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Output commitment through product bundling: Experimental evidence ☆

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ABSTRACT

We analyze the impact of product bundling in experimental markets. One firm has monopoly power in a first market but competes with another firm à la Cournot in a second market. We compare treatments where the multi-product firm (*i*) always bundles, (*ii*) never bundles, and (*iii*) chooses whether to bundle or not. We also contrast the simultaneous and the sequential order of moves in the duopoly market. Our data indicate support for the theory of product bundling: with bundling and simultaneous moves, the multi-product firm offers the predicted number of units. When the multi-product firm is the Stackelberg leader, the predicted equilibrium is better attained with bundling, especially when it chooses to bundle, even though in theory bundling should not make a difference here. In sum, bundling works as a commitment device that enables the transfer of market power from one market to another.

1. Introduction

In its 2004 landmark decision, the European Commission (EC) found Microsoft guilty of abusing its dominant market position. Microsoft had bundled its operating system Microsoft Windows with its Windows Media Player, thereby abusing its dominant position in the operating systems market (European Commision, 2007). The EC fined the company €497 million, the largest fine ever handed out by the EC at that time, and gave Microsoft 90 days to produce a version of Microsoft Windows without Windows Media Player. In 2006, and again in 2008, the EC fined Microsoft an additional €280.5 million and €899 million respectively for not complying with the 2004 ruling. In the meantime, Microsoft offered an operating system without Windows Media Player and has paid all fines (reduced to €860 million) in full.[1] To date, Microsoft has been

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[1] In January 2009, Microsoft was once again convicted for product bundling when the EC ordered the company to unbundle its internet browser from Microsoft Windows, stating that "…Microsoft's tying of Internet Explorer to the Windows operating system harms competition between web browsers, undermines product innovation and ultimately reduces consumer choice". (European Commission, 2009). It was agreed that Microsoft would offer

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fined nearly €2.2 billion for its bundling practices, €561 million of which are currently being challenged by Microsoft in the General Court.[2]

Product bundling is a business strategy that can be harmful to competitors and, ultimately, to consumers. The leverage theory of product bundling states that a firm which enjoys market power in one market can transfer this power to another possibly unrelated market by selling the goods involved as a single bundle (Martin, 1999; Nalebuff, 2004). The Microsoft case illustrates that product bundling can qualify as an abuse of market dominance also in practice. Moreover, the importance of bundling as a business strategy is reflected in the fact that it is covered in virtually every textbook on industrial organization and business economics.

In this paper, we report on a series of experiments which test the leverage theory of product bundling. In spite of its importance as a business practice, it is difficult to perform field studies on the effects of product bundling. Firms would not be willing to (randomly) experiment with this business strategy as it might significantly affect sales (possibly for the worse), and because it could qualify as an abuse of a dominant position. Moreover, instances of product bundling that significantly affect sales volumes are rare, making it difficult to draw general conclusions from the various case studies on the wider impact of product bundling on market performance.

Damme et al. (2009, p. 107) review the experimental literature on abusive practices and conclude that "little experimental work has been done in this area". Indeed, our paper is part of this small but growing experimental literature on abusive market practices. Isaac and Smith's (1985) experimental work on predatory pricing (see also Goeree et al., 2004) is a pioneer of abuses of dominant positions. Recent work in this area includes experimental analyses of vertical foreclosure (Martin et al., 2001), price discrimination (Normann et al., 2007), and exclusive dealing (Landeo and Spier, 2009; Smith, 2011; Boone et al., in press). These papers have in common that they provide experimental tests of business practices that may constitute abuses of market power.

As is common in the literature, we analyze the scenario where one firm (the multi-product firm) has monopoly power in one market but faces competition by a second firm (the single-product firm) in another unrelated market.[3] For this second market we employ a Cournot quantity-setting framework. Our first treatment variable is "bundling" versus "no bundling." When bundling, the multi-product firm bundles its products for the two markets. We consider both the situation where bundling/not bundling are exogenous to the multi-product firm and the situation where it can choose whether to bundle. The treatments where bundling is a choice allow us to examine whether the multi-product firm deliberately influences market performance by adopting a bundling strategy.

Our second treatment variable is the order of moves in the duopoly market: simultaneous versus sequential. We introduce this second treatment variable to examine the commitment effect of product bundling (as highlighted by Whinston, 1990; Martin, 1999; Nalebuff, 2004). With simultaneous-move Cournot competition, the bundling firm trades off reduced sales in its monopoly market to increased output in the duopoly market, possibly at the expense of losing some customers in the monopoly market (even if demand is independent across the two markets). The bundling strategy works as a commitment to sell more in the competitive segment: ex post, the multi-product firm would prefer to deviate from this outcome and would want to best respond against the second firm (and at the same time, earn monopoly profits in the market where it does not face a rival). In the Stackelberg setting, when both markets have identical demand and cost structures, bundling does not imply additional commitment because the multi-product firm is a first mover anyhow. That is, in theory, bundling does not affect optimal quantities. This feature allows us to test whether bundling gives the Stackelberg leader additional leverage because, as is known from previous experiments, Stackelberg leaders find it difficult to gain from their first-mover advantage without bundling (Huck et al., 2001, 2002; Fonseca et al., 2005; Müller, 2006).[4]

Our results are as follows. For the duopoly markets with and without exogenous bundling, we find that firms roughly play the predicted Cournot-Nash outputs. These market outcomes do not change significantly when the multi-product firm is allowed to bundle endogenously. The data of our Stackelberg markets, where bundling is not an option for the multi-product firm, reject the predictions; followers produce more and leaders produce less than predicted—an observation which is in line with earlier experimental results. However, the discrepancy between observations and prediction is greatly reduced in the Stackelberg markets with exogenous product bundling. Finally, in the Stackelberg markets with endogenous bundling, we note a surprising bifurcation of outcomes: while results resemble a symmetric Cournot solution when the multi-product firm chooses not to bundle, they almost perfectly match the Stackelberg prediction when the multi-product firm does decide to bundle.

In sum, we find that bundling successfully works as a commitment device to sustain increased production (and therefore larger market shares), an observation that is robust with respect to the order of moves (simultaneous or sequential) and to

(*footnote continued*)
customers of Microsoft Windows a choice of 12 internet browsers. Microsoft dropped this feature however in the Windows 7 Service Pack 1 in February 2011 for 14 months onwards, inducing the EC to fine Microsoft €561 million in March 2013.

[2] Other notable antitrust bundling cases include U.S. vs. Microsoft (2001) and *LePage's Inc. v. 3M* (2003) in the U.S.; and *Hilti* (1987), and *Tetra Pak II* (1991) in the E.U.

[3] If markets are related, the multi-product firm has an incentive to bundle in order to price discriminate (Adams and Yellen, 1976; McAfee et al., 1989). To focus exclusively on the exclusionary effect of bundling, in our design the two markets are not related.

[4] In line with the theoretical literature to date (see Chung et al., 2013, for a recent overview), we do not consider the situation where firms interact repeatedly. In that sense our paper is more an experimental test of conceived theories, and less an experimental test of the workings of real markets.

whether bundling is a choice or not. Accordingly, we find that product bundling has an exclusionary effect: in both the Cournot and Stackelberg treatments, and both with exogenous and endogenous bundling, the profits of the single-product firm drop significantly if the multi-product firm bundles. At the same time, bundling does not significantly affect the profits of the multi-product firm.[5]

Caliskan et al. (2007) is the only experimental paper on product bundling that we are aware of.[6] They run a series of experiments where one firm has the option to bundle. This firm holds a monopoly in one market and is one of the four competitors in another unrelated and much smaller market. Moves are always simultaneous. Caliskan et al. (2007) focus on how a fringe competitor in the monopoly market affects welfare. In a posted-offer-market setting, they find that the fringe seller increases consumer surplus while decreasing seller surplus, and that the fringe seller does not affect the consumer surplus extracted from the bundle, despite a decrease in the bundle's transaction price. As to the effect of bundling, Caliskan et al. (2007) find neither any significant exclusionary effect nor any significant effect on consumer welfare and total welfare. In our design, bundling affects a larger part of the market because the two markets we employ are of equal size, and because the multi-product firm faces only one rival in the oligopolistic market. This may well explain why we do observe that bundling significantly affects markets.

From a behavioral perspective our results seem surprising. One of the key results in experimental economics is that subjects dislike payoff asymmetries.[7] Therefore, equilibrium predictions for our product bundling experiments (with their substantial payoff differences in Nash equilibrium because of the multi-product firm's monopoly profit) were *a priori* unlikely to be observed in lab experiments. However, we find that the implied payoff differences have little impact on the observed outcomes in the duopoly market. Instead, our results suggest a large congruence with the standard theory.

Nevertheless, we argue in Section 5 that our results are not inconsistent with inequality aversion. Regarding the question of why our no-bundling treatments confirm previous standard duopoly experiments despite amplified payoff differences, we point out that the multi-product firm's profit in the monopoly market does not affect the marginal costs and benefits of "punishment" (that is, producing more than the standard best reply) by the single-product firm in the duopoly market. A related question is why our results in the Stackelberg bundling treatment are more in line with the prediction than the no-bundling treatment, even though bundling yields greater payoff inequalities. The answer lies in the possibility to commit to an output level through product bundling. A non-bundling multi-product firm can give in to the "punishing" behavior of the smaller firm by producing less. But a bundling multi-product firm would lose the additional payoff from such concessions and is thus less likely to reduce output. This is anticipated by the single-product firms which therefore punish less. We also discuss this issue in detail in Section 5.

From a legal context, exclusion is considered to be anticompetitive if the excluded firm is at least as efficient as the excluding firm. As there are no cost differences in our experiment, the observed drop in the single-product firm's profits due to bundling is hence exclusionary. In this sense, our findings support the recent interest of competition authorities in product bundling as a potentially harmful practice. At the same time, using the markets in which bundling is impossible as the point of departure, we find that allowing for the choice to bundle does not have a significant effect on overall market performance because instances of voluntary bundling are relatively rare. Taken together these results support the current policy practice whereby each instance of bundling is considered individually, and is prohibited only when the (possible) exclusion of rivals qualifies as an abuse of a dominant position.

The remainder of the paper is organized as follows. In Section 2 we derive several theoretical predictions, followed by an outline of the experimental design and procedure in Section 3. The experimental results are in Section 4. In Section 5 we briefly discuss our results and Section 6 concludes.

2. Model and predictions

The Cournot model underlying our experiments has two firms, 1 and 2, and two markets, D and M, where 'D' and 'M' stand for 'duopoly' and 'monopoly' respectively. In market D, firm 1 and firm 2 are Cournot duopoly competitors; in market M, firm 1 is a monopolist. We assume that in both markets inverse demand is linear, such that $p^D = d^D - q_1^D - q_2^D$ and $p^M = d^M - q_1^M$, and identical across markets, $d^D = d^M = d$. Both firms produce at a constant marginal cost of c. Firm 1 will sometimes be referred to as the multi-product firm whereas firm 2 will occasionally be labeled the single-product firm.

[5] Our design, however, inherently undervalues the profitability of bundling for the multi-product firm as we do not consider fixed costs. If these exceeded the profits of the single-product firm due to bundling, this firm would have to leave the market altogether.

[6] Muris and Smith (2008) report on the same experiment.

[7] See, for example, the literature on ultimatum games (Roth, 1995; Güth, 1995). In industrial organization, structural differences, including cost and capacity asymmetries, and a sequential order of moves yield asymmetric equilibria with substantial payoff differences. Experimental data typically refute these theoretical predictions (see, e.g., Mason et al. (1992) or, to a lesser extent, Keser (1993) in the context of Cournot competition with asymmetric costs; Huck et al. (2001, 2002) in the context of Stackelberg markets; Fonseca and Normann (2008) in the context of a Bertrand–Edgeworth setting with asymmetric capacities; or Henze and Schuett (2011) in the context of a game with endogenous quality choices). While at odds with standard IO theory, the experimental results are often well explained by models of other-regarding preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). The behavior of Stackelberg followers, for example, can be rationalized when players have Fehr and Schmidt (1999) preferences (see the theory papers by Santos-Pinto, 2008; Lau and Leung, 2010), or when they are thought to act reciprocally (Cox et al., 2007). And inequality aversion can explain why players often achieve equal profits in asymmetric Cournot oligopoly (Iris and Santos-Pinto, 2010).

Table 1
Treatments and treatment labels.

	Exogenous Bundling		Endogenous bundling
	No bundling	Bundling	
Cournot	Cour-Exo-NB	Cour-Exo-B	Cour-Endo
Stackelberg	Stack-Exo-NB	Stack-Exo-B	Stack-Endo

2.1. Cournot – no bundling

Let us first suppose that there is no bundling, that is, output decisions in markets D and M are independent. In this case, we obtain the following profit function for firm 1

$$\pi_1 = (d - q_1^D - q_2^D - c)q_1^D + (d - q_1^M - c)q_1^M, \tag{1}$$

while firm 2's profit function is

$$\pi_2 = (d - q_1^D - q_2^D - c)q_2^D. \tag{2}$$

For market D, the unique Cournot-Nash equilibrium is $q_1^D = q_2^D = (d-c)/3$, and the equilibrium profits are $\pi_1^D = \pi_2^D = (d-c)^2/9$. The equilibrium quantity on market M is $q_1^M = (d-c)/2$ and the monopoly profit is $\pi_1^M = (d-c)^2/4$.

2.2. Cournot – bundling

Now consider the bundling case. Bundling implies that firm 1 can credibly commit to producing its output for both markets as a fixed proportion. Without loss of generality, we assume that this ratio is one-to-one (see also Martin, 1999): for each unit of q_1^D, one unit of q_1^M will be produced such that we can simply state $q_1^D = q_1^M = q_1$. Accordingly, in the bundling case, firm 1's profit function is

$$\pi_1 = (d - q_1 - c)q_1 + (d - q_1 - q_2^D - c)q_1, \tag{3}$$

while firm 2's profit function reads as

$$\pi_2 = (d - q_1 - q_2^D - c)q_2^D \tag{4}$$

In this case, the best-reply functions are $q_1(q_2^D) = (d - q_2^D/2 - c)/2$ and $q_2^D(q_1) = (d - q_1 - c)/2$. Nash equilibrium outputs (bundles) are $q_1 = 3(d-c)/7$ and $q_2^D = 2(d-c)/7$, and Nash equilibrium profits are $\pi_1 = 18(d-c)^2/49$ and $\pi_2 = 4(d-c)^2/49$.

Note that firm 1's equilibrium output of $q_1 = 3(d-c)/7$ satisfies $(d-c)/3 < q_1 < (d-c)/2$. That is, the optimal output with bundling is larger than the Cournot duopoly solution but smaller than the monopoly output. For firm 2, we get $q_2^D = 2(d-c)/7 < (d-c)/3$. Hence, bundling increases firm 1's profits while it reduces the profits of firm 2.

2.3. Stackelberg – no bundling

If firm 1 does not bundle but is the first mover in market D, we obtain the Stackelberg duopoly solution. Profit functions are as in the Cournot case, but firm 1 has a first-mover advantage such that equilibrium outputs become $q_1^D = (d-c)/2$ and $q_2^D = (d-c)/4$. Profits are $\pi_1^D = (d-c)^2/8$ and $\pi_2^D = (d-c)^2/16$. The monopoly solution for market M is as above in the Cournot case.

2.4. Stackelberg – bundling

Suppose firm 1 bundles its products and is the first mover in market D. It is straightforward to see that we then obtain the same equilibrium as in the Stackelberg case without bundling. The reason is that with linear demand a Stackelberg leader produces the same output as an otherwise identical monopolist. Accordingly, if firm 1 moves first in market D, it will choose the same output as it supplies to market M.

Our design is thus suitable for exploring the commitment value of product bundling. We can investigate this commitment value both in the case of simultaneous moves (where product bundling should affect quantity choices) and in the case where moves are sequential (where product bundling should not affect quantity choices).

3. Experimental design and procedures

We employed a two-by-three treatment design. The two treatment variables are bundling/no bundling/optional bundling, and Cournot/Stackelberg. Table 1 summarizes the treatment design and treatment labels.

We implemented the above model by giving subjects a payoff table (see Appendix B), which was derived from the model using the parameter values $d=54$ and $c=6$. Subjects had to choose integer quantities between 9 and 27.[8] In each session, half the subjects played the role of firm 1 and the other half the role of firm 2. These roles remained fixed for the entire course of the experiment. The experimental markets were repeated over 15 periods and subjects were informed of the number of periods in the instructions. In each period, subjects were randomly matched ("strangers" design).

Regarding bundling, subjects who played the role of firm 1 were put in a situation where they could either not bundle at all ("*NB*") or had to bundle in all periods ("*B*"). In the treatments with endogenous bundling, they had the option to bundle: at the beginning of each period, the firm-1 subjects had to decide whether they wanted to bundle.

In the instructions (see Appendix A), subjects were told that they would act as a firm which, together with another firm serves a market, and that one of the firms would gain some additional business in a second market. In all treatments, at the end of each round subjects received feedback about what had happened in their market. The output decision of both duopolists in market *D* and also firm 1's output in market *M* was displayed on the computer monitor. Feedback on profits was given about firm *i*'s own payoff. The information feedback after each period, the instructions (which were also read aloud) and the payoff table, ensured common knowledge of the rules of the game. After reading the instructions, participants could privately ask questions. Before the start of the experiment subjects were asked to answer several control questions.

The experiments were computerized (Fischbacher, 2007) and conducted at the CentERlab of Tilburg University (The Netherlands). For each treatment, a total of 32 subjects participated. Subjects were randomly matched within groups of eight participants. Hence, we have four independent observations for each treatment. Sessions usually had 16 participants but in two cases we had to reduce the session size to eight because an insufficient number of subjects showed up. Participants were students from various departments, many from fields other than economics or business administration. The monetary payment was computed by using an exchange rate of 500 "points" for €1 and adding a flat fee of €5 (this payment was made to help subjects avoid making a loss in the experiment). Average earnings were €29.50 and €11.40 for subjects in the role of firm 1 and 2, respectively, including the flat fee. The sessions lasted between 60 and 75 min.

4. Experimental results

We present our experimental results in four subsections. In Section 4.1, we report on the Exo-NB treatments for both Cournot and Stackelberg competition and analyze the two Exo-B treatments in Section 4.2. Section 4.3 is devoted to the Endo treatments. While we focus on output and bundling decisions up to that point, we then discuss the issue of a possible abuse of dominance by reporting on profits and surplus as measures of market performance in Section 4.4.

Fig. D1 in Appendix D shows the evolution of average quantities chosen by the multi-product and the single-product firm in the various treatments. (Appendix C lists all per-period quantities for each individual matching group.) It seems fair to say that by and large there are no clear time trends in our data.[9] Indeed, even if we ignore the possible dependence between observations within sessions and treat each decision as an independent observation, we do not observe a significant correlation between quantity choices and time in any of the treatments.[10] Hence, for the presentation of the experimental results, we focus on treatment averages.

4.1. treatments without bundling (exo)

Table 2 summarizes the predictions and average quantities observed in the six treatments where instances of bundling and no bundling in the two endogenous treatments (Cour-Endo and Stack-Endo) are reported separately. The three average quantities are firm 1's output in market *D* (q_1^D), firm 2's output in market *D* (q_2^D), and firm 1's output in market *M* (q_1^M, which is equal to q_1^D in the case of bundling). The asterisks next to the inequality signs indicate whether the observed differences are significant according to exact non-parametric rank-sum tests (Wilcoxon), while a " $\approx$ " indicates statistical insignificance. We report two-sided *p*-values throughout.[11]

First, in the Cour-Exo-NBtreatment , the average observed quantities correspond fairly accurately to the predicted values, as has already been observed in earlier studies (Holt, 1985; Huck et al., 2001). Here, both firms produce only slightly more

[8] The payoff table gives all the necessary details of the model while avoiding formulas, parameters, and technical terms. In the experiment and the instructions we relabeled the strategy space such that subjects had to choose a number between 1 and 19. As subjects were unfamiliar with the model, the labels of the actions were meaningless to them. In the results section, Section 4, we worked with the "original" quantities ranging from 9 and 27. Further, as is well known (Holt, 1985), payoff tables with integer choices sometimes do not have unique best replies. Whenever necessary, we manipulated the payoff table by increasing or decreasing a couple of payoffs to the next integer value such that all best replies are unique.

[9] An exception is firm 2's quantity choice in treatment Stack-Exo-NB. One interpretation of the observed pattern is that followers initially punish the Stackelberg leaders strategically despite the random matching scheme, but then either give up on doing so or realize that it is "not needed" anymore because leaders stop choosing higher quantities in the second half of the experiment.

[10] Spearman's rho is always smaller than 0.1 and is not significant for all treatments and all three output decisions.

[11] For each observation we also calculate the 95% confidence interval using the four independent observations that underlie each entry in Table 2. In particular, let $\bar{x}$ be the average and σ the concomitant standard error. Assuming the averages follow a Normal distribution, the 95% confidence interval is then given by $[\bar{x}-\sigma t_{0.975,n-1}/\sqrt{n}, \bar{x}+\sigma t_{0.975,n-1}/\sqrt{n}]$, where n denotes the number of observations. In Table 2, the theoretical predictions are underlined when they fall outside this interval.

Table 2
Average quantities and theoretical predictions.

	Market D, Firm 1			Market D, Firm 2			Market M, Firm 1		
	q_1^D			q_2^D			q_1^M		
	NB		B	NB		B	NB		B
Cour-Endo									
Theory	*16.00*		*20.00*	*16.00*		*14.00*	*24.00*		*20.00*
Observed	**15.81**	$<^{*}$	**19.62**	**16.34**	$>^{*}$	**15.04**	**24.1**	$>^{*}$	**19.62**
	$\approx$		$\approx$	$\approx$		$\approx$	$\approx$		$\approx$
Cour-Exo									
Theory	*16.00*		*20.00*	*16.00*		*14.00*	*24.00*		*20.00*
Observed	**16.32**	$<^{**}$	**19.43**	**16.76**	$>^{*}$	**15.42**	**24.41**	$>^{**}$	**19.43**
	$\neq^{**}$		$\neq^{**}$	$\neq^{**}$		$\neq^{*}$	$\approx$		$\neq^{**}$
Stack-Exo									
Theory	*24.00*		*24.00*	*12.00*		*12.00*	*24.00*		*24.00*
Observed	**19**	$<^{**}$	**22.08**	**15.58**	$>^{**}$	**13.59**	**23.92**	$>^{**}$	**22.08**
	$\neq^{**}$		$\neq^{**}$	$\neq^{*}$		$\approx$	$\approx$		$\neq^{**}$
Stack-Endo									
Theory	*24.00*		*24.00*	*12.00*		*12.00*	*24.00*		*24.00*
Observed	**17.65**	$<^{**}$	**23.36**	**16.57**	$\approx$	**15.12**	**24.73**	$>^{**}$	**23.36**

Notes: *NB*=No bundling, *B*=Bundling. Observations (in bold) correspond to the average over the (four) underlying independent observations. Theoretical predictions (in italics) are underlined in case they lie outside the 95% confidence interval of the respective observation. Significance levels are calculated with Wilcoxon rank-sum tests, conservatively counting each matching group as one independent observation; ** and * indicate statistical significance at the 5% and 10% level, respectively. $\approx$ Indicates not significantly different.

than the predicted numbers of units, but there are no economically or statistically significant differences between firms and the predictions are contained in the 95% confidence intervals. Also, in the monopoly market, the multi-product firm produces roughly the same as the monopoly output. Effectively, our data confirm the theoretical predictions and the results from previous experiments.

Second, in the Stack-Exo-NB treatment, the theory fails: the Stackelberg leaders produce less, while the Stackelberg followers produce more than predicted. This result is very similar to the Huck et al. (2001) finding. These authors also use linear demand and cost in their experiments but have different parameter values. We can compare both their results and ours by taking the ratio of observed output levels and predictions. In Huck et al. (2001), the ratio of produced to predicted output is 8.32/6.00=1.39 for Stackelberg followers, and 10.19/12.00=0.85 for the Stackelberg leaders. For our data, the ratios are 15.58/12=1.30 and 19.00/24.00=0.79, respectively. While both Stackelberg leaders and followers produce relatively less in our data, it is probably fair to say that these ratios are of a similar magnitude. At the same time, firm 1 produces roughly the monopoly output in market *M*.

Result 1. *In the exogenous no-bundling treatments, the data confirm the predictions in the Cournot markets, and reject the predictions in the Stackelberg markets. Both results confirm previous experimental results.*

While the Cournot and Stackelberg no-bundling results are consistent with previous experiments, this confirmation is, at least at first sight, surprising. Recall that in our experiments the multi-product firm earned an extra monopoly profit, causing rather large payoff differences. Given that subjects dislike payoff asymmetries, *a priori* it is not obvious that the single-market settings as analyzed by Huck et al. (2001) are confirmed by our data. We will come back to this point in Section 5.

4.2. treatments with bundling (exo)

We now turn to the exogenous bundling treatments. In the Cour-Exo-B markets, firm 1 produces on average slightly less than the predicted 20 units, but the average observed quantity of 19.42 is within the 95% confidence interval. Firm 2 produces on average 15.42, which is more than the Cournot-Nash equilibrium quantity of 14, but this value is also inside the 95% confidence interval. By and large, the asymmetric equilibrium predicted for market *D* prevails.

In the Stack-Exo-B treatment, outputs are now closer to the prediction than in Stack-Exo-NB. Stackelberg leaders produce only two output units less than predicted (92% of the predicted output), as compared to the five units under production absent bundling (79% of the theoretical benchmark). Stackelberg followers produce roughly 1.6 units more than predicted (113% of the prediction), as opposed to 3.6 units more than predicted (130% of the equilibrium value) without bundling. Overall, product bundling brings average outputs closer to the prediction.

Result 2. *In the exogenous bundling treatment, the predictions in the Cournot markets are confirmed by the data. In the Stackelberg markets the deviation from the theoretical benchmark is much smaller than in the exogenous no-bundling treatment.*

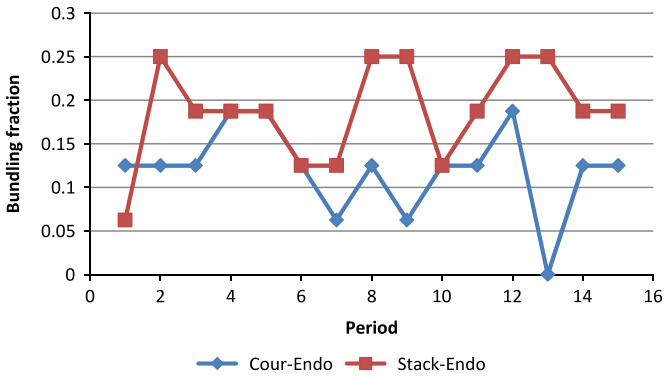

Fig. 1. Fraction of multi-product firms bundling over time.

Table 3
Average firm profits and theoretical predictions

	Firm 1			Firm 1			Firm 1			Firm 2		
	Market *D*			Market *M*			Total			Market *D*		
	NB		B	NB		B	NB		B	NB		B
Cour-Endo												
Theory	*256*		*280*	*576*		*560*	*832*		*840*	*256*		*196*
Observed	**244**	$<^{*}$	**259**	**575**	$>^{*}$	**554**	**819**	$\approx$	**813**	**254**	$>^{*}$	**196**
	$\approx$		$\approx$	$\approx$		$\approx$	?*		$\approx$	$\approx$		$\approx$
Cour-Exo												
Theory	*256*		*280*	*576*		*560*	*832*		*840*	*256*		*196*
Observed	**236**	$\approx$	**253**	**574**	$>^{**}$	**553**	**810**	$\approx$	**805**	**245**	$>^{**}$	**196**
	$\approx$		$\approx$	$\approx$		?**	$\approx$		$\approx$	?**		?**
Stack-Exo												
Theory	*288*		*288*	*576*		*576*	*864*		*864*	*144*		*144*
Observed	**242**	$\approx$	**269**	**574**	$>^{**}$	**567**	**816**	$\approx$	**836**	**199**	$>^{**}$	**163**
	$\approx$		$\approx$	$\approx$		?**	$\approx$		$\approx$	?**		$\approx$
Stack-Endo												
Theory	*288*		*288*	*576*		*576*	*864*		*864*	*144*		*144*
Observed	**235**	$\approx$	**222**	**573**	$\approx$	**574**	**808**	$\approx$	**795**	**222**	$>^{**}$	**129**

Notes: *NB*=No bundling, *B*=Bundling. Observations (in bold) correspond to the average over the (four) underlying independent observations. Theoretical predictions (in italics) are underlined in case they lie outside the 95% confidence interval of the respective observation. Significance levels are calculated with Wilcoxon rank-sum tests, conservatively counting each matching group as one independent observation; ** and * indicate statistical significance at the 5% and 10% level, respectively. $\approx$ Indicates not significantly different.

4.3. *Treatments with endogenous bundling choices*

We first examine the extent to which the multi-product firms choose to bundle if given the opportunity. Bundling choices are rather rare: in Cour-Endo the multi-product firm bundles in 12.1% of all cases while in Stack-Endo it bundles in 18.8% of all cases, and this difference is not statistically significant ($p=0.561$). Fig. 1 illustrates that the bundling decisions are quite stable over time.

In theory, the bundling option is predicted to be exercised in the Cournot market while it is inconsequential for the Stackelberg market. Table 3 reports the average profits and shows that, on average, endogenously bundling and non-bundling Stackelberg leaders do not earn statistically different profits. For the endogenous Cournot markets, Table 3 indicates that a multi-product firm earns only slightly and only weakly significantly more when it bundles both products than when it does not. Given the relatively low and stable time pattern of bundling, it seems that these small profit differences are insufficient to induce more bundling.

Result 3. *Product bundling is not chosen very often; there are 12% and 19% bundling decisions with simultaneous and sequential moves, respectively.*

What is the effect of introducing the option to bundle on quantities supplied? For Cournot competition, the answer is clear-cut: introducing this option has (almost) no statistically significant impact on quantities. In fact, by focusing on the row labeled Cour-Endo in Table 2, we observe that—as in the Cour-Exo treatments—all quantity choices are within the 95% confidence interval of the theoretical predictions, with the exception of the single-product firm should the multi-product firm decide to bundle. Moreover, note that a vertical or column-wise comparison of the two rows labeled Cour-Endo and

Cour-Exo in Table 2 shows that there are no statistically significant differences between quantities chosen in the exogenous Cournot treatments and the endogenous Cournot treatment conditional on bundling/no bundling.

This correspondence is not observed for the Stackelberg treatments. When the Stackelberg leader in market D decides not to bundle, it supplies significantly less to market D compared to the situation where it does not have the option to bundle (17.65 versus 19.00), while the Stackelberg follower supplies significantly more (16.57 versus 15.58). On the other hand, the multi-product firm supplies significantly more to market D (and market M) when it chooses to bundle than the amount it supplies if it is forced to bundle (23.36 versus 22.08), while the Stackelberg follower supplies insignificantly more (15.12 versus 13.59). Note, however, that even though the follower's increase in output is not significant, it occurs while the Stackelberg leader is increasing its output. That is, the follower's response appears to get somewhat more aggressive (we come back to this in Section 5).

Note that, in the case of endogenous bundling, the observed choices of the Stackelberg leader and follower in market D are indistinguishable from the theoretical prediction. To the best of our knowledge, this has not been observed in any previous Stackelberg experiment. It appears that if a leader in the Stack-Endo treatment does not bundle its two products, quantity choices in market D resemble those of a Cournot market. In fact, the average quantity choice of firm 2 is statistically indistinguishable from the Cournot prediction of 16. On the other hand, if a Stackelberg leader decides to bundle, it exploits its first-mover advantage in market D as fully as possible, and this is largely accepted by the single-product firm that more or less acts as a profit-maximizing follower. At the same time, firm 1 produces roughly the monopoly output in market M.

Result 4. *Regarding the quantities supplied, in the Cournot treatments it does not matter whether bundling is exogenous or endogenous to the multi-product firm. This is not the case in the Stackelberg treatments: the multi-product firm supplies more to market D and less to market M when it decides to bundle, and vice versa when it decides not to bundle; and the single-product firm supplies (more) less to market D given that the multi-product firm decides (not) to bundle.*

Taken together, our data show that bundling has a similar effect in the Cournot and the Stackelberg treatments regardless of whether the decision (not) to bundle is exogenous or endogenous. The multi-product firm significantly increases its output in the duopolistic market at the expense of losing some customers in the market where it holds a monopoly, and the single-product firm adapts to this increased output by significantly reducing its supply. Put differently, product bundling allows the multi-product firm to leverage market power in the market where it does not have a dominant position. As a result, an asymmetric outcome emerges in the Cournot treatments. However, in the Stackelberg treatments bundling should not have any effect because the same asymmetric outcome is predicted without bundling. If anything, our findings are in contrast to the several experimental studies that fail to find support for asymmetric equilibria in the lab.

Result 5. *The effect of product bundling, whether exogenous or endogenous, is similar in the Cournot and Stackelberg treatments. The multi-product firm supplies more to the duopolistic market and less to the market where it holds a monopoly; the single-product firm produces less.*

4.4. Abuse of dominance?

For an assessment of product bundling as an abuse of dominance, we look at market performance indicators. In the following, we discuss profits and surplus measures observed in the various treatments, concentrating on the most salient results.

Table 3 shows firm profits. It allows us to compare the entries column-wise from left to right. While profits for firm 1 in market D are usually statistically the same with or without (exogenous or endogenous) bundling, firm 1's profits in market M are usually significantly higher with (exogenous or endogenous) bundling. On balance, these opposing effects cancel out, as firm 1's total profits are unaffected by (exogenous or endogenous) bundling. However, and more importantly, if firm 1 bundles, firm 2's profits unambiguously decrease in a statistically significant way, both when firm 1 is forced to bundle and if it does so voluntarily, a result that is independent of the order of moves in market D. That is to say, product bundling has a clear exclusionary effect.

Result 6. *Bundling does not have a statistically significant effect on the profits of the multi-product firm. Bundling does have an unambiguous exclusionary effect: in both the Cournot and Stackelberg treatments, bundling reduces the profits of the single-product firm. This holds for exogenously imposed bundling as well as for endogenously chosen bundling.*

We note that if firm 2 were to incur a fixed cost, product bundling could be more profitable to firm 1. In that case, the exclusionary effect could drive firm 2's profits below its fixed cost, which would force it to leave the market altogether. Presumably, our design yields a conservative estimate of the profitability of product bundling for firm 1.

Moreover (and in line with the results for quantities), exogenous vs. endogenous bundling is almost inconsequential for profits in our Cournot markets. In fact, only one of the statistical tests comparing profits between cases in the Cour-Endo treatment and the corresponding Cour-Exo treatments returns a significant result.

Table 4 reports standard surplus measures. In line with the theory, both consumer surplus and total surplus are higher in the Stackelberg treatments than in the Cournot treatments. The effect of product bundling is also quite clear: it reduces consumer surplus in market M while it increases consumer surplus in market D. The net effect is either an insignificant reduction in total consumer surplus, or a significant increase in total consumer surplus (treatment Stack-Endo with bundling). If firms move simultaneously in market D, bundling significantly reduces total surplus. This also occurs in the event of sequential moves in market D when (no) bundling is exogenous.

Table 4
Average values of consumer surplus and total surplus

	Consumer surplus			Consumer surplus			Consumer surplus			Total surplus		
	Market *D*			Market *M*			Total					
	NB		B	NB		B	NB		B	NB		B
Cour-Endo												
Theory	*512*		*578*	*288*		*200*	*800*		*778*	*1888*		*1814*
Observed	**523**	≈	**604**	**291**	$>^{*}$	**194**	**813**	≈	**798**	**1886**	$>^{*}$	**1807**
	≈		≈	≈		≈	≈		≈	≈		≈
Cour-Exo												
Theory	*512*		*578*	*288*		*200*	*800*		*778*	*1888*		*1814*
Observed	**553**	$<^{*}$	**612**	**299**	$>^{**}$	**190**	**852**	≈	**802**	**1907**	$>^{**}$	**1803**
	?*		≈	≈		?**	≈		?*	≈		?**
Stack-Exo												
Theory	*648*		*648*	*288*		*288*	*936*		*936*	*1944*		*1944*
Observed	**609**	≈	**640**	**287**	$>^{**}$	**247**	**896**	≈	**887**	**1911**	$>^{*}$	**1886**
	≈		?*	≈		?**	≈		?*	≈		?**
Stack-Endo												
Theory	*648*		*648*	*288*		*288*	*936*		*936*	*1944*		*1944*
Observed	**593**	$<^{**}$	**748**	**307**	$>^{**}$	**274**	**900**	$<^{**}$	**1021**	**1930**	≈	**1946**

Notes: *NB*=No bundling, *B*=Bundling. Observations (in bold) correspond to the average over the (four) underlying independent observations. Theoretical predictions (in italics) are underlined in case they lie outside the 95% confidence interval of the respective observation. Significance levels are calculated with Wilcoxon rank-sum tests, conservatively counting each matching group as one independent observation; ** and * indicate statistical significance at the 5% and 10% level, respectively. ≈ Indicates not significantly different.

Result 7. *In the Cournot treatments, bundling does not significantly affect consumer surplus, but it does significantly reduce total surplus. In the Stackelberg treatments, bundling significantly reduces total surplus if bundling/no bundling is exogenous whereas it yields a significant increase in total consumer surplus when the multi-product firm chooses to bundle.*

Results 6 and 7 summarize the effects of product bundling on market performance. Note, however, that they do not reveal the effect on market performance of prohibiting product bundling *per se*. For that, the extent to which bundling occurs endogenously has to be taken into account as well. That is, the exogenous no-bundling treatments have to be compared with the endogenous bundling treatments *without* distinguishing instances of bundling/no bundling in the endogenous treatments. This analysis[12] shows that allowing the multi-product firm to bundle hardly affects overall market performance in the Cournot or Stackelberg markets. The likely reason for this finding is that endogenous product bundling is not frequently observed (recall Result 3).

Result 8. *Allowing for product bundling does not have a significant effect on overall market performance.*

Whereas Result 8 does not motivate a *per se* prohibition of product bundling on account of a significant drop in total surplus, Result 6 shows that bundling, if it occurs, does have a clear exclusionary effect. Taken together, these results support the current policy practice whereby each instance of bundling is considered separately and prohibited only when the (possible) exclusion of rivals qualifies as an abuse of a dominant position.

5. Discussion

One notable pattern in our experiments is that asymmetric equilibria with substantial payoff differences are observed.[13] From a behavioral economics perspective, this appears to be at odds with theories of inequality aversion.[14] Specifically, our results raise two questions. First, why do our no-bundling results confirm those of previous duopoly experiments even though in previous studies the extra monopoly payoff did not exist and, accordingly, the payoff inequality was much smaller?[15] Second, why are the results in the bundling treatments (more) in line with the predictions, especially when the multi-product firm bundles voluntarily, even though product bundling implies even greater payoff inequalities?

[12] The analysis includes individual profits, producer, consumer, and total surplus, and is reported in Table C1 in Appendix C.

[13] In Cour-Exo-NB the multi-product firm is predicted to earn 576 in the monopoly market, and both firms should earn 256 in the duopoly market; thus, the multi-product firm is predicted to earn 3.3 times more than the duopolist. In both Stackelberg treatments, the leader (follower) is predicted to earn 288 (144) in the duopoly market plus 576 for the multi-product firm; hence, the multi-product firm is predicted to earn six times as much. The observed average profit ratio (multi-product firm profit over single-product firm profits) ranges from 3.2 (Cour-End-NB) to 6.2 (Stack-Endo- B), see Table 3. These observed payoff differences are quite substantial.

[14] Inequality aversion may be relevant for firms in the field if, for example, managers maximize relative, not absolute, profits (Armstrong and Huck, 2010).

[15] Indeed, inequality-aversion is considered to be the prime explanation for the Stackelberg data in Huck et al. (2001) and similar experiments.

Regarding the first question, note that in models of inequality aversion (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999), the additional profit of the multi-product firm reduces players' utilities compared to standard duopolies. However, the *marginal* change in utility from the duopolist producing more than predicted is the same in both the regular duopolies and in our multi-product setup. The reason is that the output chosen in the duopoly market does not affect the payoff in the monopoly market. This explains why our no-bundling results are in line with previous experiments: the amounts produced by firm 2 in Stack-Exo-NB compared to the prediction are very similar to the figures observed in the Stackelberg duopolies of Huck et al. (2001), as noted above. This behavior is consistent with the Fehr and Schmidt (1999) model because the utility-maximizing output choice of the Stackelberg follower (balancing the marginal cost of producing more than the standard best reply and the marginal gain of reducing the payoff inequality) is the same in regular duopolies and our multi-product setup. A similar argument explains why the multi-product firms in Stack-Exo-NB and in Stack-Endo without bundling produce similar amounts as in the standard Stackelberg duopolies of Huck et al. (2001). Finally, given that the prediction for the duopoly market in Cour-Exo-NB is symmetric, observed play is expected to be in line with this prediction (as in Holt, 1985, or Huck et al. 2001, and many others). To sum up, outcomes are not affected by the multi-product firm earning additional profits in another unrelated market and this is consistent with models of inequality aversion.[16]

Moving on to the second question, we note that bundling creates a connection between the two markets because it makes the multi-product firm's profit in the monopoly market, π_1^M, a function of its quantity q_1^D in the duopoly market as well. Due to the bundling of products, it is more costly for firm 1 to reduce output below the optimal amount. Any reduction of output in market D will cause losses in the monopoly market. In both the exogenous and the endogenous Cournot markets with bundling, we observe that firm 1 produces what the theory predicts, and that in both the exogenous and the endogenous Stackelberg markets firm 1 produces significantly more with bundling than without (22.08 versus 19.00 in Stack-Exo, and 23.36 versus 17.65 in Stack-Endo, respectively). Reflecting the multi-product firm's cost of reducing the inequality, these results are consistent with inequality aversion.

In line with the change in firm 1's behavior is the observation that, in the bundling treatments with sequential moves, firm 2's behavior also changes.[17] We illustrate this by looking at the average observed response functions, estimates of which are shown in Table 5.[18] These estimates are accompanied by Fig. 2 which shows the average observed response function graphically (top) and histograms of leader choices (bottom) in the Stackelberg markets; exogenous markets on the left, and endogenous market on the right. The histograms indicate, among other things, which Stackelberg leader quantities were observed by most followers.

We first discuss the Stackelberg treatment with exogenous bundling/no bundling. Recall that the standard best response function is given by $q_2^D(q_1^D) = 24 - 0.5q_1^D$. Comparing the estimated response functions in the two exogenous Stackelberg treatments, we observe that the one in Stack-Exo-B is closer to the best response function than the one in Stack-Exo-NB. The estimated intercept is larger and the slope smaller in the bundling treatment than the corresponding estimates in the no-bundling treatment.[19] Note that in the no-bundling case, the slope is negative but is insignificantly different from zero.

The logic as to why single-product firms "accept" higher outputs whenever the monopolist bundles could be as follows. In Stack-Exo-B it is more costly for the multi-product firm to give concessions in the form of a lower output. Since the bundling firm has to take care of its monopoly profit in its home market, the higher output with bundling (see the lower left histogram in Fig. 2) is apparently not interpreted as overly greedy toward the duopolist. Indeed, a non-bundling Stackelberg leader can freely earn monopoly rents in its home market and is not forced to produce the Stackelberg leader quantity in the duopoly market. Hence, observed play is much closer to the Stackelberg equilibrium in Stack-Exo-B.[20]

Perhaps surprisingly, the treatments where bundling is endogenous support this interpretation of the data. Looking at Table 5, the estimated response function in Stack-Endo-B again appears to be closer to the best response function than that in Stack-Endo-NB. Once more, the intercept is larger and the slope is smaller in the bundling case. In fact, when the

[16] Our setting is comparable to the ultimatum game implemented in Armantier (2006) where the proposer (or receiver) earns an additional amount of money regardless of the responder's actions. He finds that, over time, "…rich (poor) proposers make smaller (larger) offers, while rich (poor) receivers are willing to reject (accept) larger (smaller) offers. In other words, rich players become more greedy, and this behavior is tolerated by poor subjects." Inequality aversion (as in Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) predicts that the additional payoff would not affect responder rejection rates.

[17] In both Cour-Exo-B and Cour-Endo with bundling, the single-product firm tries to discipline the multi-product firm to produce less, to no avail, however. This confirms the commitment power of product bundling that will be discussed further below. The remainder of the discussion is restricted to the Stackelberg treatments because empirical response functions can only be estimated properly for these treatments, and because our bundling results stand out against the previously reported no-bundling results that deviate quite substantially from the theoretical prediction.

[18] We estimate the panel regression model $(q_2^D)_{it} = \beta + \beta_1(q_1^D)_{it} + v + \varepsilon_{it}$, where $(q_2^D)_{it}$ is the individual quantity set by follower firm i in period t, $(q_1^D)_{it}$ is a leader i's quantity in period t, v_i is the subject-specific random error component, and ε_{it} is the overall error component. We additionally control for possible non-independence of choices at the matching group level.

[19] We cannot reject the hypotheses that both intercept and slope parameters are the same in the two treatments.

[20] At first sight, another explanation could be that our experiments remove the possibility of an equal split. As has been observed (Andreoni and Bernheim, 2009; Güth et al., 2001), this causes behavior to be more in line with what the theory predicts. However, an equal split is not possible in any of our treatments because one of the two players will always earn the extra monopoly profits. It cannot, therefore, explain why the bundling results are more in line with what the theory predicts.

Table 5
Estimates of the actual response function of Stackelberg followers

	Stack-Exo-B	Stack-Exo-NB	Stack-Endo-B	Stack-Endo-NB
$(q_2^D)_{it} = \beta_0 + \beta_1 (q_1^D)_{it} + v_i + \varepsilon_{it}$				
β_0	21.92***	18.35***	24.16***	14.30***
	(2.85)	(1.62)	(2.36)	(2.80)
β_1	−0.38***	−0.15	−0.38***	0.14
	(0.11)	(0.10)	(0.08)	(0.17)

Notes: For the estimated equation, see footnote 16. *** and ** denotes statistical significance at the 1% and 5% level, respectively. Standard errors in parentheses.

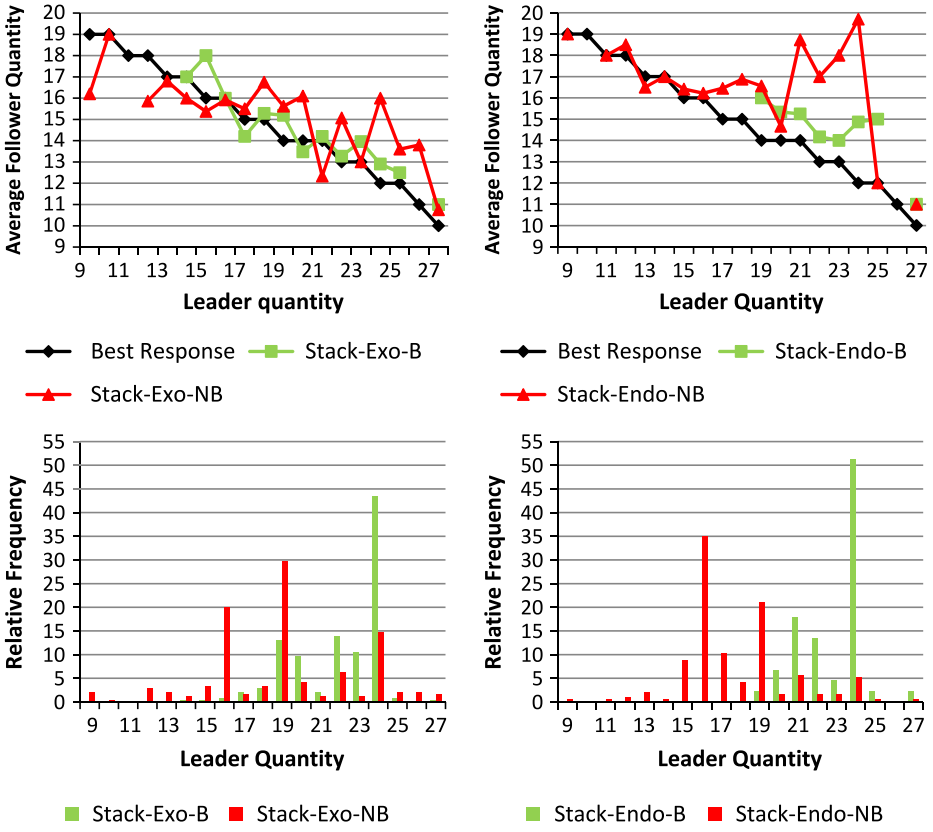

Fig. 2. Observed response function (top) and histograms of leader choices (bottom) in the Stackelberg markets [Exogenous markets on the left, endogenous market on the right].

multi-product firm chooses not to bundle the response function is upward sloping, although the slope parameter is not significantly different from zero.[21]

Indeed, when we compare the bundling and no bundling results, it again appears that the larger output of the multi-product firm is tolerated to a larger extent by the single-product firm. Punishment (whereby followers choose larger quantities than their best response) is less harsh when the Stackelberg leader endogenously bundles than when it does not. As a result, when the multi-product firm endogenously chooses to bundle, an outcome that is rather close to the prediction emerges. Alternatively, when the multi-product firm endogenously chooses not to bundle, the market outcome (almost)

[21] A cautionary note is in place here. Inspecting the graphs of the average response functions in the upper right-hand panel in Fig. 2 suggests that a simple linear regression of the response functions is not appropriate, or is at least problematic, in the case of endogenously (not) bundling. It may be inappropriate because there is a highly non-linear pattern in the average observed response function in the case of no bundling. As the two response functions are not observed for a similar range of Stackelberg leader quantities, it may be problematic. In fact, the histogram in the lower right panel in Fig. 2 shows that, in the case of endogenous bundling, firm 1 never chooses a quantity below 19.

resembles the results of the Cournot treatment. (See Figure 3 and the bottom row of Table 2.) Both findings are in line with what we have observed in the exogenous Stackelberg treatments.

In sum, the data in the Stackelberg treatments are consistent with the idea that Stackelberg leaders are better able to exploit their first-mover advantage when they (exogenously or endogenously) bundle their two products. The reason is that the followers are more likely to "accept" the leader's increased output, independent of whether the leader was exogenously forced to bundle or endogenously chose to do so.

6. Conclusion

Product bundling is a strategy dominant firms may use to attempt to leverage market power from one market to another. Even if demand is independent between markets, a multi-product firm can credibly increase its market share in a competitive market at the expense of losing some customers in its monopolistic market (Martin, 1999; Nalebuff, 2004).

In our experimental test of this leverage theory, one firm has monopoly power in one market but competes with a second firm in another market. We implement the simultaneous (Cournot) and the sequential (Stackelberg) order of moves in the duopoly market, and compare instances where the multi-product firm (*i*) always bundles, (*ii*) never bundles, and (*iii*) chooses whether or not to bundle.

To a large extent, our data indicate support for the theory of product bundling. In the case of Cournot competition, firms produce the predicted numbers of units even if bundling is exogenously implemented/excluded or if there is an endogenous choice of the multi-product firm. In the Stackelberg markets, the theory finds more support when we move from markets with exogenously excluded bundling to those where bundling is exogenously implemented. And the theory is pretty much in line with observed outcomes when the multi-product firm endogenously chooses to bundle its products. Interestingly, when the multi-product firm chooses not to bundle, the market outcomes resemble those of Cournot.

The effect of exogenous or endogenous product bundling is similar in the Cournot and Stackelberg treatments in that the multi-product firm supplies more to the duopolistic market and less to the market where it holds a monopoly, while the single-product firm produces less. Whereas bundling does not have a statistically significant effect on the profits of the multi-product firm, in both the Cournot and Stackelberg treatments, exogenous or endogenous bundling reduces the profits of the single-product firm. At the same time, we find that allowing for endogenous product bundling does not have a significant effect on the overall market performance because instances of product bundling are relatively rare. Insofar as our experimental results have implications for competition policies, the message would be a confirmation of current policy practice: there is no need for a *per se* prohibition of product bundling for fear of a significant drop in total surplus if it is allowed, but instances of product bundling should be considered in detail because bundling has a clear exclusionary effect which is quite likely to reduce total surplus. This effect has then to be measured against the potential benefits of product bundling.

Appendix A. Instructions

Cournot – bundling

Welcome!

This is an experiment on market decision-making. Take the time to read the instructions carefully. A good understanding of the instructions and well-thought-out decisions during the experiment can earn you a considerable amount of money. All earnings from the experiment will be paid to you in cash at the end of the experiment.

Your role and task in the experiment

In this experiment, you, just like everybody else in the room, will represent a firm. There are two types of firms, firm A and firm B. The computer randomly assigns half of the participants the role of firm A and the other half the role of firm B. Your role as firm A or firm B will remain fixed throughout the experiment, and you will learn whether you are firm A or firm B before we begin the experiment.

The experiment takes place over 15 rounds. In each round, one firm A and one firm B will meet in a market for a fictitious commodity, called Market 1. Firm A also operates in Market 2 but firm B does not.

The computer will randomly match two firms (one firm A, one firm B) for Market 1 in every round from a group of eight subjects. The matching is completely random, meaning that there is no relation between the participant you were matched with in the last round (or any other previous round) and the participant to whom you will be assigned to this round.

In every period, firm A and firm B have to choose a quantity. This quantity can be any whole number between 1 and 19. Firm B's choice applies to Market 1. Firm A's quantity choice is relevant both in Market 1 as well as in Market 2. That is, firm A only has one quantity choice so that the quantity in Market 1 will be the same as the one in Market 2.

Profit calculation

In the table we distributed, you can see how the profits for both firms are determined. Generally, the column on the left ("Market 2") indicates the profit of firm A on Market 2 and the big payoff table ("Market 1") indicates the profits for firm A and firm B in Market 1.

Market 1

In the payoff table for Market 1, the head of each row represents an A-firm quantity and the head of the column represents the quantity of the other firm (the B-firm). For each quantity combination (that is, for each of the firm A choices in the rows and the firm B choices in the columns), there is one relevant cell in the payoff table. In these cells, the lower left entry is firm A's profit and the upper right profit is firm B's profit in Market 1.

Market 2

As mentioned, firm A also operates in Market 2. Firm A's profit in Market 2 is contained in the second column of your table, the one with the title "Market 2". The profit firm A earns in Market 2 is in addition to the profit it earns in Market 1.

At the end of each period, Firm A will be informed of the quantity choice of Firm B and Firm B will be informed of the quantity choice of Firm A, and the computer also calculates your profits.

Each period

In each of the 15 rounds, you and the other participant with whom you are randomly matched have to simultaneously decide on your quantities. That is, you have to pick your quantity without knowing what the other participants will choose.

At the end of each period, you will be informed of the quantity the other participant chose, and the computer will also calculate your profits.

Payments

The profits in the table are denoted in a fictitious unit of money which we call Florin. For each 500 Florin, you (like all other participants) will be paid 1 in cash at the end.

At the beginning of the experiment, we will pay you and the other participants 2500 Florin as an initial capital to start with (this is the €5 show-up fee you were promised). Also these 2500 Florins will be paid in cash to you at the end.

Questaions?

If you have a question, please indicate so by raising your hand and we will answer immediately and privately.

Stackelberg – bundling

Each period

In each of the 15 rounds, you and the other participant with whom you are randomly matched have to decide on your quantities. Firm A will choose its quantity first. The computer will then inform Firm B of Firm A's choice in Market 1 and Market 2, and then Firm B has to pick the quantity, knowing Firm A's choice.

*In the endogenous bundling treatments (at the end of Section "***Your role and task in the experiment***")*

Before Firm A and Firm B make the quantity choices, Firm A has to decide between the following two options:

- *Option 1: One quantity choice for both Markets* In this case, firm A makes only **one quantity choice** that is relevant in Market 1 as well as in Market 2. That is, in this case firm A makes only one quantity choice, so that the quantity supplied by firm A in Market 1 will be the same as what it supplies in Market 2.
- *Option 2: Two independent quantity choices for Market 1 and Market 2* In this case, firm A makes **two quantity choices**, one quantity choice for Market 1 and one quantity choice for Market 2. In this case Firm A's quantity in Market 2 can be the same or it can be different to Firm A's quantity in Market 1.

Firm A's decision on Option 1 or Option 2 is binding and Firm B will be informed of this choice **before** firms A and B make their quantity choices.

Appendix B. Payoff Table

Quantities of the A-Firm in Market 2	Firm A's Profit in Market 2	Quantities of the A-Firm in Market 1 / Quantities of the B-Firm in Market 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	351	1	270	290	308	324	338	350	360	368	374	378	380	379	378	374	368	360	350	338	324
			270	261	252	243	234	225	216	207	198	189	180	171	162	153	144	135	126	117	108
2	380	2	261	280	297	312	325	336	345	352	357	360	361	360	357	352	345	336	325	312	297
			290	280	270	260	250	240	230	220	210	200	190	180	170	160	150	140	130	120	109
3	407	3	252	270	286	300	312	322	330	336	340	342	341	340	336	330	322	312	300	286	270
			308	297	286	275	264	253	242	231	220	209	198	187	176	165	154	143	131	121	110
4	432	4	243	260	275	288	299	308	315	320	323	324	323	320	315	308	299	288	275	260	243
			324	312	300	288	276	264	252	240	228	216	204	192	180	168	155	144	132	120	108
5	455	5	234	250	264	276	286	294	300	304	306	305	304	300	294	286	276	264	250	234	216
			338	325	312	299	286	273	260	247	234	221	208	195	181	169	156	143	130	117	104
6	476	6	225	240	253	264	273	280	285	288	289	288	285	280	272	264	253	240	225	208	189
			350	336	322	308	294	280	266	252	238	224	210	196	182	168	154	140	126	112	98
7	495	7	216	230	242	252	260	266	270	272	271	270	266	260	252	242	230	216	200	182	162
			360	345	330	315	300	285	270	255	240	225	209	195	180	165	150	135	120	105	90
8	512	8	207	220	231	240	247	252	255	256	255	252	247	240	231	220	207	192	175	156	135
			368	352	336	320	304	288	272	256	239	224	208	192	176	160	144	128	112	96	80
9	527	9	198	210	220	228	234	238	240	239	238	234	228	220	210	198	184	168	150	130	108
			374	357	340	323	306	289	271	255	238	221	204	187	170	153	136	119	102	85	68
10	540	10	189	200	209	216	221	224	225	224	221	216	209	200	189	176	161	144	125	104	81
			378	360	342	324	305	288	270	252	234	216	198	180	162	144	126	108	90	72	54
11	551	11	180	190	198	204	208	210	209	208	204	198	190	180	168	154	138	120	100	78	54
			380	361	341	323	304	285	266	247	228	209	190	171	152	133	114	95	76	57	38
12	560	12	171	180	187	192	195	196	195	192	187	180	171	160	147	132	115	96	75	52	27
			379	360	340	320	300	280	260	240	220	200	180	160	140	120	100	80	60	40	20
13	567	13	162	170	176	180	181	182	180	176	170	162	152	140	126	110	92	72	50	26	0
			378	357	336	315	294	272	252	231	210	189	168	147	126	105	84	63	42	21	0
14	572	14	153	160	165	168	169	168	165	160	153	144	133	120	105	88	69	48	25	0	-27
			374	352	330	308	286	264	242	220	198	176	154	132	110	88	66	44	22	0	-22
15	575	15	144	150	154	155	156	154	150	144	136	126	114	100	84	66	46	24	0	-26	-54
			368	345	322	299	276	253	230	207	184	161	138	115	92	69	46	23	0	-23	-46
16	576	16	135	140	143	144	143	140	135	128	119	108	95	80	63	44	23	0	-25	-52	-81
			360	336	312	288	264	240	216	192	168	144	120	96	72	48	24	0	-24	-48	-72
17	575	17	126	130	131	132	130	126	120	112	102	90	76	60	42	22	0	-24	-50	-78	-108
			350	325	300	275	250	225	200	175	150	125	100	75	50	25	0	-25	-50	-75	-100
18	572	18	117	120	121	120	117	112	105	96	85	72	57	40	21	0	-23	-48	-75	-104	-135
			338	312	286	260	234	208	182	156	130	104	78	52	26	0	-26	-52	-78	-104	-130
19	567	19	108	109	110	108	104	98	90	80	68	54	38	20	0	-22	-46	-72	-100	-130	-162
			324	297	270	243	216	189	162	135	108	81	54	27	0	-27	-54	-81	-108	-135	-162

Appendix C. Results of Additional Tests

See Table C1.

Table C1
Effect of prohibiting product bundling on market performance

	Cour-Exo-NB		Cour-Endo	Stack-Exo-NB		Stack-Endo
π_1^D	236	$\approx$	246	242	$\approx$	233
π_2^D	245	$\approx$	249	199	$\approx$	207
CS^D	553	$\approx$	528	609	$\approx$	619
TS^D	1034	$\approx$	1023	1050	$\approx$	1058
CS^M	299	$\approx$	280	287	$\approx$	294
TS^M	873	$\approx$	852	861	$\approx$	868
$\pi_1^D+\pi_1^M$	810	$<^*$	819	816	$\approx$	806
CS^D+CS^M	852	$\approx$	807	896	$\approx$	913
TS^D+TS^M	1907	$\approx$	1874	1911	$<^*$	1925

Notes: Significance levels are calculated with Wilcoxon rank-sum tests, conservatively counting each matching group as one independent observation; ** and * indicate statistical significance at the 5% and 10% level, respectively. $\approx$ Indicates not significantly different.

Appendix D. Data

See Table D1-D3 and Fig. D1.

Table D1
q_1^D.

	Cour-Exo-B				Cour-Exo-NB				Cour-Endo			
Matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	20.25	17.00	21.50	19.00	17.00	16.75	13.75	14.00	14.00	18.50	17.00	15.75
2	20.25	18.00	20.50	17.75	17.00	16.50	16.00	13.75	14.00	18.00	16.75	16.75
3	19.75	17.75	19.50	17.75	16.25	16.00	18.00	14.00	13.25	15.75	16.50	15.25
4	20.25	18.00	20.00	19.75	17.00	19.50	16.75	12.75	14.25	17.25	16.50	15.75
5	20.25	17.75	20.00	20.00	16.25	17.75	17.50	13.75	14.25	18.00	17.25	16.00
6	21.00	18.25	20.00	20.50	17.75	18.50	17.25	13.50	14.25	19.00	17.00	16.25
7	19.75	18.00	19.75	18.50	15.00	17.75	17.00	14.25	14.25	18.00	16.75	15.75
8	20.25	19.25	19.50	19.25	16.75	18.50	17.75	14.75	14.25	20.00	16.75	15.75
9	20.25	19.25	19.50	19.75	17.75	18.50	16.75	15.00	14.25	18.25	14.75	15.25
10	19.00	18.75	20.00	18.75	16.75	16.50	15.50	14.50	14.25	18.00	15.75	15.00
11	20.25	19.25	19.50	19.75	17.50	16.50	16.00	14.75	13.75	18.75	15.75	14.75
12	20.25	19.25	19.25	19.00	17.25	18.50	16.75	14.75	13.75	19.25	16.75	15.75
13	20.25	19.25	19.75	19.00	17.75	18.25	15.75	14.50	13.50	18.00	16.00	15.75
14	20.25	19.25	19.75	19.00	17.00	15.75	15.75	15.25	15.00	18.50	18.25	15.50
15	20.25	19.25	19.75	19.00	16.75	18.25	15.75	16.25	14.25	19.25	17.25	15.25
	Stack-Exo-B				Stack-Exo-NB				Stack-Endo			
Matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	20.75	22.25	23.50	20.25	14.75	19.25	21.75	15.75	17.50	19.75	21.50	19.25
2	20.50	21.75	22.75	21.25	17.50	19.25	19.50	16.25	17.75	21.50	20.50	18.25
3	22.75	22.25	21.50	21.00	19.25	17.75	19.50	19.00	19.00	21.00	20.75	19.75
4	22.25	22.50	23.00	21.75	21.50	18.75	20.25	22.00	19.00	20.00	19.00	19.25
5	22.25	20.25	22.75	23.25	19.25	18.00	21.00	21.25	17.25	16.25	17.50	20.50
6	21.50	21.50	22.50	22.00	18.50	19.25	20.25	20.00	20.00	16.25	17.75	20.75
7	21.00	22.50	24.00	22.00	16.75	19.00	19.50	18.25	18.25	16.50	17.75	20.50
8	23.25	22.25	22.75	21.50	17.00	18.5	19.50	19.25	20.00	16.00	16.50	21.50
9	23.00	21.75	23.00	22.25	17.75	19.25	20.25	19.00	20.00	16.75	16.50	21.50
10	23.00	22.75	22.00	22.00	17.00	20.00	19.50	21.25	18.00	17.50	18.25	19.75
11	22.75	22.00	22.50	21.50	17.75	21.25	17.00	19.75	17.00	16.25	16.00	22.50
12	22.25	21.25	22.00	21.00	17.75	19.75	19.50	19.00	18.25	16.25	15.75	21.50
13	22.25	20.75	22.50	21.75	16.75	17.50	19.50	19.75	18.50	16.25	16.00	21.50
14	22.50	21.75	22.50	22.25	17.75	20.25	19.50	19.00	17.25	16.00	16.25	21.50
15	22.50	22.25	22.50	21.25	19.50	20.25	17.00	20.25	19.00	16.00	17.50	21.25

Table D2
q_2^D.

	Cour-Exo-B				Cour-Exo-NB				Cour-Endo			
Matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	16.00	15.50	17.25	15.00	17.00	15.75	17.25	17.25	11.50	17.00	18.75	17.00
2	14.50	15.50	15.25	13.00	19.00	16.75	16.50	19.25	14.75	17.25	17.50	19.50
3	14.25	16.00	17.25	12.50	17.50	18.00	17.00	17.00	16.00	16.50	14.75	17.00
4	16.25	15.75	15.50	15.00	18.75	14.50	15.75	18.00	15.50	18.50	15.25	14.50
5	16.75	15.50	14.75	13.25	17.25	16.25	16.25	16.25	15.50	15.75	16.50	14.50
6	16.50	15.50	15.25	13.75	16.00	15.75	16.25	17.75	15.00	15.25	15.25	15.25
7	16.25	15.50	15.25	14.25	15.75	16.00	16.25	17.25	15.75	14.50	15.25	14.50
8	15.75	15.50	14.75	14.75	15.50	15.25	16.50	17.50	17.25	16.00	16.00	15.75
9	16.75	15.25	16.00	13.00	16.25	16.50	16.25	17.50	16.75	14.75	16.00	16.25
10	16.25	15.50	15.75	13.50	16.00	16.75	16.50	17.25	17.00	16.75	16.00	16.00
11	17.75	16.25	15.75	14.75	17.50	16.50	16.50	16.75	17.75	17.50	16.50	16.25
12	18.00	16.25	16.00	14.25	17.25	16.25	16.50	17.25	17.75	15.75	16.50	16.50
13	16.25	15.50	15.25	15.50	17.50	15.75	15.50	17.50	17.75	17.50	16.00	15.50
14	18.25	15.50	15.25	14.25	17.75	16.00	16.00	17.25	17.50	15.50	15.75	15.75
15	16.00	16.25	14.25	14.25	17.50	17.50	15.75	17.25	17.25	14.75	17.00	15.25
	Stack-Exo-B				Stack-Exo-NB				Stack-Endo			
matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	13.50	12.00	11.50	15.25	15.25	12.75	14.50	14.50	15.75	19.25	16.75	15.00
2	14.00	15.00	12.50	13.50	16.50	12.25	14.75	16.75	18.75	18.00	17.00	17.00
3	12.75	16.25	13.25	12.25	14.50	14.25	14.25	15.75	14.75	20.75	14.75	15.50
4	13.00	14.75	12.50	12.50	13.75	16.00	14.75	16.75	16.50	20.00	16.25	15.75
5	13.00	15.50	15.25	11.75	19.00	14.25	16.00	13.25	15.50	15.50	17.50	15.00
6	13.25	16.75	12.75	12.25	18.00	14.75	17.75	13.25	16.25	16.75	16.50	14.25
7	13.50	14.00	12.00	15.50	15.25	17.25	18.50	16.00	18.25	16.50	17.00	14.75
8	12.50	15.25	12.50	12.25	18.00	14.50	18.50	18.00	14.25	16.25	16.50	14.75
9	12.50	16.25	12.75	12.25	15.25	14.00	17.75	18.25	15.25	17.00	16.75	15.00
10	12.50	16.25	13.00	12.50	18.00	14.00	17.25	15.75	17.25	17.75	17.00	15.00
11	12.75	16.00	13.00	12.25	15.50	13.50	18.50	14.00	15.75	16.25	16.75	14.50
12	12.75	16.50	13.50	12.75	14.75	14.75	14.25	15.50	15.25	16.50	17.25	14.50
13	12.75	15.50	13.25	12.75	13.75	15.75	16.50	14.25	17.50	16.75	15.75	14.75
14	12.75	17.25	13.25	12.25	17.75	14.50	16.50	15.75	17.25	16.50	17.25	14.50
15	12.75	16.75	13.25	13.00	14.75	13.75	13.25	17.50	15.00	17.00	19.50	13.75

Table D3
q_1^M.

	Cour-Exo-B				Cour-Exo-NB				Cour-Endo			
Matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	20.25	17.00	21.50	19.00	24.00	25.25	26.00	21.00	24.00	22.25	22.75	25.50
2	20.25	18.00	20.50	17.75	24.00	24.25	25.75	24.25	24.00	24.25	22.75	24.75
3	19.75	17.75	19.50	17.75	24.00	24.50	25.50	24.00	24.00	22.50	22.75	24.75
4	20.25	18.00	20.00	19.75	24.00	24.50	25.50	24.00	24.00	22.00	22.75	24.75
5	20.25	17.75	20.00	20.00	24.00	24.50	25.50	24.00	24.00	22.50	22.75	24.75
6	21.00	18.25	20.00	20.50	24.00	24.50	25.50	24.00	24.00	24.00	22.75	24.00
7	19.75	18.00	19.75	18.50	24.00	24.50	25.50	24.00	24.00	24.00	22.75	24.00
8	20.25	19.25	19.50	19.25	24.00	24.50	25.50	24.00	24.00	22.75	22.75	24.00
9	20.25	19.25	19.50	19.75	24.00	24.50	25.50	24.00	24.00	22.75	24.75	24.00
10	19.00	18.75	20.00	18.75	24.00	24.50	25.50	24.00	24.00	22.50	22.75	24.00
11	20.25	19.25	19.50	19.75	24.00	24.50	24.75	24.00	24.00	22.00	24.75	24.00
12	20.25	19.25	19.25	19.00	24.00	24.50	24.75	24.00	24.00	22.25	22.75	24.00
13	20.25	19.25	19.75	19.00	24.00	24.50	24.75	24.00	24.00	23.75	24.75	24.00
14	20.25	19.25	19.75	19.00	24.00	24.50	24.75	24.00	24.00	22.75	22.75	24.00
15	20.25	19.25	19.75	19.00	24.00	24.50	24.75	24.00	24.00	22.75	22.75	24.00
	Stack-Exo-B				Stack-Exo-NB				Stack-Endo			
Matching group period	1	2	3	4	1	2	3	4	1	2	3	4
1	20.75	22.25	23.50	20.25	22.75	21.75	22.25	25.00	24.00	22.75	24.50	25.50
2	20.50	21.75	22.75	21.25	24.00	22.75	23.75	24.75	25.25	23.25	24.75	25.50
3	22.75	22.25	21.50	21.00	24.00	24.00	24.00	23.75	25.25	23.25	23.75	24.50
4	22.25	22.50	23.00	21.75	24.00	24.25	24.00	25.50	24.25	24.00	24.50	24.25
5	22.25	20.25	22.75	23.25	24.00	24.75	24.00	24.00	24.75	24.00	24.75	22.50
6	21.50	21.50	22.50	22.00	24.00	23.50	24.00	24.75	24.00	24.00	25.00	24.25
7	21.00	22.50	24.00	22.00	24.00	24.25	24.00	23.75	24.25	24.00	24.75	24.25
8	23.25	22.25	22.75	21.50	24.00	24.25	24.00	23.25	24.00	24.00	24.50	23.50
9	23.00	21.75	23.00	22.25	24.00	24.00	24.00	24.25	24.00	24.00	24.75	23.75
10	23.00	22.75	22.00	22.00	24.00	24.00	24.00	24.75	24.00	24.00	24.75	23.75
11	22.75	22.00	22.50	21.50	24.00	23.50	24.00	24.75	24.00	24.00	24.75	24.50
12	22.25	21.25	22.00	21.00	24.00	22.75	24.00	25.25	24.00	24.00	24.75	23.50
13	22.25	20.75	22.50	21.75	24.00	22.50	24.00	23.50	24.00	24.00	24.75	23.50
14	22.50	21.75	22.50	22.25	24.00	24.00	24.00	23.50	24.00	24.00	24.75	23.50
15	22.50	22.25	22.50	21.25	24.00	23.50	24.00	24.00	24.00	24.00	24.75	25.50

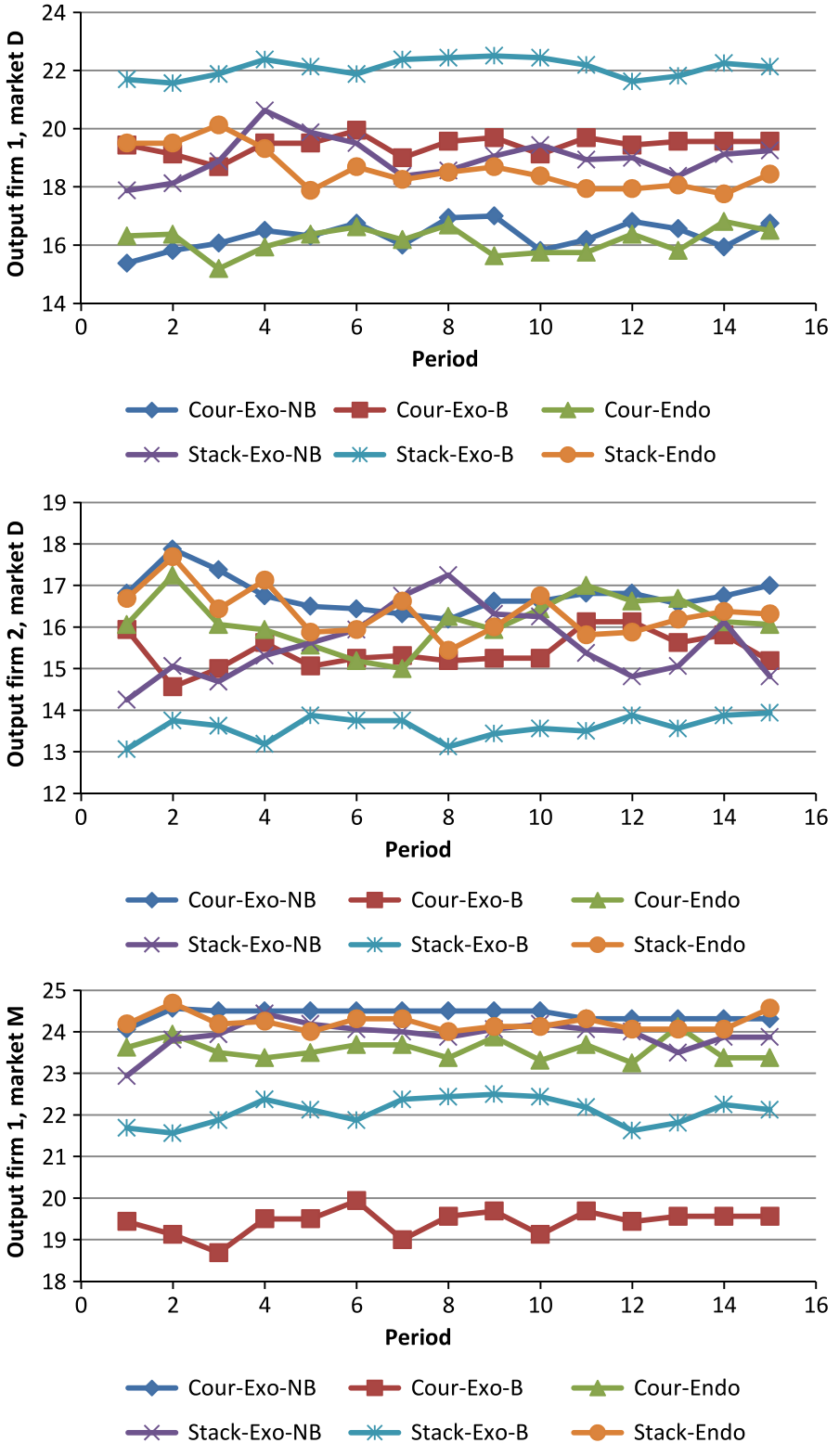

Fig. D1. Average quantities over time.

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Erratum

Erratum to "Output commitment through product bundling: Experimental evidence" [Eur. Econ. Rev. 65 (2014) 164–180]

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The publisher regrets that due to an error, a typesetting error in Tables 2–4 was not corrected prior to publication. The correct tables are now reproduced below.

The publisher would like to apologise for any inconvenience caused.

Table 2
Average quantities and theoretical predictions.

		Market D, Firm 1 q_1^D			Market D, Firm 2 q_2^D			Market M, Firm 1 q_1^M		
		NB		B	NB		B	NB		B
Cour-Endo	*Theory*	*16.00*		*20.00*	*16.00*		*14.00*	*24.00*		*20.00*
	Observed	**15.81**	$<^{*}$	**19.62**	**16.34**	$>^{*}$	**15.04**	**24.10**	$>^{*}$	**19.62**
		$\approx$		$\approx$	$\approx$		$\approx$	$\approx$		$\approx$
Cour-Exo	*Theory*	*16.00*		*20.00*	*16.00*		*14.00*	*24.00*		*20.00*
	Observed	**16.32**	$<^{**}$	**19.43**	**16.76**	$>^{*}$	**15.42**	**24.41**	$>^{**}$	**19.43**
		$\wedge^{**}$		$\wedge^{**}$	$\vee^{**}$		$\vee^{*}$	$\approx$		$\wedge^{**}$
Stack-Exo	*Theory*	*24.00*		*24.00*	*12.00*		*12.00*	*24.00*		*24.00*
	Observed	**19.00**	$<^{**}$	**22.08**	**15.58**	$>^{**}$	**13.59**	**23.92**	$>^{**}$	**22.08**
		$\vee^{**}$		$\wedge^{**}$	$\wedge^{*}$		$\approx$	$\approx$		$\wedge^{**}$
Stack-Endo	*Theory*	*24.00*		*24.00*	*12.00*		*12.00*	*24.00*		*24.00*
	Observed	**17.65**	$<^{**}$	**23.36**	**16.57**	$\approx$	**15.12**	**24.73**	$>^{**}$	**23.36**

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Table 3
Average firm profits and theoretical predictions.

		Firm 1								Firm 2		
		Market D			Market M			Total			Market D		
		NB		B	NB		B	NB		B	NB		B
Cour-Endo	*Theory*	*256*		*280*	*576*		*560*	*832*		*840*	*256*		*196*
	Observed	**244**	$<^{*}$	**259**	**575**	$>^{*}$	**554**	**819**	$\approx$	**813**	**254**	$>^{*}$	**196**
		$\approx$		$\approx$	$\approx$		$\approx$	$\vee^{*}$		$\approx$	$\approx$		$\approx$
Cour-Exo	*Theory*	*256*		*280*	*576*		*560*	*832*		*840*	*256*		*196*
	Observed	**236**	$\approx$	**253**	**574**	$>^{**}$	**553**	**810**	$\approx$	**805**	**245**	$>^{**}$	**196**
		$\approx$		$\approx$	$\approx$		$\wedge^{**}$	$\approx$		$\approx$	$\vee^{**}$		$\vee^{**}$
Stack-Exo	*Theory*	*288*		*288*	*576*		*576*	*864*		*864*	*144*		*144*
	Observed	**242**	$\approx$	**269**	**574**	$>^{**}$	**567**	**816**	$\approx$	**836**	**199**	$>^{**}$	163
		$\approx$		$\approx$	$\approx$		$\wedge^{**}$	$\approx$		$\approx$	$\wedge^{**}$		$\approx$
Stack-Endo	*Theory*	*288*		*288*	*576*		*576*	*864*		*864*	*144*		*144*
	Observed	**235**	$\approx$	**222**	**573**	$\approx$	**574**	**808**	$\approx$	**795**	**222**	$>^{**}$	**129**

Table 4
Average values of consumer surplus and total surplus.

		Consumer surplus								Total surplus		
		Market D			Market M			Total				
		NB		B	NB		B	NB		B	NB		B
Cour-Endo	*Theory*	*512*		*578*	*288*		*200*	*800*		*778*	*1888*		*1814*
	Observed	**523**	$\approx$	**604**	**291**	$>^{*}$	**194**	**813**	$\approx$	**798**	**1886**	$>^{*}$	**1807**
		$\approx$		$\approx$	$\approx$		$\approx$	$\approx$		$\approx$	$\approx$		$\approx$
Cour-Exo	*Theory*	*512*		*578*	*288*		*200*	*800*		*778*	*1888*		*1814*
	Observed	**553**	$<^{*}$	**612**	**299**	$>^{**}$	**190**	**852**	$\approx$	**802**	**1907**	$>^{**}$	**1803**
		$\wedge^{*}$		$\approx$	$\approx$		$\wedge^{**}$	$\approx$		$\wedge^{*}$	$\approx$		$\wedge^{**}$
Stack-Exo	*Theory*	*648*		*648*	*288*		*288*	*936*		*936*	*1944*		*1944*
	Observed	**609**	$\approx$	**640**	**287**	$>^{**}$	**247**	**896**	$\approx$	**887**	**1911**	$>^{*}$	**1886**
		$\approx$		$\wedge^{*}$	$\approx$		$\wedge^{**}$	$\approx$		$\wedge^{*}$	$\approx$		$\wedge^{**}$
Stack-Endo	*Theory*	*648*		*648*	*288*		*288*	*936*		*936*	*1944*		*1944*
	Observed	**593**	$<^{**}$	**748**	**307**	$>^{**}$	**274**	**900**	$<^{**}$	**1021**	**1930**	$\approx$	**1946**