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THE BENEFITS OF COST SYSTEM ACCURACY IN A COMPETITIVE PRICE SETTING DUOPOLY

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ABSTRACT

This study reports the results of an experiment to investigate the value of increased cost report accuracy in competitive pricing decisions. Prior work has shown that in more competitive environments, cost system choice matters less since there is opportunity to learn from informative market signals. Our study argues that in a dynamic duopoly, learning from such informative market signals is distorted when decision makers act as market leaders deciding first on prices. Compared to second movers (followers), a leader with a biased cost report continues to prefer his own distorted cost figures over the informative signals emanating from better informed market players. Consequently he realizes lower performance and can be taken advantage of by opponents with access to superior cost data. We conclude that in order to achieve profit leadership, current reputational market leaders have a great interest in improving the accuracy of their own cost report system.

Keywords: Competition, activity based costing, learning, price setting, market leader

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1. Introduction

This study reports experimental evidence on the benefits of more accurate cost reports for pricing decisions in a competitive market environment. Regarding this matter there exists a large discrepancy between the practitioner and academic research literature. The practitioner-oriented literature generally argues that firms benefit more from accurate cost systems when the market becomes more competitive (Cooper, 1988; Cooper and Kaplan, 1998; Hanson, 1998). Competitive settings amplify the need for improved pricing, which should motivate investments in cost system refinement. Cooper and Kaplan (1998), for instance, argued that activity based costing (ABC) provides a firm with significant advantages for price setting, especially when their competition continues to follow signals from less refined cost systems, which makes them vulnerable to targeted actions by competitors having access to superior costing data.

Both theoretical and experimental contributions in the academic literature have raised doubt about the generalization of these claims. It is argued that cost system choice does not matter in markets with several competing players making price offers, since firms can learn from the actions of superior players (Waller, Shapiro and Sevcik, 1999). Vives (1990) has shown mathematically that for price setting, a less informed competitor can benefit from the firm who has access to more accurate data. Briers, Chow, Hwang, and Luckett (1999) demonstrated empirically that decision makers' pricing decisions rapidly improve over time by incorporating informative market signals, even if they receive biased cost data. Although none of these studies directly considered ABC, one could argue that decision makers in a competitive setting would always base their decisions on better information in the market -when it is available- which would make any exercise in cost system refinement redundant. In addition, since a firm with inferior cost data seems to learn from the price choices of a superior rival, it is for the latter difficult to gain the advantage suggested by the managerial literature (Cooper and Kaplan, 1998).

We will contribute to this debate by testing whether highly informative market feedback is always used in the decision process. If such market signals would be underutilized, more accurate ABC information would continue to facilitate profit

improvement. Secondly, if even decision makers with inferior cost data would underutilize informative market signals, they would continue to be vulnerable to the actions of rivals using superior cost information.

2. Related literature and hypothesis development

A long line of research has investigated the value of different accounting systems for pricing and output decisions when firms act individually as monopolists (Ashton, 1976; Briers, Luckett and Chow, 1997; Gupta and King, 1997, Hilton, Swieringa and Turner, 1988; etc.). The well-accepted main conclusion is that decision makers tend to fixate their decisions on the output of the cost system (Ashton, 1976). Even when diagnostic outcome feedback is available, subjects tend to anchor on accounting figures for subsequent adjustments in the decision process (Briers et al., 1997; Gupta & King, 1997). Apparently, providing subjects with simple outcome feedback is not enough to reduce their reliance on cost figures. In such scenario's increased cost accuracy will lead to improved pricing policies (Briers et al., 1997).

In a more competitive context, decision makers receive additional feedback from other market players' actions. Most of the relevant research suggests that competitors are able to learn from the feedback they receive out of the market (Briers et al 1999; Bruns and McKinnon, 1993; Vives 1990; Waller, 1995; Waller et al. 1999). A priori it is unclear to us why competitors would always let the most diagnostic information guide their decisions, if monopolists are not. We offer a two-fold theoretical rationale for our skepticism.

Our first argument is based on the well-known cognitive limitations to learning in complex environments. Competitive 'games' are dynamic. They extend over multiple periods and take place in information rich environments. Period-by-period profit feedback and potentially diagnostic market and cost system signals are mixed with irrelevant information (Bloomfield, Libby and Nelson, 1999; Cooper, 1996; Roth and Erev, 1995). Bounded rationality puts limits on the ability of the decision maker to filter in and weigh the relevant information, and to filter out the irrelevant (Coughlan and Mantrala, 1992), and will interfere with learning from experience

(Brehmer 1984; Cardinaels, Roodhooft and Warlop 2002). Appropriately factoring in diagnostic market feedback will therefore be difficult.

While the complexity will increase as the number of relevant competitors increases, we perform a strong test by assuming a duopoly in which only one other player is the source of potentially relevant market signals. We perform a direct test of whether less-informed decision makers with biased cost data can learn from better-informed rivals with access to more accurate cost data when they play against each other in an interactive price setting task over multiple periods. In fact, we will compare an asymmetric information scenario – in which one player receives an ABC report while the other player received a traditional volume based cost report – with symmetric scenarios in which both parties receive either ABC or volume based cost reports. It is important to note that neither participant in our study knows which cost information the other party can rely on. They will have to learn through experience whether the pricing behavior of the other party constitutes a valid signal for their own decisions.

Our second argument refers to the emotional correlates of finding oneself in either the leader or the follower position. We argue that participants in a leader role are less sensitive to relevant external market signals. Underutilization of external signals from competitors has been documented in experimental economics by Camerer and Lovallo (1999), who labeled it as 'reference group neglect'. They showed that in some circumstances decision makers in an interactive game with competing rivals exhibit a bias that leads them to disregard their competition. In their study participants were more likely to neglect their competing rivals in market entry decisions, when they had voluntarily signed up for a task stating that their performance would largely depend on their own skills. The underutilization of competitor data resulted into excess entry with inferior decision performance (Camerer and Lovallo, 1999).

In contrast with Camerer and Lovallo (1999) we do not induce our competitors to concentrate on their own skills by formerly stating that performance would depend on own actions. Rather, we suspect that the role assigned in an adaptive play duopoly spontaneously guides attention to either internal or external market information. In our experiment, we inform both players that historically they have either been 'barometric' leaders, or followers. Characteristics of barometric leadership are that

the leading firm responds more quickly to market conditions than its rivals, and that it serves as a barometer for current market conditions for other firms without having in itself significant market power or a cost advantage (Cooper, 1996; Scherer, 1980). Participants who are assigned such a leadership role in our experiment may spontaneously assume that their performance largely depends on their own skills as a leader, and they may be more inclined to neglect competitor feedback (are more prone to reference group neglect). Followers, on the other hand, might be more inclined to scan the competitive environment as they are looking for solutions to improve their competitive position.

Because of this tendency to ignore feedback of other market players, we expect leaders to resort to their own cost system just like monopolists would do (Ashton, 1976; Briers et al. 1997, Gupta and King, 1997). This will provide an advantage to those leaders who receive more accurate costing data (Gupta and King, 1997). But if their own system produces biased cost information we expect that the leaders' performance will generally be lower, even if there is an opportunity to learn from a competitor with access to more accurate cost data. We predict that the rational argument that less informed participants benefit from better informed rivals (Vives, 1990) will hold for followers but not for leaders in a duopoly. Formally, we can state the following hypothesis:

H1: Since leaders are more likely to neglect competitor data, they only improve performance when their own cost report provides more accurate cost information

For followers the relationship between their own cost information and competitor data is different. Followers do not exhibit this tendency to ignore competitor feedback. Similar to arguments made by Briers et al. (1999) and Waller et al. (1999), we therefore argue that the follower's own cost information is made redundant when there is an opportunity to learn from better-informed leaders. If followers receive biased cost data they can improve performance by imitating the price choices of a competitor who has access to accurate cost data. Although followers might also be influenced by less relevant competitor feedback (Iselin, 1996), we expect more accurate cost data to provide an advantage since they allow decision makers to weigh the price choices of a

less informed competitor against the own accounting data (Cardinaels, Roodhooft and Warlop, 2002). The more accurate these data, the sooner the follower will realize that price choices of a less informed competitor are not a valid source of information. We therefore predict an interaction between the followers' own cost data and their competitor feedback, such that the followers' accounting feedback will be redundant when their leaders receive more accurate cost data but not when the rivals are less informed about cost:

H2: The follower's own cost accounting system is made redundant only when the competitor has access to more accurate cost data

We also consider the profit performance of followers compared to that of leaders in the experiment. Theoretical work of Gal-Or (1985) shows that when competitors are rational and perfectly informed, second movers are able to earn higher profits compared to their first mover counterparts when they compete on prices. However in an adaptive play scenario where players with different cost information compete against each other, this relation might be different. Experimental work in accounting (Bloomfield, Libby and Nelson, 1999) shows that investors are outperformed by other investors when they have an informational disadvantage, especially one of which they are not aware. Our third research question therefore mainly focuses on duopolies where one party has less accurate cost information compared to the other party. Because we assumed that leaders are more likely to ignore competitor feedback (Camerer and Lovallo, 1999) we can argue that leaders are less aware of a cost disadvantage when their follower receives more accurate cost data. Following the arguments of Bloomfield et al. (1999) a better-informed follower should outperform a less-informed leader. Leaders with more accurate cost data, on the other hand, are less able to outperform followers with less accurate costs, since followers reduce or eliminate their cost disadvantage by taking into account the actions of a better-informed leader (Waller et al., 1999).

H3: In a duopoly where one party has access to more accurate cost data, only better informed followers (but not better informed leaders) are able to outperform their less-informed rivals

In general these hypotheses predict that learning from accounting data and competitor feedback is less effective for leaders. Leaders first of all do not learn from better-informed competitors when their own system provides inaccurate cost data, while followers do. Secondly, less informed leaders are also outperformed by better informed followers due to the fact that one as a leader is less aware of possible cost information disadvantages.

3. Experimental design

3.1. Experimental market environment

Participants play against each other in two market segments denoted by A and B. Each market segment is characterized by a Von Stackelberg price setting duopoly in which one firm (firm i) acts as a first mover while the other firm (firm j) acts second. A typical demand function for differentiated products -e.g. products differing in their brand names - was defined for each market segment (Callahan and Gabriel, 1998):

$$Q_{is} = u_s - v_s P_{is} + w_s P_{js}, \qquad s = A, B \quad (1)$$

where Q_{is} is the quantity demanded by the first mover in market segment s, and P_{is} and P_{js} are the price charged by respectively the first and the second mover in market segment s. Parameter u_s (>0) represents the demand at zero prices. Parameters v_s is set higher than w_s ($v_s > w_s$; v_s, $w_s > 0$) in order to make the firm's own price effect more dominant than the competitor's cross-price demand effect. These parameters are displayed in table 1.

The actual cost function for each firm is defined as a second degree of output and is given by formula (2). Both the first and the second mover face the same cost function. It is important to note that parameters are chosen in such a way 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 cost increase with larger amounts as output increases (parameters y en z).

$$C(Q_{is}) = f_s + y_s Q_{is} + Z_s Q_{is}^2 \qquad s = A, B \quad (2)$$

Table 1: Parameters for the demand and cost functions in each market segment

Demand	Segment A	Segment B	Cost	Segment A	Segment B
u	5500	2325	f	1750000	700000
v	3.0	1.25	y	220	195
w	1.05	0.3	z	0.25	0.14

The subject's task was to maximize profits by differentiating prices across the two market segments given the price choices of the other firm. In fact the profit function of each firm can be written in terms of the decision variable price:

$$\pi_{is} = P_{is} (u_s - v_s P_{is} + w_s P_{js}) - y_s(u_s - v_s P_{is} + w_s P_{js}) - z_s(u_s - v_s P_{is} + w_s P_{js})^2 - f_s \qquad s = A, B \quad (3)$$

Since our primary focus is on cost, parameters were set such that in order to increase profits, market A required much higher prices then market B, because A was compared to B more costly. Because we want to investigate how different levels of cost accuracy affect pricing decisions, the participants were not given the actual cost but received imperfect cost reports in which we manipulated the degree of cost (in)accuracy. Besides cost information, subjects were also informed of the price choices of their competitor and his realized profit. Since both firms face similar market conditions, this source of feedback can also be used in the price setting process (Frederickson, 1992).

In each period of the game the following sequence of events took place. All subjects received an initial imperfect cost report and a report showing the price choices of their competitor and his realized profit in the previous period. Starting prices for the first period were set by the experimenter. In the first stage the leader (firm i) chose prices for market A and B. In the following stage, the second mover (firm j) was able to observe the price choices of the first mover, after which he determined his own price choices for market A and B. In the final stage, both markets cleared and firms received outcome feedback, an updated imperfect cost report and an updated report on the price choices of the competitor and his total profit. This cycle of events was repeated over 10 trials.

3.2. Experimental factors

The experiment was run as a 2 x 2 x 2 between-subjects design. The first factor was the **'role'** subjects played in the duopoly. They were assigned either the role of first mover (leader) or the role of second mover (follower). In order to induce barometric price leadership (Scherer, 1980), the first mover was described to both players as a firm which sets prices first due to fact that it has built up a strong reputation and brand name in the past. The second mover was described as a firm that recognizes this leadership and therefore moves second after the first mover has announced his price choice.

The second factor was the **'own cost information'**. After the new price choices were determined, participants were issued an imperfect cost report as shown in appendix A. Subjects either received a traditional cost report or a more accurate ABC report. In the traditional cost report, typical marketing costs were assigned to each market segment using sales volume as a driver. This driver was unable to capture the differences in actual cost to serve each market segment (Selnes, 1992), resulting in a highly biased cost picture at the market segment level (see appendix A). In an ABC report marketing costs were assigned using a two-step procedure (Kaplan and Atkinson, 1998). In the first step marketing costs were assigned to three marketing activities. In the second stage, ABC allocated the cost of each activity across market segments using their respective activity drivers (number of orders, software licenses, and deliveries). Market A required a lot more of these activity drivers compared to market B, rendering it per unit more costly to serve. Appendix A shows that ABC revealed unit cost figures that were a fairly close approximation of actual cost-to-serve differences among market segments[1].

'Competitor feedback' was manipulated as a third factor. Since subjects played against each other, each participant in the experiment could either receive feedback from a competitor having access to more accurate cost information (ABC), or a competitor using traditional cost reports. Neither participant did in fact know which cost system their opponent received, and they were not made aware that differences in

[1] ABC is still an imperfect 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.

the cost report systems might have existed. After each decision they only received the competitor's price choices for market A and B and his corresponding realized overall profit.

The design created four types of experimental duopolies that each had a different information structure (see table 2; with the number of participants in each cell between brackets). The duopolies of type 1 and type 4 had a symmetric information structure since both first mover (leader) and second mover (follower) received either a traditional cost report (TRAD) or a more accurate activity based costing report (ABC). The duopolies of type 2 and 3 are characterized by an asymmetric information structure since either only the follower, or only the leader had access to the more accurate cost information.

Table 2: the four different types of duopolies and their information structure

	Type 1	**Type 2**	**Type 3**	**Type 4**
First Mover (leader)	TRAD (14)	TRAD (14)	ABC (15)	ABC (15)
Second Mover (follower)	TRAD (14)	ABC (14)	TRAD (15)	ABC (15)

3.3. Experimental procedures

Participants were recruited from management accounting courses at a large West-European university. They were all graduate students - on average 23 years old - with a university degree, completing Master programs in Accountancy, Insurance, Applied Economics or Industrial Management. The accounting courses had dealt with ABM issues such as applying ABC for customer profitability analysis and price differentiation among customers and market segments. A total of 116 students –were randomly assigned to one of the eight experimental cells. They completed the task on a computer. Each session lasted about 1,5 hours. To induce motivation, subjects were notified in advance that the best eight players - with the highest profit realized over all trials - would receive a 20 € gift coupon[2] exchangeable against books or CD's.

[2] In reality we rewarded the best player in each of the six experimental cells with a coupon. Average profit was taken as a reward, in order to restrict people from taking risky decisions for one of the trials. McIntyre & Ryans (1983) use a similar compensation scheme.

Before starting the experimental task, participants saw information concerning the target company and their task on the computer screen. The target company was described as an importer of portable computers of a particular brand, which distributed its PCs in two market segments. In order to induce prior cost knowledge, participants were explicitly told that both markets had different cost structures due to the fact that customers in market A were more demanding with respect to orders, deliveries and software requirements. Subjects were told that they would play against a competing distributor of a different brand, operating in the same two markets and facing similar cost structures. The firm that moved first (leader) was described as a leading distributor of PCs with a strong brand name and reputation. The second mover was described as a firm that recognized this leadership and only acted when the leader had announced his price choices.

Subjects were instructed to maximize profits by determining new selling prices for PCs within each market segment. The task was performed over ten periods. A price bracket[3] between €1200 and € 2100 was established. To provide ample opportunity to improve, the starting prices were set such that they were not in line with the cost-of-serving (the price for market A was lower price than for market B while market A was in fact more costly)[4]. After each period, an updated cost report and a report on the competitor's price choices and realized profits were issued to the participants. Throughout the experiment the subject's price choices and total profits for the last five trials, together with those of the competitor, remained on the screen. After the last trial, the task automatically finished. An exit questionnaire assessed the subjects' task motivation[5]. They were all highly motivated (average: 4.29 on a 5-point scale) and, importantly, no motivational differences were detected with respect to the role ($F_{(1,108)}$: 0.16; p>.68) the own cost information ($F_{(1,108)}$: 2.02; p>.15) or the competitor's cost information ($F_{(1,108)}$: 0.18; p>.67), nor with respect to any of the interactions among these factors (all p's > .16).

[3] This was done in order to ensure that quantities demanded remained positive at all times, given the competitor's price choice.

[4] In each duopoly the first mover initial price choices were PA= 1650 and PB = 1710 while for the second mover the starting prices were PA = 1645 and PB = 1706.

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

4. Results

4.1. The effect on individual 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 TRAD). On the other hand, they might have considered the price choices and the realized performance of their competitor, who in turn used a particular cost report (ABC or TRAD). Therefore we consider the factors 'own costing system' (OS), 'competitor feedback' (CF), and their interaction as potential explanatory variables for decision performance. In addition, participants were expected to improve performance as they gained experience in the task (Gupta & King, 1997). Hence, cumulative experience -reflected by the trial number T - was included as a control variable. Since we expected differential effects of these feedback conditions according the role participants performed in the duopoly, the influence on decision performance was analyzed separately for leaders and followers in the experiment.

Several metrics of decision performance were tested. We first tested a model with the total realized profit score (absolute profit) as a dependent variable. Secondly, for each trial we checked how close participants were to the optimal performance level, given the price choices of their opponent. Besides the percentage deviation from optimal profit (%dev.profit) we also considered the deviation from optimal price levels (%dev.price)[6] as a possible dependent variable.

Three regression models were tested for leaders (role=0) and followers (role=1) separately. Because of evidence of higher order serial correlation, parameters of the models were estimated using the Yule-Walker method that corrects for serial order correlation in the data. Table 3 displays the summary statistics while Table 4 shows the corresponding regression results for the different roles:

[6] For each trial t and each participant i we derived the optimal profit and price levels that could be achieved given the other participants (competitor) price choice for that trial; %dev.profit = $(\pi_{it}^{*}-\pi_{it})/\pi_{it}^{*}$ where π_{it}^{*} the optimal profit and π_{it} the profit actually realized by the participant i in trial t; %dev.price = $(Pa_{it}^{*}-Pa_{it})/Pa_{it} + (Pb_{it}^{*}-Pb_{it})/Pb_{it}$ where Pa_{it}^{*} and pb_{it}^{*} the optimal price in market A and B and Pa_{it} and Pb_{it} the actual prices charged in both markets for participant i in trial t.

Model 1: Absolute $profit_{it}$ = b0 + b1 OS + b2 CF + b3 OS*CF + b4 T

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

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

with absolute $profit_{it}$, % $dev.profit_{it}$ and % $dev.price_{it}$, the metrics for 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.

Table 3: Average statistics over the ten trials for each test metric[a]

	Type 1 L: TRAD [F: TRAD]	**Type 2** L: TRAD [F: ABC]	**Type 3** L: ABC [F: TRAD]	**Type 4** L: ABC [F: ABC]
Absolute profit	556751 [533192]	570875 [620027]	647018 [649401]	623186 [655129]
%dev.profit	30.41% [33.37%]	27.43% [22.31%]	18.94% [20.01%]	18.09% [16.83%]
%dev.price	29.57% [30.35%]	27.64% [23.25%]	21.72% [22.34%]	18.13% [17.10%]
trial/subject obs.(n)	140 [140]	140 [140]	150 [150]	150 [150]

[a] Cells contain the means for the leader, [means for the follower], over the 10 trials

In panel A of table 4 one can observe the regression results for the participants acting as **leaders**. Since trial T was significant in all models we can conclude that leaders improved as experience is gained in the task (Gupta and King, 1997). More interesting are the effects for the different feedback conditions. In all three models only the participant's own cost system (OS) was significant. This indicates that cost accuracy was always important for the leader, irrespective of the feedback received from the other market player. As predicted in H1, leaders had a tendency to base their decisions on their own cost system. When comparing the means in Table 3 for participants in the leadership role, one can observe that leaders mainly improved when they themselves have ABC. Contrary to the findings in other studies (Briers et al., 1999; Vives, 1990; Waller et al. 1999) they learned little from a better informed competitor with superior performance when they receive more biased cost data (compare type 2 with type 1).

Table 4: regression results for the three different models (using Yule-Walker method)

Panel A: Parameter estimates and significance levels for the '**leader**' role on the three dependent variables

	Dependent variables		
Estimate	absolute profits	%dev.profit	%dev.price
Intercept	508239***	0.3735***	0.3433***
Own system (OS)	91532***	-0.1143***	-0.0782***
Competitor feedback (CF)	9815	-0.0302	-0.0180
OS*CF	-34442	0.0164	-0.0238
TRIAL (T)	8925***	-0.0123***	-0.0083***
R-square	0.3873***	0.4013***	0.6073***

Panel B: Parameter estimates and significance levels for the '**follower**' role on the three dependent variables

	Dependent variables		
Estimate	absolute profits	%dev.profit	%dev.price
Intercept	478034***	0.4067***	0.3580***
Own system (OS)	95491***	-0.1238***	-0.0846***
Competitor feedback (CF)	112670***	-0.1295***	-0.0784***
OS*CF	-86340**	0.0850**	0.0303
TRIAL (T)	9835***	-0.0127***	-0.0092***
R-square	0.4968***	0.4694***	0.6414***

Significance: * p<.10 level; ** p <.05 level; *** p < .01 level

Panel B of Table 4 displays the results for the **follower's** 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 indicates that the follower's own cost system became redundant when feedback was received from a competitor using accurate cost data but not when this competitor used biased cost data. This finding supports our H2. When comparing the means for both profit metrics, Table 3 reveals that followers were able to learn from their better-informed leaders when they received biased cost data (type 3). They actually performed as good as if they would had received ABC (type 4). However, when the competitor received inferior cost data, cost system choice matters. These followers improved when more accurate cost data was provided (compare type 1 vs. type 2).

For the model with deviation from optimal prices we did not find a significant interaction term between the feedback conditions. Apparently, the value of ABC for price setting is not completely redundant when there is an opportunity to learn from price choices of better-informed rivals. However, this observed price effect did not result into significant profit effects.

4.2. The effect on relative performance

In this section we report analyses on two metrics assessing the relative performance of each player compared to his opponent. Besides the difference in absolute profits between followers and their leaders, we also report the total market share[7] of the follower. When the difference in absolute profits is different from zero or the follower's market share is different from 50%, we can argue that one player was able to outperform the other.

In Panel A of table 5 these metrics are reported for each duopoly type. We first compare settings in which one party has access to more accurate cost data, while the other party has not (Type 2 and 3 duopolies). In a type 2 duopoly, one can observe that not only the difference in profits between a follower and a leader is significantly higher than zero, but that also the follower's market share is significantly higher than 50%. Followers with more accurate costing data than their leaders, did outperform those leaders. On the other hand, when leaders had a costing system advantage (a type 3 duopoly), they were not able to outperform their less-informed rivals. The profit difference was not different from zero, nor did the market share differ from a fifty-fifty division. These results support our H3: only followers can outperform their less-informed counterparts, while leaders can not. Leaders appear less sensitive than followers of the fact that they received more biased cost data than their opponent, and therefore longer rely on them, which provides the opportunity for the better-informed follower to take advantage of the leader (Bloomfield et al., 1999).

As a side note, it is interesting to observe that followers were also able to gain higher profits when both players receive ABC (see duopoly of type 4). Gal'Or (1985) indeed

[7] The market share of the follower is equal to the profit of the follower divided by the total market profit (=profit follower + profit leader)

showed that in a scenario of rational competitors, second movers (followers) earned higher profits then their first mover counterparts. A plausible explanation for this result is that rational play becomes more likely as both players have access to accurate cost data.

Table 5: Summary of mean observations for each **duopoly type** (n=58)

Panel A: Summary statistics for the outperforming metrics

	Type 1 L: TRAD F: TRAD	**Type 2** L: TRAD F: ABC	**Type 3** L: ABC F: TRAD	**Type 4** L: ABC F: ABC
Mean (profit F- profit L)	-23559	49152[a]	2383	31943[a]
Mean market share F	49.00%	51.99%[b]	50.17%	51.20%[b]
Number of duopolies	14	14	15	15

[a] Significantly different from zero at the 5% level
[b] Significantly different from 0.5 at the 5% level

Panel B: Anova results for duopoly type and estimates for the different contrasts codes and their significance levels

	(profit F- profit L)	market share F
Source of variation	F-value	F-value
Duopoly type	3.93 **	3.41 **
Contrasting effects[c]	Estimate	Estimate
Type 1 vs. 2 {-1 1 0 0}	72711 ***	0.0299 ***
Type 2 vs. 3 {0 -1 1 0}	-46768 **	-0.0183 **
Type 3 vs. 4 {0 0 -1 1}	29560 *	0.0104
Interaction 12 vs. 34 {1 -1 -1 1}	43151 *	0.0195 *

[c] Contrast codes can be found between brackets. Reported significance levels are based on a one sample t-test

Significance: * p<.10 level; ** p <.05 level; *** p < .01 level

In panel B of table 5, relative performance is compared among the four duopoly types. The duopoly type significantly explains the variance in both relative performance metrics. More interesting however are the contrast effects. First of all H3 is again confirmed, since the contrast effect comparing the two asymmetric duopolies (Type 2 vs. 3) is significant. A less-informed follower learns from a better-informed leader and performs as good as the leader (Type 3). On the other hand followers outperformed their rivals, when they receive the superior cost data (Type 2).

In addition we also found additional support for the fact that more accurate cost became more redundant for followers when leaders were better informed (H2). When we compare the duopolies where the leader received biased cost information (type 1 vs. 2) we can observe that cost system accuracy is highly important for followers. Followers significantly increased the profit difference against their leader by 72711 and significantly improved their market share by 2.99% when ABC is received. When the leader had access to ABC (type 3 vs. 4), more accurate cost data was less important for followers since the gain in market share of 1.04% was not significant and the gain in profit performance against the leader of 29560 was only marginally significant. The interaction effects of 43151 (which is the difference between 72711 and 29560) for the profit difference and of 1.95% (=2.99%-1.04%) for the market share were significant at the 10% level. This seems to indicate that ABC is more (less) redundant for followers in terms of outperforming when leaders receive accurate (less accurate) cost data, thereby reinforcing H2.

4.3. Additional analyses

Our results indicated that leaders have a strong tendency to rely on their own costing system. Even when their own costing system produced biased cost data, participants acting as leaders did not learn from better informed rivals. These results suggest that leaders neglect the information received from other market players. In the exit questionnaire several items checked whether participants in the leadership role where indeed more prone to the phenomenon of 'reference group neglect' (Camerer and Lovallo, 1999). Compared to followers, leaders found the price choices of the competitor less important ($F_{(1,108)}$: 24.45; $p<.01$) and took to a lesser extent these price choices into account ($F_{(1,108)}$: 20.83; $p<.01$). Moreover, when evaluating the two 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 apparently attached a stronger value to their own actions since they consider their own realized profit performance more important for improving their price choices ($F_{(1, 108)}$: 3.09 $p<.09$).

From these additional analyses, one can conclude that participants assigned to the leadership role were indeed more inclined to neglect the feedback received from other

market players and mainly focus on the cost system. Followers however weighed this feedback against their own cost data. Cost system choice mattered less for profit improvement when they received feedback from a leader receiving ABC, while good cost system choice became more valuable for enhancing performance when their rival received biased cost data (see also section 4.1 and 4.2).

5. Discussion

This study provides experimental evidence concerning the value of ABC in more competitive environments. Prior experimental and theoretical work assumed ABC to be highly redundant in a competitive environment, because decision makers tend incorporate informative feedback on other market players into their decisions. In a more adaptive competitive duopoly in which one player decides first, our results show that the learning from more informative market signals is less effective when one has to act first as a market leader. Participants in a leadership role exhibited a bias labeled "reference group neglect" which renders them more ignorant about feedback received from the competitor (Camerer and Lovallo, 1999). Leaders do not learn from superior competitors having access to accurate cost data when their own system produces biased cost figures. Since they prefer these biased cost figures for price setting over informative market feedback, they are outperformed by followers having access to more accurate cost data. In order to improve profits participants acting as leaders in a competitive setting have considerable interest in refining the accuracy of their cost report. On the other hand, followers better weigh the feedback of other market players against their own cost signals. When feedback is received from superior players with accurate cost data, followers utilize this feedback and cost system choice is less important. For followers cost accuracy does matter, however, when their rivals base their decisions on distorted cost figures.

It is important to note that in our experiment, leadership was induced by merely describing a 'barometric' leadership role to participants. Leadership was not related to advantages in the cost structure for one firm since both firms faced similar cost. Due to the mere feeling of leadership reputation, participants acting as leaders relied heavily on their own (distorted) cost information for price setting and were more likely to neglect more informative market signals. Apparently the neglecting of

competitors, which was more explicitly induced in prior research on market entry decisions (Camerer and Lovallo, 1999), also occurs spontaneously in more natural leader-follower price setting scenario's. Further research is however needed to advance our understanding under which circumstances underutilization of such informative market feedback is more likely to occur.

Our experiment investigated the dynamic interplay of cost information and market feedback in a competitive price setting duopoly consisting of two market players. The question whether market leaders would continue to ignore informative market signals - and at the same time attach high value to their own cost system- when the nature of competition changes would be a fascinating area for future research. In extreme forms of competition where price choices of superior competitors would result in large losses for the less informed firm, it would be harder to avoid using feedback from superior market players. Altering the competition by changing the numbers of competitors (Krishnan, Luft and Shields, 2002) may also have an influence on value attached to accounting data with respect to other types of feedback.

However, market feedback is not the only source of feedback managers receive in addition to cost information (Bruns and McKinnon, 1993, Malmi, 1997). They may hold and use firmly entrenched prior theories on customers and appropriate strategies, confirmed by casual observation of competitors and customers, and potentially strengthened by contacts with other managers holding similar views. It is important to also ask ourselves whether these additional potential inputs in managerial decision making are always appropriately weighted against objective costing data. Strong priors may lead to overconfidence in opinions, insensitivity to external information, insufficient search for the information most relevant to the decision, and rigidity in strategic action (Alba and Hutchinson, 2000). As managers often indicate to be satisfied with and to be confident about the cost figures their existing cost systems produce (Innes and Mitchell, 1995), they may not consider alternative sources of feedback even if their accounting data are highly biased.

As our data suggest, ABC does not always result in a competitive advantage for price setting. Followers quickly learned to mirror the superior price choices of the better-informed market leader when they themselves received biased cost data which made it

difficult for the leader to gain a significant profit benefit. However in competitive duopoly markets there are many other strategic considerations in which the accuracy of cost information is important. The success of cost reduction initiatives such as changing the business process or the product-mix may vary with the quality of cost accounting data. The strategic changes in the way of doing business that firms can derive from the activity information in an ABC report could result in significant cost advantages, which may strongly strengthen the firm's market position. However, managers should always outweigh any benefit derived from accurate cost systems against potential implementation costs. Follow-up experiments could discover in which circumstances managers are more inclined to invest in costly cost system refinement to improve or assist their managerial decision making. In order to further understand the value of cost accuracy in competitive markets, it is important that these future experiments maintain a focus on adaptive play and learning.

APPENDIX A

This appendix shows how total **actual** costs incurred are allocated to the two market segments using ABC or traditional 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 where € 1650 for market A and € 1710 for market B, while the follower responded with € 1645 for segment A and € 1706 for segment B. These 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. While subjects also receive limited competitor feedback as displayed in the right hand sight of table A1, they do not receive the actual cost figures. Instead imperfect cost reports are issued (see table A2 and A3).

Table A1: Actual results for the leader and the feedback received from the competitor

Actual results for the leader

	segment A	**margin**	**segment B**	**margin**	**Total**	**margin**
Price	1650		1710			
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**			

Feedback competitor

Price market A	1645
Price market B	1706
Total profit	500639

We assume that part of the 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:

$$\text{Cost of goods sold (COS)} = 630 * Qa + 710 * Qb$$
$$= 630 * 2277.25 + 710 * 699.3 = 1931171$$

The remaining part of total actual cost incurred (4452289 – 1931171 = 2521118), defined here as customer costs, 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, costs are spread over three cost-to-serve 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 cost report. Market A incurs per unit more cost since it requires more activities (more orders, deliveries and custom design) than market B. This corresponds with actual cost data where market A is also shown as more costly (see table A1).

Table A2: Underlying assumptions in the ABC condition and the ABC report

Panel A: assumptions of the ABC system

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.

	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	2177171	57.9%	343947	28.8%	2521118	50.9%
	Drivervol.	Cost	Drivervol.	Cost	Drivervol.	Cost
Order Processing	771790	20.5%	110601	9.2%	882391	17.8%
Software installation	869189	23.1%	139258	11.6%	1008447	20.4%
Delivery	536191	14.3%	94088	7.9%	630279	12.7%
Profits	145624	3.9%	355353	29.7%	500977	10.1%
Unit Costs	1586.1		1201.8			

Under traditional volume based costing (Table A3), customer costs are allocated to the two market segments using sales volume as a driver. Since this driver is unable to differentiate between the cost of servicing the two market segments, subjects receive a highly biased cost picture on market segment level compared to actual cost. Market B is shown to be more costly then market A while in fact it incurs per unit less cost.

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			

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