varying the level of competition between monopoly, competition with exclusive trade and competition with nonexclusive trade and varying the form of hidden information between private and common values such that there are six experimental treatments. For the nonexclusive competition treatment under common values, we also include a control treatment with slightly altered incentives. The control treatment provides stronger incentives for sellers to exclude L-type buyers than the main nonexclusive competition treatment.

In all treatments, the stage game is repeated for 16 periods and a matching group size of eight players is implemented in each treatment. The assignment to a matching group is random and does not change during the experiment. Within a matching group, four players take on the role of sellers and the other four that of buyers, with two of the

[14] We have only briefly outlined the strategic considerations under nonexclusive competition that we test in the experiment. For an extensive analysis, see Attar et al. (2014). Note that in Attar et al. (2014), there is only one buyer whereas we assume multiple buyers. However, because we assume that each seller can only offer one contract menu to the whole market and not different menus to individual buyers, and that the profit of a seller remains additive, and equal to the sum of the profits he obtains from each buyer, the game remains the same.

latter group acting as L-type buyers and two as H-type buyers. The roles and types are randomly assigned at the beginning of the experiment and do not change during the 16 periods. Individual sellers and buyers cannot be identified such that there is no possibility of individual reputation building.

In the experiment, we discretize the quantities that sellers can offer to buyers. There are three (basic) goods: good A, representing low quantity; good B, representing intermediate quantity; and good C, representing high quantity.

In all treatments, each seller decides in each period for each good $j \in \{A, B, C\}$ whether he wants to offer the good, and, if offered, at what price. In all treatment, the prices can be any integer between 0 and 100 for good A, between 0 and 150 for good B and between 0 and 200 for good C.[15] Thus, in each period, each seller can make a menu offer to buyers.

In the monopoly treatments, each seller is randomly matched with exactly one buyer in the matching group. After observing the menu offer made by the matched seller, a buyer can then make at most one trade, where a trade is the purchase of a good offered by the matched seller at the quoted price. A buyer may also abstain from trading.

In the competition treatments, buyers observe the menus offered by all sellers in their matching group. In the exclusive competition treatments, a buyer can make at most one trade, where a trade is the purchase of a good from one of the sellers in the matching group at the price quoted by this seller for the good. A buyer may also abstain from trading.

In the nonexclusive competition treatments, a buyer can make up to two trades, but at most one trade per seller.[16] If, under nonexclusive competition, a buyer purchases good $j \in \{A, B, C\}$ from seller k in one trade and good $l \in \{A, B, C\}$ from seller $k' \neq k$ in another trade, we say, with a slight abuse of wording and notation for the sake of simplicity, that the buyer purchases good $j + l$. As in the other treatments, a buyer may also abstain from trading.

In all treatments, after buyers have made their purchasing decisions, sellers and buyers observe their period profit. Sellers additionally observe how many trades they conducted, the price charged for each of the goods sold in the trades, and the cost of providing each of the goods. Furthermore, under competition, sellers observe all menus offered in the market[17]; under monopoly, they see only their own menu.

[15] Restricting prices to integers is standard experimental practice.

[16] Sellers in a matching group are randomly assigned a seller number in each period so that buyers can differentiate between the offers of various sellers in a given period. Buyers know that these seller numbers are randomly assigned in each period.

[17] One concern might be that sellers try to collude. Our results in terms of pricing and offer rates do

The valuation of a buyer of type θ for good i is denoted by v_θ^i, $i \in \{A, B, C, A+A, A+B, A+C, B+B, B+C, C+C\}$, and the cost incurred by a seller of providing good $j \in \{A, B, C\}$ to a buyer of type θ is denoted by c_θ^j.[18] Buyers' valuations are shown in *Table 4*, and sellers' costs are displayed in *Table 5*.

Table 4: Valuations.

	Private Values		Common Values	
Good	Low Type	High Type	Low Type	High Type
A	30	45	30	70
B	55	85	55	130
C	65	120	65	185
A + A	50	70	50	120
A + B	70	100	70	190
A + C	78	130	78	200
B + B	85	135	85	210
B + C	90	150	90	230
C + C	95	160	95	255

Table 5: Costs.

	Private Values	Common Values	
Good	Low Type & High Type	Low Type	High Type
A	20	18	50
B	40	35	90
C	60	50	130

A seller's profit per round is 0 if no buyer chooses to trade with the seller. Otherwise, the seller's profit amounts to the sum of the prices for the goods sold less the sum of

not indicate collusive behavior, see *Section 4*.

[18]For notational convenience, in the following cost and valuations are not indexed by private or common values experimental treatments, as these are always considered separately.

the costs for providing the goods. In any treatment, if a buyer does not trade, her profit per round is 0. Under monopoly and exclusive competition, a buyer of type θ's profit from purchasing good $j \in \{A, B, C\}$ at price p^j is the valuation v^j minus the price p^j. Under nonexclusive competition, if a buyer of type θ purchases good $i \in \{A, B, C, A + A, A + B, A + C, B + B, B + C, C + C\}$, the buyers' profit amounts to v^i_θ minus the sum of prices paid in the buyer's trades.

Our parameterization differs between private and common values settings, as sellers' costs for providing a particular good vary between L and H-type buyers under common values. In order to ensure that the private and common value markets are comparable in terms of surplus generation, we choose a parametrization that leads to equal total gains of trade under symmetric information.

Control treatment under common values We include an additional control treatment (*CV CompNE Control*) for nonexclusive competition under common values. In the control treatment, we adapt H-type buyers' valuations for goods $A + A$, $A + B$, $A + C$ etc. to slightly modify incentives (see Section 3.3). In particular, incentives to exclude L-type buyers are even stronger. The valuations for *CV CompNE Control* are shown in *Table 6*.

Table 6: Valuations in *CV CompNE Control*.

	Common Values Control	
Good	Low Type	High Type
A	30	70
B	55	130
C	65	185
A + A	50	120
A + B	68	190
A + C	75	220
B + B	78	225
B + C	85	255
C + C	90	270

Table 7: Number of subjects and matching groups (in parentheses) per treatment.

		Form of hidden information	
		Private values	Common values
Contracting environment	Monopoly/Bilateral	PV Mon 64 (8)	CV Mon 64 (8)
	Exclusive Competition	PV CompE 64 (8)	CV CompE 64 (8)
	Nonexclusive Competition	PV CompNE 56 (7)	CV CompNE 48 (6) CV CompNE - Control 32 (4)

3.2 Procedures

The experimental sessions were conducted in March and April 2016 at the ETH Decision Science Laboratory. In total, 392 subjects participated in the experiment. Participants were on average 22.46 years old, and 59.69% of the participants were female. Almost all participants were enrolled students (96.17%). Among these, more than one fourth was enrolled for natural sciences, 15% for engineering, 13% for medicine and for humanities each, and 12% for economics.

In each of the treatments except the nonexclusive competition treatment under common values, 64 subjects participated; we conducted the *CV CompNE* treatment with 48 subjects, and 32 subjects participated in the control treatment (*CV CompNE Control*) with slightly altered incentives.[19] In one session of the *PV CompNE* treatment, eight subjects had to be sent home after one participant became ill while answering the control questions.[20] The number of participants and matching groups per treatment are displayed in *Table 7*. We recruited participants using ORSEE (Greiner, 2015) and performed the experiments using z-Tree (Fischbacher, 2007).

Subjects participated in exactly one session. The average time per session was about two hours. Participants earned on average 53.18 CHF. The instructions were read aloud at the beginning of each session to demonstrate common knowledge. A comprehensive set of control questions ensured that all participants understood the sequence of decisions in the experiment and the payoff consequences.

[19]Thus, in total 80 subjects participated in nonexclusive competition under common values.

[20]In accordance with the consent form signed by all participants, the participant who became sick was not paid. All other participants received their expected payoff of 50 CHF.

After the experiment we elicited risk preferences using Holt and Laury (2002) and social preferences using Kerschbamer (2015). For the elicitation of risk preferences, we double the amounts used by Holt and Laury (2002) to account for inflation and higher opportunity costs in Switzerland than in the US. Of our participants, 93% (365 out of 392) made consistent choices[21] whereas Holt and Laury find up to 25% inconsistent choices. However, similar to the original study (5.3 out of 10), the average number of safe choices in our experiment amounted to 5.81 out of 10. For the social preference test, we obtained qualitatively similar results to those of Kerschbamer (2015).[22]

3.3 Hypotheses

In the experiment, we restricted the available quantities that sellers could offer to 3 options in the form of goods A, B, and C. The experimental set-up and parametrization was chosen to provide the crucial incentives and strategic considerations from the adverse selection set-up presented in *Section 2* so that some of the most prominent results from the theoretical literature could be tested. In both the private and common values treatments, the efficient goods are good C for H-types and good B for L-types. The purchase of good A is a distortion for any buyer type in any treatment.

The experimental set-up and parametrization is such that under the assumption of rationality and expected payoff maximization, an equilibrium in pure strategies exists in each treatment; more, the equilibrium allocation is unique and has the properties summarized below:

Lemma 1. *Under private values,*

(i) in PV Mon*, in the unique equilibrium allocation a H-type buyers receive their efficient good C and L-type buyers are excluded. Good C is traded at price v_H^C.*

(ii) in PV CompE*, in the unique equilibrium allocation, H-type buyers receive their efficient good C and L-type buyers receive their efficient good B. Good C is traded at price p^C with $p^C \in \{c^C, c^C+1\}$ and good B is traded at price p^B with $p^B \in \{c^B, c^B+1\}$.*

[21] 21 participants switched more than once and 6 participants did not switch at all. Due to the low number of inconsistent choices, we follow Holt and Laury's approach and use the number of safe choices as an indicator for risk aversion even when the choices were not consistent. We base our analysis with respect to risk aversion on all 392 subjects.

[22] Kerschbamer (2015) differentiates between nine different social preference types. *Figure 14* in *Appendix D* shows the distribution of the nine types across all subjects. In Section 4, we discuss that our results cannot be explained by the preference types elicited from the social preference test.

(iii) the unique equilibrium allocation in PV CompNE *coincides with that in* PV CompE.

Furthermore, under common values,

(iv) in CV Mon*, in the unique equilibrium allocation H-type buyers receive their efficient good C and L-type buyers are excluded. Good C is traded at price v_H^C.*

(v) in CV CompE*, a pure strategy equilibrium exists and in the unique equilibrium allocation, H-type buyers receive their efficient good C and L-type buyers' trade is distorted, receiving good A. Good C is traded at price p^C with $p^C \in \{c_H^C, c_H^C + 1\}$ and good A is traded at price p^A with $p^A \in \{c_L^A, c_L^A + 1\}$.*

(vi) in CV CompNE *and* CV CompNE Control*, a pure strategy equilibrium exists and in the unique equilibrium allocation, H-type buyers receive their efficient good C and L-type buyers are excluded. Good C is traded at price p^C with $p^C \in \{c_H^C, c_H^C + 1\}$.*

Proof. See *Appendix A*. □

Note that in the experiment, the prices that sellers can post are restricted to be integers, such that under competition equilibria exist in which the equilibrium price is 1 above the cost, since undercutting does not increase profits in this case. In the following analysis, we will reason with cost pricing; however, everything holds for prices just above the costs.

In *PV Mon*, there is standard "no distortion at the top", i.e. the efficient good C for H-types is offered. In the chosen parametrization, a seller's profit from offering only good C at price $v_H^C = 120$ (thus excluding L-type buyers), is higher than the profit from offering any menu that includes either good A or good B at a price at which a L-type buyer would have a nonnegative payoff from buying either good.

Under competition, prices for each good are driven down to the cost of providing the respective good. At cost pricing, under both exclusive and nonexclusive competition, buyers of type H then maximize their payoff by choosing good C and buyers of type L maximize their payoff by choosing good B .

In *CV Mon*, although the costs of providing a good depend on the buyer's type, a seller's profit-maximization problem is similar to that under private values as discussed in section 2. There is standard "no distortion at the top", i.e., the efficient good C for H-types is offered. In the chosen parametrization, a seller's profit from offering only good C at price $v_H^C = 185$ (thus excluding L-type buyers), is higher than the profit from offering any menu that includes either good A or good B at a price at which an L-type buyer would have a nonnegative payoff from buying either good.

Under exclusive competition (*CV CompE*), the prices for each good are driven down to the cost of providing the respective good. Good B, which is the efficient good for an L-type buyer, cannot be offered at a price at which an L-type buyer would purchase it without it also being preferred by a H-type buyer over good C even when good C is offered at cost pricing. However, pooling on B cannot be sustained, since $v_L^B < \frac{c_L^B + c_H^B}{2}$.[23] Good A can be offered at a price p^A with $p^A \in \{c_L^A, c_L^A + 1\}$ without being attractive to H-types if good C is offered at price p^C with $p^C \in \{c_H^C, c_H^C + 1\}$: The payoff of a H-type buyer from buying good A at price $c_L^A = 18$ is $v_H^A - c_L^A = 70 - 18 = 52$ which is lower than her payoff from buying good C at price $c_H^C + 1$ (which amounts to $v_H^C - (c_H^C + 1) = 54$), i.e. the menu of good C at H-type cost pricing and A at L-type cost pricing satisfies incentive compatibility.[24] As noted above, there is no profitable pooling deviation on good B; furthermore, the same is true for good C. Thus, an equilibrium exists in which H-type buyers receive good C and L-type buyers are distorted, receiving good A, and the equilibrium allocation is unique.

Under nonexclusive competition (*CV CompNE*), in equilibrium good C must be offered at H-type cost pricing: Good C is the H-type's efficient good, and there is no pooling on goods A, B or C since L-types are not willing to purchase any good at a pooled price that does not entail losses for sellers.[25] Competition ensures that good C is always offered at H-type cost pricing. However, in contrast to *CV CompE*, good A can not be offered in equilibrium to L-type buyers at a price at which L-type buyers would be willing to purchase good A:[26] At any such price, good B can be offered at a price that would be when taken out by H-types, and H-types would then prefer to purchase $A + B$ instead of C at H-type cost pricing. For an example, suppose that good A is offered at price $v_L^A = 30$ by some seller and good B is not offered. Then,

[23] Note that, in adverse selection models with exclusive competition, pooling generally cannot be sustained: Due to single-crossing, a cream-skimming deviation is always possible. This is also the case here, where cream-skimming is possible with good A. However, in our parametrization there is an even simpler reason for the non-sustainability of pooling, namely the fact that the L-type's valuations are too low for a profitable pooling on good B or good C. Observe that this latter feature is chosen deliberately as it is necessary for existence of equilibrium under nonexclusive competition in the general model.

[24] With regard to the incentive compatibility for L-types, an L-type buyer's valuation for good C is lower than c_H^C.

[25] Furthermore, there cannot be pooling across sellers on combinations of goods since for any such market constellation, either a buyer type is unwilling to purchase at prices that do not entail losses for sellers, or there exists a profitable deviation by either a buyer or a seller as shown in proof of Lemma 1.

[26] The reasoning that explains why good B cannot be offered to buyers of type L is the same as under exclusive competition above.

another seller could offer good B at price $95 > c_H^B$, and H-types would receive a payoff of $v^{A+B} - 30 - 95 = 190 - 125 = 65$ which is larger than 55, an H-type's payoff from purchasing good C at price c_H^C. Thus, if good A is offered at a price at which an L-type would be willing to purchase it, either offering good B additionally would be a profitable deviation for some seller, or some H-type buyer would like to combine good A and already offered good B such that good A is loss-making. Thus, in equilibrium, H-type buyers receive good C, and L-type buyers are excluded.[27]

Table 8: Experimental set-up – Predictions.

	Private Values	Common Values
Monopoly	Efficient trade for H-types L-types **excluded** No rent for H-typse Positive profits for sellers	Efficient trade for H-types L-types **excluded** No rent for H-types Positive profits for sellers
Exclusive Competition	Efficient trade for H-types **Efficient** trade for L-types Rent for L and H-types Zero profits for sellers	Efficient trade for H-types L-types' trade is **distorted** Rent for L and H-types Zero profits for sellers
Nonexclusive Competition	Efficient trade for H-typse **Efficient** trade for L-types Rent for L and H-types Zero profits for sellers	Efficient trade for H-types L-types **excluded** Rent for H-types Zero profits for sellers

In the control treatment *CV CompNE Control*, we adapt H-type buyers' valuations such that these buyers have an incentive not only to purchase $A+B$ if B is offered, but also to purchase good $A+C$ if sellers offer good A at a price that is attractive for L-types (see *Table 6*).[28] Thus, our control treatment provides an even stronger incentive for sellers to exclude L-type buyers than in *CV CompNE*. In *CV CompNE Control* in

[27]In our experimental set-up, to sustain equilibrium sellers offer good B at cost pricing. This is the equivalent, in terms of strategic logic, of latent contracts where H-types can buy any quantity at their unit costs in the continuous framework.

[28]In *CV CompNE Control*, only valuations for goods $A+A$, $A+B$, etc. are modified compared to *CV CompNE*. The relevant modified valuations are v_H^{A+B} and v_H^{A+C}.

equilibrium, H-types receive their efficient good C and L-type buyers are excluded. *Table 8* provides an overview of the results and implications of Lemma 1. On this basis, we can formulate our hypotheses for the private and common value treatments:

Hypothesis 1. *(Private Values)*

a) *(Exclusion rates) The exclusion rate of L-type buyers is higher in* PV Mon *than in* PV CompE *and* PV CompNE*.*

b) *(Rejection rates) Average rejection rates of L-type buyers are lower in* PV CompE *and* PV CompNE *than in* PV Mon*. Average rejection rates of H-type buyers do not differ between* PV Mon*,* PV CompE *and* PV CompNE*.*

c) *(Traded goods) On average, more goods B are traded by L-type buyers in* PV CompE *and* PV CompNE *than in* PV Mon*. Average trade rates of good C by H-type buyers do not differ between* PV Mon*,* PV CompE *and* PV CompNE*.*

d) *(Price offers) Average prices for traded goods C are lower in* PV CompE *and* PV CompNE *than in* PV Mon*.*

e) *(Surplus) Average total surplus is lower in* PV Mon *than in* PV CompE *and* PV CompNE*.*

Hypothesis 2. *(Common Values)*

a) *(Exclusion rates) The exclusion rate of L-type buyers is higher in* CV Mon *and* CV CompNE[29] *than in* CV CompE*.*

b) *(Rejection rates) Average rejection rates of L-type buyers are lower in* CV CompE *than in* CV Mon *and* CV CompNE*. Average rejection rates of H-type buyers do not differ between* PV Mon*,* PV CompE *and* PV CompNE*.*

c) *(Traded goods) On average, good A is bought more often by L-types in* CV CompE *than in* CV Mon *and* CV CompNE*. Average trade rates of good C by H-type buyers do not differ between* CV Mon*,* CV CompE *and* CV CompNE*.*

d) *(Price offers) Average prices posted for goods C are higher in* CV Mon *than in* CV CompE *and* CV CompNE*.*

e) *(Surplus) Average total surplus is lower in* CV Mon *and in* CV CompNE *than in* CV CompE*.*

[29] Since the predictions for *CV CompNE Control* are the same as those for *CV CompNE*, in the following we refer to both treatments jointly under *CV CompNE* in formulating the hypotheses.

4 Results

We first provide an overview of the descriptive results for all treatments in summarizing Figure 2. These charts depict sellers' offer rates for each of the three goods A, B, and C, the exclusion rate of L-type buyers, interaction shares, and shares of the goods bought by each buyer type. Sellers' offer rates represent the share of offer decisions for which sellers decided to offer the respective good. The exclusion rate of L-type buyers is defined as the rate of bu ying decisions for which the maximum attainable payoff of L-types from trading is negative. We define interaction shares as the rate of buying decisions in which buyers decide to purchase at least one good. For the shares of goods bought, we indicate by means of shaded bars (to the right) whether the decision made by each buyer type was payoff-maximizing given the available contract offers.

This overview is followed in Section 4.1 by a discussion of our results related to each of our hypotheses. We report non-parametric test results based on two-tailed *Mann-Whitney U* tests if not stated otherwise. The results are reported to be (weakly) significant if the two-tailed test's p-value is less than 0.05 (0.10). We consider the average over all individuals in a matching group and over all periods as one independent observation.[30]

4.1 Comparisons between treatments: Testing hypotheses and discussion

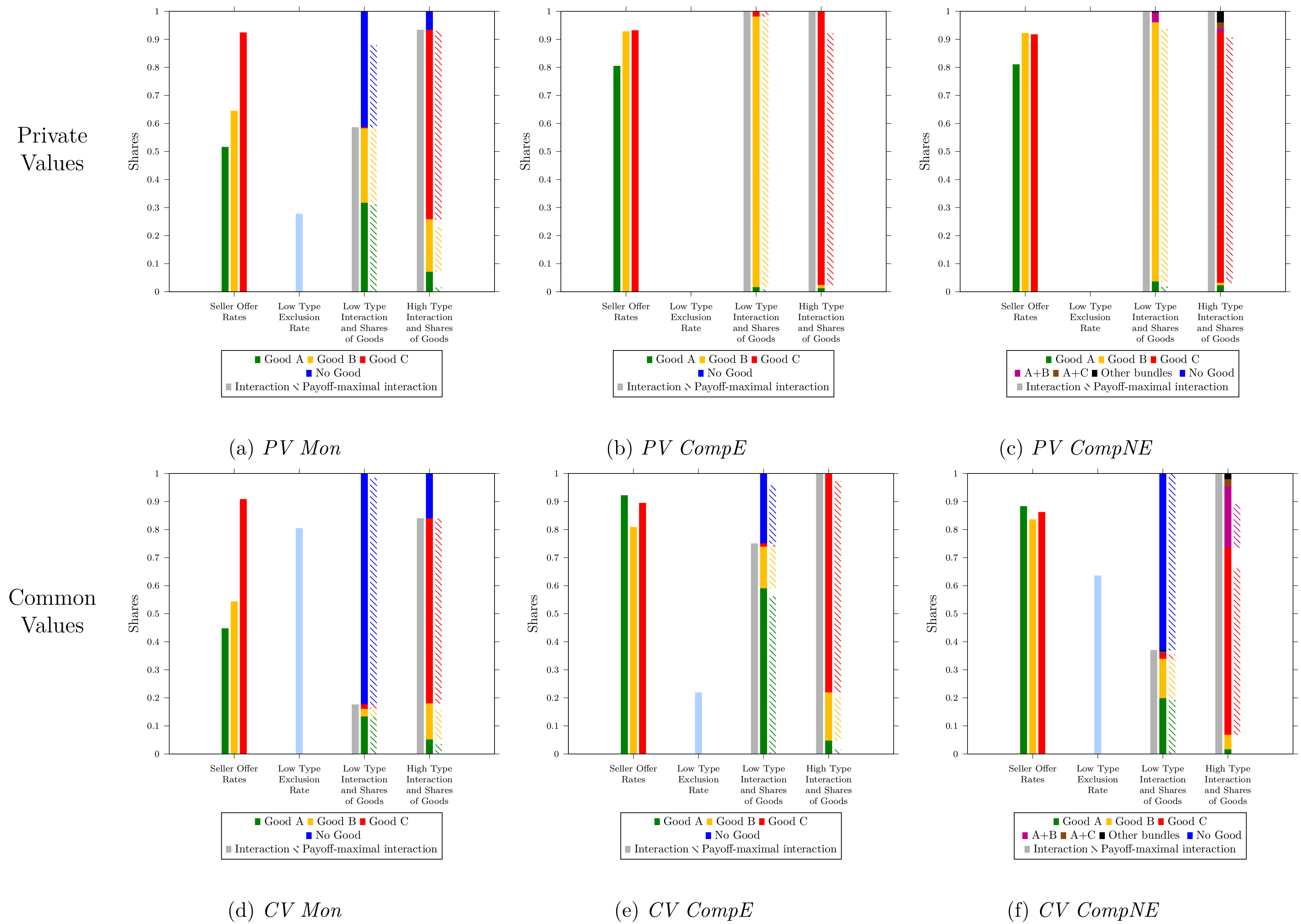
We now turn to a comparison of treatment differences in which we test our hypotheses and a discuss the results. For both private and common values, we first provide an overall qualitative result that is subsequently substantiated by the hypothesis testing and discussion.

4.1.1 Private values

Result Overall PV Results. *There is partial exclusion of L-types in* PV Mon*. The efficient allocation is attained in* PV CompE *and* PV CompNE*. Surplus is higher under competition than in* PV Mon*.*

Table 9 provides an overview across the private values treatments. We start with the exclusion rate of L-types.

[30]When reporting average prices, we discard 10 out of 2295 sellers' offers of good A, 3 out of 2444 sellers' offers of good B and 4 out of 2839 sellers' offers of good C in our analysis because the prices considerably exceeded both buyer types' valuations, i.e. prices were more than 200 ECU.



(a) *PV Mon* (b) *PV CompE* (c) *PV CompNE*

(d) *CV Mon* (e) *CV CompE* (f) *CV CompNE*

Figure 2: Results for all treatments at a glance.

Table 9: Comparison across PV treatments.

Variable	PV Mon	PV CompE	PV CompNE
Offer Rates Seller Level			
Good A	51.56%[a b]	80.47%[a]	81.03%[b]
Good B	64.45%[a b]	92.77%[a]	92.19%[b]
Good C	92.38%	93.16%	91.74%
Offer Rates Market Level			
Good A	51.56%[a b]	100.00%[a]	100.00%[b]
Good B	64.45%[a b]	100.00%[a]	100.00%[b]
Good C	92.38%[a b]	100.00%[a]	100.00%[b]
Offer Rates Market Level Attracting L-Type			
Good A	43.95%[a b]	100.00%[a]	100.00%[b]
Good B	38.09%[a b]	100.00%[a]	100.00%[b]
Good C	4.10%[a b]	89.84%[a]	97.32%[b]
Average Price Posted			
Good A	29.49[a]	24.64[a]	27.72
Good B	59.04[a b]	45.19[a]	48.58[b]
Good C	92.25[a b]	67.56[a]	69.38[b]
Average Price per Trade			
Good A	26.35[a]	21.86[a c]	30.91[c]
Good B	52.82[a b]	41.52[a]	41.83[b]
Good C	89.36[a b]	61.43[a]	61.53[b]
Good A+A	-	-	45.67
Good A+B	-	-	71.00
Good A+C	-	-	86.00
Good B+B	-	-	83.00
Good B+C	-	-	103.33
Good C+C	-	-	124.00
Exclusion Rate			
L-Type Buyer	27.73%[a b]	0.00%[a]	0.00%[b]
Interaction Rates			
L-Type Buyer	58.59%[a b]	100.00%[a]	100.00%[b]
H-Type Buyer	93.36%[a b]	100.00%[a]	100.00%[b]
Shares H-Type Buyer Purchasing			
Good A	7.03%	1.17%	2.23%
Good B	18.75%[a b]	1.17%[a]	0.89%[b]
Good C	67.58%[a b]	97.66%[a]	89.29%[b]
Good A+B	-	-	1.34%
Good A+C	-	-	2.23%[b c]
Other Bundles	-	-	4.02%
Shares L-Type Buyer Purchasing			
Good A	31.64%[a b]	1.56%[a]	3.57%[b]
Good B	26.56%[a b]	96.48%[a]	92.41%[b]
Good C	0.39%	1.95%	0.00%
Good A+B	-	-	3.57%[b c]
Good A+C	-	-	0.00%
Other Bundles	-	-	0.45%

Mann-Withney U-tests for pairwise differences between treatments
[a] Significant PV Mon versus PV CompE ($p < 0.05$)
[b] Significant PV Mon versus PV CompNE ($p < 0.05$)
[c] Significant PV CompE versus PV CompNE ($p < 0.05$)

Result 1.a. *L-type buyers are excluded from trading in* PV Mon *significantly more often than in* PV CompE *and* PV CompNE.

Result 1.a confirms *Lemma 1.a.* L-type buyers are excluded from trading in 27.73% of all buying decisions[31] in *PV Mon* but are never excluded from trading in *PV CompE* or *PV CompNE* (MWU: p=0.0012 resp. p=0.0021). Competition drives prices down to costs for the goods, ensuring the efficiency of trade.

Although the exclusion rate in *PV Mon* is significantly higher than in the competitive treatments, it is substantially lower than predicted in Lemma 1.(i). This may be due to the rather small difference in expected profits between excluding and nonexcluding menus: The expected profit obtained by excluding L-type buyers of $0.5*(v_H^C - c^C) + 0.5*0 = 30$ is only slightly higher than the profit from offering a separating menu with goods A and C which yields a profit of $0.5*[v_L^A - c^A] + 0.5*[v_H^C - (v_H^A - v_L^A) - c^C] = 27.5$. In 30.66% of all periods, sellers in fact offer a contract menu based on good A and good C that separates L- and H-type buyers with prices $p_A \in [c^A, v_L^A]$ and $p^C \in [v_H^C - (v_H^A - p_A)]$ and a sufficiently high price for good B. We also observe a considerable share of periods (17.77%) in which sellers post separating prices based on goods B and C at prices $p_B \in [c^B, v_L^B]$ and $p_C \in [v_H^C - (v_H^B - t^B)]$ and a sufficiently high price for good A. The expected profit also amounts to $0.5*[v_L^B - c^B] + 0.5*[v_H^C - (v_H^B - v_L^B) - c^C] = 27.5$ and is thus again only slightly less than the expected profit from an L-type excluding offer.[32]

A further factor may be that sellers are risk averse and thus post price menus that will attract both buyer types. Sellers thereby ensure a positive profit in each period independent of whether the matched buyer is an L- or an H-type buyer. In fact, the risk elicitation task shows that sellers are on average risk averse (6.06 out of 10 on the Holt and Laury (2002) scale) in *PV Mon*. We also find descriptive evidence for this explanation: Of the risk-averse sellers, 24.29% post L-type excluding menus whereas 44.79% of risk-neutral or risk-loving sellers post an excluding price menu. However, only five out of 32 sellers were classified as risk-neutral and only one as risk loving. The low number of non-risk-averse sellers may explain why a parametric analysis does not give support to this explanation (see *Table 10*).[33] Thus, overall, the small differences in

[31] A buying decision is a situation in which buyers can decide whether and with which seller(s) to make up to one trade (up to two trades) in the monopoly and exclusive competition (nonexclusive competition) treatments.

[32] Hoppe and Schmitz (2013) find a low type exclusion rate of about 90% in a set-up in which sellers (employers) do not offer menus but instead choose a single price (wage). In their set-up, the relative difference in expected profits between an excluding and a nonexcluding wage offer is considerably higher than in our *PV Mon* treatment.

[33] In line with theoretical predictions, we find virtually no exclusion under *PV CompE* and *PV*

expected profits are likely to explain why sellers offer nonexcluding menus in *PV Mon*, in particular when we take risk aversion into account.[34]

Table 10: Random effects panel probit regressions on sellers' likelihood of posting L-type buyers' excluding offers, with robust standard errors on the subject level.

Seller posts *L-type* buyer excluding price menu	M1	M2
Period	-0.003	-0.003
	(0.028)	(0.028)
Risk aversion	-0.041	-0.151
	(0.200)	(0.196)
=1 if Female		0.897
		(0.604)
Age		-0.046
		(0.104)
Social preferences	No	Yes
Constant	-0.822	0.811
	(1.202)	(2.798)
Observations	512	480

Standard errors in parentheses are clustered on subject level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Social preferences do not significantly impact the probability of sellers posting a menu that excludes L-type buyers.

Regression results also suggest that the impact of social preferences on the likelihood of exclusion is not significant in *PV Mon*. This finding may be explained by the strict market setting that we apply for which previous literature has shown that social preferences play less of a role.

Result 1.b. *Average rejection rates of L-type buyers and H-type buyers are significantly higher in* PV Mon *than in* PV CompE *and* PV CompNE*.*

Comparing sellers' offer rates across treatments, we find significantly higher offer rates for good B (good A) under *PV CompE* and *PV CompNE* than under *PV Mon* (MWU: p=0.001 (p=0.003) and p=0.002 (p=0.009), respectively, for good B (good A)).

Higher offer rates for goods A and B in *PV CompE* and *PV CompNE* translate into significantly lower rejection rates of L-type buyers than in *PV Mon* (MWU: p<0.001

CompNE. We hence only report regression results on exclusion rates with respect to *PV Mon*.

[34] The models are based on a continuous risk aversion variable. However, using a binary variable indicating whether the seller is risk averse or not does not lead to different results.

and p<0.001) as predicted. Whereas we observe full interaction in the competitive market settings under private values, in *PV Mon*, we observe that more than 40% of the *L*-type buyers refuse to interact.

In contrast to theoretical predictions, we also find a significantly higher rejection rate of *H*-type buyers in *PV Mon* than in *PV CompE* and *PV CompNE* (MWU: p=0.004 and p=0.006). However, the descriptives show that whereas we observe full interaction of *H*-type buyers in *PV CompE* and *PV CompNE*, *H*-type buyers' interaction rates in *PV Mon* are only slightly lower, at 93.35%.

A closer look at these *H*-type buyers that decline to interact is warranted. Social preferences such as inequity aversion may drive *H*-type buyers refusal to interact if payoffs from interacting differ substantially between sellers and *H*-type buyers. In fact, we observe that the average price paid per trade by *H*-type buyers for good *A* (*B* / *C*) is 27.89 (54.67 / 89.50) whereas prices offered when the *H*-type buyers rejected to interact amounted to 44.00 (75.40 / 110.93).[35] This indicative evidence of the potential role of inequity aversion is however not reflected in the findings from our social preference elicitation task. Only one *H*-type buyer was classified as inequality averse in *PV Mon* and this buyer never refused to interact. Rather, 12 of the *H*-type buyers refusing to interact were selfish types, 15 were maximins, and four were spiteful.

Result 1.c. *On average, significantly more goods B are traded by L-type buyers in* PV CompE *and* PV CompNE *than in* PV Mon*. The trade rate of good C by H-type buyers is significantly lower in* PV Mon *than in* PV CompE *and in* PV CompNE.

Higher offer rates for good *B* (as well as lower prices posted) also lead to a more efficient provision of goods in *PV CompE* and *PV CompNE* than in *PV Mon.* Whereas *L*-type buyers purchase good *B* in 26.56% of all buying decisions in *PV Mon*, *L*-type buyers purchase their efficient good in 96.48% of all buying decisions in *PV CompE* and in 92.41% in *PV CompNE*. These results confirm *Lemma 1.c* that significantly more goods *B* are traded by *L*-type buyers in *PV CompE* and *PV CompNE* than in *PV Mon* (MWU: p=0.001 resp. p=0.001).

Also in line with theory, *H*-type buyers purchase their efficient good *C* in both treatments with competition.[36] In contrast to our prediction, the trade rate of good *C* among *H*-type buyers (67.58%) is significantly lower in *PV Mon* than in *PV CompE*

[35] Note that there are not enough price observations per matching group for non-interacting *H*-type buyers to test significance.

[36] The excess principal treatment in Cabrales et al. (2011) is similar to our *PV CompNE*. However, due to variations in design and data presentation, we cannot compare our results in terms of efficient trade.

and *PV CompNE* (MWU: p=0.001 resp. p=0.004). The reason for this deviation from predictions on the part of H-type buyers is that purchasing good B instead of good C in these cases was almost always (85.42%) payoff-maximizing. As discussed above, sellers might offer good B in *PV Mon* due to risk aversion.

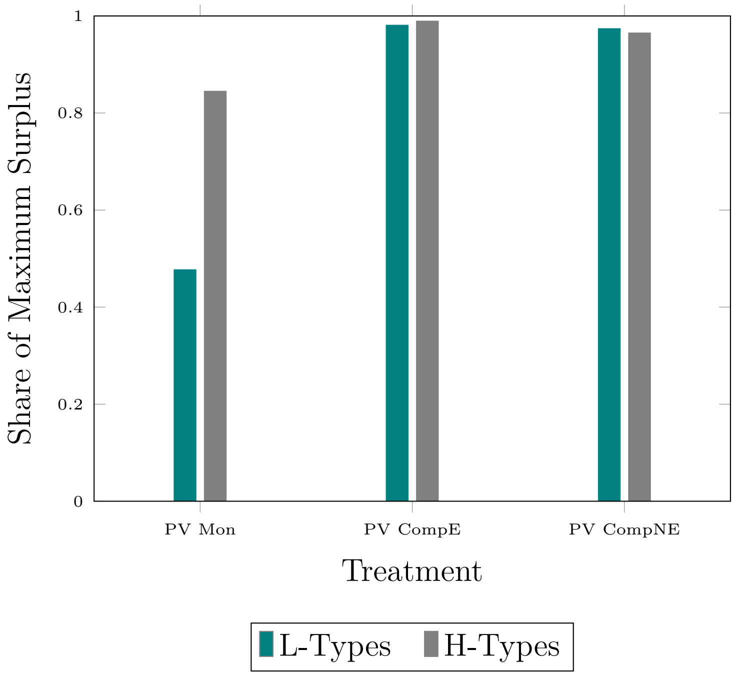
Result 1.d. *Average prices for traded goods C are significantly lower in* PV CompE *and* PV CompNE *than in* PV Mon*.*

Tables 9 shows the average prices posted per seller and period and average prices paid per trade in the three private value treatments. The average price paid per trade for good B is 52.82 in *PV Mon*, 41.52 in *PV CompE*, and 41.83 in *PV CompNE*; for good C the average price paid per trade are 89.36 (*PV Mon*), 62.30 (*PV CompE*) and 61.71 (*PV CompNE*). In line with *Lemma 1.d*, the prices offered for good C are significantly higher in *PV Mon* than in *PV CompE* and *PV CompNE* (MWU: p=0.001 and p=0.002 respectively); nonetheless, the average price per trade for good C in PV Mon is significantly lower than predicted (Wilcoxon Signed Rank Test: p=0.0117). The average price per trade for good C splits the surplus of a trade in *PV Mon* almost equally between seller and H-type buyer. This finding can be interpreted as sellers taking into account potential inequality aversion on the part of buyers instead of seeking to extract all possible surplus from H-type buyers. Looking at the buyers, our elicitation of social preferences suggests that only one of the 32 buyers in *PV Mon* was inequity averse. However, sellers' uncertainty over how a particular buyer will react to an unequal offer may drive posted prices down and lead to the equal split of surplus. These findings are similar to the results of Hoppe and Schmitz (2015): In their private values setting, most monopolists post separating price menus when it is profitable to do so, but then prices are such that they split the surplus between the seller and H-type buyers close to equally whereas L-type buyers receive about one third of the surplus.[37] Note that, by reducing the profit made on H-type buyers by sellers, this may increase sellers incentives to offer good A or good B to buyers of type L, which might partially explain the lower experimental exclusion rates of L-type buyers in *PV Mon* than predicted by theory when social preferences do not play a role.

Observe as well that in *PV CompE* and *PV CompNE*, average price paid per trade for good B and good C are only marginally above the competitive prediction. We find that this is stable across periods such that there is no evidence of successful collusion on price on the part of sellers.

[37]Similarly, Cabrales et al. (2011) find that monopolistic principals who can select among six exogenous menus—none of which is exclusionary—choose a menu that offers agents slightly higher payoffs than the equilibrium menu more often than the equilibrium menu.

Figure 3: Surplus per buyer type for private value treatments.



Result 1.e. *Average total surplus is significantly lower in* PV Mon *than in* PV CompE *and* PV CompNE*.*

Figure 3 shows the surplus per buyer type as a share of maximum attainable surplus per buyer type for all private values treatments. Due to some exclusion of L-type buyers in *PV Mon* and close to efficient allocations under competition, we observe a significantly higher surplus in *PV CompE* and *PV CompNE* than in *PV Mon* supporting *Lemma 1.e* (MWU: $p<0.001$ resp. $p=0.002$). A virtually maximal surplus is attained under competition.

To sum up, competition—both exclusive and nonexclusive—increases offer rates, drives down prices, and thus leads to an efficient provision of goods for L- and H-type buyers. The higher surplus in *CV Mon* due to lower than predicted exclusion rates is partially reduced by H-types, as H-type buyers refuse to interact when prices posted for good C do not result in rents being shared between sellers and H-type buyers. We do not include a separate analysis of behavior over time, as exclusion rates, offer rates and prices are fairly stable over time.[38]

[38]The full regression model on L-type excluding offers for PV in *Appendix B* shows that neither the period coefficient nor the coefficients for the interaction terms of PV treatments and period are significant.

4.1.2 Common values

Result Overall CV Results. *L-types are largely distorted but not excluded from trading in* CV CompE. *In contrast, L-types are mostly excluded from trading in* CV CompNE *and in* CV Mon. *Surplus is higher in* CV CompE *than in* CV Mon *and* CV CompNE.

Table 11 provides an overview across the common values treatments. We start again with the key part, the exclusion rate of L-types.

Result 2.a. *L-type buyers are significantly more often excluded from trading in* CV Mon *and* CV CompNE *than in* CV CompE.

Result 2.a supports *Lemma 2.a.* The exclusion rate of L-type buyers of 80.47% in *CV Mon* and 63.54% in *CV CompNE* is significantly higher than the exclusion rate of 21.88% in *CV CompE* (MWU: $p = 0.0013$ resp. $p = 0.0265$). Sellers again exclude L-type buyers by posting prices for the goods that are higher than the L-type buyers' valuations or by not offering goods. This finding supports the theoretical prediction that L-types are excluded under monopoly and nonexclusive competition but not under exclusive competition.

Offer rates for good A (good B) are significantly lower in *CV Mon* than in *CV CompE* and *CV CompNE* (MWU: p<0.0001 (p=0.0100), p=0.0019 (p=0.0098)). Sellers offer good A (good B) in *CV Mon* in 44.72% (54.30%) of the periods; offer rates increase to 92.18% (80.85%) in *CV CompE* and 84.37% (88.28%) in *CV CompNE.* However, note that conditional on offering good A (B / C), 92.60% (96.24 / 97.74%) of the prices posted exceed the L-type buyers' valuation in *CV CompNE.* Nevertheless, as customers can choose between different sellers in *CV CompNE*, the exclusion behavior of individual sellers has less impact on the L-type buyers' exclusion rate than in *CV Mon* such that the L-type buyers' exclusion rate in *CV CompNE* is lower than in *CV Mon.* Using parametric regressions, we further investigate whether additionally risk aversion and/or social preferences play a role in sellers' decisions to post an L-type excluding offer.

We perform the regression analysis for each treatment separately as dynamics are heterogeneous across treatments. The separate analysis further allows for a direct interpretation of the coefficients rather than an interpretation relative to the reference treatment.[39]

[39]The comprehensive regression including all treatments under private respectively common values is relegated to Appendix B.

Table 11: Comparison across CV treatments.

Variable	CV Mon	CV CompE	CV CompNE	Control
Offer Rates Seller Level				
Good A	44.73%[a,b,c]	92.19%[a]	88.28%[b]	84.38%[c]
Good B	54.30%[a,b,c]	80.86%[a]	83.59%[b]	83.20%[c]
Good C	90.82%	89.45%	86.20%	87.50%
Offer Rates Market Level				
Good A	44.73%[a,b,c]	100.00%[a]	100.00%[b]	100.00%[c]
Good B	54.30%[a,b,c]	100.00%[a]	100.00%[b]	100.00%[c]
Good C	90.82%[a,b,c]	100.00%[a]	100.00%[b]	100.00%[c]
Offer Rates Market Level Attracting L-Type				
Good A	12.70%[a]	74.22%[a,d,e]	36.46%[d]	21.88%[e]
Good B	4.30%[a]	20.31%[a]	19.79%	9.38%
Good C	1.76%[c]	3.13%	13.54%	6.25%[c]
Average Price Posted				
Good A	52.86[a]	44.00[a,e]	50.92	52.42[e]
Good B	109.96[a,b,c]	94.46[a]	94.82[b]	95.09[c]
Good C	161.31[a,b,c]	136.61[a]	135.56[b]	136.05[c]
Average Price per Trade				
Good A	31.15[a,b]	24.19[a]	24.71[b]	23.84
Good B	83.75[a]	46.78[a]	45.08	50.60
Good C	156.65[a,b,c]	127.80[a]	118.34[b]	126.51[c]
Good A+A	-	-	71.00	56.67
Good A+B	-	-	124.35	130.18
Good A+C	-	-	195.00	110.00
Good B+B	-	-	220.00	167.50
Good B+C	-	-	-	-
Good C+C	-	-	-	195.00
Exclusion Rate				
L-Type Buyer	80.47%[a]	21.88%[a,d,e]	63.54%[d]	75.00%[e]
Interaction Rates				
L-Type Buyer	17.58%[a]	75.00%[a,d,e]	36.98%[d,f]	24.22%[e,f]
H-Type Buyer	83.98%[a,b,c]	100.00%[a]	100.00%[b]	100.00%[c]
Shares H-Type Buyer Purchasing				
Good A	5.08%	4.69%	1.56%	0.78%
Good B	12.89%[b,c]	17.19%[e]	5.21%[b]	0.78%[c,e]
Good C	66.02%	78.13%[e]	66.67%	56.25%[e]
Goods A+B	-	-	21.88%[f]	28.91%[f]
Goods A+C	-	-	2.60%[f]	9.38%[f]
Other Goods	-	-	2.08%	3.91%
Shares L-Type Buyer Purchasing				
Good A	13.28%[a]	58.98%[a,d,e]	19.79%[d]	18.75%[e]
Good B	2.73%[a]	14.84%[a]	14.06%	3.13%
Good C	1.56%	1.17%	1.56%	1.56%
Goods A+B	-	-	0.52%[f]	0.00%[f]
Goods A+C	-	-	0.52%[f]	0.00%[f]
Other Goods	-	-	0.52%	0.78%

Mann-Withney U-tests for pairwise differences between treatments
[a] Significant CV Mon versus CV CompE ($p < 0.05$)
[b] Significant CV Mon versus CV CompNE ($p < 0.05$)
[c] Significant CV Mon versus Control ($p < 0.05$)
[d] Significant CV CompE versus CV CompNE ($p < 0.05$)
[e] Significant CV CompE versus Control ($p < 0.05$)
[f] Significant CV CompNE versus Control ($p < 0.05$)

Table 12: Random effects panel probit regressions on sellers' likelihood of posting L-type buyers' excluding offers, with robust standard errors on the subject level.

Seller posts *L-type* buyer excluding price menu	CV Mon: M1	CV Mon: M2	CV Comp: M1	CV Comp: M2	CV CompNE: M1	CV CompNE: M2
Period	0.052**	0.052**	-0.147***	-0.147***	0.050**	0.050**
	(0.025)	(0.025)	(0.029)	(0.029)	(0.020)	(0.020)
Risk aversion	-0.026	0.000	-0.237*	-0.356**	0.352***	0.374***
	(0.100)	(0.083)	(0.124)	(0.152)	(0.118)	(0.126)
=1 if female		-0.505		0.280		0.336
		(0.579)		(0.502)		(0.588)
Age		-0.074		-0.009		0.086
		(0.085)		(0.101)		(0.072)
Social preferences	No	Yes	No	Yes	No	Yes
Constant	1.233*	2.847	3.205***	4.071	-0.845	-3.034*
	(0.707)	(2.084)	(0.824)	(2.674)	(0.594)	(1.586)
Observations	512	496	512	512	384	352

Standard errors in parentheses are clustered on subject level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The left two columns of *Table 12* display the results for *CV Mon*. Similar to *PV Mon*, neither the measure for risk aversion nor social preferences appear to have an influence on the likelihood of sellers posting excluding offers in *CV Mon*. The positive coefficient of *Period* indicates that sellers increase the number of L-type buyer excluding offers over time. A possible explanation is that sellers learn over time how to optimally respond to the common values under the information asymmetry. The right two columns of Table 12 displays the results from *CV CompNE*, which indicate that sellers with higher risk aversion are more likely to post an L-type buyer excluding offer. This results confirms intuition, since a seller posting a nonexclusionary offer faces the risk of a large loss if a contract intended for L-types is bought by an H-type. As in *CV Mon*, we also observe a time trend in *CV CompNE* whereby sellers are more likely to post L-type buyer excluding offers in later periods.

Overall, exclusion rates under common values show the predicted differences between treatments. Exclusion rates differ over time but only depend upon risk aversion under *CV CompNE*. However, the extent to which L-type buyers are excluded under *CV CompNE* is considerably lower than predicted.

Result 2.b. *Average rejection rates of L-type buyers are significantly lower in* CV CompE *than in* CV Mon *and* CV CompNE. *Average rejection rates of H-type buyers are significantly higher in* CV Mon *than in* CV CompE *and* CV CompNE.

L-type buyers decline interaction significantly less often (25.00% of all buying decisions) in *CV CompE* than in *CV Mon* (82.43%) and *CV CompNE* (63.02%) (MWU: $p < 0.0007$ resp. $p < 0.0384$). Although theory predicts full interaction across all three common values treatments, H-type buyers interact significantly less often (83.98%) in *CV Mon* than in *CV CompE* (100%) and *CV CompNE* (100%) (MWU: p=0.004 and p=0.001). As in *PV Mon*, we observe in *CV Mon* that average prices paid per trade for good A (B / C) of 41.00 (89.48 / 159.01) are considerably lower than the prices offered when H-type buyers refuse to interact, namely 66.14 (122.91 / 173.63). We again find an almost equal split of profits between sellers and H-type buyers when H-type buyers purchase their efficient good C. When sellers seek to extract most of the rent from trading, H-type buyers prefer to decline to interact. Our social preference test suggests that such refusals come from maximin-types, whereas the remaining selfish and inequality averse H-type buyers almost always interact.

Result 2.c. *On average, good A is bought significantly more often by L-types in* CV CompE *than in* CV Mon *and* CV CompNE. *Average H-type buyer trade rates of good C do not differ significantly between* CV Mon, CV CompE *and* CV CompNE.

In *CV CompE*, *L*-type buyers purchase good *A* in 58.98% in all buying decisions, and efficient good *B* in 14.84% of decisions and virtually never (1.17%) purchase good *C* (see *Table 11*). In line with *Lemma 2.c*, *L*-type buyers purchase good *A* significantly more often in *CV CompE* than in *CV Mon* (13.28%) and *CV CompNE* (19.79%) (MWU: $p = 0.0011$ resp. $p = 0.0052$). Combining these results with *Result 2.a* suggest that *L*-type buyers' trade is distorted in *CV CompE* but *L*-type buyers are not excluded from trading.

As predicted in *Lemma 2.c*, good *C* purchases by *H*-type buyers do not differ significantly between *CV Mon*, *CV CompE* and *CV CompNE*. Note however that the trading rates of only good *C* of 66.02% in *CV Mon*, 78.13% in *CV CompE* and 66.67% in *CV CompNE* are considerably lower than the theoretical benchmark of 100%. In *CV Mon*, this is due in part to *H*-type buyers refusing to interact (as discussed above), and in part due to good *B*— and, to a lesser extent, good *A*—being offered at prices at which it is payoff-maximizing for *H*-types to purchase these goods instead of good *C*. Similarly, the payoff-maximizing purchase of good *B* is the primary reason for a deviation from the theoretical prediction in *CV CompE*. In *CV CompNE*, about half of the deviation from the theoretical prediction can be explained by some sellers offering good *A* at prices such that *H*-type buyers' purchases of $A + B$ are payoff-maximizing.

Result 2.d. *Average price posted for goods C is significantly higher in* CV Mon *than in* CV CompE *and* CV CompNE*.*

In line with *Lemma 2.d*, the average price posted for good *C* is significantly higher in *CV Mon* than in *CV CompE* and *CV CompNE* (MWU: p=0.0008 resp. p=0.0019). As under private values, the average price per trade in the monopoly treatment splits the surplus of trading good *C* between seller and *H*-type buyer approximately equally.

Note that because good *A* is theoretically predicted to be traded only in *CV CompE* and good *B* in none of the treatments[40], we could not derive hypotheses with regard to price differences across treatments for goods *A* and *B*. However, in this section we will discuss interesting results related to observed prices and price differences.

With respect to good *A*, the few *L*-type buyers purchasing good *A* in *CV Mon*, purchase the good at an average price per trade of 27.38 which leaves most of the rent to the seller. The average price per trade for good *A* in *CV CompE* is 24.19 (see *Table 11*). Notice that this price splits the surplus between sellers and *L*-type buyers about equally. This is surprising as competition would be expected to drive prices down

[40]Good *B* should be offered at *H*-type cost to prevent deviations, but should not be traded.

to the costs of good A. However, a higher price on good A also reduces its attractiveness for H-type buyers and relaxes the incentive constraint of H-type buyers. Thus, price competition on good A in *CV CompE* appears to be attenuated, potentially explained by sellers' concern over H-types choosing good A if the price is too low. Asparouhova (2006) finds similar effects in a lending experiment with contract menus and different types of buyers/entrepreneurs: Lenders make zero profit on the contracts designed for high-risk entrepreneurs, but they make strictly positive profits on the contracts designed for low-risk entrepreneurs.

In *CV CompNE*, the average price per trade for good A is only slightly higher than in *CV CompE*. This price amounts to 24.71 and is thus attractive for both L-type buyers as well as H-type buyers purchasing goods $A + B$ and $A + C$. As the average price per trade for good B is also sufficiently low, in about 10% of the interactions it is payoff maximizing for H-type buyers to purchase $A + B$.

Sellers who offer good A in *CV CompNE* at a price below the cost of provision for H-type buyers change their offering behavior in the next period in 83.33% of cases when at least one H-type buyer purchased good A. Sellers incur losses on trading good A and adapt their offering behavior by not offering good A in the next period or by posting a price that covers the cost of provision for H-type buyers. Similarly, sellers offering good B at a price below the cost of provision for H-type buyers adapt their offering behavior in the same way when at least one H-type buyer purchased good B, here even in all cases.

Result 2.e. *Surplus is (weak) significantly higher in* CV CompE *than in* CV Mon *and* CV CompNE*.*

Supporting *Lemma 2.e*, we find that the exclusion of L-type buyers in both *CV Mon* (22.48) and *CV CompNE* (28.53) leads to a (weak) significantly lower total surplus than in *CV CompE* (30.50) (MWU: p=0.0008 for *CV Mon*; p=0.0707 for *CV CompNE*). Looking at the control treatment under nonexclusive competition, in *CV CompNE Control* the additional H-type buyer incentive to purchase good $A + C$—if good A is offered— results in an even more clear-cut exclusion of L-type buyers and thus also in a significantly lower surplus level in *CV CompNE Control* compared to *CV CompE*.

Figure 4 illustrates the share of the maximum attainable surplus per buyer type for the treatments and the control treatment. There is little variation in the share of surplus created by H-type buyers' interactions; in contrast, L-type buyers' share of surplus created by interaction varies markedly.

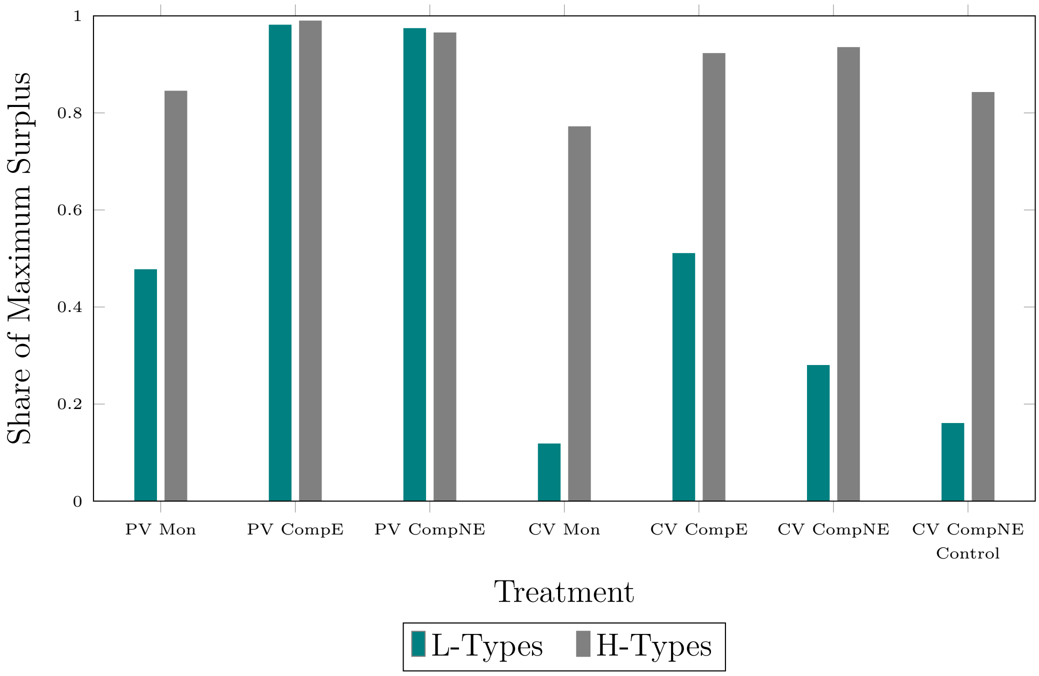


Figure 4: Surplus per buyer type for all treatments.

Overall, we observe a distortion of L-type buyers' trading under *CV CompE* but not an exclusion. In *CV Mon* and *CV CompNE*, L-type buyers are excluded at high rates leading to a (weak) significantly lower surplus than under *CV CompE*.

Nonexclusive competition: CV Control treatment

An overview of the results from *CV CompNE Control* is given in *Figure 5*. We find qualitatively similar results to *CV CompNE* in *CV CompNE Control*. Sellers offer good A (B / C) in 84.38% (83.20% / 83.20%) of all periods and post prices that exceed L-type buyers' valuations for the respective goods in 92.59% (96.24% / 96.88%) of periods.[41]

Overall, L-type buyers are excluded from trade in 75.00% of all buying decisions. At 75.00%, the L-type buyers' exclusion rate is higher in CV CompNE Control than in *CV CompNE* (63.54%); however, the difference is not statistically significant. This increase in the exclusion rate however amplifies the difference in surplus compared to the exclusive competition treatment.

[41]The average prices posted by sellers in *CV CompNE Control* are similar and do not differ significantly from average prices posted in *CV CompNE* (Good A / B / C: MWU: $p = 0.6698$ / $p = 0.8312$ / $p = 0.6698$). Prices per trade for bundles differ between *CV CompNE Control* and *CV CompNE*; however, this finding cannot be meaningfully interpreted due to the small number of observations.

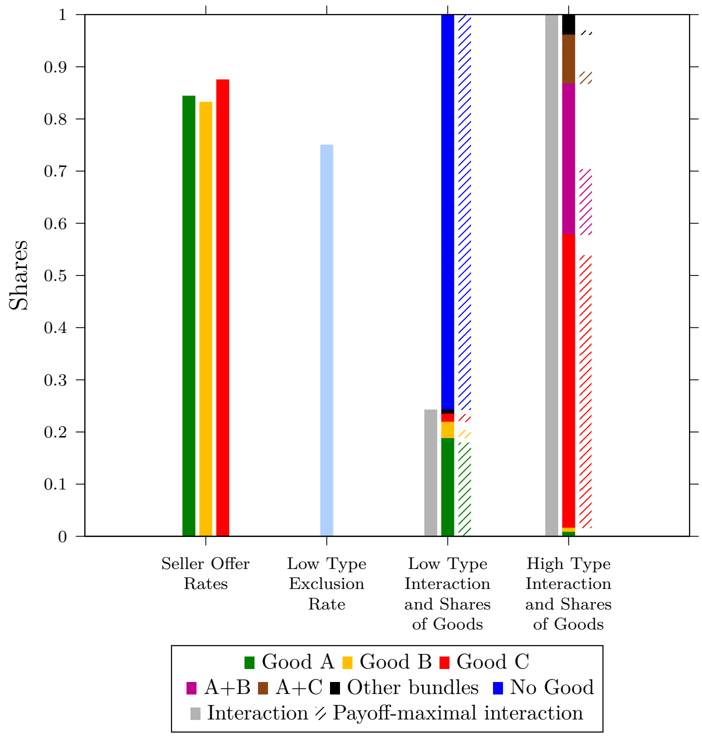


Figure 5: Results for *CV CompNE Control* at a glance.

4.2 Exclusion over time and individual seller behavior under common values

Although our experimental findings are surprisingly close to theoretical predictions given the complex set-up under common values, a closer examination of seller behavior to explain divergence from the theoretical predictions is warranted. In particular, we are interested in analyzing the role of seller learning over time. *Figure 6* depicts the exclusion rate over time for the common value treatments.

Interestingly, we see differences in the (speed of) adoption of exclusionary practices for the various market environment. Under monopoly, the average L-type buyer exclusion rate in periods $1-5$ is already high at 72.93%. In the final five periods, the average L-type exclusion rate increases to 84.4%.

Under exclusive competition, although the average L-type exclusion rate in periods $1-4$ is relatively high at 62.5%, it drops to 21.86% on average in the second quarter of periods and further to 0% from period 10 onwards. Thus, although under exclusive competition there are initially some markets in which offers below the L-type's valuation for good A (or good B) are not made, by the later periods some sellers have learned that they can offer good A at a price below v_L^A without incurring losses (see the middle two

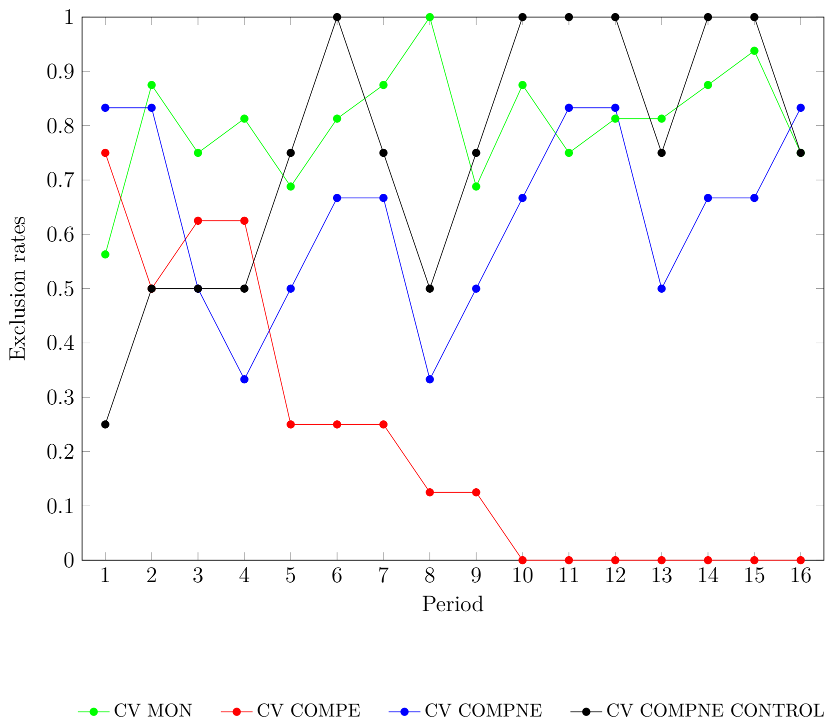


Figure 6: Exclusion rate over time for all CV treatments.

columns in *Table 12* for the regression results on the dynamics under *CV Comp*). The rapid adoption of the (non-)exclusionary practice under *CV CompE* is accompanied by a lower average number of losses per seller in periods $1-5$ than under *CV CompNE* (0.406 vs. 0.875). The seller learning pattern in *CV CompE* is also confirmed by an examination of individual seller behavior: Although we frequently observe that sellers who have made a loss on good A in some early period only offer good A at (exclusionary) H-type costs in intermediate periods, many sellers then switch to offering good A at nonexclusionary prices for the final periods. *Figure 7* shows the offers of two exemplary sellers from the *CV CompE* treatment with the described behavior: one who incurred losses and one who did not.[42]

Another interesting offer pattern frequently observed under exclusive competition is sellers attempting to pool H-and L-types on good B, despite this being unprofitable for any price at which L-types would be willing to accept buying good B. Sellers who attempted such pooling incurred losses[43] and then subsequently in many cases did not offer good B or only offered good B at a price higher than H-type cost. An example of

[42]However, there were also some sellers who never posted offers at prices below the H-type cost in *CV CompE*, an example of this and other frequently observed patterns of seller behavior are given in *Appendix C*.

[43]Many sellers also irrationally offered good A at a lower price than good B while attempting to pool types on good B

this is given in the left panel of *Figure 8* below. In addition, we observe sellers trying to attract buyers by any means, as well as sellers who do not appear to have understood the market well, frequently incurring losses as a consequence. An example of this is given in the right panel of *Figure 8*.

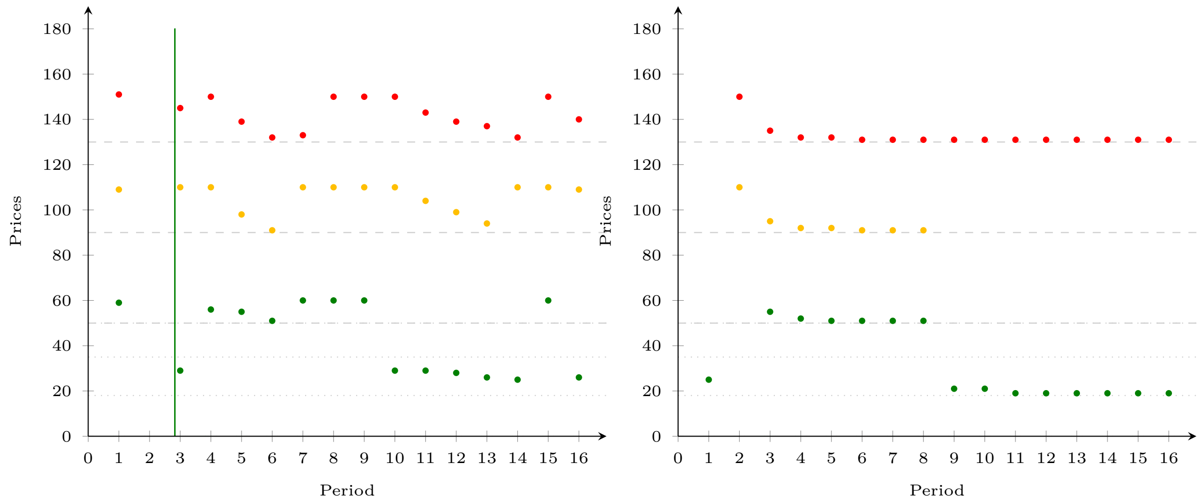


Figure 7: Offers of subjects 43 (left) and 49 (right) in *CV CompE*.
Offer of good A is depicted in green, of good B in yellow and of good C in red. A vertical line indicates that the seller made a loss, the colour of the line identifies the good/offer on which the loss was made.

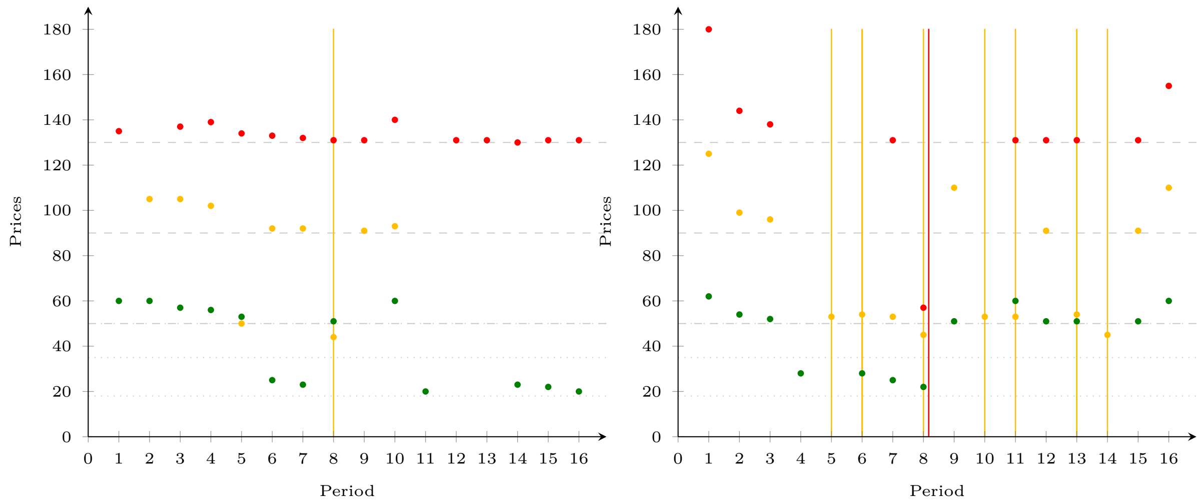


Figure 8: Offers of subjects 310 (left) and 289 (right) in *CV CompE*

For nonexclusive competition, we find that the number of L-type excluding offers for both *CV CompNE* and *CV CompNE Control* is (weakly) significantly higher in the final periods in comparison to the first periods (CompNE: p=0.0523, CompNE Control: p= 0.0947), with a more pronounced effect for *CV CompNE Control*. In *CV CompNE*

Control, the average period in which good A is offered at a price below v_L^A is 5.31. In two out of four markets, such offers are only observed in the first five periods.

In analyzing individual seller behavior in *CV CompNE*, we find that sellers who offer good A at a price below the cost of provision for H-type buyers change their offering behavior in the next period in 83.33% of cases when at least one H-type buyer purchases good A. Such sellers incur losses on trades of good A and consequently adapt their offering behavior by not offering good A in the next period or by posting a price that covers the cost of provision for H-type buyers. Two examples of this type of seller behavior are given in *Figure 9*.

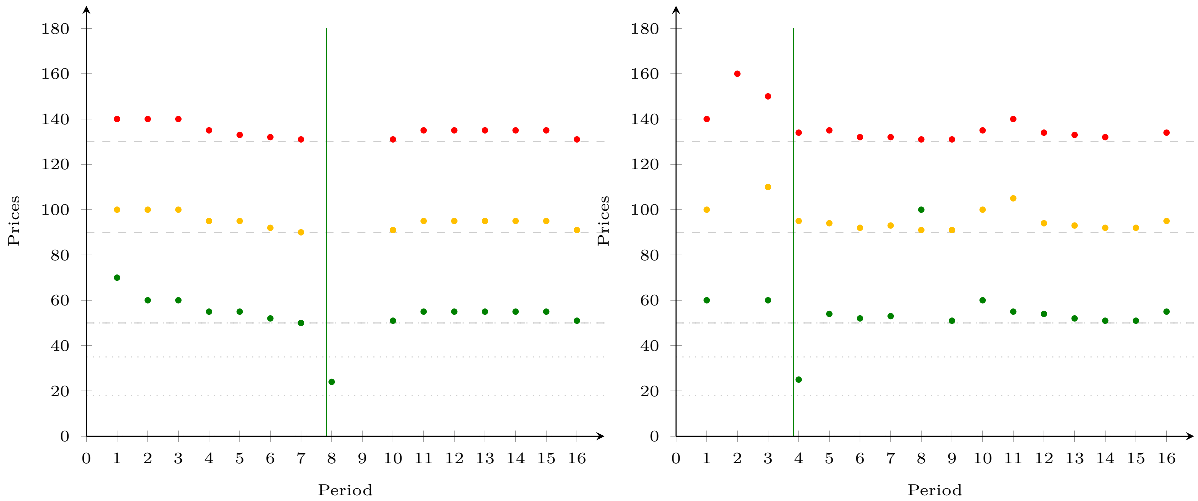


Figure 9: Offers of subjects 321 (left) and 330 (right) in *CV CompNE*.

Similarly, sellers offering good B at a price below the costs of provision for H-type buyers adapt their offering behavior analogously when at least one H-type buyer purchased good B. Furthermore, a considerable share of sellers in *CV CompNE* (29.2%) never offered any good at prices below the costs of serving H-types (which corresponds to equilibrium behavior). An example of this is given in the left panel of *Figure 10* below. However, as in *CV CompE*, under nonexclusive competition there were also sellers who tried to attract buyers by any means, as well as sellers who do not appear to have understood the market well, frequently incurring losses as a result. An example of this is given in the right panel of *Figure 10* below.

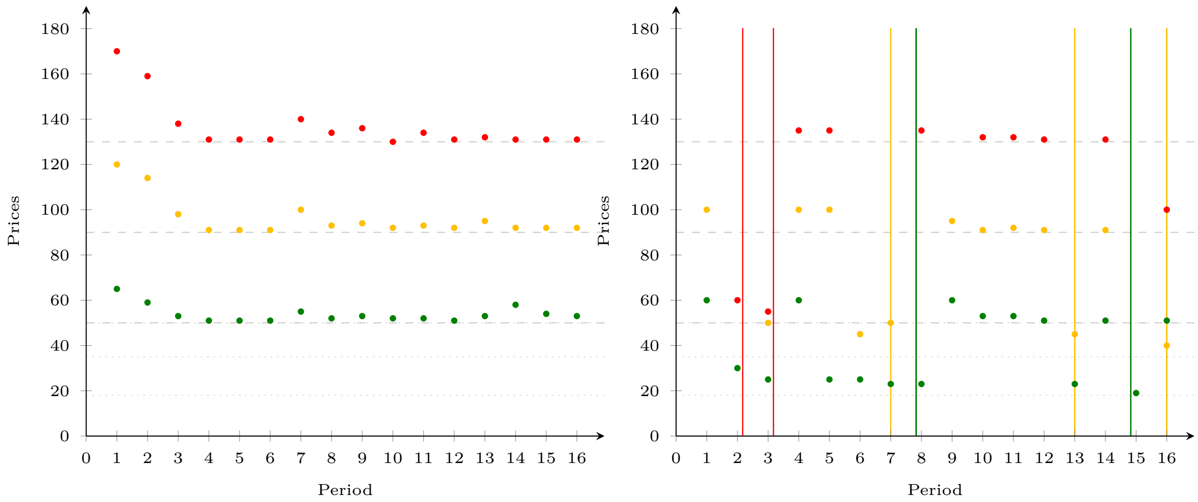


Figure 10: Offers of subjects 351 (left) and 344 (right) in *CV CompNE*.

Further investigation of sellers who did not offer any good at prices below the cost of serving H-types reveals that in the last periods (12-16), the share of these sellers increases to 75% in *CV CompNE* and 87.5% in *CV CompNE Control*. Interestingly, while the shares of sellers who did not offer any good at prices below the costs of serving H-types in the final periods significantly differs between *CV CompNE* and *CV CompE* (MWU: p=0.0062) and *CV CompNE Control* and *CV CompE*(MWU: p=0.0052), the corresponding shares do not differ significantly between exclusive and nonexclusive competition treatments during the first periods (1-5). This provides further evidence that our findings under nonexclusive competition are not driven by the behavior of prudent seller types, but instead result from equilibrium play in the final periods.

Conclusion

We provide a first systematic experimental analysis of the impact of hidden information on market outcomes across different contracting environments. We find that under hidden information of the private values form, competition leads to the efficient allocation. When hidden information takes the form of common values as in the Rothschild-Stiglitz model, we observe that low types are largely excluded under monopoly and nonexclusive competition whereas their trade is only distorted under exclusive competition. This leads to a significantly higher surplus under exclusive competition than under monopoly and nonexclusive competition. Thus, our experimental results confirm that under common values, nonexclusive competition may be detrimental to surplus generation.

Our experimental results by and large confirm the theory on which they are based, even in the cases of competition under common values. This is surprising given the complex strategic considerations, and, from a theory point of view, reassuring. However, this has not been the universal conclusion before. In contrast to other studies that were framed e.g. with a labor market context, our design implements a pure, neutrally framed market setting in which context-dependent considerations or social preferences deliberately were not activated in order to concentrate on the strategic implications of asymmetric information across different market structures. We believe that this systematic analysis in a neutrally framed market setting is a first important step, and our results show that standard theory works well here. There are many markets such as trading in financial markets, which are likely to be well captured by this neutrally framed market setting. A next step would be to investigate whether different contexts, such as a health market context, yield results that suggest that the theory of markets with information problems needs to be systematically adjusted to account for the context of the market interaction.

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A Proofs

Proof of Lemma 1. (Equilibria and Equilibrium Properties in Experimental Game).

Preliminaries:
Let $F := \{A, B, C\}$ and furthermore let $J := \{A, B, C, A + A, A + B, A + C, B + B, B + C, C + C\}$. For notational convenience, in the following cost and valuations are not indexed by private or common values experimental treatments, as these are always considered separately. The experimental parametrization satisfies:

- observe that, with the parametrization and restrictions on pricing, seller profits and buyer payoffs are finite.
- Costs:
  - General: For all $\theta \in \{L, H\}$, $c_\theta^C > c_\theta^B > c_\theta^A > 0$.
  - Private Values conditions: For all $i \in F$, $c_H^i = c_L^i$.
  - Common Values conditions: For all $i \in F$, $c_H^i > c_L^i$.
- Valuations (Private and Common Values):
  - For all $\theta \in \{L, H\}$, $v_\theta^C > v_\theta^B > v_\theta^A > 0$ and for all $j \in J$, $v_H^j > v_L^j$.
  - Single Crossing (w.r.t. goods A,B,C): $v_H^C - v_H^B > v_L^C - v_L^B$, $v_H^B - v_H^A > v_L^B - v_L^A$ and $v_H^A > v_L^A$.
- Efficient goods
  - Private Values: $v_L^B - (c^B + 1) > v_L^j - c^j \ \forall j \in J, j \neq B$ and $v_H^C - (c^C + 1) > v_H^j - c^j \ \forall j \in J, j \neq C$ such that good B is the efficient good for a type L buyer and good C is the efficient good for a type H buyer. Note that good B and C are the efficient goods even when the cost for the respective good is increased by 1.[44]
  - Common Values: $v_L^B - (c_L^B + 1) > v_L^j - (c_L^j + 1) \ \forall j \in J, j \neq B$ and $v_H^C - c_H^C > v_H^j - c_H^j \ \forall j \in J, j \neq C$ such that good B is the efficient good for an L-type L and good C is the efficient good for a H-type buyer.
- Incentive compatibility of the efficient allocation under Private Values:
  - $v_L^B - (c^B + 1) > v_L^C - c^C$ and $v_H^C - (c^C + 1) > v_H^B - c^B$, i.e. the efficient allocation is incentive compatible (even when prices are one above costs.)
- Profitability of undercutting:
  - To facilitate the exposition, we will introduce seller contracts here: Define seller contract $\omega = (j, x)$ where $j \in F$ and x is the integer price. Denote the profit of a seller from contract ω when taken out by a θ-type buyer by $b_\theta(\omega)$ and the payoff of a buyer from making a trade in which he buys this contract ω by $w_\theta(\omega)$.

[44]Since, as is standard in experiments, prices are restricted to be integers, this takes account of the fact that sellers may not undercut at a price $c^j + 1$.

– Under exclusive competition, $w_\theta(\omega) = v^j - x$. Under nonexclusive competition, in case the buyer has made a second trade in which he purchased good $k \in F$, we define $w_\theta(\omega) = v^{k+j} - v^k - x$, i.e. as the increase in buyer valuation from trading contract ω minus the price specified in ω.

– For both Private Values and Common Values: Observe that for any type θ, any contract ω with $b_\theta(\omega) \geq 2$ and $w_\theta(\omega) > 0$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\omega)$ and $b_\theta(\omega') \geq b_\theta(\omega) - 1$.

- Pooling costs under Common Values:
  - good A: $\bar{c}^A = \frac{c_L^A + c_H^A}{2} = 34$. It holds that $\bar{c}^A > v_L^A$.
  - good B: $\bar{c}^B = \frac{c_L^B + c_H^B}{2} = 62.5$. It holds that $\bar{c}^B > v_L^B$.
  - good C: $\bar{c}^C = \frac{c_L^C + c_H^C}{2} = 90$. It holds that $\bar{c}^C > v_L^C$.

(i) PV Mon
A seller chooses which goods to offer at what prices to one randomly matched buyer. The matched buyer can either purchase one of the offered goods by the seller at the quoted price or abstain from trade. The seller maximizes her expected profit given the buyer's incentive compatibility and participation constraints. From standard arguments that can be applied since the parametrization complies with the relevant model assumptions as shown in the preliminaries above, the efficient quantity of buyer type H, good C, will be offered. We need to check whether the seller's profit is maximized by an incentive compatible menu such that type L would buy either good C, good B, good A or no good. The seller's profit from optimally, i.e. seller payoff-maximizing, implementing the allocation (Q_L, Q_H) where an L-type buyer purchases good Q_L and an H-type buyer purchases good Q_H, for

- (C, C) is $v_L^C - c^C = 5$
- (B, C) is $(1-\gamma)(v_L^B - c^B) + \gamma(v_H^C - (v_H^B - v_L^B) - c^C) = 22.5$
- (A, C) is $(1-\gamma)(v_L^A - c^A) + \gamma(v_H^C - (v_H^A - v_L^A) - c^C) = 27.5$,
- $(0, C)$ is $\gamma(v_H^C - c^C) = 30$.

Thus, to maximize profits, a seller offers good C at price $p^C = v_H^C$ and type L is excluded since $v_L^C = 65 < v_H^C$.

(ii) PV CompE
We need to show that in equilibrium, each H-type buyer purchases good C and each L-type buyer purchases good B and that good C is traded at price p^C with $p^C \in \{c^C, c^C + 1\}$ and good B is traded at price p^B with $p^B \in \{c^B, c^B + 1\}$.
To show that an equilibrium with these properties exists, consider the following strategies: Each of the four sellers offers good C at price c^C and good B at price c^B. Buyers purchase goods at sellers such that, given goods and prices offered, their payoff is maximized. If there are more than one trade options such that a buyer's payoff is maximized, a buyer randomizes equally between these trade options.

If all players behave accordingly, sellers make zero profits and a buyer of type L receives a payoff of $v_L^B - c^B$ and a buyer of type H receives a payoff of $v_H^C - c^C$. First, from above, $v_L^B - c^B > v_L^C - c^C$ and $v_H^C - c^C > v_H^B - c^B$ such that no buyer has an incentive to deviate. It remains to check whether a seller has an incentive to deviate. A seller cannot profitably deviate by lowering the price on either good B or C, since then he would make profits lower than zero, or by raising the price on either good B or good C, since then no buyer would trade with him. A seller can also not profitably deviate by offering good A, since, at any price $p^A = c^A + \epsilon$, $\epsilon > 0$, from the preliminaries above, no buyer would purchase good A.

To show that there are no other equilibrium allocations, assume to the contrary that an equilibrium exists in which either H-type buyers do not purchase good C at price p^C with $p^C \in \{c^C, c^C + 1\}$ or L-type buyers do not purchase good B at price p^B with $p^B \in \{c^B, c^B + 1\}$.

Let Ω denote the set of seller contracts taken out with positive probability in the equilibrium. Denote by $\overline{B}$ the maximum of $b(.)$ on this set, i.e. the highest profit made per contract on contracts taken out (see the preliminaries for the definition of $b(.)$), and denote by $\overline{\omega}$ a corresponding contract from Ω. Let the buyer type that takes out $\overline{\omega}$ with positive probability be $\overline{\theta}$. Suppose that $\overline{B} \geq 2$. Aggregate profits on all buyers of type $\overline{\theta}$ are at most equal to $2\overline{B}$, so one of the sellers, say seller 1, earns at most $2\overline{B}/4$ on average on buyers of type $\overline{\theta}$ and not more than $2\overline{B}/4$ on average on buyers of type $\theta \neq \overline{\theta}$. We will show how seller 1 can profitably attract all buyers of type $\overline{\theta}$ without losing anything from other buyers. First, since for any type θ, any contract ω with $b_\theta(\omega) \geq 2$ and $w_\theta(\omega) > 0$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\omega)$ and $b_\theta(\omega') \geq b_\theta(\omega) - 1$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\overline{\omega})$ and $b(\omega') = \overline{B} - 1$. Now let seller 1 deviate by adding contract ω'. All buyers of type $\overline{\theta}$ strictly profit from this deviation and buy ω', and seller 1 receives $2(\overline{B} - 1)$, which is larger than $2\overline{B}/4$ for $\overline{B} \geq 2$. Observe that, either buyers of the other type do not change their behavior since they do not profit from the new contract, or they also switch to ω'. But given the definition of $\overline{B}$, these buyers did not generate a profit larger than $2\overline{B}/4$ for seller 1, so this switch does not decrease seller 1's payoffs. Thus, there is a profitable deviation and we have a contradiction.

Therefore, $\overline{B} \leq 1$. Then, since $v_L^B - (c^B + 1) > v_L^j - c^j \; \forall j \in J, j \neq B$ and $v_H^C - (c^C + 1) > v_H^j - c^j \; \forall j \in J, j \neq C$, if goods B and C are offered, it cannot be that buyers of type L purchase a good different from good B and buyers of type H purchase a good different from good C. If either good B or good C is not offered, then again using $v_L^B - (c^B + 1) > v_L^j - c^j \; \forall j \in J, j \neq B$ and $v_H^C - (c^C + 1) > v_H^j - c^j \; \forall j \in J, j \neq C$, some seller can profitable deviate by offering the respective good $j \in \{B, C\}$ at price $c^j + 2$.

(iii) PV CompNE

The existence part is the same as for *PV CompE* and is therefore omitted.

To show that there are no other equilibrium allocations, assume to the contrary that an equilibrium exists in which either H-type buyers do not purchase good C at price p^C with $p^C \in \{c^C, c^C + 1\}$ or L-type buyers do not purchase good B at price p^B with $p^B \in \{c^B, c^B + 1\}$. Let Ω denote the set of seller contracts taken out with positive probability in the equilibrium. Denote by $\overline{B}$ the maximum of $b(.)$ on this set, i.e. the highest profit made per contract on contracts taken out (see the preliminaries for the definition of $b(.)$), and denote by $\overline{\omega}$ a corresponding contract from Ω. Let the buyer type that takes out $\overline{\omega}$ with positive probability be $\overline{\theta}$. Suppose that $\overline{B} \geq 2$. Buyers can make up to two trades, i.e. purchase up to two contracts, and there are two buyers of each type. However, since a buyer can only make one trade per seller, one of the sellers, say seller 1, earns at most $2\overline{B}/4$ on average on buyers of type $\overline{\theta}$ and at most $2\overline{B}/4$ on average on buyers of type $\theta \neq \overline{\theta}$.

We will show how seller 1 can profitably attract all buyers of this type without losing anything from other buyers. First, since for any type θ, any contract ω with $b_\theta(\omega) \geq 2$ and $w_\theta(\omega) > 0$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\omega)$ and $b_\theta(\omega') \geq b_\theta(\omega) - 1$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\overline{\omega})$ and $b(\omega') = \overline{B} - 1$. Note that this here can refer to the second trade of a buyer with $w_\theta(\omega)$ as defined in the Preliminaries for this case. Let seller 1 deviate by adding contract ω'. All buyers of type $\overline{\theta}$ strictly profit from this deviation and buy ω', and seller 1 receives $2(\overline{B} - 1)$, which is larger than $2\overline{B}/4$ for $\overline{B} \geq 2$. Observe that either buyers of the other type do not change their behavior since they do not profit from the new contract, or they also switch to ω', if they can switch to seller 1, i.e. they do not purchase another contract from seller 1. However, if they cannot switch, there is also no change in profit from these buyers. But given the definition of $\overline{B}$, these buyers did not generate a profit larger than $2\overline{B}/4$ for seller 1, so this switch does not decrease seller 1's payoffs. Thus, there is a profitable deviation and we have a contradiction.

Therefore, $\overline{B} \leq 1$. Then, it is easy to see that since $v_L^B - (c^B + 1) > v_L^j - c^j \; \forall j \in J, j \neq B$ and $v_H^C - (c^C + 1) > v_H^j - c^j \; \forall j \in J, j \neq C$, if goods B and C are offered, it cannot be that buyers of type L purchase a good different from good B and buyers of type H purchase a good different from good C. If either good B or good C is not offered, then again using $v_L^B - (c^B + 1) > v_L^j - c^j \; \forall j \in J, j \neq B$ and $v_H^C - (c^C + 1) > v_H^j - c^j \; \forall j \in J, j \neq C$, some seller can profitable deviate by offering the respective good $j \in \{B, C\}$ at price $c^j + 2$.

(iv) CV Mon

A seller chooses which goods to offer at what prices to one randomly matched buyer. The matched buyer can either purchase one of the offered goods by the seller at the quoted price or abstain from trade. The seller maximizes her expected profit given the buyer's incentive compatibility and participation constraints. From standard arguments that can be applied since the parametrization complies with the relevant model assumptions as shown in the preliminaries above, the efficient quantity of buyer type H, good C, will be offered. We need to check whether the seller's profit is maximized by an incentive compatible menu such that type L would buy either good C, good B, good A or no good. The seller's profit from optimally, i.e. seller payoff-maximizing, implementing the allocation (Q_L, Q_H) where an L-type buyer purchases good Q_L and an H-type buyer purchases good Q_H, for

- (C, C) is $v_L^C - (\gamma c_H^C + (1-\gamma) c_L^C) = 65 - 90 = -25$,
- (B, C) is $(1-\gamma)(v_L^B - c_L^B) + \gamma(v_H^C - (v_H^B - v_L^B) - c_H^C) = 0$
- (A, C) is $(1-\gamma)(v_L^A - c_L^A) + \gamma(v_H^C - (v_H^A - v_L^A) - c_H^C) = 13.5$,
- $(0, C)$ is $\gamma(v_H^C - c_H^C) = 27.5$.

Thus, the seller optimally sets a menu such that only good C is offered at price $p_C = v_H^C$ and type L is excluded.

(v) CV CompE

We need to show that in equilibrium, each H-type buyer purchases good C and each L-type buyer purchases good A and that good C is traded at price p^C with $p^C \in \{c_H^C, c_H^C + 1\}$ and good A is traded at price p^A with $p^A \in \{c_L^A, c_L^A + 1\}$.

To show that an equilibrium with these properties exists, consider the following strategies: Each of the four sellers offers good C at price c_H^C and good A at price c_L^A. Buyers purchase goods at sellers such that, given goods and prices offered, their payoff is maximized. If there are more than one trade options such that a buyer's payoff is maximized, a buyer randomizes equally between these trade options. If all players behave accordingly, sellers make zero profits and a buyer of type L receives a payoff of $v_L^A - c_L^A = 30 - 18 = 12$ and and a buyer of type H receives a payoff of $v_H^C - c_H^C = 55$: First, the allocation is incentive compatible. The payoff of an H-type buyer from buying good A at price 18 is $v_H^A - c_L^A = 70 - 18 = 52$ which is lower than his payoff from buying good C which is $v_H^C - c_H^C = 55$ and an L-type buyer's valuation for good C is lower than c_H^C. For each buyer, purchasing the respective good also yields a higher payoff than abstaining from trade. It remains to show that there is no profitable seller deviation. First, a deviation to a higher price on goods C or A, is not profitable, since no buyer would be attracted. We need to check whether there is a profitable deviation by offering a different menu, e.g. trying to pool both types. First, notice that there cannot be a profitable pooling deviation with pooling on A, since good A is offered at c_L^A. Second, there cannot be a profitable pooling deviation with pooling on B, since $v_L^B < \frac{c_L^B + c_H^B}{2}$, nor on C, since $v_L^C < \frac{c_L^C + c_H^C}{2}$. It remains to check a deviation with a menu of goods B and C. For good B to be bought by an L-type buyer, the price has to be lower than v_L^B. However, we have $v_H^B - v_L^B > v_H^C - c_H^C$ such that good B would be bought by H-types as well, and since $v_L^B < \frac{c_L^B + c_H^B}{2}$, this is not profitable.

It remains to show that there are no other equilibrium allocations. First, pooling on any good $j \in F$ cannot be an equilibrium, as for any non-loss making pooling prices L-type buyers are not willing to purchase the respective good (see Preliminaries). Let l^* and h^* denote the goods taken out with positive probability in equilibrium by L- and H-type buyers respectively. Observe that from single crossing, we must have that $v_H^{h^*} \geq v_L^{l^*}$, as otherwise, H-type buyers would strictly prefer to make the trade that L-types are taking. Since we have shown above that there cannot be pooling, we have $v_H^{h^*} > v_L^{l^*}$, ruling out allocations in which e. g. L-type buyers purchase good C and H-type buyers purchase good B.

We need to check other potential allocations. To do so, assume to the contrary that an equilibrium exists in which types are not pooled and for which $v_H^{h^*} > v_L^{l^*}$, but in which either H-type buyers do not purchase good C at price p^C with $p^C \in \{c^C, c^C + 1\}$ or L-type buyers do not purchase good A at price p^A with $p^A \in \{c_L^A, c_L^A + 1\}$.

Assume that the equilibrium is such that L-type buyers abstain from trading. First, it cannot be that H-type buyers purchase good A or good B, since due to $v_H^C - c_H^C > v_H^j - c_H^j \; \forall j \in F, j \neq C$, for any non-loss-making price on the respective good, there exists a deviation by offering good C such that higher profits on H-types are made (and if L-types were attracted, deviation profits would even be higher. Thus, H-types

purchase good C. We will now show that profits per contract with H-type buyers cannot be larger than 1. Let Ω_H denote the set of seller contracts taken out with positive probability in the equilibrium by H-types. Denote by $\overline{B}_H$ the maximum of $b(.)$ on this set, i.e. the highest profit made per contract on contracts taken out by H-types. Denote by $\overline{\omega_H}$ a corresponding contract from Ω_H. Suppose that $\overline{B} \geq 2$. Aggregate profits on all H-type buyers are at most equal to $2\overline{B}$, so one of the sellers, say seller 1, earns at most $2\overline{B}/4$ on average on H-type buyers of type $\overline{\theta}$ and no profits on L-type buyers since these abstain from trading. Since for any type θ, any contract ω with $b_\theta(\omega) \geq 2$ and $w_\theta(\omega) > 0$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\omega)$ and $b_\theta(\omega') \geq b_\theta(\omega) - 1$, there exists a contract ω' such that $w_\theta(\omega') > w_\theta(\overline{\omega})$ and $b(\omega') = \overline{B} - 1$. Now let seller 1 deviate by adding contract ω'. All H-type buyers strictly profit from this deviation and buy ω', and seller 1 receives $2(\overline{B} - 1)$, which is larger than $2\overline{B}/4$ for $\overline{B} \geq 2$. Thus, $\overline{B}_H \leq 2$. Then, however, some seller, say seller 1, can offer contract $\hat{\omega} = (A, 20)$. $\hat{\omega}$ attrachts all L-types, since they receive a payoff of $30 - 20 = 10 > 0$, but it does not attract H-types, since for any contract $\omega = (C, x - c_H^C)$ with $0 \leq x - c_H^C \leq 1$, H-type buyers prefer ω to $\hat{\omega}$. Thus, we have a contradiction.
Now assume that the equilibrium is such that H-type buyers but not L-type buyers abstain from trading. However, from single-crossing, H-types would receive a higher payoff from taking out a contract that L-type buyers are buying, a contradiction. Furthermore, observe if all buyers abstain from trade, a seller can profitably deviate by offering some good, say good C, at a price x with $c_H^C < x < v_H^C$.
Now assume that in equilibrium, L-type buyers purchase good B with positive probability. Then, purchasing some contract with good B must yield at least a payoff of 0, as otherwise, L-type buyers would deviate by abstaining from trade. Then, however, for any contract $\omega = (B, x)$ with $x \leq v_L^B$ purchased with positive probability by L-type buyers, H-type buyers would prefer to buy contract (B, x) which gives them a payoff of at least $v_H^B - v_L^B = 130 - 55 = 75$, over any other contract that is non-loss-making on H-type buyers, since these can give a payoff of at most $v_H^C - c_H^C = 55$. Then, however, (B, x) would be loss-making, a contradiction.
It remains to show that if L-type buyers purchase good A and H-type buyers good C, it cannot be that either is sold at per contract profit larger than 1. Let Ω denote the set of seller contracts taken out with positive probability in the equilibrium. Denote by $\overline{B}$ the maximum of $b(.)$ on this set, i. e., the highest profit made per contract on contracts taken out and denote by $\overline{\omega}$ a corresponding contract from Ω. Let the buyer type that takes out $\overline{\omega}$ with positive probability be $\overline{\theta}$. Suppose that $\overline{B} \geq 2$. Assume that $\overline{\omega} = H$. From arguments analogous to those above, there is price undercutting, since this increases profits of some seller on H-type buyers, and would further increase them if L-type buyers were attracted.
Now assume that $\overline{\theta} = L$. Observe that, with the parametrization, for any $x > 0$ such that $v^A - c_L^A - x \geq 0$, $v_H^C - c_H^C - x > v_H^A - c_L^A - x - 1$, i.e., if there is undercutting on the price $c_L^A + x$ for good A, we can find an incentive compatible H-type contract with good C such that H-types prefer to buy good C and profits on H-types are not reduced. Then, analogously to above, since there are 2 L-type buyers and 4 firms, there would be a profitable deviation by undercutting on the price of good A for some firm. Thus, there is a profitable deviation and we have a contradiction.

(vi) CV CompNE and *CV CompNE Control*
We need to show that in equilibrium, each H-type buyer purchases good C and L-type buyers abstain from trading and that C is traded at price p^C with $p^C \in \{c_H^C, c_H^C + 1\}$. To show that an equilibrium with these properties exists, consider the following strategies: Each of the four sellers offers good C at price c_H^C and good B at price c_H^B. Buyers purchase goods at sellers such that, given goods and prices offered, their payoff is maximized. If there are more than one purchase options such that a buyer's payoff is maximized, a buyer randomizes equally between these. If all players behave accordingly, sellers make zero profits, a buyer of type H buys good C and receives a payoff of $v_H^C - c_H^C = 55$, since H-type buyer's payoff from buying C at price c_H^C is higher than abstaining from trade, purchasing good $B+B$ at price $c_H^B + c_H^B$, purchasing good $B+C$ at price $c_H^B + c_H^C$ or purchasing good $C+C$ at price $c_H^C + c_H^C$. L-type buyers abstain from trade since their payoff from buying good $j \in \{B, B+B, C, C+C\}$ at the respective prices is lower than zero. It remains to show that there is no profitable seller deviation. First, there is no profitable deviation with a higher price on good C, as then no buyer would purchase from the deviating seller. Furthermore, there is no profitable deviation by raising the price on good B, since it would not be taken out by any buyer. We need to check whether there is a profitable deviation by offering a different menu.
First, there is no profitable deviation with offering good A at a price at which L-type buyers would prefer buying good A to abstaining from trade: For any price for good A $p^A \leq v_L^A$, $v_H^{A+B} - c_H^B - p^A > v_H^C - c_H^C$, i.e. H-type buyers would buy good $A+B$. Then, however, A is loss-making and thus offering A such that L-type buyers would purchase A is not a profitable deviation. Furthermore, there is no profitable deviation by offering good A at a price such that no losses are made on H-types, since at such prices good A would not be taken out by H-types as their efficient good C at price c_H^C is on offer. Last, there is no profitable deviation by offering either good C or good B at prices lower than c_H^C and c_H^B since for any non-loss making pooling prices L-type buyers are not willing to purchase the respective good.
It remains to show that there are no other equilibrium allocations. First, pooling on any good $j \in F$ cannot be an equilibrium, as for any non-loss making pooling prices L-type buyers are not willing to purchase the respective good (see Preliminaries). With decreasing marginal payoffs from goods $j \in F$ which are bought in a second trade (see parametrization), there is as well no pooling on any good $j \in J \setminus F$.
We will now show that in equilibrium, L-type buyers abstain from trade. Assume to the contrary that they are making at least one trade. Denote by $\hat{\omega}$ the contract that an L-type buyer trades with positive probability on which the corresponding seller does not make a loss. Note that, it cannot be that sellers make losses on all trades with L-type buyers, since, from the cost structure, L-types cannot be cross-subsidized on any contract by H-types, and then some seller would increase his payoff by not offering the contracts on which losses are made with L-types. Now since an L-type buyer trades $\hat{\omega}$ with positive probability, $w_L(\hat{\omega}) \geq 0$. We will show that then there is a profitable deviation by some seller or buyer. Observe that, if there is no pooling with L-types, each contract taken out by H-type buyers has to be non-loss-making on H-types. Furthermore, from arguments analogous to those in *CV CompE*, in equilibrium no contract is taken out in which good $j \in F$ is offered at a price higher than $c_H^j + 1$, since otherwise there would be a profitable deviation by undercutting.

Thus, in equilibrium, the profit per contract on H-type buyers $\overline{B}_H$ satisfies $\overline{B}_H \leq 1$. Let some corresponding contract be denoted by $\tilde{\omega}$ and an H-type buyers payoff in the equilibrium by w_H^*. Observe that w_H^* can be at most 55.
Now if either $\hat{\omega} = (B, x)$ with $35 \leq x \leq 55$ or $\hat{\omega} = (C, x)$ with $50 \leq x \leq 65$, then H-types would purchase $\hat{\omega}$, since $v_H^B - 55 > v_H^C - c_H^C$, (i.e. higher payoff than the highest possible at their cost pricing with efficient good) and $v_H^C - 65 > v_H^C - c_H^C$, a contradiction.
If $\hat{\omega} = (A, x)$ with $18 \leq x \leq 30$,

- and good B is offered at price $p^B \in \{c_H^B, c_H^B + 1\}$, then, independent of good C being offered at price $p^C \in \{c_H^C, c_H^C + 1\}$ or not a buyer of type H has the higher payoff from purchasing $\hat{\omega}$ in one trade and good B in a second trade. Then, however, $\hat{\omega}$ is loss-making, a contradiction.

- good B is not offered but good C is offered at price $p^C \in \{c_H^C, c_H^C + 1\}$, then some seller, say seller 1, can profitably deviate by offering good B at price $c_H^B + 2(x - c_L^A)/4 + 1 + 2(p^C - c_H^C)/4$, since then H-type buyers get a higher payoff from purchasing $\hat{\omega}$ in one trade and good B from seller 1 in a second trade, since $v_H^{A+B} - 2(30-18)/4 - 1 - 90 - 30 > 55$, and seller 1 makes a higher profit when the corresponding contract is taken out by H-types. Thus, there is a profitable deviation.

- and neither good B is offered at price $p^B \in \{c_H^B, c_H^B + 1\}$ nor good C is offered at price $p^C \in \{c_H^C, c_H^C + 1\}$, then either H-type buyers take out $\hat{\omega}$ or some seller can deviate by undercutting on good B or good C, a contradiction.

Thus, we have a contradiction.
It remains to show that H-type buyers do not purchase a good different from C. If C is not offered, there is a profitable deviation by offering good C since it is the efficient good for H-type buyers. If C is offered, then from arguments similar to above there will be undercutting until the profit per contract on good C is not larger than 1. Then, it is optimal to buy good C for H-type buyers.

B Full regression model on L-type excluding offers

Seller posts *L-type* buyer excluding price menu	PV Full Model	CV Full Model
Period	-0.010	-0.142***
	(0.027)	(0.026)
PV Mon	0.646*	
	(0.371)	
PV CompNE	-0.332	
	(0.369)	
CV Mon		-0.738*
		(0.395)
CV CompNE		-0.829**
		(0.405)
CV CompNE Control		-0.956**
		(0.408)
PV Mon x Period	0.006	
	(0.038)	
PV CompNE x Period	0.032	
	(0.038)	
CV Mon x Period		0.192***
		(0.036)
CV CompNE x Period		0.193***
		(0.033)
CV CompNE Control x Period		0.274***
		(0.058)
Risk aversion	-0.071	-0.043
	(0.064)	(0.062)
Gender (=1 if female)	0.228	0.038
	(0.291)	(0.263)
Age	0.049	0.025
	(0.034)	(0.036)
Social preferences	Yes	Yes
Constant	-2.222**	1.402
	(0.941)	(1.025)
Observations	1472	1664

Standard errors in parentheses are clustered on subject level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The exclusive competition treatments are the reference categories for the treatments. Social preferences do not significantly impact the probability of sellers posting a menu that excludes L-type buyers.

C Examples of seller behavior

The figures below show further examples of seller behavior for the common value competitive treatments that were not highlighted in the main text.

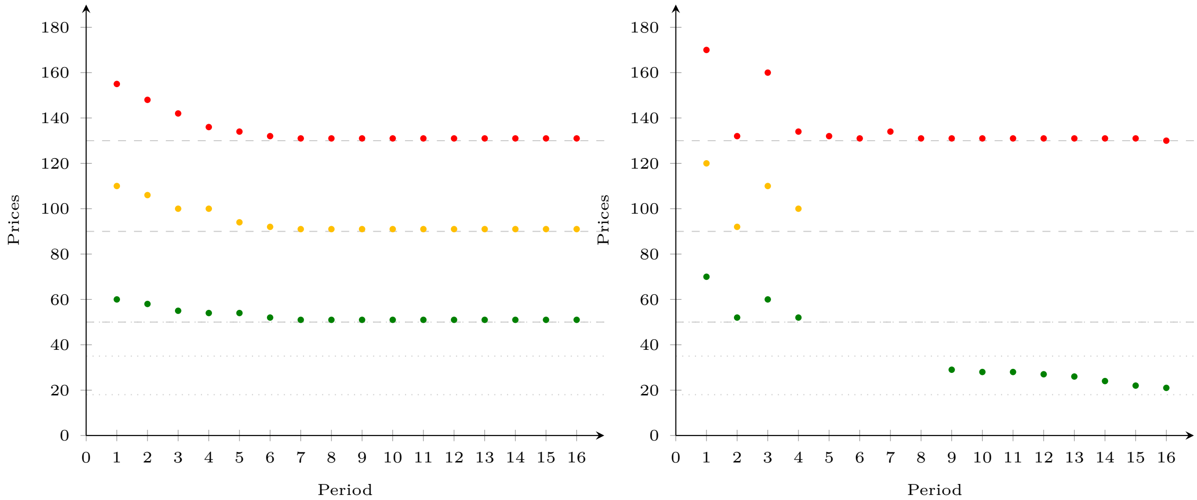

Figure 11: Offers of subjects 306 (left) and 287 (right) in *CV CompE*.

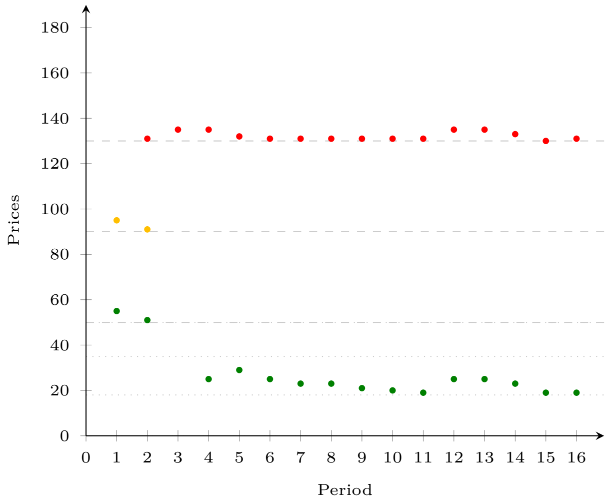

Figure 12: Example subject no 52 in *CV CompE*: Fast learning, play close to equilibrium play.

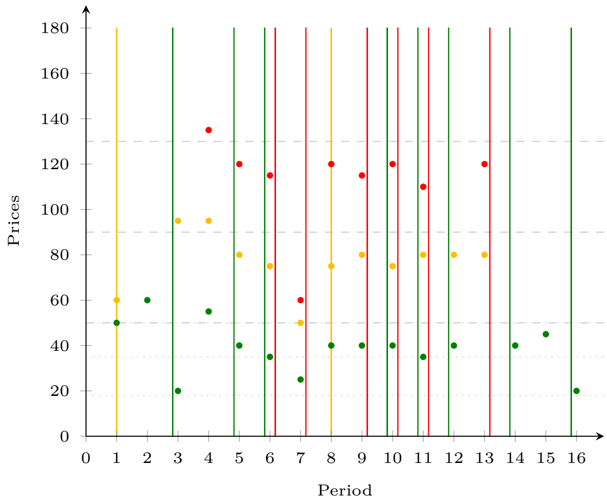

Figure 13: Example subject no 362 in *CV CompNE Control*: Presumably no understanding of the market game.

D Distribution of Social Preferences

Figure 14 displays the distribution of the nine social preference types in our experiment that Kerschbamer (2015) differentiates:

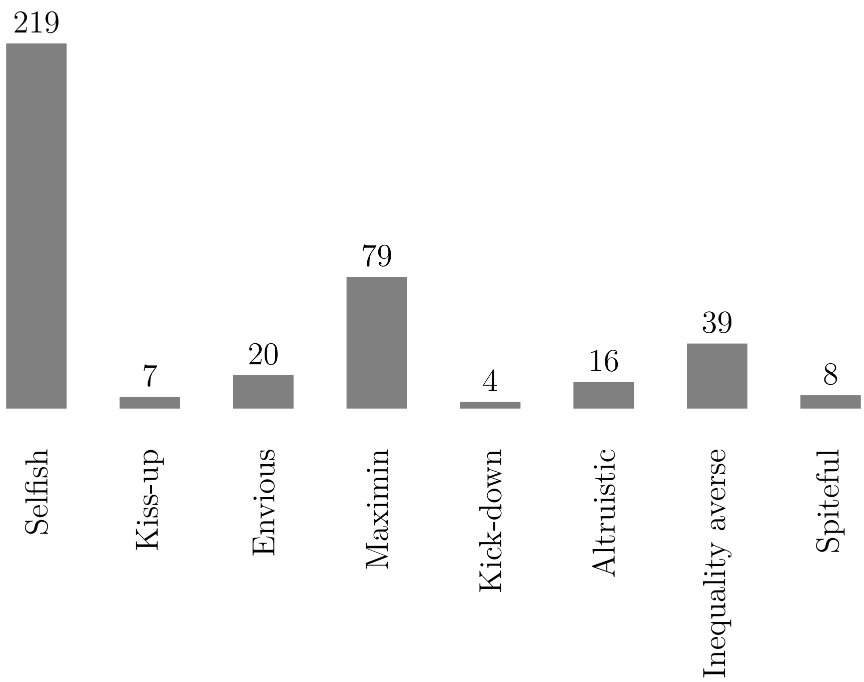

Figure 14: Distribution of social preference types across all 392 participants.

E Instructions

In the following, we present the instructions for the *PV Mon* and the *CV CompNE* conditions. Similar instructions were used for the other four main conditions. We provide both the original German version as well as an English translation.

E.1 Original instructions: German version

E.1.1 PV Mon

Anleitung zum Experiment

Herzlichen Dank für Ihre Teilnahme am Experiment. Bitte lesen Sie die folgenden Informationen aufmerksam durch. Falls Sie Fragen zu den Instruktionen haben, heben Sie bitte die Hand. Wir werden dann zu Ihrer Kabine kommen und Ihnen die Fragen beantworten. Bitte sprechen Sie bis zum Ende des Experiments nicht mehr mit anderen Teilnehmern.

Für Ihr rechtzeitiges Erscheinen erhalten Sie 10 Franken. Für das Beantworten der sich an die Instruktionen anschliessenden Kontrollfragen erhalten Sie 5 Franken. Während des Experiments können Sie weiteres Geld verdienen. Die Höhe Ihres Verdienstes hängt von Ihren Entscheidungen und den Entscheidungen anderer Teilnehmer ab. Alle Entscheidungen werden anonym getroffen, d. h. keiner der anderen Teilnehmer erfährt Ihre Identität. Auch die Auszahlung am Ende des Experiments erfolgt anonym, d.h. kein anderer Teilnehmer erhält über Ihre Auszahlung Bescheid. Der Verdienst während des Experiments wird in ECU (=Experimental Currency Unit) angegeben. Sie erhalten eine Anfangsausstattung in Höhe von 30 ECU. Das Experiment hat mehrere Runden. In jeder dieser Runden können Sie **Gewinne, aber auch Verluste** machen. Zum Ende des Experiments wird **eine Runde zufällig ausgewählt**. Der Gesamtgewinn aus dieser zufällig ausgewählten Runde wird zu der Anfangsausstattung hinzugerechnet bzw. der Gesamtverlust aus der zufällig ausgewählten Runde von der Anfangsausstattung abgezogen. Der resultierende Betrag wird Ihnen zu folgendem Umrechnungskurs ausgezahlt:

2 ECU = 1 Franken

Auf den folgenden Seiten erklären wir den genauen Ablauf des Experiments.

Ablauf des Experiments:

- Das Experiment besteht aus 16 Runden. Innerhalb jeder dieser 16 Runden treffen Sie dieselbe Abfolge an Entscheidungen.

- Es gibt 2 verschiedene Rollen: Verkäufer und Käufer. Die Käufer sind entweder vom Typ 1 oder vom Typ 2. Ihnen wird zum Beginn des Experiments zufällig entweder die Rolle des Verkäufers oder die Rolle des Käufers vom Typ 1 oder Typ 2 zugewiesen. Sie behalten diese Rolle und die Käufer auch Ihren Typ während des gesamten Experiments. Ihre Rolle und bei Käufern auch Ihr Typ wird Ihnen zu Beginn des Experiments auf dem Bildschirm angezeigt.

- Zu Beginn des Experiments werden Sie ausserdem zufällig einer Gruppe zugeordnet. Jede Gruppe setzt sich aus vier Verkäufern, zwei Käufern vom Typ 1 und zwei Käufern vom Typ 2 zusammen. Die Zusammensetzung Ihrer Gruppe ändert sich während des Experiments nicht.

Ablauf einer Runde:

1. Jedem Verkäufer wird zufällig genau einer der vier Käufer aus seiner Gruppe zugeordnet.

2. Jeder Verkäufer wählt, ob und welche der drei Güter A, B, C er dem ihm zugeordneten Käufer anbietet. Jeder Verkäufer kann mehrere Güter anbieten, also z.B. Gut A und Gut B. Für jedes Gut, das der Verkäufer anbietet, wählt er einen Preis.

3. Der Käufer sieht die vom Verkäufer angebotenen Güter und die dafür verlangten Preise. Der Käufer kann maximal ein Gut kaufen. Alternativ kann der Käufer auch kein Gut kaufen.

4. Der Kauf eines Gutes hat für einen Käufer den folgenden Wert:

Käufer vom Typ 1	
Gut	Wert
A	30
B	55
C	65

Käufer vom Typ 2	
Gut	Wert
A	45
B	85
C	120

   Kauft ein Käufer kein Gut, so hat dies einen Wert von 0 für den Käufer.

5. Beim Kauf eines Gutes durch den Käufer entstehen dem Verkäufer durch den Verkauf des Gutes folgende Kosten:

Gut	Kosten
A	20
B	40
C	60

6. Informationen zum Ende jeder Runde:

   - Jeder Käufer sieht zum Ende jeder Runde, welches Gut er zu welchem Preis gekauft hat. Er erhält ausserdem die Information, wie hoch sein Gesamtgewinn in der Runde ist.
   - Jeder Verkäufer sieht zum Ende jeder Runde, ob der ihm zugeordnete Käufer ein Gut gekauft hat. Falls der Käufer ein Gut gekauft hat, sieht der Verkäufer welches Gut der Käufer gekauft hat. Er erhält zudem die Information, welche Kosten ihm durch den Verkauf des Gutes entstanden sind, welchen Preis er pro Gut verlangt hatte, welchen Gewinn er pro Gut gemacht hat und wie hoch sein Gesamtgewinn in der Runde ist. Jeder Verkäufer sieht ausserdem, welche Güter in der Runde zu welchen Preisen von ihm angeboten wurden.

Gesamtgewinn pro Runde:

- Verkäufer:
  - Falls kein Gut verkauft wurde: Gesamtgewinn = 0.
  - Falls ein Gut verkauft wurde: Gesamtgewinn = Preis des verkauften Gutes – Kosten des verkauften Gutes.
- Käufer:
  - Falls kein Gut gekauft wurde: Gesamtgewinn = 0.
  - Falls ein Gut gekauft wurde: Gesamtgewinn = Wert des gekauften Gutes – Preis des gekauften Gutes.

Übersicht für Käufer über den Wert des gekauften Gutes abhängig von Ihrem Typ

Käufer vom Typ 1	
Gut	Wert
A	30
B	55
C	65

Käufer vom Typ 2	
Gut	Wert
A	45
B	85
C	120

Übersicht für Verkäufer über Ihre Kosten pro verkauftem Gut abhängig vom gekauften Gut

Gut	Kosten
A	20
B	40
C	60

E.1.2 CV CompNE

Anleitung zum Experiment

Herzlichen Dank für Ihre Teilnahme am Experiment. Bitte lesen Sie die folgenden Informationen aufmerksam durch. Falls Sie Fragen zu den Instruktionen haben, heben Sie bitte die Hand. Wir werden dann zu Ihrer Kabine kommen und Ihnen die Fragen beantworten. Bitte sprechen Sie bis zum Ende des Experiments nicht mehr mit anderen Teilnehmern.

Für Ihr rechtzeitiges Erscheinen erhalten Sie 10 Franken. Für das Beantworten der sich an die Instruktionen anschliessenden Kontrollfragen erhalten Sie 5 Franken. Während des Experiments können Sie weiteres Geld verdienen. Die Höhe Ihres Verdienstes hängt von Ihren Entscheidungen und den Entscheidungen anderer Teilnehmer ab. Alle Entscheidungen werden anonym getroffen, d. h. keiner der anderen Teilnehmer erfährt Ihre Identität. Auch die Auszahlung am Ende des Experiments erfolgt anonym, d.h. kein anderer Teilnehmer erhält über Ihre Auszahlung Bescheid. Der Verdienst während des Experiments wird in ECU (=Experimental Currency Unit) angegeben. Sie erhalten eine Anfangsausstattung in Höhe von 30 ECU. Das Experiment hat mehrere Runden. In jeder dieser Runden können Sie **Gewinne, aber auch Verluste** machen. Zum Ende des Experiments wird **eine Runde zufällig ausgewählt**. Der Gesamtgewinn aus dieser zufällig ausgewählten Runde wird zu der Anfangsausstattung hinzugerechnet bzw. der Gesamtverlust aus der zufällig ausgewählten Runde von der Anfangsausstattung abgezogen. Der resultierende Betrag wird Ihnen zu folgendem Umrechnungskurs ausgezahlt:

$$2 \text{ ECU} = 1 \text{ Franken}$$

Auf den folgenden Seiten erklären wir den genauen Ablauf des Experiments.

Ablauf des Experiments:

- Das Experiment besteht aus 16 Runden. Innerhalb jeder dieser 16 Runden treffen Sie dieselbe Abfolge an Entscheidungen.

- Es gibt 2 verschiedene Rollen: Verkäufer und Käufer. Die Käufer sind entweder vom Typ 1 oder vom Typ 2. Ihnen wird zum Beginn des Experiments zufällig entweder die Rolle des Verkäufers oder die Rolle des Käufers vom Typ 1 oder Typ 2 zugewiesen. Sie behalten diese Rolle und die Käufer auch Ihren Typ während des gesamten Experiments. Ihre Rolle und bei Käufern auch Ihr Typ wird Ihnen zu Beginn des Experiments auf dem Bildschirm angezeigt.

- Zu Beginn des Experiments werden Sie ausserdem zufällig einer Gruppe zugeordnet. Jede Gruppe setzt sich aus vier Verkäufern, zwei Käufern vom Typ 1 und zwei Käufern vom Typ 2 zusammen. Die Zusammensetzung Ihrer Gruppe ändert sich während des Experiments nicht.

Ablauf einer Runde:

1. Jeder Verkäufer wählt, ob und welche der drei Güter A, B, C er den Käufern in seiner Gruppe anbietet. Jeder Verkäufer kann mehrere Güter anbieten, also z.B. Gut A und Gut B. Für jedes Gut, das der Verkäufer anbietet, wählt er einen Preis. Jeder Verkäufer kann mehrere Einheiten von jedem angebotenen Gut verkaufen.

2. Jeder Käufer sieht alle innerhalb seiner Gruppe angebotenen Güter und die dafür verlangten Preise. Die Liste der angebotenen Güter ist nach Gütern und innerhalb von Gütern nach dem aufsteigenden Preis sortiert. Bieten mehrere Verkäufer dasselbe Gut zum gleichen Preis an, so werden die Angebote in zufälliger Reihenfolge dargestellt. Ausserdem sieht ein Käufer, welche Güter durch denselben Verkäufer angeboten werden. Die dazu genutzte Verkäufer-Nummer wird in jeder Runde neu und zufällig einem Verkäufer zugewiesen, sodass keine Rückschlüsse auf die Identität des Verkäufers gezogen werden können. Jeder Käufer kann insgesamt maximal zwei Einheiten kaufen. Die zwei Einheiten können von einem Gut oder von zwei verschiedenen Gütern sein. Ein Käufer kann zwei Einheiten nicht von demselben Verkäufer kaufen, sondern nur bei zwei verschiedenen Verkäufern. Zum Beispiel kann ein Käufer eine Einheit von Gut A bei Verkäufer mit Nr. 3 kaufen und eine Einheit von Gut B von Verkäufer mit Nr. 4. Alternativ kann ein Käufer auch kein Gut kaufen.

3. Der Kauf einer Einheit eines Gutes, zweier Einheiten eines Gutes oder einer Einheit zweier Güter hat für einen Käufer den folgenden Wert:

Käufer vom Typ 1	
Gut	Wert
A	30
B	55
C	65
A + A	50
A + B	68
A + C	75
B + B	78
B + C	85
C + C	90

Käufer vom Typ 2	
Gut	Wert
A	70
B	130
C	185
A + A	120
A + B	190
A + C	200
B + B	210
B + C	230
C + C	255

   Kauft ein Käufer kein Gut, so hat dies einen Wert von 0 für den Käufer.

4. Beim Kauf eines Gutes durch den Käufer entstehen dem Verkäufer durch den Verkauf des Gutes folgende Kosten. Die Höhe der Kosten hängt davon ab, ob ein Käufer vom Typ 1 oder ein Käufer vom Typ 2 das Gut kauft:

Kosten bei einem Käufer vom Typ 1	
Gut	Kosten
A	18
B	35
C	50

Kosten bei einem Käufer vom Typ 2	
Gut	Kosten
A	50
B	90
C	130

Kaufen mehrere Käufer bei einem Verkäufer, so entstehen dem Verkäufer Kosten, die sich aus der Summe der Kosten pro Gut zusammensetzen.

5. Informationen zum Ende jeder Runde:

   - Jeder Käufer sieht zum Ende jeder Runde, welches Gut er zu welchem Preis gekauft hat. Er erhält ausserdem die Information, wie hoch sein Gesamtgewinn in der Runde ist.
   - Jeder Verkäufer sieht zum Ende jeder Runde, wie viele Käufer vom Typ 1 und Käufer vom Typ 2 bei ihm welches Gut gekauft haben. Er erhält zudem die Information, welche Kosten ihm durch den Verkauf pro Gut entstanden sind, welchen Preis er pro Gut verlangt hatte, welchen Gewinn er pro Typ und Gut gemacht hat, welchen Gewinn er pro Gut gemacht hat und wie hoch sein Gesamtgewinn in der Runde ist. Jeder Verkäufer sieht ausserdem, welche Güter in seiner Gruppe in der Runde zu welchen Preisen von anderen Verkäufern und von ihm angeboten wurden.

Gesamtgewinn pro Runde:

- Verkäufer:
  - Falls kein Gut verkauft wurde: Gesamtgewinn = 0.
  - Falls ein/mehrere Güter verkauft wurden: Gesamtgewinn = Summe der Preise der verkauften Güter – Summe der Kosten der verkauften Güter.
- Käufer:
  - Falls kein Gut gekauft wurde: Gesamtgewinn = 0.
  - Falls ein Gut gekauft wurde: Gesamtgewinn = Wert des gekauften Gutes – Preis des gekauften Gutes.
  - Falls zwei Einheiten von Gütern gekauft wurden: Gesamtgewinn = Wert der gekauften Güter – Summe der Preise der gekauften Güter.

    Hinweis: Der Wert zweier Einheiten von Gütern entspricht nicht der Summe der Werte der einzelnen Güter.

Übersicht für Käufer über den Wert des gekauften Gutes/der gekauften Güter abhängig von Ihrem Typ

Käufer vom Typ 1	
Gut	Wert
A	30
B	55
C	65
A + A	50
A + B	68
A + C	75
B + B	78
B + C	85
C + C	90

Käufer vom Typ 2	
Gut	Wert
A	70
B	130
C	185
A + A	120
A + B	190
A + C	200
B + B	210
B + C	230
C + C	255

Übersicht für Verkäufer über Ihre Kosten pro verkaufter Einheit abhängig vom Typ des Käufers und vom gekauften Gut

Kosten bei einem Käufer vom Typ 1	
Gut	Kosten
A	18
B	35
C	50

Kosten bei einem Käufer vom Typ 2	
Gut	Kosten
A	50
B	90
C	130

E.2 Translated instructions: English version

E.3 PV Mon

Instructions of the Experiment

Thank you very much for participating in this experiment. Please read the following information carefully. If you have any questions regarding the instructions please raise your hand. We will answer your questions at your cubicle. Please note that communication between participants is strictly prohibited until the end of the experiment.

For your arrival on time you receive 10 Swiss Francs. For answering the control questions after the instructions you receive 5 Swiss Francs. During the experiment, you can earn additional money. The amount of earnings during the experiment depends on your decisions and the decisions of other participants. All decisions will be made anonymously meaning no other participant will know your identity. At the end of the experiment you will be paid out anonymously meaning no other participant will know the amount of payment you received. During the experiment the earnings will be measured in ECU (= Experimental Currency Unit). You receive an initial endowment of 30 ECU. The experiment consists of several periods. In each period you can make **profits or losses**. At the end of the experiment **one period** will be randomly chosen to be payoff relevant. The total gain or loss in the randomly chosen period is added to the initial endowment resulting in the total amount of ECU earned. The exchange rate is:

$$2 \text{ ECU} = 1 \text{ Swiss Franc}$$

The exact procedure of the experiment is explained on the following pages.

The Experimental Procedure:

- The experiment consists of 16 periods. Each period consists of the same sequence of decisions.
- There are two different roles: sellers and buyers. The buyers are either of type 1 or type 2. Your role as a seller, a buyer of type 1 or a buyer of type 2 will be drawn randomly at the beginning of the experiment. Your role remains the same during the entire experiment. Your role will be displayed to you on your screen at the beginning of the experiment.
- At the beginning of the experiment you will be randomly matched to a group. Each group consists of four sellers, two buyers of type 1 and two buyers of type 2. The composition of the group does not change during the entire experiment.

The procedure in each period:

1. Each seller will be matched randomly with one of the four buyers of his group.
2. Each seller decides which of the three goods A, B, C (if any) he or she will offer to the matched buyer. Each seller can offer several goods, e.g. good A and good B. For each good that the seller offers he chooses a price.
3. The buyer observes the offered goods and the respective prices. The buyer can at most buy one good. Alternatively, he could also purchase no good at all.
4. The purchase of one good has following values for a buyer:

Buyer of type 1	
Good	Value
A	30
B	55
C	65

Buyer of type 2	
Good	Value
A	45
B	85
C	120

   If the buyer does not buy any good his value is 0.

5. If a good is purchased by a buyer, a seller has the following costs for the provision of the good:

Good	Costs
A	20
B	40
C	60

6. Information ath the end of each period:
   - At the end of each period each buyer observes which good was sold at which price. Besides, the buyer observes his total profit in this period.
   - At the end of each period each seller observes if the appropriate buyer purchased a good. If the buyer bought a good, the seller observes which good was purchased. Besides, the seller observes the costs per good, the price stated per good, the profit made per good and the total profit in this period. Moreover, each seller observes which goods was offered at which prices.

Total profit per period:

- Seller:
  - If no good was sold: Total profit = 0.
  - If one good was sold: Total profit = Price of sold good – Costs of sold good.
- Buyer:
  - If no good was bought: Total profit = 0.
  - If one good was bought: Total profit = Value of purchased good – Price of purchased good.

Overview for buyers on the value of purchased good dependent on the buyer's type

Buyer of type 1	
Good	Value
A	30
B	55
C	65

Buyer of type 2	
Good	Value
A	45
B	85
C	120

Overview for sellers on costs per unit sold dependent on the purchased good

Good	Costs
A	20
B	40
C	60

E.3.1 CV CompNE

Instructions of the Experiment

Thank you very much for participating in this experiment. Please read the following information carefully. If you have any questions regarding the instructions please raise your hand. We will answer your questions at your cubicle. Please note that communication between participants is strictly prohibited until the end of the experiment.

For your arrival on time you receive 10 Swiss Francs. For answering the control questions after the instructions you receive 5 Swiss Francs. During the experiment, you can earn additional money. The amount of earnings during the experiment depends on your decisions and the decisions of other participants. All decisions will be made anonymously meaning no other participant will know your identity. At the end of the experiment you will be paid out anonymously meaning no other participant will know the amount of payment you received. During the experiment the earnings will be measured in ECU (= Experimental Currency Unit). You receive an initial endowment of 30 ECU. The experiment consists of several periods. In each period you can make **profits or losses**. At the end of the experiment **one period** will be randomly chosen to be payoff relevant. The total gain or loss in the randomly chosen period is added to the initial endowment resulting in the total amount of ECU earned. The exchange rate is:

$$2 \text{ ECU} = 1 \text{ Swiss Franc}$$

The exact procedure of the experiment is explained on the following pages.

The Experimental Procedure:

- The experiment consists of 16 periods. Each period consists of the same sequence of decisions.
- There are two different roles: sellers and buyers. The buyers are either of type 1 or type 2. Your role as a seller, a buyer of type 1 or a buyer of type 2 will be drawn randomly at the beginning of the experiment. Your role remains the same during the entire experiment. Your role will be displayed to you on your screen at the beginning of the experiment.
- At the beginning of the experiment you will be randomly matched to a group. Each group consists of four sellers, two buyers of type 1 and two buyers of type 2. The composition of the group does not change during the entire experiment.

The procedure in each period:

1. Each seller chooses which of the three goods A, B, C (if any) he or she will offer to buyers in his group. Each seller can offer several goods, e.g. good A and good B. For

each good that the seller offers he chooses a price. Each seller can sell several units of the goods offered.

2. Each buyer observes all goods offered in his group and the respective prices. The list of the offered goods is sorted by good and within goods by increasing prices. If several sellers offer the same good at the same price, offers are displayed in a random order. Moreover a buyer observes which of the goods are offered by the same seller. The seller number used for this purpose is randomly drawn for each seller in each period such that no inferences on the sellers' identity can be made. Overall, each buyer can at most buy two units. The two units may be from the same good or from two different goods. A buyer cannot buy two units from the same seller but only from two different sellers. E.g., a buyer may buy one unit of good A from seller n° 3 and one unit of good B from seller n° 4. Alternatively a buyer might also buy no good at all.

3. The purchase of one unit of one good, two units of one good or one unit of two goods has following value for a buyer:

Buyer of type 1	
Good	Value
A	30
B	55
C	65
A + A	50
A + B	70
A + C	78
B + B	85
B + C	90
C + C	95

Buyer of type 2	
Good	Value
A	70
B	130
C	185
A + A	125
A + B	175
A + C	220
B + B	225
B + C	255
C + C	270

If the buyer does not buy any good his value is 0.

4. If a good is purchased by a buyer, a seller has the following costs for the provision of good. The costs depends on whether buyers of type 1 or type 2 buy the good:

Costs for buyers of type 1	
Good	Costs
A	18
B	35
C	50

Costs for buyers of type 2	
Good	Costs
A	50
B	90
C	130

If several buyers buy from the same seller, seller's costs amount to the sum of each cost per good.

5. Information at the end of each period:

- At the end of each period each buyers observes which good the buyer bought at which price. Besides, the buyer observes his total profit in this period.
- At the end of each period each seller observes how many buyers of type 1 and how many buyers of type 2 bought which good from him. He additionally observes the costs per good and sale, the price posted per good, the profit made per type and good, the profit made per good and the total profit in this period. Moreover, each seller observes which goods were offered in his group in this period by other sellers and at which price.

Total profit per period:

- Seller:
  - If no good was sold: Total profit = 0.
  - If one/several good/s were sold: Total profit = Sum of prices of sold goods - Sum of costs of sold goods.
- Buyer:
  - If no good was bought: Total profit = 0.
  - If one good was bought: Total profit = Value of purchased good - Price of purchased good.
  - If two units of goods were bought: Total profit = Value of purchased goods - Sum of prices of purchased goods.

    Hint: The value of two units of good is not the same as the sum of values of the single goods.

Overview for buyers on the value of purchased good/s dependent on the buyer's type

Buyer of type 1	
Good	Value
A	30
B	55
C	65
A + A	50
A + B	70
A + C	78
B + B	85
B + C	90
C + C	95

Buyer of type 2	
Good	Value
A	70
B	130
C	185
A + A	125
A + B	175
A + C	220
B + B	225
B + C	255
C + C	270

Overview for sellers on costs per unit sold dependent on buyer's type and the good sold

Costs for buyers of type 1	
Good	Costs
A	18
B	35
C	50

Costs for buyers of type 2	
Good	Costs
A	50
B	90
C	130