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ABSTRACT

This study experimentally investigates the value of cost report accuracy in an interactive pricing context. Market agents received feedback about their own profits via either a volume-based costing or a more accurate activity-based costing report. They also received a typical market report containing the performance of their rivals. While prior work suggested that market discipline and learning from salient competitors can overcome performance decrements due to inaccurate costing, our results imply that the corrective nature of market feedback depends on the decision maker's role in the competitive play. Compared to other participants, decision makers endowed with the role of a 'reputational' market leader are less effective in screening available market feedback because they predominantly fixate on their own cost data. Even when receiving biased volume-based costing, reputational leaders ignore valuable market signals of opponents having access to more accurate cost data. Consequently other market players can take advantage of them.

INTRODUCTION

Whether it is worthwhile for a firm to invest in the accuracy of cost data depends to a large extent on its ability to 'read' the feedback emanating from its rivals' actions and results (Briers et al. [1999], Vives [1990]). The more effectively managers can filter useful decision inputs from market feedback, the less sensitive their decisions will be to the quality of their own cost reports. Very little research however has examined the factors affecting managers' ability to use market feedback, and infer information about their own costs (Narayanan [2003]). We propose that one such factor is the beliefs decision makers hold about the competitive reputation of their firm in the market. More specifically, we propose that 'reputational' leaders, defined by Scherer [1980, 177] and Cooper [1996] as a leading firm with a strong reputation without having a significant market power or cost advantage, will be less sensitive to market feedback than followers, and more dependent on the quality of their own cost reports. To address this issue, we studied how decision makers use cost reports and competitor feedback in a competitive pricing game. Market agents played against each other to maximize their profits. Market feedback was available to all players by displaying price choices and profits of their rivals. We manipulated for each player whether they received high accuracy (ABC-based) or low accuracy (volume-based) cost reports, and whether they believed to be leaders or followers in the market.

Our results show that the mere assignment of a role in competitive play had a large impact on sensitivity to informative market feedback. Participants who believed to be reputation leaders, tended to be biased towards exclusive use of their own cost reports. Even when their system produced distorted cost data, they underutilized informative market signals, and were taken advantage of by better-informed rivals. In contrast, participants assigned to the follower role, were able to capitalize on the feedback from well-informed rivals, and used their own cost data only to extent that market feedback was uninformative.

Our research presents a contribution to both academic and practitioner literature. First, we extend prior research by demonstrating the value of ABC in a more natural multi-period competitive pricing context. Secondly, while prior literature tends to favor market discipline as an alternative for cost system choice (Waller, Shapiro and Sevcik [1999]), our results suggest an important limitation to this position. Decision makers will be less sensitive to valuable market signals when they believe to be a 'reputational' leader. In practice, leadership beliefs are often instilled by organizational culture on a firm's marketing and financial managers, who tend to make the pricing decisions (Sherer [1980]). Those firms should

therefore always consider following the practitioner's advice to refine their costing system (Cooper and Kaplan [1998]), as they will otherwise be vulnerable to targeted actions by better informed rivals.

RELATED LITERATURE AND HYPOTHESIS DEVELOPMENT

Research on the role of cost system accuracy for decision-making is slowly expanding from individual decision settings (Ashton [1976], Hilton, Swieringa and Turner [1988], Briers, Luckett and Chow [1997], Gupta and King [1997]) towards more competitive market settings (Callahan and Gabriel [1998], Waller, Shapiro and Sevcik [1999], Krishnan, Luft and Shields [2002]). A unique feature of competitive markets is that they provide decision makers with feedback about the actions of their rivals (Waller et al. [1999]). Whether decision makers can effectively use this feedback to make inferences about their own costs, such that they do not have to invest in more accurate costing, however remains debatable [Narayanan, 2003]).

Waller et al. [1999] have argued that markets foster learning from superior market rivals, reducing the *bias to fixate* on cost accounting data that has traditionally been observed in monopolistic settings (Ashton [1976], Briers et al. [1997], Turner and Hilton [1989], Gupta and King [1997]). Waller et al. [1999] tested the effects of variable versus absorption costing when sellers made competitive price offers. The differential impact of the costing system quickly disappeared in markets because participants learned from more successful sellers. Briers et al. [1999] studied decision making with biased volume-based costing in a pricing task where superior market feedback was available. Their task did not directly involve any direct competition nor did they study ABC. Nevertheless, they showed that subjects could effectively use competitive benchmark reports to improve pricing decisions way beyond when they would have solely fixated on their biased cost system. Similar as to evidence in financial accounting research (Berg, Dickhaut and McCabe [1995]; Libby, Bloomfield and Nelson [2002]) these studies argue that market discipline can often correct for biases in pricing due to cost-system inaccuracies. Following this principle, ABC may not always be beneficial for price setting, because market agents with biased cost data can learn from better-performing rivals. Analytical work of Vives [1999] also comports with the view that agents benefit from observing better-informed market agents under price competition.

This view sharply contrasts with the general practitioners' argument that cost system accuracy is especially valuable in competitive contexts (Hanson, [1998]). Cooper and Kaplan [1998] argue that agents with access to ABC will outperform agents that continue to rely on

less refined costing systems. In fact they assume that decision makers with biased costing data would still fixate on cost systems, and ignore valuable signals of a better-informed rivals using ABC. Cardinaels, Roodhooft and Warlop (2004) directly investigated this assumption experimentally, and found only one exception to pricing behavior dominated by market discipline. When volume based costing reported unusual losses for a generally profitable market, certain participants stopped using informative market signals from a computerized rival. Overall, results were still highly dominated by market discipline. This exception raises the question whether there exist 'fundamental' environmental factors inducing market agents to systematically neglect informative market feedback. If such factors would exist, there are still strong incentives to invest in ABC in competitive settings.

To explore this issue, we performed a direct test of whether less-informed decision makers with biased cost data can learn from better-informed rivals with access to more accurate ABC when they *play against each other* in an *interactive multi-period* pricing duopoly [1]. Compared to prior studies, we also performed a fairer and ecologically more valid test. It is hard to disregard market feedback when it is based on explicitly presented benchmarks of optimal behavior (Briers et al. [1999]; Cardinaels et al. [2004]) or when successful sellers attract all sales (Waller et al. [1999]). We therefore study a differentiated duopoly with residual sales for both players. In fact, we compared asymmetric information scenarios – in which one player received an ABC report while the other player received traditional volume based costing – with symmetric scenarios where both parties received either ABC or volume based costing. Neither participant knew the other party's cost system. They only received a market report with the rival's profit and price choices and had to decide whether the other party's prices constitute a valuable signal for their own decisions.

Our main proposition is that the emotional correlate of finding oneself in the leader position in our duopoly (as opposed to the follower role) may lead to market agents being less sensitive for market signals. In experimental economics, Camerer and Lovallo [1999] documented underutilization of market signals from competitors, which they labeled as 'reference group neglect'. In their study, participants were more likely to disregard their rivals in market entry decisions, when they had voluntary signed up for a task that stated their

[1] To our knowledge we are one of the few to introduce human competitors by focusing on the dynamic interplay between participants in a multiple period pricing task in two heterogeneous markets. In general, prior research on cost information in competitive settings, often assumes simpler one-period models (Callahan and Gabriel, [1998], Krishnan et al. [2002]) or introduces "computerized" market feedback (Cardinaels et al. [2004]) sometimes even without any interaction (Briers et al. [1999]). The study of Waller et al. [1999] involves human competitors, but cost allocation was not an issue, because they used a simpler setting with one product, while we introduce multiple markets.

performance largely depended on their own skills. The under-utilization of competitor data resulted into excess entry, with inferior decision performance (Camerer and Lovallo [1999]).

Unlike Camerer and Lovallo [1999], we do not explicitly induce our participants to focus on their own skills. Rather, we argue that different roles in our duopoly may guide attention to either internal or external market information. In our experiment, we informed players that historically their firms had acquired the reputations of either 'barometric' leaders, or followers. Barometric leaders are defined as firms that do not have a significant market power or cost advantage, but having acquired a reputation to respond more quickly to market conditions, serve as a barometer for other market agents (Cooper [1996] and Sherer [1980]). We predict that by being assigned to a leadership role, participants adopt an 'inside perspective' (Kahneman and Lovallo [1993]). It leads decision makers to focus on their own abilities and the case material at hand (e.g. own cost report), without effectively screening the data of other parties. It can be triggered by various numbers of factors (Kahneman and Lovallo [1993]) and we expect that identification with a 'reputational' leader may be such a factor that induces decision makers to ignore their competition. In practice, leading firms indeed underestimate competing rivals (Roll [1986]), and often expect other market agents to accommodate (Haskel and Scaramozizino [1997, 41]).

If leaders neglect market feedback, they may act like decision makers in monopolistic settings, and exhibit a similar bias to fixate on the cost report (Ashton [1976], Gupta and King, [1997]). This will not create a disadvantage as long as they use accurate costing data (Gupta and King [1997]). However, if their own system produces biased cost information, we expect that the leader's performance will generally be lower, even if there is opportunity to learn from a competitor with access to more accurate cost data (follower with ABC). In contrast to prior predictions based on market discipline (Vives [1990]; Waller et al. [1999]), we therefore predict that less informed leaders will not benefit from receiving competitor feedback of a better-informed rival. Consequently, we predict that the leader's performance is dominated by the accuracy of his own cost information:

H1: "Leaders improve prices and profit performance only if their own cost report provides more accurate cost data (irrespective the type of market feedback)."

For participants in the follower role, the relationship between their own cost report and competitor feedback is different. Followers are less prone to ignore competitor feedback. Similar to arguments made by Briers et al. [1999] and Waller et al. [1999], we argue that the follower's own cost information is redundant when there is an opportunity to learn from

better-informed rivals. Hence, when rivals have better cost data (leaders using ABC), we expect market discipline to prevail, indicating that even followers with biased cost reports can improve prices and profit performance by imitating price choices of their better-informed competitor. However unlike in previous research (Briers et al. [1999]), the followers in our study may also face less informed rivals. Will those followers still rely on market feedback rather than their cost reports? Coughlan and Mantrala [1992] suggest that it is difficult to filter out irrelevant market feedback in competitive plays. Less-informed rivals are less appropriate benchmarks (Frederickson [1992]) but this may be difficult to infer when followers themselves use biased cost data. However, Iselin [1996] argues that more relevant cost data help decision makers filter out irrelevant feedback. Under ABC, followers do have relevant cost data that may help them to realize that rivals are less-informed about costs. We therefore predict an interaction between the followers' own cost data and competitor feedback, such that a followers' cost system will be redundant for improving performance when their rivals receive accurate cost data but not when rivals are less informed about cost:

H2: "Differences in the accuracy of the follower's cost report will not affect price and profit performance when the follower's rival receives accurate cost data but matter when the rival receives less accurate cost data."

While the preceding hypotheses tested whether and when market agents are guided by market discipline or fixation on their cost reports, our third hypothesis directly compares profit performance of leaders vis-à-vis followers in the experiment. While performance is expected to be similar when both parties have the same cost data and likely to be higher when those data are ABC, it is more interesting to focus on the asymmetric duopolies where only one party has access to accurate ABC-data while the other party has not (Vives [1990]). We will test the relevance of the practitioner's claim suggesting that market agents maintaining less refined cost data will be outperformed by market players using better ABC-data (Kaplan and Cooper [1998]). Bloomfield, Libby and Nelson [1999] showed that investors are outperformed by other investors when they have an informational disadvantage, especially one of which they are not aware. Because leaders are more prone to reference group neglect, they will probably be less aware of an information disadvantage emanating from followers having superior cost data. In line with the reasoning of Bloomfield et al. [1999] we predict that followers with ABC are able to outperform a less-informed leader. At the same time, we assume that leaders with ABC will be less able to outperform followers with less accurate cost data, since followers eliminate this cost disadvantage by taking in to account the actions of a

better-informed leader. The practitioner's argument of vulnerability to targeted actions by market rivals using ABC particularly applies to the less-informed leader, because he will mistakenly focus on biased cost signals, as he is unaware of opportunities to learn from market feedback.

H3a: "Unlike the less-informed follower, only the less informed leader will be outperformed by its better-informed rival in asymmetric duopolies."

H3b: "Performance is similar across agents when both use the same cost data."

EXPERIMENTAL DESIGN

The experimental market environment

Participants competed on prices in two market segments, denoted by A and B, in which another participant acts as their rival. Market segments were Von Stackelberg duopolies with differentiated demand functions (e.g. products with different brand names, see Callahan and Gabriel [1998]) whereby one participant acted first assuming the role of the leading firm (firm i), while their counterpart acted as follower (firm j). In Panel A of Table 1 the demand function for the leading firm is given by equation (1), where Q_{is} is the quantity demanded for the leading firm in market segment s, and P_{is} and P_{js} are the price charged by respectively the leader and the follower in market segment s. Parameter u_s (>0) represents the demand at zero prices. Parameter v_s is set higher than w_s (v_s, w_s > 0) in order that the firm's own price effect is more dominant than the competitor's price effect[2]. Parameters are displayed in Panel A of Table 1.

We note that leadership is not defined as cost leadership, as both the leading firm and its follower faced a similar cost function. The actual cost function for each firm is defined as a second degree of output and is given by equation (2). Parameters are chosen such that the market segments are highly **heterogeneous** in the costs they incur. Table 1 shows that market A is a high cost-to-serve market because it has a much higher fixed cost (parameter f) and because costs increase more sharply as output (sales) increases (parameters y and z). The quadratic cost function was chosen to ensure that volume-based costing, mistakenly assuming

[2] Similar as in Callahan and Gabriel (1998) this resulted in a differentiated demand duopoly (e.g. differences in brand name). In such a duopoly a market players would be left with residual demand and profits if the rival would charge lower prices.

a volume relation between sales and costs, results in more biased cost data compared to ABC (as discussed later).

Subjects were to maximize their profits by differentiating prices across market segments, given the price choices of the other firm. Profit functions for the leader and the follower are displayed in equations (3) and (4) in panel B of Table 1. They can easily be derived from the demand and cost functions in equation (1) and (2). The Nash-equilibrium is derived by backward induction and is displayed by equations (5) and (6). Due to important differences in costs, market A required a much higher price than market B at equilibrium in order to recover these costs.

This section only described the background of the game. None of this information was revealed to the participants. As discussed in the next sections, participants actually received, besides outcome feedback (total realized profit), an imperfect cost report and a market report containing prices choices and total realized profit of their competitor.

Insert Table 1 About Here

Experimental factors

Three factors were manipulated between subjects. The first factor was the **'role'** subjects played in the duopoly. They were assigned either the role of the leading firm or the role of the following firm. In order to induce barometric price leadership (Scherer [1980]), the leading firm was described to both players as a firm that sets prices first, due to fact that it had built up a strong reputation and brand name in the past. The follower firm was described as a firm that recognized this leadership and therefore only acted after the leader had made his price choices. We explicitly told participants that both firms faced similar cost structures, suggesting that leadership was not achieved through cost leadership, but merely via reputation.

The second factor was the '**own cost information**'. After determining prices, participants received not only total outcome feedback but as shown in appendix A they were also issued one of two cost reports that sharply differed in the degree of accuracy of allocating cost and profits to market segments. Reports were based on either traditional (biased) volume based costing (VBC) versus more accurate activity based costing (ABC). Under VBC, marketing costs were assigned to market segments using sales volume as a driver (Selnes, [1992]). This driver failed to capture the actual cost-to-serve differences among markets,

resulting into biased cost allocations across market segments (see appendix A). Conversely, an ABC report assigned marketing costs on the basis of a two-step procedure (Kaplan and Atkinson [1998]). In the first step marketing costs were assigned to three marketing activities. In the second step, ABC allocated the cost of each activity across market segments using their respective activity drivers (number of orders, software licenses, and deliveries). Rather than assuming a volume-relationship, ABC assumed that market A required much more activities than market B, rendering it per unit more costly to serve. Appendix A shows that resulting ABC figures were closer to actual cost-to-serve variations among market segments[3].

'Competitor feedback' was manipulated as a third factor. Because participants played against each other they could either receive feedback from a competitor having access to more accurate cost information (ABC), or a competitor using VBC reports. It is important to note that participants did not know which cost system their opponent received nor were they made aware of possible differences in cost systems among parties. After each decision they only received the competitor's price choices for market A and B and his realized overall profit. Nevertheless, their rival faced a similar price setting task and through a series of plays participants could learn whether or not the rival was as a useful benchmark (Frederickson [1992]).

As indicated by Table 2, our design had four types of experimental duopolies, each with different information structures. Duopolies of type 1 and 4 had a symmetric information structure since both the leader and the follower received either biased VBC or more accurate ABC reports. Type 2 and 3 duopolies were characterized by asymmetric information since either only the follower, or only the leader had access to the more accurate cost information. Initial prices were set to the same starting values for all four duopolies. In each duopoly, participants viewed an initial cost report (either VBC or ABC) and a market performance report of their rival before commencing their task. The task was performed over 10 consecutive trials. The details of the procedure are described in the next section.

Insert Table 2 About Here

[3] ABC is still a far from perfect cost report (Christensen and Demski 1995) since costs are assigned using drivers that are linear with respect to output (appendix A), while the actual cost function is non-linear. However ABC-drivers recognize that market A significantly requires more resources.

Participants and experimental procedures

Participants -on average 23 years old is het hier niet de mediaan? Hoe kom je anders uit op een rond getal? - were recruited from various management accounting courses. All had a university degree and completed a masters program in Accounting, Insurance, Applied Economics, or Industrial Management. Their various courses had dealt with ABM issues such as applying ABC for price differentiation among customers or market segments. In total 116 students participated in the experiment. The task was performed on a computer. Each session lasted for 90 minutes and contained an even number of participants ranging from 8 to 16 students.

When entering the computer lab, participants were randomly assigned to one of the four duopolies either as leader or follower. Subjects were widely spread across the room and no oral communication of any kind was allowed during the session. In addition, it was impossible to figure out with whom they were competing since they could not observe the other players' screens. In order to induce motivation, participants were told that the best eight players- with the highest overall profit - would receive a 20 € gift coupon exchangeable against CD's[4]. Before starting the experimental task, subjects read a few instruction screens about the case company and their task. The case company represented an importer of portable computers for a particular brand. All subjects explicitly received prior cost knowledge on the two heterogeneous market segments in which the company operated; They were told that customers in market A were more demanding with respect to ordering, delivery and software requirements. Instruction screens mentioned that subjects would play against a competing distributor of a different brand, operating in the same two market segments facing similar cost structures. Participants in the leadership role were explicitly told that they would act for a leading firm with a strong brand name and reputation. Followers represented the other firm, described as firm that recognized this leadership. They only acted when the leader had announced his price choices[5].

The subjects' task was to maximize profits by setting new selling prices for PC's within each market segment. To provide opportunity for improvement, the starting prices were not in line with the cost-of-serving (the price for market A was much lower than for B,

[4] In reality we rewarded the best player in each of the eight experimental cells with a coupon. Average profit was taken as a reward, in order to discourage participants from taking risky decisions in particular trials. McIntyre and Ryans (1983) used a similar compensation scheme.

[5] We also introduced different brand names. The leading firm was labeled as 'Toshiba' whereas the following firm was 'Acer'. Pretests indicate that Toshiba is generally believed as a firm having a stronger reputation. Details of the instructions and task are available on author's request.

while market A was in fact more costly)[6]. As a consequence of reputation, the leader would choose prices first. The follower moved second and determined his or her own price choices after observing the price choices of the leader. Next, markets cleared and both players received an updated cost report (either based on VBC or ABC) and a report on their competitor's price choices and his realized total profit. This procedure was repeated for ten trials. Throughout the experiment, price choices and profits of the last five trials for both the own and the rival's firm remained on the screen. After finishing the task, participants received an exit questionnaire to assess their task motivation[7]. Motivation was high (mean of 4.29 on a 5-point scale). Importantly, no motivational differences were detected for the role ($F_{(1,108)}$: 0.16; p>.68) the own cost system ($F_{(1,108)}$: 2.02; p>.15) the competitor's feedback ($F_{(1,108)}$: 0.18; p>.67) and any of its interactions (all p's >.16).

Manipulation checks

The exit questionnaire further probed the participants' perceived use of the different feedback conditions (own cost information versus competitor feedback). We tested whether our manipulation of 'reputational' leadership made participants being more prone to the phenomenon of 'reference group neglect' (Camerer and Lovallo [1999]). Compared to followers, leaders rated the price choices of the competitor as less important ($F_{(1,108)}$: 24.45; p<.01) and used this information to a lesser extent ($F_{(1,108):}$ 20.83; p<.01). Moreover, when evaluating the two feedback sources against each other, participants acting as leaders evaluated their own cost information much more important than competitor feedback ($F_{(1,\ 108)}$: 20.82; p<.01). Leaders also considered their realized profit performance much more important for improving their price choices ($F_{(1,\ 108)}$: 3.09 p<.09), suggesting that they attach strong importance to the outcomes of their own actions. From these results we can conclude that unlike followers, participants acting as leaders develop a sort of 'inside perspective', whereby they are more inclined to neglect feedback from other market players (Camerer and Lovallo [1999]).

[6] Initial price in each duopoly equaled PA=1650 and PB =1710 for the leader; and PA =1645 and PB =1706 for the follower. A price bracket between € 1200 and € 2100 was established to ensure that quantity demanded remained positive, given the rival's price choice.

[7] The exit questionnaire also assessed the subjects' subjective experience of sensitivity to the behavior of the other player. These results are discussed below.

RESULTS

Effect of feedback on decision performance

In this section, we analyze how the participants learned to improve their decisions based on the different kinds of feedback they received. Participants could have based their decisions on their own costing system (either ABC or VBC). On the other hand, they may have considered the price choices and the realized performance of their competitor, who in turn used a particular cost report (ABC or VBC). Therefore the factors 'own cost system' (OS), 'competitor feedback' (CF), and their interaction are considered as explanatory variables of decision performance. In addition, participants would probably improve decision performance as they gain experience in the task (Gupta and King [1997]). Hence, experience - reflected by the trial number T - was included as a control variable. Since we expected differential effects of these feedback types according to the subject's role in a duopoly, the influence on decision performance was analyzed separately for leaders and followers in the experiment.

We tested several metrics of decision performance. First, we considered the realized profit of a participant in each trial (realized π). In addition, we tested how far a participant's profit would have been removed from the expected optimum (Panel B of Table 1) when the other party would have set optimal prices (%dev_π). Besides profits, we also tested the distance of the participants price choices of their theoretical optimum given the other party is expected to play optimal (%dev_price). Compared to realized profit, the latter two metrics[8] have some advantages. They take into account that leaders at equilibrium realize slightly lower profits than participants acting as followers (see table 1). By setting the other party's prices to expectations, the unique effect of a participant not playing according to expectations is singled out.

[8] Deviation metrics were defined as follows. For participants in the leader role we assumed prices of the follower in each trial to be based on the expectations in panel B of Table 1 (PA = 1834.4; PB=1337.3). We recalculated the leader's profit that would have been realized based on these expectations and we tested how far this profit was removed from the theoretical maximum profit for the leader (Optimal firm profit for leader= 777215.8; Table 1). For the price metric we took the percentage deviation of the leader's prices choices from optimal prices of the leader (Pa=1848.2; Pb=1348.0; Table 1) again assuming equilibrium prices on part of the follower. Given that prices above and below the theoretical optimum are possible, the absolute deviation is taken:
%Dev_π = (Profit Leader given expectations of the follower– **777215.8**)/777215.8
%Dev_P = abs (PA Leader – 1848.2)/1848.2 + abs (PB Leader – 1348.0)/1348.0
We follow the same reasoning for participants acting as follower. As such, deviation metrics for the follower take into account that followers can realize slightly more profits than leaders:
%Dev_π = (Profit follower given expectations of the leader – **790998.0**)/790998.0
%Dev_P = abs (PA Leader – 1848.2)/1848.2 + abs (PA Leader – 1348.0)/1348.0

The three regression models were tested for leaders (role=0) and followers (role=1) separately. Because of evidence of serial correlation, coefficients were estimated using the Yule-Walker method to correct for serial order correlation in the data:

Model 1: $Realized\ p_{it} = b_0 + b_1\ OS + b_2\ CF + b_3\ OS*CF + b_4\ T + e$

Model 2: $\%\ dev\_p_{it} = b0 + b1\ OS + b2\ CF + b3\ OS*CF + b4\ T + + e$

Model 3: $\%\ dev\_P_{it} = b0 + b1\ OS + b2\ CF + b3\ OS*CF + b4\ T + + e$

with realized p_{it}, % dev_p_{it} and % dev_P_{it}, the metrics of decision performance for each participant i in trial t; with OS the own cost system (OS=1 for ABC, 0 otherwise); with CF the competitor feedback (CF=1 if the competitor uses ABC, 0 otherwise); T = trial 1, 2,…, 10.

Panel B of Table 3 displays the regression results for the participants acting as **leaders**. Since trial T was significant in all models we can conclude that leaders improve as experience is gained in the task (Gupta and King [1997]). More interesting are the effects of the different feedback conditions. In all three models only the main effect of the participant's own cost system (OS) was significant. Neither competitor feedback, nor its interaction with the cost system was significant. As predicted by H1, the leader's performance is dominated by the accuracy of the own cost system. Their tendency to rely on their own costing data leads to underutilization of useful market feedback. The means in Panel A of Table 3 and the graph indeed show that leaders, even those using volume-based costing, learn little from a better-informed competitor using accurate ABC-data (Compare CF=VBC with CF=ABC when leader receives VBC). Rather than being guided by market discipline (Briers et al. [1999]; Waller et al. [1999]), reputational leaders in a duopoly exhibit similar cost fixation biases as observed in monopolistic settings (Ashton [1976]). In sum, H1 is supported [9].

Insert Table 3 About Here

[9] We performed several robustness checks. One could argue that leaders (and followers) receive feedback from rivals only when trial one has been completed. This may provide rational for leaving out prices choices of the first trial. Results did however not alter when leaving out the first trial. In addition we also tested a deviation in which the participant's performance was compared against the maximum profit that could have been realized if he actually would knew the other parties price choices. Results were similar again. However we think that deviation metrics using expected prices of an opponent which are reported in Table 1, are more appropriate, because participants acting as leaders can only anticipate expected prices of their opponent.

Panel B of Table 4 shows the regression results for participants in the **follower role**. As did the leaders, followers increased their performance over time, since trial (T) is significant in each model. The main effects of the own cost system (OS) and competitor feedback (CF), and their interaction, are all significant in the models with absolute profit and the deviation against optimal profit as dependent variables. The significant interaction term suggests that the follower's own cost system becomes redundant when feedback is received from a competitor using accurate cost data but not when this competitor used biased cost data. This finding strongly supports H2. When comparing the means of both profit metrics, Panel A of Table 4 confirms that followers learn from their better-informed leaders. When their leader receives ABC (CF=ABC) followers perform better through market discipline, reducing the effect of the own cost system (Waller et al. [1999]) But when their competitor receives biased volume based costing (CF=VBC), the own cost system does matter again.

For the model with the deviation from optimal prices we did not find a significant interaction. Only main effects were significant. The main effect of competitor feedback still suggests that followers were guided by market discipline because they improved prices even further when their competitor received ABC. Unlike the profit models, this superior feedback from a better-informed leader, however, did not significantly reduce the effect of the follower's own costing system for price setting. Given the robust interactions[10] of the profit models we are inclined to suggest that the follower's own cost system matters less when their rivals uses ABC.

Insert Table 4 About Here

The performance of leaders against followers in each duopoly type

This section analyzes whether participants in a particular **role** (either leader or follower) can take advantage of (outperform) their competing party (H3). We need to focus on profits effectively realized by leaders vis-à-vis those of followers because deviation metrics assuming optimal behavior of the rival, do not allow for such tests. The regression below checks for each type of duopoly whether the 'role' significantly explains variations in realized profits. Similar to previous models we included trial as a control variable and parameters are estimated via the Yule-Walker procedure:

[10] For followers, we performed the same robustness checks as for leaders. Leaving out the first trial or testing other deviation metrics did not alter the reported interactions in the profit models.

$$Realized\ p = b_0 + b_1\ Role + b_4\ T + e$$

In duopolies where both parties hold the same information we do not expect any difference (duopoly type 1 and 4). Differences in profits are expected when only one of the parties has an informational disadvantage as opposed to the other party (type 2 and 3). We will first concentrate on these duopolies. Panel A of table 5 shows that in a duopoly of type 2, the variable role is significant suggesting that followers with ABC are able to outperform leaders relying on VBC. Presumable, leaders are outperformed because, by fixating on biased cost data and neglecting important market feedback, they are less aware of their informational disadvantage (Bloomfield et al. [1999]). The figure shows that followers with ABC take advantage of their leader in each trial. Conversely, in a duopoly where leaders have more accurate ABC data, followers with VBC are not outperformed, because they are able to follow up market signals through market discipline. The figure (duopoly type 3) shows that while the leader with ABC outperforms the follower in the first trial, he or she is unable to maintain this advantage in subsequent trials. Hypothesis H3a, suggesting that only less-informed leaders are vulnerable to being outperformed by rivals using ABC, is supported. Hence, leaders have a big interest in refining their cost system to remove this informational disadvantage.

Further analyses in Panel A of Table 5 indicate, that the variable 'role' is not significant when both parties are equally well informed (both use ABC or VBC). H3b is thus supported[11]. Interestingly, in the duopoly in which both players have only access to biased volume based costing (Type 1), the effect of trial is not significant. In this setting participants do not learn via experience. This may indicate that the game was sufficiently complex (Roth and Erev [1995]), as learning through outcome feedback is apparently not achieved under VBC. More accurate data by one of the parties is an important enabler for learning.

Insert Table 5 About Here

[11] We note, however, that followers realize slightly more profits then leaders, to be precise a follower's profits are 101.77% of that of a leader at equilibrium (790998.0/777215.8), which is due to the fact that follower actually moves second. However we can preclude that followers would simply realize more profits, because they move second. Such an effect would always persists, especially in symmetric scenario's (Type 1 and 4), but it was not observed. To completely rule out this interpretation, we performed a robustness check, whereby we artificially augmented the leader's profit with the above percentage. Results remained robust, only in a type 2 duopoly, participants acting as follower outperformed their leaders.

Additional analysis: information assymmetries and market performance

In Panel B of Table 5 we further analyzed differences in the realized market profit achieved by both participants across various duopoly types. First of all, ABC leads to significantly higher market profits when at least one of the parties has access to ABC (Type 2, 3 and 4 have higher market profits compared to Type 1). Interestingly a duopoly of type 3 where only the leader has access to ABC performs similar as to a duopoly where both parties use ABC (type 4). This suggests that the follower using VBC behaves as if he receives ABC, suggesting that followers are guided by market discipline (followers learn from rivals with access to ABC). Significance levels in panel B of Table 5 further indicate that a duopoly of type 2 performs worse in terms of market profit than type 3. This reconfirms that unlike followers who follow up informative market signals in a type 3 duopoly, leaders with VBC in a type 2 duopoly are not guided by market discipline. Because leaders stick to biased cost information market performance is much lower in a type 2 duopoly.

DISCUSSION

The overtone of recent research on the value of various cost systems in competitive markets, has been the prevalence of market discipline (Briers et al. [1999], Cardinaels et al. [2004], Waller et al. [1999]). It has often been suggested that decision makers will use information in the market rather than using (fixating on) their cost report. As a result, initial differences in various cost report types would not persist (Waller et al. [1999]). By extending previous research to a more realistic multi-period and interactive pricing duopoly, we propose that the sensitivity to market signals cannot be generalized as far as prior work has suggested. Our results indicate that agents acting as leaders, even those using biased volume based costing (VBC), tend to ignore opportunities to learn from better informed rivals. Rather than observing market discipline, they predominantly fixate on cost reports. Because of this fixation, leaders with VBC are even outperformed by rivals using ABC. Conversely, followers are more effective in screening market feedback. Cost system choice is unimportant when they face rivals that use ABC, but their own cost report matters when leaders use biased cost data.

Apparently, the finding that market feedback may not always help to alleviate cost system fixation bias has practical implications for cost system design. If learning from market feedback is interfered with by the mere belief that one's firm is a reputational leader, there must be many real life business contexts in which managers rely too often and too much on their own cost data. The practical implication is that adopting more refined costing systems,

like ABC, can benefit many firms (Cooper and Kaplan [1998]), as their cost fixation bias may otherwise lead to being outperformed in the market. Worth mentioning is that supplementary analyses on market performance of the dynamic interplay stress other importance aspects of more refined cost systems in competitive settings. Market performance is hard to improve via simple outcome feedback, if both parties rely on VBC. At least one of the parties should use ABC, but still performance is lower when followers rather than leaders have access to the more accurate data, due to a leader's failure to follow market discipline.

We attribute our findings to reputational leaders being more prone to reference group neglect. Unlike Camerer and Lovallo [1999] were the phenomena occurred when the task explicitly suggested that own actions would be important, we show that without explicitly labeling which data are important, 'reputational' leaders spontaneously fixate on their own cost system, even if it produces biased cost data. Reference group neglect is typically observed in competitive settings and is related to managerial overconfidence in other studies (Alba and Hutchinson [2000]; Nelson, Krische, and Bloomfield [2003]), but there are differences as suggested by Camerer and Lovallo [1999]. While leaders in our setting indicated to ignore market feedback, Camerer and Lovallo [1999] suggest that more confident agents would not neglect competition, but would prefer the own cost system anyway because of strong beliefs in their own abilities. Nevertheless, we believe that the difference is subtle in competitive settings. We therefore suggest follow up research using individual decision or prediction tasks. We see applications in the recent studies testing whether subjects can debias distorted cost information when their own system would also provide other types of feedback such as objective market trends, historical data, informal cost estimates. (Dearman and Shields [2001], Bruns and McKinnon [1993], Malmi [1997]). A highly confident agent may be less effective in updating cost system bias as he may not appropriately weigh each type of feedback.

We also highlight some limitations that may stimulate future research. Our setting has only two market agents, in which the leader fixated on (even biased) cost data, while the follower effectively screened market feedback. The question remains whether these results extend to more competitive environments. With more market agents, it may be harder to neglect important market data (Waller et al. [1999]). In contrast, more competitive settings with a larger number of players create complexity, in which decision makers may exhibit even more (irrational) behavior (Coughlan and Mantrala [1992], Roth and Ever [1995]). While followers in our setting effectively screen market feedback, such screening may be difficult under greater competition.

While reputational leadership is well dispersed and typically occurs in competitive settings (Sherer [1980]; Cooper [1996]), there are many other strategic considerations in a competitive context (Hansen, 1998) that can further be examined. Via similar underlying cost functions we explicitly focused on reputational leadership, but one can also test if firms can use ABC for managing cost reduction initiatives to achieve cost leadership in a particular market. Our study also assumed a design that excluded communication among participants. It would be fascinating to study how cost systems can strategically be used to coordinate efforts of different market agents to achieve higher profits over the long run than simply under a competitive equilibrium. Finally, our participants could not choose their role but further work can explore the fact of who will choose to lead. Reputational leaders in the long run may give up a leading position when they continue to rely on biased cost data. ABC may then serve as a prerequisite to maintain a leadership position. In any event, it is important that future experiments that investigate these long-term strategic decisions maintain a focus on a multi-period competitive adaptive play.

APPENDIX A

This appendix shows how total **actual** costs incurred are allocated to the two market segments using ABC or volume based costing. We only display the report for the leader, since a report for the follower is similar. At the start of the experiment, the leader's initial prices were €1650 for market A and € 1710 for market B, while the follower responded with €1645 for segment A and €1706 for segment B. Prices were clearly not in line with the cost of serving (market A received a lower price while in fact it was more costly). Table A1 displays the leader's **actual** results at these initial prices, based on the functions of Table 1. Subjects did not receive these actual figures. They only received the market report of table A1 with the rival's prices and his total profits but further had access to imperfect cost reports (see Table A2 and A3).

Insert Table A1 About Here

For cost allocation, we assume that part of total actual cost (4452289, see shaded area in Table A1) is in fact the cost of goods sold. Products are imported at a fixed price where the import price for market B is slightly higher than that for market A:

*Cost of goods sold = 630 * Qa + 710 * Qb = 630 * 2277.25 + 710 * 699.3 = 1931171*

The remaining part of total actual cost incurred (4452289 – 1931171 = 2521118), defined here as customer costs and is allocated to the two market segments using different cost accounting systems. An ABC system uses a two-stage procedure to allocate this cost (see panel A of Table A2). In the first stage, the system spreads the costs over three marketing activities - ordering, delivery and software installation – on the basis of the time that each activity consumes. In the second stage, the cost of each activity is allocated to the two segments based on activity drivers. Panel B of table A2 displays the ABC report. Market A incurs per unit more cost since it requires more activities (more orders, deliveries & custom design) than market B. This corresponds with actual cost data where market A is also shown as more costly (see Table A1).

Insert Table A2 About Here

Under volume-based costing (VBC, Table A3), customer costs are allocated to the two market segments using sales volume as a driver. This driver is unable to differentiate between the cost of servicing the two market segments. VBC produces a highly biased cost picture when compared to actual unit cost s of Table A1. Market B is shown to be more costly than market A while in fact it incurs per unit less cost.

Insert Table A3 About Here

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TABLE 1

Functions used in the experiment and game-theoretical equilibrium

Panel A: demand and cost functions and parameters per market segment (s = A, B)

Demand: $Q_{is} = u_s - v_s P_{is} + w_s P_{js}$ (1) Cost: $C(Q_{is}) = f_s + y_s Q_{is} + z_s Q_{is}^2$ (2)

	U	V	W		f	y	Z
Segment A	5500	3.0	1.05	***Segment A***	1750000	220	0.14
Segment B	2325	1.05	0.3	*Segment B*	700000	195	195

Panel B: Game-theoretic equilibrium derived via backward induction (s = A, B)

* Profit Objective functions for leaders and followers:

Profit leading firm: $p_{is} = P_{is}(u_s - v_s P_{is} + w_s P_{js}) - y_s(u_s - v_s P_{is} + w_s P_{js}) - z_s(u_s - v_s P_{is} + w_s P_{js})^2 - f_s$ (3)

Profit follower: $p_{js} = P_{js}(u_s - v_s P_{js} + w_s P_{is}) - y_s(u_s - v_s P_{js} + w_s P_{is}) - z_s(u_s - v_s P_{js} + w_s P_{is})^2 - f_s$ (4)

* Optimal reaction function for the follower (firm j) to prices of leader (firm i):

$$\boldsymbol{P_{js}} = \frac{(2\,u_s v_s z_s + u_s + v_s y_s) + (2\,v_s w_s z_s + w_s)\,\boldsymbol{P_{is}}}{2(v_s + v_s^2 z_s)} \quad (5)$$

* Optimal strategy for the leading firm given the follower's reaction function:

$$\boldsymbol{P_{is}} = \frac{m_s - n_s y_s - 2 z_s m_s n_s}{2 n_s (z_s n_s - 1)} \qquad m_s = \left[\frac{u_s + w_s(2\,u_s v_s z_s + u_s + v_s y_s)}{2(v_s + v_s^2 z_s)}\right] \text{ and } n_s = w_s^2\left[\frac{(2 v_s z_s + 1) - v_s}{2(v_s + v_s^2 z_s)}\right] \quad (6)$$

* Optimal values via equations (3)-(6) using the parameters of panel A:

	OPTIMA FOR THE LEADING FIRM		*OPTIMA FOR THE FOLLOWING FIRM*	
	PRICE (6)	*PROFIT (3)*	*PRICE (5)*	*PROFIT (4)*
Segment A	1848.2	428483.8	1834.4	439345.5
Segment B	1348.0	348732.0	1337.3	351652.5
Total profit	-	777215.8	-	790998.0

[a] Demand is based on a typical demand function for differentiated products (v > w; there is no threat of losing all sales to a rivals). Cost functions are similar for leaders and followers. Profit objective functions can be derived from equations and (1) and (2). Game theoretical optima are found via backward induction and were verified by the solver function of a spreadsheet program Details of the calculations can be provided on authors' request. None of this information is revealed to participants. Optima only serve as benchmarks for comparing performance of participants in the experiment.

TABLE 2

The four different types of duopolies and their information structure

	Type 1	Type 2	Type 3	Type 4
Participant as a leader	VBC (14)	VBC (14)	ABC (15)	ABC (15)
Participant as a follower	VBC (14)	ABC (14)	VBC (15)	ABC (15)

[a] subjects either play the role of leader or follower (factor 1). Leaders decide before followers. After setting prices feedback is issued via the participants' own cost system (factor 2) either volume based costing (VBC) or activity-based costing (ABC) and a market report (factor 3) with prices and total profit of the rival (also using VBC or ABC). The number of subjects per cell is shown between brackets.

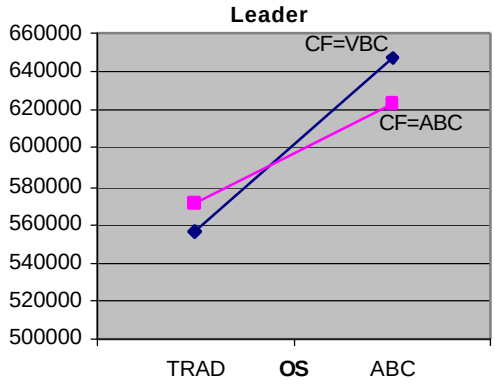
TABLE 3

Regression results of the three different models for the leader role – Hypothesis 1

Panel A: Descriptive statistics

OWN SYSTEM

COMPETITOR FEEDBACK (CF) TRIAL TOKR		**VBC**	**'OS'**	**ABC**
	VBC	556752 (43.7%) [35.7%] {140}		647018 (27.8%) [25.7%] {150}
	'CF'	570875 (38.24%) [32.3%] {140}		623186 (24.18%) [21.0%] {150}
	ABC			



Panel B: Parameter estimates and significance levels of the models (Yule-walker)

	Dependent variables		
Parameter estimates	Realized π	%dev_π	%dev_P
Intercept	508239***	0.5371***	0.4180***
Own system (OS)	91532***	-0.1607***	-0.1017***
Competitor feedback (CF)	9815	-0.0570	-0.0346
OS*CF	-34442	0.0121	-0.0163
TRIAL (T)	8925***	-0.0173***	-0.0105***
R-square	0.3873***	0.5030***	0.6687***

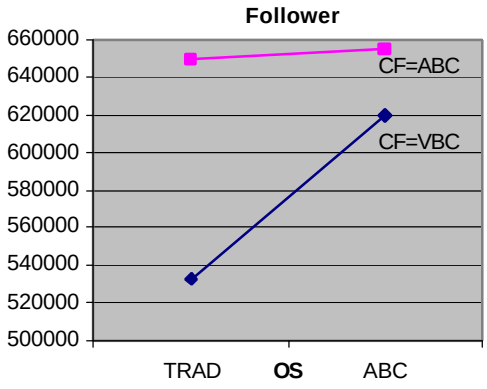
[a] Cells in Panel A contain the mean of a leader's realized profit, (the mean % deviation of a leader's profit from optimal profit given expectations of the follower playing optimal), [the mean % deviation of a leader's prices from optimal prices], {the number of trial/participants observations}. The graph shows the effect of the feedback types on realized profit. Models in panel B test the effects of feedback received from the participant's cost system 'OS' (ABC or VBC), the feedback on prices and profits of their competitor 'CF' (either also using ABC or VBC), the interaction 'OS*CF' and a learning effect represented by the trial number 'T' on the three defined metrics of decision performance. Significance: * p<.10 level; ** p <.05 level; *** p < .01 level.

TABLE 4

Regression results of the three different models for the follower role – Hypothesis 2

Panel A: Descriptive statistics

		OWN SYSTEM	
COMPETITOR FEEDBACK		***VBC***	***ABC***
VBC		533192 (47.2%) [36.6%] {140}	620027 (32.9%) [28.6%] {140}
ABC		649401 (28.7%) [26.7%] {150}	655129 (23.6%) [20.5%] {150}



Panel B: Parameter estimates and significance levels of the models (Yule-walker)

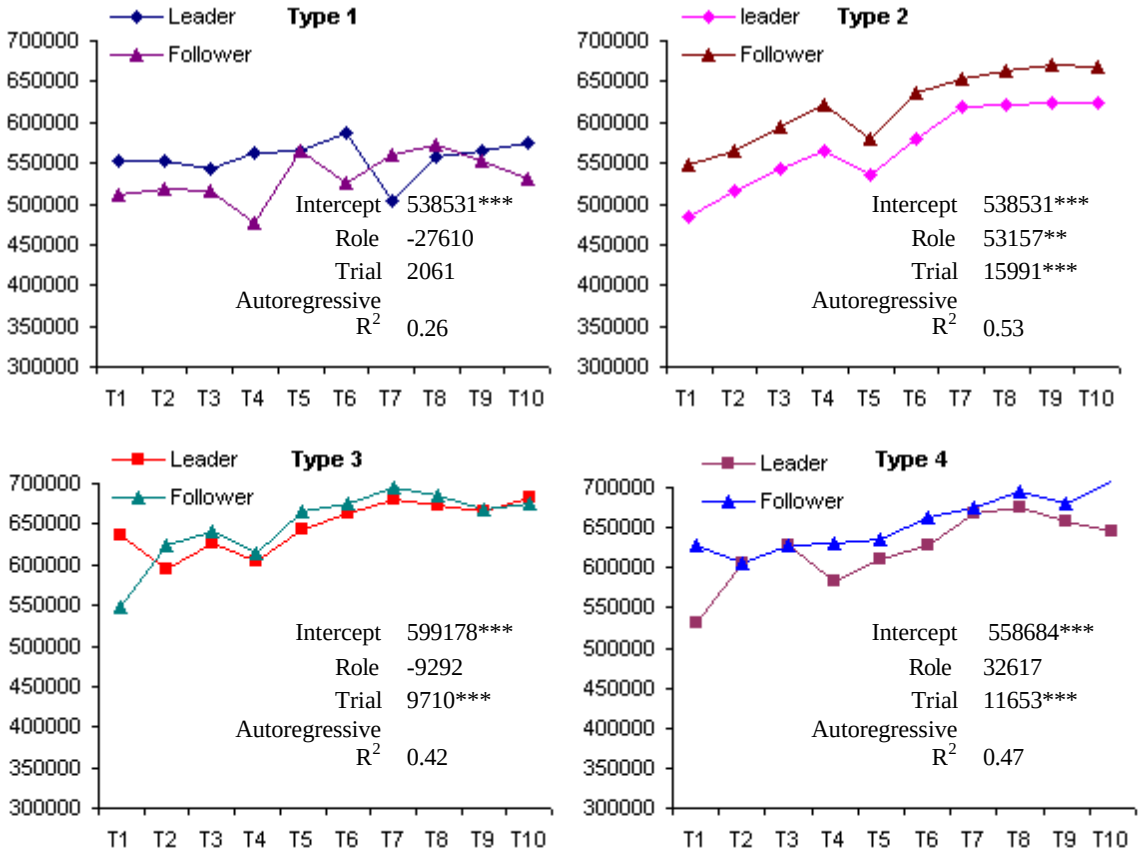
	Dependent variables		
Parameter estimates	Realized π	%dev_π	%dev_P
Intercept	478034***	0.5759***	0.4326***
Own system (OS)	95491***	-0.1662***	-0.0956***
Competitor feedback (CF)	112670***	-0.1797***	-0.0967***
OS*CF	-86340**	0.1039**	0.0305
TRIAL (T)	9835***	-0.0176***	-0.0113***
R-square	0.4968***	0.5682***	0.6812***

[a] Cells in Panel A contain the mean of a follower's realized profit, (the mean % deviation of a follower's profit from optimal profit given expectations of the leader playing optimal), [the mean % deviation of a follower's prices from optimal prices], {the number of trial/participants observations}. The graph shows the effect of the feedback types on realized profit. Models in panel B test the effects of feedback received from the participant's cost system 'OS' (ABC or VBC), the feedback on prices and profits of their competitor 'CF' (either also using ABC or VBC), the interaction 'OS*CF' and a learning effect represented by the trial number 'T' on the three defined metrics of decision performance. Significance: * p<.10 level; ** p <.05 level; *** p < .01 level.

TABLE 5

Performance of leaders compared to followers for each duopoly type –Hypothesis 3

Panel A: Autoregressive model per duopoly type: $p = b_0 + b_1 \text{Role} + b_2 \text{trial} + e$ **(test of H3)**



Panel B: Additional analysis for the differences between duopoly types

	Type 1 L: VBC F: VBC	**Type 2** L: VBC F: ABC	**Type 3** L: ABC F: VBC	**Type 4** L: ABC F: ABC
Realized profit leader (a)	556752	570875	647018	623186
Realized profit follower (b)	533192	620027	649401	655129
Market performance **(a)+(b)**				
Total Profit realized in market	1089944	1190903	1296420	1278315

0.0596 **0.0548** 0.9504

0.052

0.0232

[a] Panel A displays the mean performance of leaders against that of followers in each of the 10 trials. Results of the auto regression (estimated via the Yule-walker procedure) to test for the effect of the role on decision performance and should be seen as a direct test of H3. *, **, ***, respectively indicate significance levels at the 10%, 5% or 1% level. Panel B contains additional analyses on the total market profit realized in each duopoly type. Pair wise comparisons indicate p-values of the Kruskal-Wallis test for the differences in means.

TABLE A1

Actual results for the leader and the competitor feedback at the start of the experiment

Actual results of the leader based on table 1 (not shown to participants)

	segment A	**margin**	**segment B**	**margin**	**Total**	**margin**
Price	1650		1710			
(Price rival)	(1645)		(1706)			
Sales volume	2277		699		2976	
Revenue	3757463		1195803		4953266	
Actual cost	3547463	94.4%	904826	75.7 %	4452289	89.9%
Profit	210000	5.6%	290977	24.3%	**500977**	**10.1%**
Cost/unit	**1557.8**		**1293.9**			

Competitor feedback shown to participants

Price market A	1645
Price market B	1706
Total profit competitor	500639

TABLE A2

Underlying assumptions in the ABC condition and the displayed ABC report

Panel A: assumptions of the ABC system (not shown to participants)

Stage 1: Allocating cost to activities		Stage 2: Activity drivers for each market segment		
	% of time		**Activity level per 100 units**	
Order processing	35 %		Segment A	Segment B
Software installation	40 %	No Orders	15	7
Delivery	25 %	No licenses	230	120
		No Deliveries	7	4

Panel B: initial ABC report issued to participants acting as leader

	Market A	margin	**Market B**	margin	**Total**	margin
Sales Volume	2277		699		2977	
Price	1650		1710			
Revenues	3757463		1195803		4953266	
Cost of goods sold	1434668	38.2%	496503	41.5%	1931171	39.0%
Customer Costs	2177171	57.9%	343947	28.8%	2521118	50.9%
	#	*Cost*	*#*	*Cost*	*#*	*Cost*
Rate						
Order Proces. 2259	*346*	*771190*	*49*	*110601*	*390*	*882391*
Software install. 166	*5238*	*869189*	*839*	*139258*	*6077*	*108447*
Delivery 3364	*160*	*536191*	*28*	*94088*	*187*	*630279*
Profits	**145624**	**3.9%**	**355353**	**29.7%**	**500977**	**10.1%**
Unit Costs	**1586.1**		**1201.8**			

TABLE A3

Initial traditional cost report issued to the participants acting as leader

	Segment A	**Margin**	**Segment B**	**Margin**	**Total**	**Margin**
Sales Volume	2277		699		2977	
Price	1650		1710			
Revenues	3757463		1195803		4953266	
Cost of goods sold	1434668	38.2%	496503	41.5%	1931171	39.0%
Customer Costs	1928815	51.3%	592302	49.5%	2521118	50.9%
Profits	**393980**	**10.5%**	**106998**	**8.9%**	**500977**	**10.1%**
Unit Costs	1477.0		1557.0			