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Drip pricing and its regulation: Experimental evidence*

Alexander Rasch^{1,2,†} Miriam Thöne^{3,‡}
Tobias Wenzel^{1,4,§}

¹Duesseldorf Institute for Competition Economics (DICE), University of Duesseldorf

²Leibniz Centre for European Economic Research (ZEW)

³TWS Partners AG

⁴University of Sheffield

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Abstract

Drip pricing is the business practice of decomposing the price into multiple components which are presented sequentially to buyers. We experimentally examine the effects of this practice on seller strategies and buyer behavior as well as the implications for regulation. Sellers set two prices: a base (or headline) price and a drip price. At first, buyers only observe the base prices and make a tentative purchase decision. Revealing the sellers' drip prices, however, comes at a cost. We find that sellers only compete in base prices and set the highest possible drip price. This makes the base price a reliable indicator for the lowest total price, and few consumers invest in drip-price search. A comparison with Bertrand competition reveals significant effects: With drip pricing, consumer surplus is lower, and seller profits are higher. When there is uncertainty over possible drip sizes, sellers also compete over drips, and consumers more frequently fail to identify the cheapest offer. Bertrand competition also leads to higher consumer surplus and lower firm profits in this case. Hence, our results point to positive effects of drip-price regulation.

JEL Classification: L13; M3; C9.

Keywords: Drip pricing; Search; Regulation.

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[†]Duesseldorf Institute for Competition Economics (DICE), University of Duesseldorf, Universitaetsstr. 1, 40225 Duesseldorf, Germany. Email: rasch@dice.hhu.de.

[‡]TWS Partners AG, Widenmayerstr. 38, 80538 Munich, Germany. Email: miriam.thoene@twspartners.com.

[§]University of Sheffield, Department of Economics, 9 Mappin Street, Sheffield, S1 4DT, United Kingdom. Email: t.wenzel@sheffield.ac.uk.

1 Introduction

Firms have come up with various pricing techniques to secure profits. Recent advances in Internet technology have made it easier for firms to adopt more elaborate pricing practices. In this paper, we analyze the implications of drip pricing, which is widely used by firms in many industries, and which has been criticized by competition authorities and consumer protection agencies. Under drip pricing, the product price consists of several components, but firms advertise only (one single) part of a product’s price (bait price) when consumers first learn about the product. The other price components (drip prices) are revealed at later stages of the purchasing process. Since going back to search for alternatives may be costly, this can lead to a lock-in of consumers.¹ Under drip pricing, consumers may therefore underestimate the total price and search too little. Examples are manifold and can be found in many industries (particularly in online trade): flight-ticket prices, online admission tickets, tourism fees², ATM fees, cleaning and service fees on Airbnb.³ First experimental evidence suggests that consumers indeed strongly and systematically underestimate the total price under drip pricing and make mistakes when searching (Huck and Wallace, 2015; Robbert, 2014; see the literature review below).

Drip and partitioned pricing are also pervasive in retail financial markets.⁴ In particular, drip pricing and financial markets and services are related in two ways: First, drip pricing as a business practice can be observed in many markets for financial services. Second, drip-price components also feature in the context of payment systems and are often levied for offering a specific financial service (method of payment; e.g., credit cards). As such, they have seen considerable regulatory intervention in recent years (see below).

Regarding the first aspect, for many financial products, the total price is split into several components. For instance, the price of a loan can be decomposed into an interest rate and additional fees (Levitin, 2018). Similarly, the overall price from borrowing via credit card might consist of more than one component, for instance, including teaser rates and late

¹Note that under add-on pricing, another elaborate pricing technique, firms typically offer additional products or services which consumers may or may not buy (i.e., they can avoid additional charges for minibars etc.), whereas under drip pricing, they must pay all price components if they want to buy the product.

Another related pricing strategy is partitioned pricing. There, the product price also consists of several components, but all parts are known from the start. Note that drip and partitioned pricing are sometimes used interchangeably.

²An extensive overview of resort fees is provided by Friedman (2020).

³In 2015 the Australian Competition and Consumer Commission found this pricing strategy to be breaching consumer law. Airbnb now includes all cleaning and service fees in its headline prices. This appears not to be the case in Europe which is why the EU Commission scrutinizes Airbnb’s pricing (see, e.g., <https://www.zeit.de/wirtschaft/unternehmen/2018-07/eu-kommission-airbnb-preisangaben-geschaeftsbedingungen-abmahnung>).

⁴See, e.g., Oxera Agenda (2009), “What’s the price? Consumers and the art of hidden charging”. Note that they refer to the more general term of ‘hidden charges’.

fees. Withdrawing cash from an ATM can involve additional charges. As many of these products and services are already inherently complex, such pricing strategies might add to consumers' difficulty in making correct decisions (e.g., Carlin, 2009). More generally, financial institutions often sell ancillary products to their customers.⁵

With regard to the second aspect, in the context of payment systems, retailers may add fees for using certain payment methods. This practice can, in particular, be observed for payments in online trade via credit cards in the form of surcharges.⁶ Such surcharges can also be viewed as a drip price, as consumers are typically only informed about such fees when finalizing the purchase (e.g., Bourguignon *et al.*, 2019).⁷ Similarly, customers who lease vehicles are required by the finance company to purchase GAP ("guaranteed auto protection") insurance to cover the value of lease payments and the residual value if the car is stolen or wrecked (Friedman, 2020).

These observations already indicate the importance of gaining a better understanding of the mechanisms at work both from a competition-policy and a consumer perspective. This is also reflected in the current political discussion and the actions taken by competition authorities around the world. Many of the regulatory interventions have been aimed at reducing the practice of drip pricing. For example, the European Commission in its Directive 2011/83/EU on Consumer Rights and the Australian Competition and Consumer Commission have recently investigated the pricing in the airline sector. Before the investigations and the subsequent prohibition of certain pricing techniques, airlines kept adding charges (fuel surcharges, payment by credit card, etc.) during the online purchasing procedure. The European Commission now requires airlines to include all applicable taxes, charges, and surcharges in the final flight price; any surcharges should reflect costs.⁸

There has also been a trend toward more regulation and consumer protection in financial markets in recent years.⁹ For instance, following the financial crisis of 2008, Dodd-Frank Wall Street Reform and Consumer Protection Act was signed into law in the US in 2010 with, among others, the aim to "help consumer finance markets work by making rules more effective, by consistently and fairly enforcing those rules, and by empowering consumers

⁵For instance, a customer who opens a current account might also be offered further financial services (such as investment advice) subsequently.

⁶There is empirical evidence that such fees are often levied in markets where consumers only buy infrequently, such as travel, see Bolt *et al.* (2010) or Hayashi (2012) and the references therein.

⁷There is a literature that explores the effects of surcharging vs. no - surcharging taking the platform structure of payment card systems into account. See, for instance, Gans and King (2003) or the survey by Rysman and Wright (2014). Bourguignon *et al.* (2019) provide an analysis of surcharging where consumers are imperfectly informed of a retailer's surcharging policy.

⁸Similarly, the U.S. Department of Transportation requires airlines to include all applicable non-optional fees and taxes in its price displays. The former Office of Fair Trading (OFT) recommended to ban excessive debit and credit card surcharges.

⁹See, for instance, Campbell (2006) and Campbell *et al.* (2011) for general discussions of consumer protection in retail financial markets.

to take more control over their economic lives.” Similarly, in the UK, the Consumers’ Association, an independent organization which trades as Which?, demanded that the Financial Services Bill amend the Unfair Terms in Consumer Contracts Regulations to make it possible for consumers to defend themselves against hidden charges in financial products. Regarding surcharges for payment cards, authorities have prohibited or limited the extent of surcharging. For instance, in the EU Article 62(4) of Directive (EU) 2015/2366 (Payment Services Directive) bans card surcharges from 2018 on.¹⁰

It is important to note that the above-mentioned regulatory interventions have been mandated under the assumption that consumers are necessarily hurt by this type of pricing technique. However, the literature has not addressed this issue so far. In this respect, the policies implemented up to now have not been subject to rigorous evaluation. Moreover, drip pricing continues to be an important aspect in the area of competition policy: As a matter of fact, drip pricing is still used in the airline industry, because companies regularly come up with new charges and techniques to increase their flight prices. Some fees for cabin baggage and seat allocation procedures are such that consumers may be forced into paying for additional services. For example, this is the case when a family traveling on a reservation with a (young) child is required to pay extra in order to sit in a seat adjacent to their offspring.^{11,12}

In order to shed light on the issue, we conduct an experimental analysis to characterize the effects of drip pricing on market players’ strategies (buyers and sellers) as well as the implications for regulation. To guide the experiment we provide a simple theoretical model based on Gabaix and Laibson (2006) and Heidhues *et al.* (2017). Our experimental market consists of one buyer and two sellers. Sellers set two prices: a base (or headline) price and a drip price. At first, buyers only observe the base prices and make a tentative purchase decision. Revealing the sellers’ drip prices, however, comes at a cost. Within this framework, we consider two different scenarios: In one scenario, buyers are perfectly informed about the maximum drip price a seller may charge. In the second scenario, buyers are only imperfectly informed about the maximum drip. These situations are relevant in practice because in many markets (in particular those in which consumers buy infrequently), consumers are unaware whether or not a firm is using a drip-price strategy. This theoretical model predicts a Bertrand-like outcome when consumers are informed about the possible drip price. Sellers charge high drip prices and low base prices, such that

¹⁰Interestingly, the practice of surcharging only arose as regulators banned the “no-surcharge rule” imposed by payment platforms with the aim to reduce the payment platforms’ market power.

¹¹In 2016 Congress addressed this problem by passing a bill aimed at making it easier for parents to sit next to their child during a flight.

¹²Drip pricing and its effects on consumers has also attracted attention by authorities in many other markets. A prominent example are so-called hotel resort fees in the US, which are essentially a compulsory drip-price component charged by hotels on top of the standard room rate. The use of this fee has considerably increased in recent years, and competition authorities are concerned about its often intransparent presentation by hotels (Sullivan, 2017).

the total price coincides with Bertrand prices and sellers earn zero profits. In contrast, where there is uncertainty about the drip size, sellers with a high drip-price limit can earn profits above the competitive level.

Hence, from a theoretical point of view, the use of different pricing techniques should not change market outcomes for competition with homogenous products when buyers are informed about possible drip prices (and are forward-looking¹³), but buyers may be hurt when the extent of the drip price is uncertain. Previous experimental studies have found that in duopoly markets, sellers earn higher profits than predicted by theory (e.g., Dufwenberg and Gneezy, 2000; Huck *et al.*, 2007). Given this observation, it is not clear a priori what happens when sellers can decide on more sophisticated pricing structures. This, however, is important to assess the necessity and the implications of the above-mentioned interventions. In particular, it is an open question whether all price components will be higher than predicted, or whether an increase in the number of pricing components increases competition.

Our contribution to the literature (surveyed below) is twofold: (i) We evaluate whether regulation leads to the desired positive effects for consumers. (ii) We do so by explicitly accounting for the incentives on the firm side as well as on the consumer side. Based on the theoretical considerations, the market experiment allows us to address four key issues which are relevant in the competition-policy debate. First, in the case in which buyers are informed about the possible drip prices, we analyze sellers' pricing strategies and whether drip pricing hampers competition. We find that firms fiercely compete in base prices but not in drip prices. Compared to the standard Bertrand setup, the total price increases when firms use drip pricing. Second, we are interested in how drip pricing affects consumers' search behavior. Our experimental study shows that given costly search, consumer search little which is mostly optimal from an ex-post perspective, as consumers anticipate identical high drip prices across sellers. Third, we investigate the implications of drip pricing for consumer surplus and firm profits compared to a situation in which sellers are required to charge an all-inclusive price (Bertrand pricing). It turns out that when firms use drip pricing, consumers are worse off, whereas firms benefit. Hence, our experiment suggests that market interventions might be useful from a consumer-protection view. Fourth, turning to the scenario in which there is imperfect information about drip prices, our experiments show that this affects competition in drip prices for sellers with a high drip-price limit in the sense that average drip prices are smaller. Importantly, buyers increasingly fail to identify the cheapest seller. As a result,

¹³In the context of consumers' purchasing behavior, models of limited attention demonstrate that the way in which information is presented or choices are framed can have a significant influence on consumer decisions. For example, Gabaix and Laibson (2006) and Heidhues *et al.* (2017) show that firms can use the shrouding of prices for additional services or products (e.g., parking, Internet access) to benefit from boundedly rational consumer behavior. They may be able to increase their profits even if competition is, in principle (i.e., with only fully rational consumers), fierce.

a regulation that bans drip pricing leads to higher consumer surplus and lower firm profits. As such, our study provides evidence that the above-mentioned regulatory policies indeed have some merit for consumers.

Related literature

Our study adds to the growing body of literature examining firm incentives and consumer behavior when faced with complex pricing strategies (see, e.g., Greenleaf *et al.*, 2016 and Ahmetoglu *et al.*, 2014 for an extensive review). In theory, complex prices can lead to search frictions which make it harder for consumers to compare offers and which can induce monopoly pricing (Diamond, 1971; Stahl, 1989). Especially a lack of consumer sophistication can give firms incentives to use complex pricing strategies, as some consumers may fail to anticipate additional charges or hidden costs (Gabaix and Laibson, 2006; Heidhues *et al.*, 2017; Shulman and Geng, 2013).

This is, in particular, the case for retail financial products and services which are often inherently complex and many consumers find it difficult to navigate these markets.¹⁴ Armstrong and Vickers (2012) and Ko and Williams (2017) provide models of add-on sales by financial institutions. Kosfeld and Schüwer (2017) shows under which conditions banks have an incentive to price discriminate add-on products between sophisticated and naive consumers. Carlin (2009) provides a framework where banks can artificially increase price complexity so that a smaller of consumers is able to identify the best offer.¹⁵ Our paper adds to this literature by exploring the implications in situations where financial institutions partition the total price into several components and sequentially present them to their customers.

The behavioral aspects of complex pricing have sparked a growing experimental literature analyzing the topic. Primarily the practices where sellers set multiple prices for a single product (partitioned pricing) or shroud the price of an add-on product have received increasing attention (Morwitz *et al.*, 1998, Carlson and Weathers, 2008). An important result from this literature is that with multiple price components, the price perceived by consumers is generally lower and that this effect increases with the number of price components (Morwitz *et al.*, 1998).¹⁶ On the seller side, there exist incentives to shroud

¹⁴There is a growing literature that documents consumer mistakes in financial markets. See, for instance, the surveys by Campbell (2006) or Campbell *et al.* (2011).

¹⁵Relatedly, Piccione and Spiegler (2012) offer a duopoly model where firms can choose different price frames in order to confuse consumers. Using a similar mechanism, Chioveanu and Zhou (2013) extends the analysis to the oligopoly case. Gu and Wenzel (2014, 2020) analyze consumer protection policies in such settings.

¹⁶Following the initial experiments by Morwitz *et al.* (1998), there is also a literature that experimentally studies under which conditions price partitioning (but with simultaneous presentation of price elements) may increase consumer purchase intentions and perception of fairness, and under which conditions it may decrease the price (see, e.g., Hossain and Morgan, 2006, Bertini and Wathieu, 2008, Xia and Monroe, 2004, Burman and Biswas, 2007, and Sheng *et al.*, 2007).

prices or deliberately confuse consumers, especially when consumers are susceptible to this type of confusion (Kalayci and Potters, 2011, Kalayci, 2015). Often, not even competitive market conditions can keep sellers from exploiting consumer limitations via complex prices (Kalayci, 2016, Normann and Wenzel, 2019, Crosetto and Gaudeul, 2017).

Only little research focuses on the practice of drip pricing. The few, primarily experimental studies, that do, find that also with drip pricing, consumers systematically underestimate the total price, and perceptions of fairness are weakened, as consumers feel deceived by the sellers (Robbert and Roth, 2014, Robbert, 2014). Furthermore, in an experimental comparison of different price frames, Huck and Wallace (2015) find that drip pricing has the largest negative effect on consumer surplus out of all frames.¹⁷ The reason for this is that drip pricing discourages consumers from searching for cheaper offers which leads to fewer optimal purchase decisions.

Our analysis differs from those studies in that we focus on both market sides (i.e., buyers and sellers), whereas previous studies focus solely on one side of the market, namely the consumer side. For example, in Huck and Wallace (2015), the size of the drip prices is determined randomly by a computer. As a result, it is often optimal for consumers to invest in comparing product prices, which few participants in the experiment did. This approach, however, may lead to biased results, since possible pricing incentives of the sellers are neglected. As our experiment shows, sellers do not choose the size of their drips randomly but rather set the highest possible drip price and only compete in the base prices. Participants in the role of the buyers anticipated this and—instead of searching for the lowest price—based their purchase decision exclusively on the base price which leads to low levels of consumer search. Contrary to Huck and Wallace (2015), not searching is often the optimal choice in our experiment as a result of sellers’ drip-price strategies and did not lead to large drops in consumer surplus. However, when there is uncertainty over drip prices, we also find a larger number of consumer mistakes, which are more aligned with Huck and Wallace (2015).

Moreover, our approach allows to evaluate the effects of regulatory interventions in the form of an abolishment of drip pricing as proposed and implemented by competition authorities. As pointed out before, it is a priori not clear whether regulation leads to the desired result of better consumer protection. Our experimental results highlight that consumers indeed benefit from such a policy intervention.

In a complementary study, Wenner (2018) studies experimental markets with one buyer and one seller where buyers may have a biased belief about the probability of an additional payment to the seller. The experiment analyzes under which conditions buyers can be

¹⁷Besides drip pricing, Huck and Wallace (2015) also investigate the effects of time-limited offers, non-linear prices, baiting, and reference pricing.

exploited. Wenner (2018) argues that exploitation only takes place when the trading environment is sufficiently complex making it harder for buyers to understand the seller’s incentives with regard to the additional payment. In contrast, in our experiment, there is competition among sellers, and we ask whether competition helps to protect consumers. Moreover, in our setting, buyers have to invest whether to find out if there are additional payments. This allows us to address the question how buyers react to complex pricing strategies (whether they search for better offers or not), and whether buyers benefit from regulation that increases market transparency. In contrast to Wenner (2018), we find that buyers are always better off with regulation. This effect is, in particular, large when buyers are uncertain about the extent of drip pricing.

The remainder of the paper is organized as follows. In Section 2, we describe the model that guides our experimental setup. Section 3 specifies the design of the experiment and derives our main hypotheses. In Sections 4 and 5, we report the results of the experimental study. Section 6 concludes.

2 Theoretical background

To guide our experiment, we develop a simple model of drip pricing building on Gabaix and Laibson (2006) and Heidhues *et al.* (2017).¹⁸ In this model, due to its sequential price presentation, drip pricing introduces a search friction. While buyers can observe all firms’ base prices, they can compare drip prices only at a cost.

We consider a market with two sellers offering a homogeneous product.¹⁹ The two sellers are identical and have the same constant per-unit production cost of $c > 0$. There is a unit mass of buyers.²⁰ Buyers are identical and have a valuation of $v > 0$ for one unit of the product.

When sellers can employ drip pricing, the total price consists of two components: the base price p_1 and the drip price p_2 such that the total price a buyer has to pay is $p_T = p_1 + p_2$. We assume that there is an upper limit \bar{p} on the drip price. Similar assumptions are imposed in related papers (e.g., Gabaix and Laibson, 2006; Armstrong and Vickers, 2012; Heidhues *et al.*, 2017). This upper limit might, for instance, represent a legal restriction and is consistent with regulation in many markets (see e.g., Heidhues *et al.*, 2018). There

¹⁸In contrast to our model, in their models, consumers do not have the option to search for additional price component. In Heidhues *et al.* (2018) consumers who only observe the base price of a random firm can decide whether to search for more detailed information of that firm’s offer (studying) or to search for the base price of another firm (browsing).

¹⁹We note that the equilibrium predictions also hold for any number of sellers exceeding two. However, as we only consider duopoly markets in our experiments, we present all theoretical results for the two-firm case.

²⁰In the experiment, there is one buyer in each market.

are no restrictions on base prices. This implies, in particular, that sellers can also charge below cost or even negative base prices.

All consumers can perfectly observe each seller's base price, but there is a search friction regarding the drip price. The drip price is only revealed during the purchase process. Upon observing both sellers' base prices, the buyer has to tentatively choose one seller. During further inspection, the drip price of this seller is revealed. If a buyer also wants to know the other seller's drip price, a search cost of $s > 0$ has to be incurred. This search cost s might represent any real costs of going through the inspection process again. Alternatively, the search cost might also represent a psychological cost to the buyer, because he might have already become attached to a product during the purchase process (e.g., Ahmetoglu *et al.*, 2014; Huck and Wallace, 2015).²¹

We consider the following sequence of events. In the first stage, sellers simultaneously choose both price components. In stage 2, base prices are revealed to buyers. Buyers tentatively decide for one seller. In stage 3, upon observing the drip price of the tentatively chosen seller, buyers can decide whether to purchase from that seller or invest into search. In stage 4, provided a buyer has chosen to search in stage 3, the buyer is now informed about the other seller's drip price. The buyer now makes the final purchase decision.

The following proposition presents the equilibrium behavior of sellers and buyers:

Proposition 1. *In equilibrium, sellers charge $p_1^* = c - \bar{p}$ and $p_2^* = \bar{p}$. The total price is $p_T^* = c$, and sellers earn zero profits. Buyers inspect only one product and do not invest into the inspection of further products.*

The intuition of the equilibrium strategies is as follows. Given that both sellers charge the same drip price at its maximum level, buyers, anticipating these drip prices, have no incentive to invest into costly search for a second drip price. On the other hand, as buyers do not compare drip prices, sellers set the drip price at its maximum level \bar{p} . Competition between sellers then takes place on the observable base price. In a Bertrand fashion, the base price is competed down until all profit made from the drip is lost. As a result, sellers earn zero profits in equilibrium.

This has several implications. Even though there is a search friction in the market and buyers only inspect one product, the market outcome coincides with the competitive benchmark of Bertrand competition. The total price equals marginal cost, sellers earn zero profit and all surplus goes to buyers. This result is independent of the magnitude of the search friction as measured by the search cost s . In essence, this is the reverse

²¹With this interpretation, it is assumed that the first search of a drip price is costless, and a buyer only incurs the costs for finding out the drip of a second seller.

of the Diamond paradox (Diamond, 1971). In Diamond (1971) there is only one price element and buyers have to incur a search cost to compare prices. The paper shows that, independent of the magnitude of the search cost, prices are at the monopoly level and there is no search. In contrast, when there is a search friction only on the drip price component, competition works via the transparent base price and all profits from the drip price are competed away via the base price. In this sense, drip pricing is more competitive.

The equilibrium price structure is closely related to models in which firms compete in two price dimensions, and (at least) some consumers are naive such as in Gabaix and Laibson (2006) and Heidhues *et al.* (2017). In those models, naive consumers only decide according to a transparent base price and ignore an add-on product or an additional price element. In both models, prices for the add-on are high and profit is competed away on the base price.²² In contrast, in our model, buyers are rational and forward-looking, but there is a search friction to compare drip prices. However, as buyers anticipate that sellers set identical drip prices, there is no search in equilibrium.

We can use Proposition 1 to evaluate the effects of a policy measure that bans drip pricing and requires firms to charge a transparent all-inclusive price (Bertrand competition):

Corollary 1. *With certain drip-price limits, banning drip pricing and requiring transparent prices does not affect the market outcome. The total price as well as seller profits and buyer surplus remains unaffected.*

Corollary 1 states that banning drip pricing does not alter market outcomes, as the total price as well as firms profits and buyer surplus remain unchanged. As a result, the model suggests that policies aimed at reducing drip prices are not an effective tool in order to improve the market outcome. It should be noted that this result is attained under the assumption that buyers perfectly anticipate the drip size.

So far, we considered situations in which all buyers were informed about the drip and the drip-price limit. In many real-life situations, buyers may be unsure about whether a firm charges a drip price or not. In our experiment, we take such considerations into account by considering a setting in which the drip-price limit is a random variable whose outcome is unknown to buyers.

To be concrete, suppose there are two possible drip-price limits \bar{p}_H and \bar{p}_L , where $\bar{p}_H > \bar{p}_L$. The different limits can also be thought of as different seller types, where a seller with the high drip-price limit is referred to as type H , and a seller with the low drip-price limit is referred to as type L . Furthermore, suppose that each limit applies to a seller with

²²Heidhues *et al.* (2017) mostly focus on the case where there is lower bound on the base price such that not all profits are competed away.

probability 0.5 (which is the value we use in the experiment) and it is independent across sellers such that sellers may end up with either identical limits (either both \bar{p}_H or both \bar{p}_L) or different limits (one seller with \bar{p}_H and one seller with \bar{p}_L). The outcome of this random draw is private information of each seller. We also assume that the drip-price limit of type H is relatively large compared to the drip-price limit of type L and the search cost s , $\bar{p}_H > \bar{p}_L + 2s$.²³

Otherwise, the game coincides with the base game described earlier. The following proposition details the Perfect Bayesian Nash equilibrium behavior of sellers (as type H and as type L) as well as the buyers' purchase and search strategy:

Proposition 2. *Suppose $\bar{p}_H > \bar{p}_L + 2s$. Then, in equilibrium, both seller types charge the same base price of $p_1^L = p_1^H = c - \bar{p}_L$. A seller of type L charges a drip price of $p_2^L = \bar{p}_L$, whereas a seller of type H charges a drip of $p_2^H = \bar{p}_L + 2s$. Seller L earns zero profit; seller H 's expected profit is equal to s . Buyers inspect only one product and do not invest into further search.*

The proposition provides the following main implications for seller behavior. In equilibrium, both seller types charge identical base prices, but differ in the drip price. Type L charges a drip equal to the upper bound, whereas type H charges a higher drip with the difference equal to $2s$. In this sense, unlike the previous case, uncertainty over the drip-price limit restricts the seller of type H to charge the maximum drip. However, the seller of type H still benefits in this case: While type L prices at marginal cost, the total price by type H exceeds cost and allows a positive profit. Seller H can make a positive profit due to mimicking type L on the base price making both sellers indistinguishable to the buyer in the inspection phase. Upon discovering the higher drip price a buyer does not find it worthwhile to search for a lower drip price due to the search cost. Yet, the extent of the search cost limits type H to charge a higher drip.

One immediate implication is that with uncertainty over drips, a seller might obtain market power, and buyers indeed can be hurt. In contrast to the setting with no drips at all or with certain and identical drip-price limits, the total price at which a buyers may purchase can be above marginal cost. More precisely, while a seller of type \bar{p}_L charges a total price equal to c , the total price of seller \bar{p}_H exceeds marginal cost. As in the inspection phase, a buyer cannot distinguish seller types (due to identical base prices), a buyer may end up purchasing at a price above cost. This finding suggests that not drip pricing per se, but only in combination with uncertainty over the use of it can lead to

²³This case is the most interesting, and the parameter values used in the experiment satisfy this condition. If, instead, the two drip-price limits were relatively close, firms would find it optimal to charge drip prices equal to these limits in equilibrium, the outcome in our analysis with certain drip-price limits.

detrimental outcomes for consumers.

These findings also suggest that banning drip pricing can be beneficial for buyers. The comparison with Bertrand competition reveals that the average (total) price paid by buyers decreases and average seller profits also decrease. The effect on sellers is, however, asymmetric. Sellers with a low drip-price limit are not affected, while the sellers with a high drip-price limit lose profits. Total welfare is not affected by this regulation, as in neither situation buyers are predicted to search.

Summarizing this discussion:

Corollary 2. *With undercertain drip-price limits, banning drip pricing does affect market outcomes: Banning drip pricing leads to lower total prices on average and increases buyer surplus. Sellers with a high-drip price limit are hurt by this regulation.*

3 Experimental design and hypotheses

3.1 Experimental design

Our main goal is to analyze buyer and seller behavior with drip pricing as well as the effects of a regulation that bans drip pricing. Therefore, we ran sessions in which sellers could employ a drip-pricing strategy and sessions in which sellers could only charge an all-inclusive price.

We consider experimental markets with two sellers and one buyer. We chose the following parametrization. A seller's per-unit cost of production amounted to 10 experimental currency units (ECUs). A buyer's valuation of the good offered by the two sellers was 35 ECUs. The buyer could not refrain from making a purchase but had to decide to buy one unit from one of the sellers in every period. In each treatment, the maximum total price a seller could set was 30, the minimum was equal to 10 ECUs. Sellers could only choose integer values.²⁴

At the beginning of a session, all participants were randomly assigned the role of a seller or a buyer and sorted into matching groups each consisting of nine players. Participants kept their assigned roles throughout the entire experiment. At the beginning of every period, participants were randomly sorted into markets. To mimic the static nature of our model we employed a random matching protocol such that within the matching groups, participants were re-matched every period. Each matching group therefore represents an independent observation.

²⁴Parameters were chosen such that in all treatments, neither of the participants could make a loss.

Every period of the experiment was structured in three stages. In the first stage, sellers chose their prices. Depending on the treatment, this could either be an all-inclusive price or a drip-pricing strategy with two prices, a base and a drip price. In the second stage, buyers made their purchase decisions. In the treatment with drip pricing, buyers could also decide whether to invest into receiving information on drip prices. We provide more details on buyers' decisions when describing the various treatments below. In the third and final stage, sellers were informed about the price choices by their competitor and the buyer's decision. Both buyers and sellers received information on their earnings in that period as well as on their cumulative earnings up until that period. The experiment was repeated for 20 rounds.

Table 1: Summary of the treatments.

Treatment	# Prices	Price range			Particip. (Indep. obs.)
		Base price	Drip price	Total price	
BERTRAND	1	[10, 30]	–	[10, 30]	54 (6)
DRIP	2	[0, 20]	[0, 10]	[10, 30]	54 (6)
BIG DRIP	2	[–10, 10]	[0, 20]	[10, 30]	54 (6)
RANDOM DRIP	2	[–10, 10] or [0, 20]	[0, 20] or [0, 10]	[10, 30]	54 (6)

There were four treatments. 54 subjects participated in each treatment which amounted to six independent observations per treatment. All four treatments are summarized in Table 1.

In the first treatment (BERTRAND), participants in the role of a seller competed in prices for the buyer in their market by charging an all-inclusive price which is fully transparent to buyers. Sellers set a single price, which could range from 10 to 30 ECUs. Upon observing both prices, the buyer made a purchase decision. This treatment serves as the benchmark to evaluate the effects of drip pricing.

In the second treatment (DRIP), the sellers were able to set two prices: a base price and an additional price (or drip price). The base price ranged from 0 to 20 ECUs. The drip price ranged from 0 to 10 ECUs. Both prices together made up the total price and we also imposed the restriction that the total price had to be at least 10 ECUs (the unit production cost). Hence, treatment DRIP is designed such that the range of the total price coincides with the range in BERTRAND. The buyer was at first only confronted with the base prices of the two sellers, without knowing the size of the additional price. The buyer could then decide whether she would like to learn the additional price of seller 1 or seller 2. After observing the additional price of the chosen seller, the buyer could again decide whether to stick with her choice and purchase from the seller whose total price

had been revealed to her or instead also learn the additional price of the respective other seller. Choosing to learn more about the other seller's drip price came at a cost of 2 ECUs and, having learned both total prices, was followed by a final purchase decision. Did the buyer instead decide to stick with her initial choice, there were no costs and the period ended.

The third treatment (BIG DRIP) only differed from the second treatment with respect to the range of price components the sellers could choose from: The base price ranged from -10 to 10 ECUs, while the additional price ranged from 0 to 20 ECUs. Thus, this treatment allows sellers to charge higher drip prices, but is designed such that the total price a seller can charge lies in the same range as in the first two treatments (BERTRAND and DRIP). In all other respects the third treatment was identical to the second treatment.

In the fourth treatment (RANDOM DRIP), buyers were faced with uncertainty regarding the limit of the drip price of the sellers. With a probability of 50% , a seller could set a maximum drip price of 20 ECUs. With a probability of 50% , the seller could only set a maximum drip price of 10 ECUs. Base prices were adapted, such that for both cases the total price could not exceed 30 ECUs but was at least equal to the marginal costs of 10 ECUs. The maximum drip price was private information of each seller and was drawn anew and independently every period. Otherwise the fourth treatment did not differ from the previous three treatments. This treatment reflects situations in which buyers are not aware of market conventions and are unsure to what extent sellers might follow drip-pricing strategies.

3.2 Procedures

All sessions were run at the DICElab for Experimental Economics at the University of Duesseldorf. Participants were drawn from a pool of mostly undergraduate students from different disciplines via email solicitations using the ORSEE system (Greiner, 2004). The procedure used during the experiments was the same throughout all sessions and each session was computerized. The experiment was programmed and conducted with the software z-Tree by Fischbacher (2007).

Before the start of each session, all participants were provided with written instructions.²⁵ For the duration of the experiments, participants were not allowed to communicate and were only able to see their own computer screen. After each period, all participants were informed about their payoffs from that period in addition to their cumulative payoff up until that period. Furthermore, after every period participants in the role of a seller were informed about the price choice of their competitor in that period.

²⁵Sample instructions are included in the Appendix.

A total of 216 students participated in nine different sessions (two sessions per treatment and an additional one for the treatment BIG DRIP). No subject participated in more than one session. A session including the instruction phase lasted between 45 and 75 minutes. After the last period, the cumulative payoffs of each of the players were converted into euros at an exchange rate of 25 ECUs to 1€. Participants were paid a show-up fee of 4€ in addition to their cumulative earnings. Including the show-up fee, average earnings of a participant amounted to 18.50€ per session if in the role of a buyer and 7€ per session if in the role of a seller.

3.3 Hypotheses

We now develop hypotheses about market outcomes in the three treatments using the theoretical considerations from Section 2. When sellers can employ drip pricing, Proposition 1 generates the following two predictions about seller and buyer behavior:²⁶

Hypothesis 1. *In treatment DRIP, sellers choose a skewed pricing scheme with a drip price at 10 ECUs and a base price of 0 ECUs. The total price equals the marginal cost of 10 ECUs, and sellers make no profits.*

Hypothesis 2. *In treatment DRIP, buyers anticipate the same drip price by the two firms and hence do not invest in search.*

As Proposition 1 and Corollary 1 predict a Bertrand-like market outcome with drip pricing, the overall outcomes in DRIP and BERTRAND should coincide.

Hypothesis 3. *In treatments BERTRAND and DRIP, total prices are equal, and sellers earn no profits.*

With regard to treatments DRIP and BIG DRIP, Proposition 1 leads to the following hypothesis:

Hypothesis 4. *Compared to DRIP, the drip price rises to 20 ECUs and the base price decreases to -10 ECUs in treatment BIG DRIP. The total price remains constant at the marginal cost of 10 ECUs.*

²⁶The following hypothesis are based on the results in Section 2 where sellers set continuous prices. In the experiment, however, sellers' choice sets were restricted to discrete prices. As a result, with discrete prices, there exists an additional equilibrium in treatments DRIP and DRIP in which both sellers choose a (base) price equal to 1 ECU. In this case, expected seller profits are equal to 0.5 ECUs. The same holds true for BIG DRIP, where there exists another equilibrium in which sellers choose a base price of -9 ECUs.

With regard to treatment RANDOM DRIP, Proposition 2 provides the following predictions:

Hypothesis 5. *In treatment RANDOM DRIP,*

- *both sellers charge an identical base price of 0 ECUs. A seller of type H chooses a higher drip price than a seller of type L (14 ECUs vs 10 ECUs). A seller of type H earns higher profits than a seller of type L.*
- *Moreover, buyers choose the seller with the lower base price and do not invest in search, as the difference in drip prices does not warrant the additional search costs.*

With regard to treatments RANDOM DRIP and BERTRAND, our theoretical model makes the following predictions (Corollary 2):

Hypothesis 6. *Compared to RANDOM DRIP, total prices are lower in BERTRAND. Profits of seller of type H are lower in BERTRAND, while profits of sellers of type L are not affected.*

4 Certain drips

This and the next section describe our experimental findings. In this section, we consider treatments in which buyers are perfectly informed about sellers' drip-price limits (while in Section 5, we consider the treatment in which buyers have uncertain information). We first describe the results of the DRIP treatment in which sellers employ drip pricing. In the second part, we compare these results to those of standard Bertrand competition in which sellers can only charge one (perfectly observable) price. Afterwards we analyze the effect of an increase in the drip size.

Table 2 provides a summary of the main results. All comparisons and tests are based on all 20 periods. Throughout the paper, we employ non-parametric tests where the number of independent observations corresponds to the number of matching groups.

4.1 Drip pricing

In the following, we report the findings of the DRIP treatment, analyzing both buyer and seller behavior separately.

Table 2: Summary of the experimental results.

Treatment	BERTRAND	DRIP	BIG DRIP	RANDOM DRIP		
				10	20	TOTAL
Base price		8.06	-2.37	6.41	2.88	4.69
Drip price		8.89	17.82	9.12	14.34	11.66
Total price	15.37	16.96	15.50	15.53	17.21	16.35
Selling price	14.52	16.26	14.77	14.76	15.56	15.18
Seller profits	2.25	3.13	2.42	2.25	2.95	2.59
Buyer surplus	20.49	18.49	19.83			19.45
Search probability		0.13	0.16			0.19
Search efforts		0.26	0.32			0.38

Seller behavior

Table 2 shows that sellers choose a skewed pricing scheme: The drip price is high and its average of 8.89 ECUs is close to the imposed upper limit of 10 ECUs. By contrast, with 8.06 ECUs, the base price is low relative to the imposed upper limit of 20 ECUs. Interestingly, this implies that the average base price is not sufficient to cover the production cost of 10 ECUs.

Figure 1 reveals how both price components evolve over time. Here we can observe two opposing trends. While the base price is continuously decreasing, the drip price is constantly rising, gradually converging to the imposed limit of 10 ECUs.

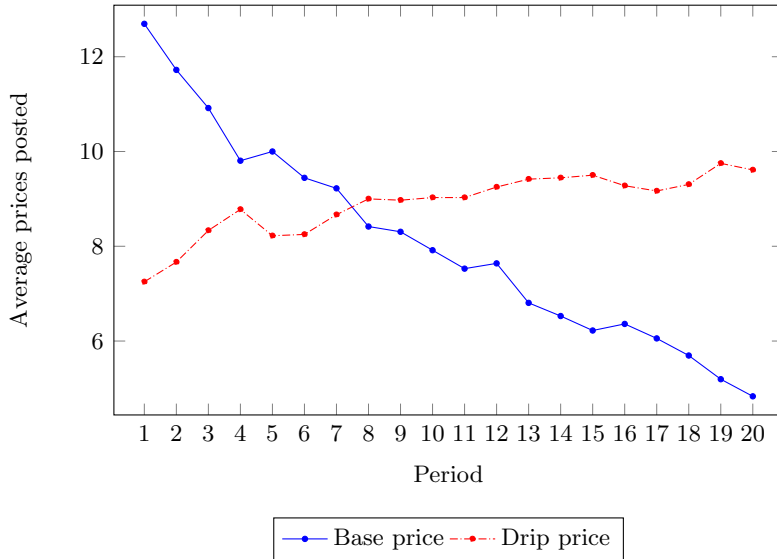
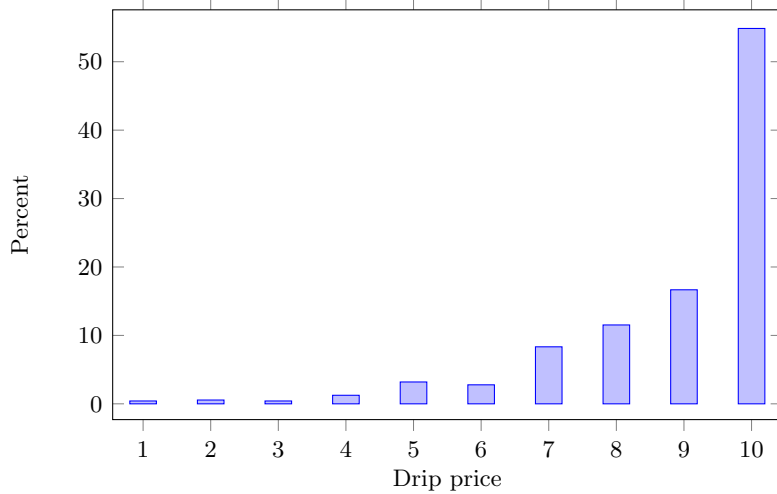
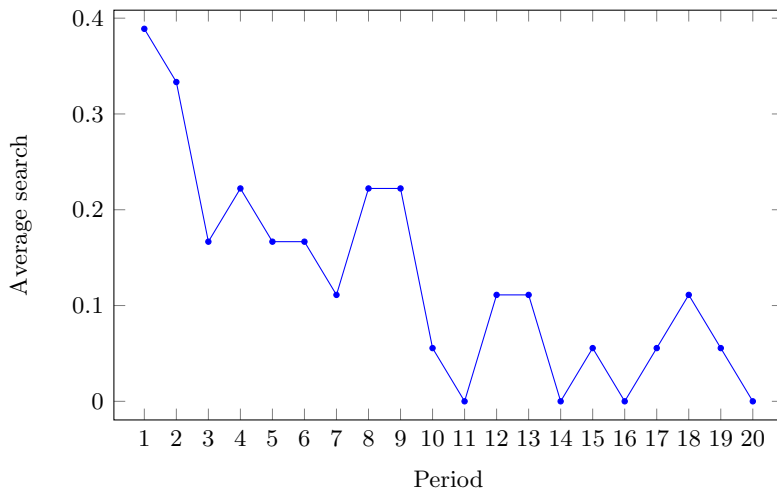


Figure 1: Evolution of price components under drip pricing (DRIP).

One important implication of these findings is that sellers primarily compete in the base price but not in the drip price. Figure 2(b) corroborates this finding, showing the distribution of drip prices. Over all periods, sellers primarily set only high drip prices. Drip prices of 9 and 10 ECUs are chosen in around 70% of cases. This finding is even more striking for the last ten periods in which the highest possible drip price of 10 ECUs is chosen in more than 70% of all cases, and the two highest values together exceed 85% of cases. Smaller drips (less than 7 ECUs) are almost never observed.



(a) Distribution of drip prices.



(b) Evolution of buyers' search decision.

Figure 2: Distribution of drip prices and search effort in treatment DRIP.

Competition in the base prices, however, is not strong enough to completely erode seller profits. Consequently, the total average price, consisting of both price components, exceeds the marginal cost. We observe an average total price of 16.96 ECUs which is higher than the production cost of 10 ECUs. Thus, firms are still earning positive profits. This

holds true even for the last periods of the experiment when base prices have reached their lowest levels. Sellers' pricing strategies are summarized in the following result:

Result 1. *With drip pricing, sellers choose a skewed pricing scheme with low base prices and high drip prices. In particular, sellers do generally not compete in drip prices but tend towards choosing the highest possible drip and make positive profits.*

Result 1 is generally in line with Hypothesis 1. As predicted by theory, the pricing scheme is highly skewed. However, we do observe a deviation in the magnitude of the observed effects. Base-price competition is not as strong as predicted by the theory so that, as a result, sellers earn positive profits. Note that the finding that in duopoly markets, sellers earn positive profits can be found in many experimental studies (e.g., Dufwenberg and Gneezy, 2000; Huck *et al.*, 2007).

Buyer behavior

Interestingly (but fully in line with theory), buyers rarely search for lower drip prices. On average, the search rate is as low as 13%. In addition, Figure 2(b) shows that the search rate is sharply decreasing over the course of the experiment. While almost 40% of the buyers decide to invest in the comparison of total prices at the beginning of the experiment, only very few keep searching towards the last periods of the experiment.

This behavior is consistent with sellers' pricing strategies. The search efforts of the first periods and increasing competition in base prices lead buyers to anticipate drip prices close to their maximum value. As a result, a large number of buyers select sellers according to the lowest base price (on average 94.5%). While this result is in consonance with the related literature, it should be noted that here, unlike in the related literature, buyers' reluctance to search does only lower their surplus to a smaller extent. This, again, is owed to the fact that drip prices are equally high, which makes the base price a reliable indicator as to which total price will be lower. Hence, in our setting, buyer decisions are indeed mostly optimal, i.e., buyers purchase from the seller with the lower price (on average 87.2% of cases). Nevertheless, drip pricing seems to hinder buyers identifying the cheapest product, and in 12.8% of cases, buyers end up purchasing at the higher price. This is summarized in the following result:

Result 2. *In the presence of drip pricing, buyers rarely search for lower drip prices. Nevertheless, buyer mistakes are small from an ex-post perspective, i.e., buyers tend to purchase at the lowest total price in the large majority of cases.*

In summary, in the DRIP treatment, sellers strongly compete in base prices but prefer to set the highest possible drip price. Buyers anticipate this and make their purchase decision only taking into account base prices instead of engaging in costly search, which is in line with Hypothesis 2.

4.2 Comparison with Bertrand competition and policy implications

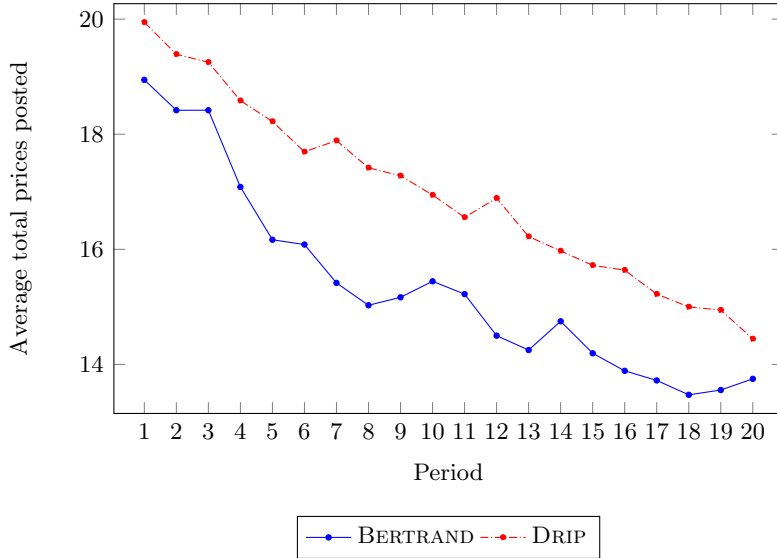


Figure 3: Evolution of total prices: Comparison of BERTRAND and DRIP.

To examine whether drip pricing increases sellers’ market power and leads to higher prices, we now compare the outcomes of DRIP with the outcomes under standard Bertrand pricing (BERTRAND) where buyers are perfectly informed about sellers’ total prices. This comparison can be viewed as a policy intervention that requires sellers to charge one fully transparent all-inclusive price.

In line with existing studies, we find that also with an all-inclusive price, the observed prices exceed the theoretical benchmark of marginal-cost prices (e.g., Dufwenberg and Gneezy, 2000). As far as the comparison of the two treatments is concerned, Table 2 shows that with drip pricing, prices are indeed significantly higher than with Bertrand competition (Mann-Whitney rank-sum test: $p = 0.025$).²⁷ On average, the total price a seller charges rises from 15.37 ECUs to 16.96 ECUs when drip pricing is employed. Figure 3 confirms that this effect remains robust over time. While total prices in both treatments are decreasing over time, the total price is consistently higher under drip pricing than under Bertrand competition.

²⁷Alternatively, selling prices are also higher under drip pricing ($p = 0.037$).

Consistent with the higher total prices, we find that seller profits increase, whereas consumer surplus declines with drip pricing (Mann-Whitney rank-sum test: $p = 0.037$ and $p = 0.01$, respectively). More precisely, profits increase from 2.25 to 3.13 ECUs and consumer surplus decreases from 20.49 to 18.49 ECUs. Thus, to the buyers' detriment, sellers have an incentive to employ drip pricing, as it increases their profits. We note that these anti-competitive effects of drip pricing are quite sizable. Indeed, average profits increase by almost 40%, whereas consumer surplus is reduced by almost 10%. However, as far as total welfare is concerned, we find that—in contrast to existing studies which report sizable welfare effects due to drip pricing (Huck and Wallace, 2015)—welfare is hardly negatively affected by drip pricing. This is due to the fact that sellers tend to charge the highest possible drip, and buyers anticipate these prices, i.e., costly search in order to find a cheaper deal is not an attractive investment. Yet, buyer mistakes are higher when drip pricing is employed (12.8% of cases with drip pricing and 0% with Bertrand pricing). The results of the comparison between drip pricing and Bertrand competition are summarized as follows:

Result 3. *Compared to Bertrand competition, drip pricing leads to higher total prices, higher seller profits, and lower buyer surplus.*

In contrast to Hypothesis 3, we find that DRIP and BERTRAND differ in total price and sellers' profits. While in both treatments, (total) prices exceed the theoretical benchmark, this effect is larger with drip pricing. The reason for this deviation from the theoretical benchmark seems to lie in the fact that in treatment DRIP, sellers are more reluctant to compete away the revenues they earn from charging the high drip component. In this sense, our results indicate that interventions that restrict drip pricing can be beneficial for consumers.

4.3 The effect of the drip size

Our previous results suggest that drip pricing has an anti-competitive effect on market outcomes. Here, we elaborate on this finding by examining a treatment in which sellers are permitted to charge a higher drip price. To do so we compare the treatment DRIP to the treatment BIG DRIP in which sellers are allowed to set a maximum drip price of 20 ECUs, instead of 10 ECUs. This treatment also serves as a benchmark for the later comparison with RANDOM DRIP where sellers are randomly assigned different drip-price limits.

With the increased drip-price limit, we find the same price pattern as in the DRIP treatment. Sellers are charging drip prices at (or close to) the upper limit and only compete

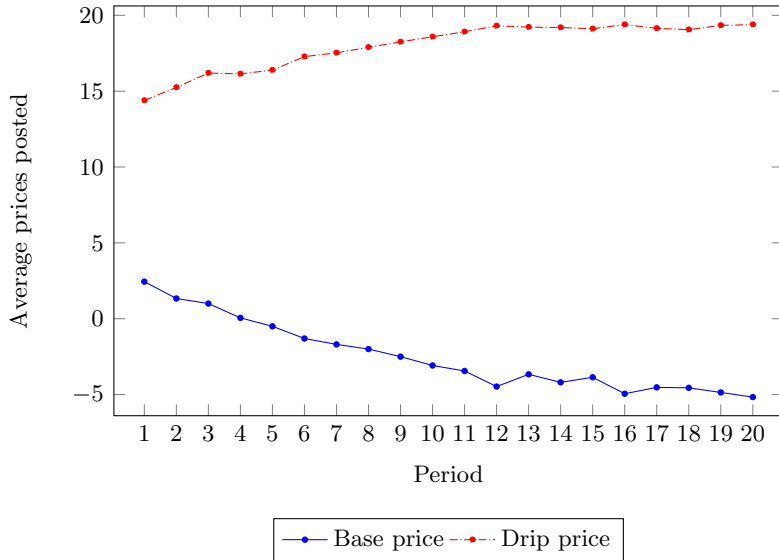
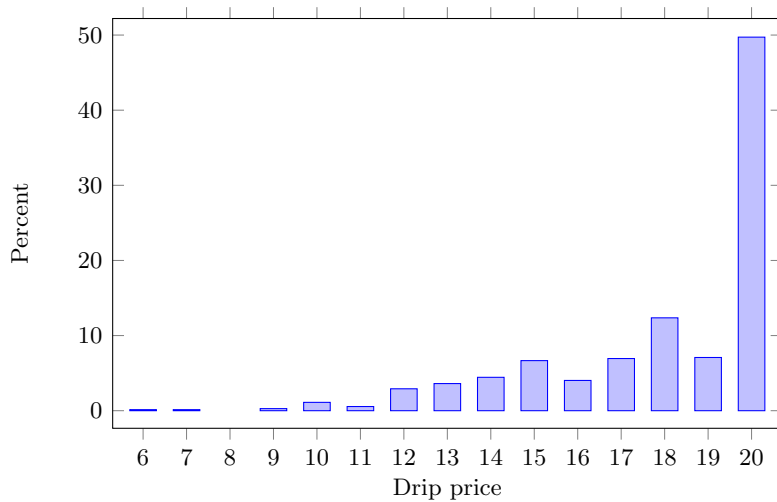


Figure 4: Evolution of price components in treatment BIG DRIP.

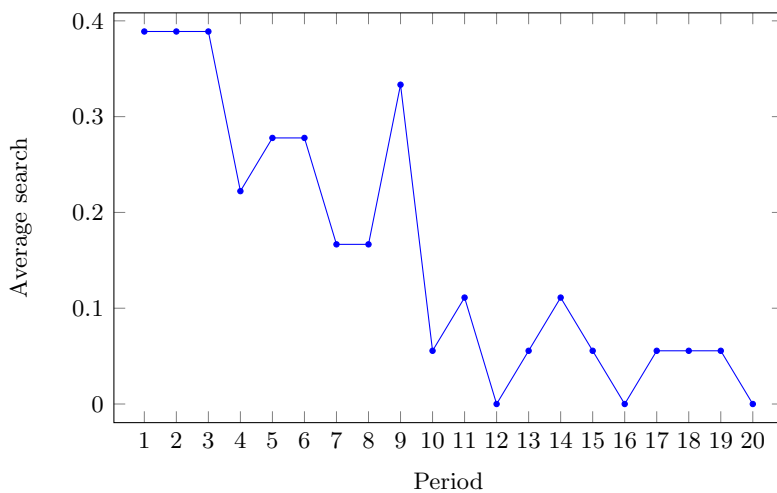
in base prices. Figure 4 shows that as sellers become more experienced, the average drip price converges toward the upper limit of 20 ECUs. By contrast, the base price decreases, taking negative values as the number of periods increases. Figure 5(a) shows the distribution of drip prices for the BIG DRIP treatment. It is apparent that the upper limit is chosen in the majority of cases. Low drip prices (i.e., less than 10 ECUs) are never observed. That is, as in the base treatment, sellers do not compete in drip prices. Also here, buyer experience drives down search rates (see Figure 5(b)), and we again observe buyers identifying the cheapest offer in the majority of cases. Only in 13.7% of cases, buyers purchase from the seller charging the higher total price.

Figure 6 represents an alternative way of highlighting similarities between the two treatments. In the figure, prices of the BIG DRIP treatment are normalized by adding 10 ECUs to the base price and subtracting 10 ECUs from the drip price. Overall, pricing components in the two treatments follow similar time trends, but the convergence towards the highest possible drip is faster in the DRIP treatment than in the BIG DRIP treatment (see Figure 6(b)).

Comparing BIG DRIP and BERTRAND we also find that total prices are lower when sellers are required to charge transparent prices (see Table 2). However, in the case of BIG DRIP, this effect is small and statistically not significant. We attribute this to two effects. First, as can be seen in Figure 6(b), sellers appear to learn more slowly about optimal drip prices in the treatment BIG DRIP. Second, the potential price of earning profits from a higher drip price seems to induce sellers to compete more harshly for buyers via lower base prices. This can be seen in Figure 6(a) where normalized base prices are lower in the treatment BIG DRIP than in DRIP. Both effects together can explain why the effect



(a) Distribution of drip prices.



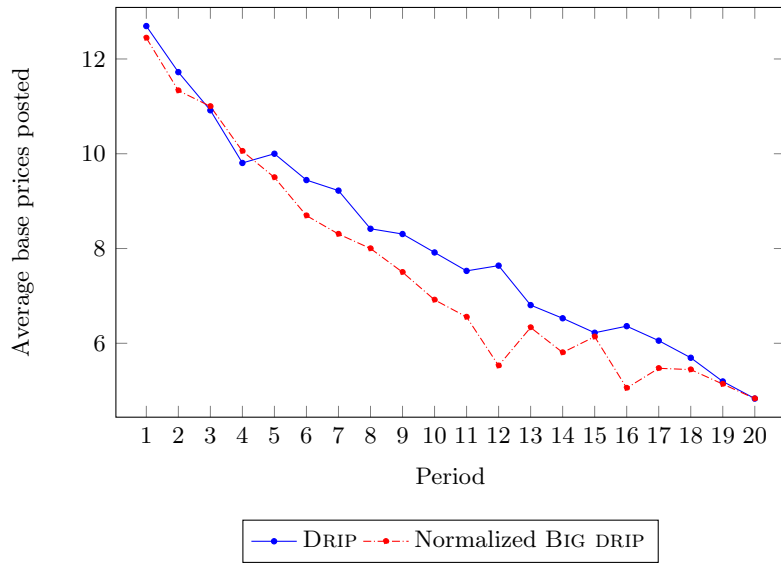
(b) Evolution of buyers' search decision.

Figure 5: Distribution of drip prices and search effort in treatment BIG DRIP.

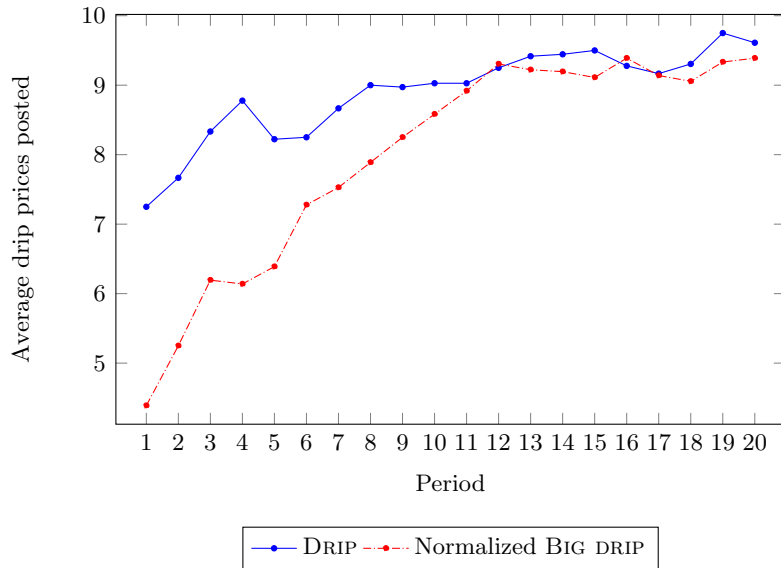
of regulation is smaller in case of BIG DRIP than in DRIP.

5 Uncertain drips

We now consider situations in which consumers are initially uninformed to which extent firms employ drip-pricing strategies. This represents decision situations in which consumers have less experience and are not familiar with conventions in a certain market. In order to account for this observation, we randomize the maximum drip-price size in the treatment RANDOM DRIP. With a probability of 50%, a seller is faced with a drip-price limit of 20 ECUs. With a probability of 50%, she is faced with a limit of 10 ECUs.



(a) Base price.



(b) Drip price.

Figure 6: Comparison of price components: DRIP and normalized BIG DRIP.

Regardless of the maximum drip price, the total price could not exceed 30 nor fall below 10 ECUs. Drip-price limits were independent across sellers and were assigned anew every period.

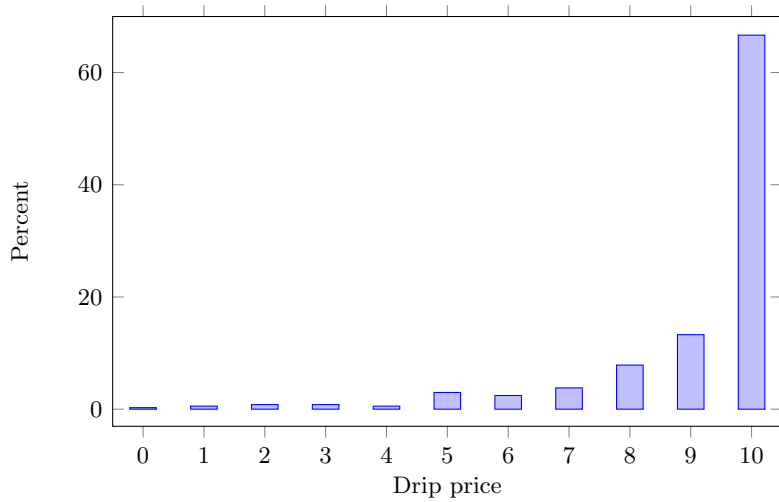
In Table 2, the results of treatment RANDOM DRIP are shown separately. Next to the total average results of the treatments, the table also shows the results for each of the two drip-price limits.

Seller behavior

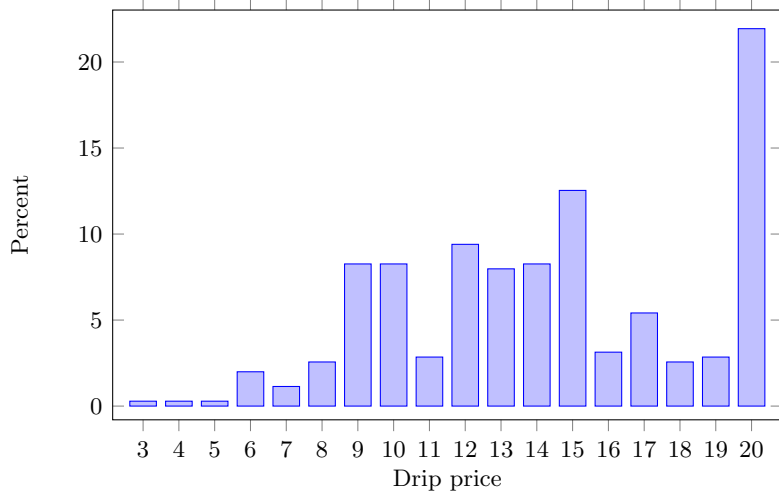
Table 2 shows that despite the random drip-price limit assignment, sellers still choose a skewed pricing scheme. Overall, sellers choose an average base price of 4.69 ECUs and an average drip price of 11.66 ECUs. Looking at each type's pricing strategy separately reveals that those sellers whose maximum drip price equals 10 choose significantly lower base prices and drip prices similar to those in the DRIP treatment (Mann-Whitney rank-sum test: $p = 0.010$ and $p = 0.337$, respectively). By contrast, sellers with a maximum drip price of 20 ECUs choose significantly higher base prices but significantly lower drip prices than their counterparts in the BIG DRIP treatment (Mann-Whitney rank-sum test: $p = 0.007$ and $p = 0.010$, respectively). Taking a closer look at the drip-price frequencies further shows that while sellers with a drip-price limit of 10 ECUs still mostly choose 10 ECUs as their drip price, there is now visibly more variation in drip prices of sellers with a drip-price limit of 20 ECUs, as shown in Figure 7. The frequencies of the drip prices in Figure 7 suggest that, in contrast to the previous treatments, sellers who were assigned a maximum drip price of 20 ECUs are constrained in setting high drip prices by the presence of sellers with lower drips. Charging a too high drip might induce buyers to engage in search for a seller with a lower drip. The average drip price of sellers with limit 20 ECUs dropped to 14.34 ECUs (compared to BIG DRIP).

Interestingly, as Table 2 also shows, sellers who were assigned the high drip-price limit charge a lower base price and higher drip price (Wilcoxon signed-rank test: $p = 0.028$ and $p = 0.028$, respectively) than their counterparts with a limit of 10 ECUs. Moreover, sellers who were assigned the high drip-price limit charge significantly higher total prices and earn higher profits (Wilcoxon signed-rank test: $p = 0.028$ and $p = 0.046$, respectively). As a result, despite the observation that there is now also competition in the drip price when the drip-price limit is high, sellers seem to be better off with the maximum drip price of 20 ECUs. We note that this advantage of sellers with the high drip-price limit also extends to the comparison with standard Bertrand pricing (Mann-Whitney rank-sum test: $p = 0.010$ and $p = 0.025$, respectively).

These findings mainly accord with our theoretical predictions (see Hypothesis 5). As hypothesized, sellers are no longer able to charge drip prices up to the maximum, but due to the presence of low-limit sellers are forced to lower it. Nevertheless, sellers with a high drip-price limit benefit by charging higher total prices and earn higher profits. In contrast to theory, however, sellers with a high drip-price limit charge lower base prices and do not fully mimic the behavior of the low-limit sellers. Yet, buyers do not seem to take this fully into account (see below), as profits are higher. We summarize the main findings regarding seller behavior in the following result:



(a) Sellers with a maximum drip price of 10 ECUs.



(b) Sellers with a maximum drip price of 20 ECUs.

Figure 7: Distribution of drip prices in treatment RANDOM DRIP.

Result 4. *With random drip-price limits,*

- i) sellers still choose a skewed pricing scheme with a low base price and a high drip price, although sellers with the high drip-price limit now set drip prices well below this limit,*
- ii) sellers with a high drip-price limit charge a lower base price and a higher drip price than their low-limit counterparts, and*
- iii) sellers with a high drip-price limit charge a higher total price and earn higher profits compared to their low-limit counterparts and also compared to standard Bertrand pricing.*

Buyer behavior

One striking observation is that, although the pattern of the drip-price frequencies in Figure 7(b) has considerably changed, the search behavior by the buyers has not. On average buyer search has only increased slightly (but not significantly) to 19% as compared to the treatments DRIP and BIG DRIP, where search probabilities amounted to 13% and 15%, respectively.

Another striking observation is that in the first stage, buyers predominantly choose according to a lower base price. In the treatment RANDOM DRIP, participants chose the seller offering the lower base price in 79% of observations. Looking only at cases in which a seller with a high drip-price limit competes against one with a low drip limit we still find that in 69% of observations, participants chose according to lower base price. As sellers with a high limit tend to have lower base prices, with a probability of almost 66% did buyers make the seller with the higher drip price their first choice whenever competing sellers differed in their drip-price limits. We interpret this as evidence for the attraction effect of lower base prices (e.g., Ahmetoglu *et al.*, 2014). Buyers seem to be drawn toward lower base prices while somewhat neglecting that exactly those sellers tend to charge higher drip prices.

Due to search friction, this implies that buyers could not always identify the lowest price. As compared to both previous drip-pricing treatments, ex-post buyer mistakes have increased to 21%. That is, on average, 21% of buyers did not choose the cheapest offer. This difference is also significant with respect to the DRIP treatment, where an even lower search probability leads to only 13% of buyers failing to identify the cheaper seller (Mann-Whitney rank-sum test: $p = 0.0538$). In those instances in which two competing sellers were assigned different drip-price limits, buyers purchasing from the seller with the higher price occurred in even more than 35% of purchase decisions.

We can thus summarize our findings as follows:

Result 5. *With random drip-price limits,*

- i) buyers search more as compared to the previous drip-price treatments, though not significantly,*
- ii) buyers choose predominantly according to lower base prices, and*
- iii) from an ex-post perspective, buyers end up with higher prices more frequently compared to the treatments in which sellers have identical drip-price limits.*

Thus, from a policy perspective, situations in which buyers are not perfectly informed about the use of drip-pricing strategies appear to be worrisome. Buyer search is still at a rather low level, and buyers fail to identify the cheapest offer in a large number of cases. This complements the findings in Huck and Wallace (2015) who also report too small search levels in an experiment in which prices are randomly drawn.

Comparison with Bertrand competition and policy implications

We now compare the outcomes in the treatment RANDOM DRIP with the outcomes under BERTRAND. Again, this can be interpreted as the effects of a policy that requires sellers to abandon drip pricing and to charge an all-inclusive price. However, unlike the situation in Section 4, this is now a situation in which sellers, depending on the individual type, might be affected to a different extent by the policy intervention.

Our results suggest that, as in the case with certain drip-price limits discussed earlier, banning drip prices promotes competitive behavior in the sense that overall total prices are lower and buyer surplus is higher (Mann-Whitney rank-sum test: $p = 0.0782$ and $p = 0.0776$, respectively). Figure 8 shows the evolution of total prices over time. The figure shows that the difference in total prices between BERTRAND and RANDOM DRIP becomes larger over time. While there is a downward trend with Bertrand prices, total prices are relatively stable in the RANDOM DRIP treatment. Besides from lower prices, buyers also benefit from a ban of drip pricing from a second source. As with transparent pricing, buyers can always identify the best offer, their surplus increases. Thus, buyer surplus is higher with Bertrand pricing.

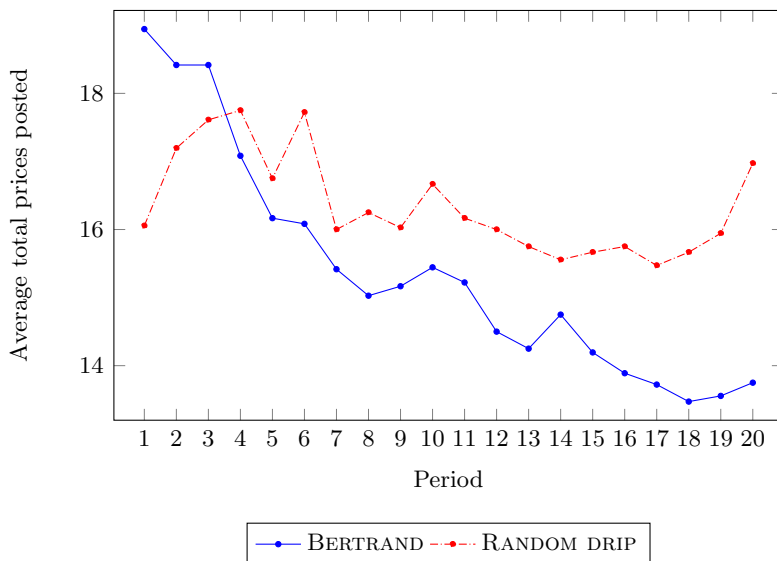


Figure 8: Comparison of total prices in BERTRAND and RANDOM DRIP.

Comparing the effects across firm types we find that profits of sellers with a drip-price limit of 20 ECUs are affected negatively by the policy intervention ($p = 0.025$), while sellers with a limit of 10 ECUs are not affected ($p = 0.873$). This differential effect of regulation on the two seller types coincides with the theoretical predictions. The seller with the high drip-price limit loses its advantage of mimicking the low type and exploiting search frictions.

Summarizing, we find that the comparison between RANDOM DRIP and BERTRAND is in line with our theoretical predictions (see Hypothesis 6):

Result 6. *Compared to drip pricing with random drips, Bertrand competition leads to*

- i) lower total prices and higher buyer surplus and*
- ii) lower profits for sellers with a high drip-price limit as well as unchanged profits for sellers with a low-drip price limit.*

6 Conclusion

Sellers often advertise only part of a product’s price in order to attract buyers and reveal additional price components at later stages of the purchasing process. This practice can be observed in many industries, including the markets for retail financial products and services. Previous studies, mostly focusing on just the buyer side of the market, have found this to be harmful, causing buyer confusion and discouraging price search. In an experimental setting, we study this pricing strategy, examining both seller and buyer behavior. We report that the effects of drip pricing depend to a large degree on consumer information on the use of drip pricing. When consumers are well informed about the use, our experiments show that even when sellers employ drip pricing, competitive market forces are not sufficient to drive (total) prices down to Bertrand competition levels. However, buyer search behavior is nearly optimal. To be precise, we find intense competition in base prices but almost no competition in drip prices. As a result, most buyers correctly anticipate total prices based on the base price and do not invest in search. These results change when uncertainty about the drip-price limit on the buyer side is introduced. There, sellers with a high drip-price limit also compete in drip prices and post significantly higher total prices than their low-limit counterparts, resulting in equally higher profits. In addition to this, buyer search is less optimal, as buyers are purchasing from sellers with higher prices more frequently.

From a policy perspective, this study has two important implications. First, in contrast to the related literature on the topic, we find that the practice of drip pricing has a

negative effect on buyers even if they are well informed about the use of drip pricing and the maximum drip a seller may charge. Total prices are lower and buyer surplus higher if sellers are required to charge a transparent price. Also in cases in which buyers are less well informed about the extent of drip prices, we find anticompetitive effects of drip pricing. In this case, drip pricing may be more detrimental to consumers, as the number of mistakes increases and consumers fail to identify the cheapest seller more often. This case might be of particular importance for retail financial products, because consumers often have only a limited understanding of these products. Second, in contrast to the real world, buyers are always aware of drip prices in our experimental setting, which is the best case for drip pricing not to have negative effects on consumers. Given that we do find anticompetitive effects even in these circumstances, we would argue that anticompetitive effects are likely to be much larger in practice where consumers may be less forward-looking and can be surprised by additional price components at later stages of the purchase process. Moreover, in more realistic settings in which firms are asymmetric in costs, consumers' failing to identify the lowest price might also lead to welfare costs from drip pricing.

A Theoretical derivations

Derivation of Proposition 2

Here we show that a pooling equilibrium exists where both types of sellers charge an identical base price of $c - \bar{p}_L$, but differ in the drip price ($p_2^L = \bar{p}_L$ and $p_2^H = \bar{p}_L + 2s$). Accordingly, with identical base prices buyers cannot identify seller types, a buyer observing a base price $c - \bar{p}_L$ expects each type with equal probability. Consider the following out-of-equilibrium beliefs. For any base price unequal $c - \bar{p}_L$, the buyer believes the seller to be the high type. In the following we show that no player has incentive to deviate from the strategies described in Proposition 2.

First note that, given prices and beliefs, a buyer will never search for a second drip. As base prices are identical, a seller type will be revealed only after the buyer inspects the first drip. There is obviously no reason to search if the buyer discovers a seller of type L . However, there is also no incentive to search if the buyer has tentatively chosen a seller of type H . Search is only worthwhile if the other seller is of type L which happens with probability 0.5 in which case the buyers saves an amount of $2s$. Hence, the benefits from search are $0.5 \cdot 2s = s$. Hence, the benefits coincide with the cost, hence, there is no incentive to search a second seller. Note also that given identical base prices, a buyer cannot distinguish seller types. Thus, consider that a buyer will choose either seller with equal probability.

Next, consider the behavior of a seller of type L . Given the proposed pricing strategies, the total price equals marginal cost and the seller is chosen with probability 1/2. The expected profit is zero. Notice that the seller cannot profitably deviate from the proposed strategies. As the seller charges the highest possible drip, it cannot also consider to reduce the drip which is never profitable. Increasing the base price is also not profitable as buyers would believe the seller to be type H and abstain from buying from this seller. Decreasing the base price would lead to a total price below cost.

Finally, consider the behavior of a seller of type H . Given the proposed pricing strategies, the total price exceeds marginal cost and the seller is chosen with probability 1/2 due to identical base price as type L . Decreasing the drip would only lead to a reduced profit margin, but no additional buyers and is therefore not profitable. Increasing the drip price is also not profitable as it would induce the buyer to search and thus to the loss of the buyer. Finally, changing the base price would the seller reveal to be type H and thus a buyer would strictly prefer to chose the other seller.

B Instructions

Here we provide a translation of the instructions. The original instructions are in German. We provide the instructions for the treatment DRIP.

In this experiment you are either assigned the role of a buyer or a seller. Which role is assigned to you is randomly determined at the start of experiment and communicated to you. You keep your role for the entire experiment.

A market consists of two sellers and one buyer. In each period of the experiment, two sellers will be randomly matched with one buyer by the computer. This matching takes place every period. Whether you are matched with entirely new participants or participants you have already been matched with in one of the preceding periods is determined randomly and cannot be anticipated.

Each seller intends to sell one unit of his product to the buyer. For the production of one unit of his product the seller incurs costs of 10 points. Each buyer purchases exactly one unit of the product. In each period the buyer therefore has to decide between the two sellers.

The sellers set two price elements: a base price and an additional price. The total price is the sum of both prices:

$$\text{total price} = \text{base price} + \text{additional price.}$$

Each period of the experiment consists of three stages:

Stage 1: The sellers determine their prices. The base price has to range from 0 to 20 points. The additional price has to range from 0 to 10 points. The total price cannot be higher than 30 points and cannot be lower than 10 points.

Stage 2: The buyer only observes the base prices of the two sellers. The buyer then tentatively decides for one of the sellers.

Stage 3: The buyer now also observes the additional price of the tentatively chosen seller and can then decide between

- stick with the initial choice and purchase from the tentatively chosen seller, or
- or invest into also observing the additional price of the other seller.

In case the buyers sticks with the initial choice, the buyer purchases one unit from the chosen seller and the period ends. In case the buyers decides to invest, the buyer incurs

costs of 2 points. The buyer now receives information on the additional price of the other seller, and the buyers can now decide from which buyer to purchase.

At the end of each period you will be informed about the points you earned. The earnings of a buyer are equal to:

$$\text{Payoff buyer} = 35 - \text{total price} - \text{cost for second price revelation (if applicable)}.$$

In each period the seller receives the total price he set in stage 1 of each period less the cost of production provided the the buyer decided to purchase your product:

$$\text{Payoff seller} = \text{total price} - 10.$$

If a buyer chooses the product of a seller's competitor, that seller does not incur any cost of production and has no earnings.

The experiment lasts for 20 periods. At the end of the experiment your earnings will be paid out to you. Your earnings comprises the show-up fee and the points you have earned during the experiment.

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