Vlerick Leuven Gent Management School
the Autonomous Management School
of Ghent University and Katholieke Universiteit Leuven

Vlerick Leuven Gent Working Paper Series 2011/12

COST INFORMATION ALTERS "COMPETITIVE" PRICING: AN EXPERIMENTAL INVESTIGATION ABOUT THE ROLE OF DISPERSION OF ACCURATE COST INFORMATION

BART DIERYNCK

FILIP ROODHOOFT

Filip.Roodhooft@vlerick.com

D/2011/6482/12

COST INFORMATION ALTERS "COMPETITIVE" PRICING: AN EXPERIMENTAL INVESTIGATION ABOUT THE ROLE OF DISPERSION OF ACCURATE COST INFORMATION

BART DIERYNCK

KU Leuven

FILIP ROODHOOFT

Vlerick Leuven Gent Management School

This study has benefited from the helpful comments from Jan Bouwens, Eddy Cardinaels, Bryan Church, Harry Evans, Jeffrey Hales, Gary Hecht, Jason Kuang, Eva Labro, Bill Lanen, Donald Moser, Nandu Nagarajan, David Smith, Jeroen Suijs, William Tayler, Kristy Towry, Alexandra Van den Abbeele, Wim Van der Stede, Shankar Venkataraman, Luk Warlop, and Gregory Waymire. We also thank workshop participants at Emory University, Erasmus University Rotterdam, Georgia Institute of Technology, Katholieke Universiteit Leuven, Lille University, University of Pittsburgh, Tilburg University, and conference participants at the 2010 New Directions Conference in Management Accounting and the 2011 Management Accounting Section Midyear Meeting.
Barrt Dierynck: Accounting, Finance and Insurance, Katholieke Universiteit Leuven. Naamsestraat 69, B-3000 Leuven, Belgium. E-mail: bart.dierynck@econ.kuleuven.be. Bart Dierynck gratefully acknowledges financial support from the Research Foundation Flanders (FWO) and from the Limperg Institute.
Filip Roodhooft: Accounting, Finance and Insurance, Katholieke Universiteit Leuven and Accounting & Finance, Vlerick Leuven Gent Management School. Naamsestraat 69, B-3000 Leuven, Belgium. E-mail: filip.roodhooft@econ.kuleuven.be

Contact:

Filip Roodhooft

Vlerick Leuven Gent Management School

Phone: ++32 16 24 88 36

Fax: ++32 16 24 88 00

E-mail: Filip.Roodhooft@vlerick.com

ABSTRACT

This study investigates the role of internal cost information for initiating and sustaining tacit collusion. Relying on the importance of cost information for setting prices, we predict that internal cost information serves as a focal point for price setting. Relying on the importance of common focal points for initiating and sustaining tacit collusion, we expect that the role of collusion-facilitating factors such as increased monitoring and common market history is moderated by the dispersion of accurate cost information in the market. Specifically, we expect that the influence of collusion-facilitating factors on firm profits will be higher if all firms in a market rely on accurate cost information (i.e. full dispersion) compared to the situation in which not all firms in the market rely on accurate cost information (i.e. partial dispersion). The results of an experiment in a differentiated price setting duopoly are consistent with our hypotheses. By illuminating the role of cost information for initiating and sustaining tacit collusion, this study emphasizes the importance of accurate cost information and common internal focal points for price coordination. Our results can also explain the inconsistent findings about the influence of competition on the accuracy of the cost system and have interesting implications for the design of competition policy.

I. INTRODUCTION

The study of how different entities coordinate their actions has a long history in economics and reveals that individuals' actions are better coordinated than traditional economic theory predicts (Crawford 2004; Fudenberg and Tirole 1991; Harsanyi and Selten 1988; Mehta et al. 1994a; Kreps 1990; Schelling 1960). The presence of focal points is often put forward to explain the gap between the predicted level of coordination and the observed level of coordination (Abbink and Brandts 2008; Bacharach and Bernasconi 1997; Bardsley et al. 2009; Mehta et al. 1994b; Sugden 1995). Though focal points can increase the efficiency of human interactions and social welfare, focal points also provide fertile ground for improving coordination that harms social welfare. Scherer (1970), for instance, suggests that tacit collusion, which can be described as the coordination of prices at a higher level than the unit cost, can be facilitated if focal points are present. Using empirical data from the credit card market in the 1980's, Knittel and Stango (2003) provides evidence for Scherer's assertion by showing that tacit collusion is much more likely in the presence of a non-binding price ceiling, which serves as an external focal point. The objective of this study is to investigate whether cost information is used as an internal focal point for price-setting, and to investigate how the dispersion of accurate cost information in a market influences the effect of well-known collusion-facilitating factors.

Pricing decisions are a cornerstone of running a profitable business and have been extensively studied in various research disciplines. Although researchers have developed various models to set optimal prices, empirical evidence shows that decision-makers have a tendency to rely on a particular focal point for setting their prices (Abbink and Brandts 2008). It has further been documented that this focal point is often a price that minimizes the risk of a loss, irrespective of the pricing decisions of competitors (Cachon and Camerer 1996). Another important observation is that pricing decisions stand in stark contrast to the unambiguous economic prescription that only marginal cost is relevant for profit-maximizing pricing decisions (Kreps 1990). Specifically, surveys of pricing practices show that most firms price their products based on the output of their cost accounting system (Foster and Gupta 1994; Govindarajan and Anthony 1983; Guilding et al. 2005). Importantly, the bias to rely on full-cost information is also observed when decision-makers know that the information is less accurate and competitive market pressures do not eradicate this bias (Cardinaels et al. 2004; 2008). In summary, the general tendency to focus on particular focal points for pricing decisions instigates decision-makers to overly rely on the output of the cost accounting system. Thus, our first hypothesis is that the output of the cost accounting system will be used as a focal point for setting prices.

The preference for higher profits has led many firms to coordinate their prices with their competitors. Evidence for such tacit collusion, which boils down to a complex coordination game, has been found in a variety of industries such as the airline industry, banking, retailing, and the beer industry. Although tacit collusion is facilitated by factors such as monitoring possibilities and a common market history, common focal points for setting prices strongly increase the odds of successful tacit collusion (Knittel and Stango 2003; Levenstein and Suslow 2006). The reliance on the output of the cost accounting system, however, presents a serious challenge for tacit collusion. As cost accounting systems vary in the degree of accuracy with respect to the estimation of the unit cost, firms with the same underlying cost structure but with different cost accounting systems will rely on different focal points for setting their prices (Kaplan and Cooper 1998). Relying on the importance of common focal points for collusive price-setting, we predict that the influence of collusion-facilitating factors such as increased monitoring and a common market history will be lower when competitors rely on cost information that differs in accuracy then when all competitors rely on accurate cost information.

To test our predictions, we conduct an experiment in which participants act as a duopolist and have to set prices in two markets over 12 rounds. The two markets differ in the amount of overhead costs that they consume so that the variations in the accuracy of the cost accounting system lead to different unit costs (Cardinaels et al. 2008). The ease of cooperation between competitors, which refers to the presence or absence of collusion-facilitating factors, is manipulated by varying the degree to which competitors can monitor each other's actions and by varying the common market history of the duopolists (Levenstein and Suslow 2006; Stigler 1964). Dispersion of accurate cost information is manipulated by giving only one competitor accurate cost information (i.e. partial dispersion) or by giving both competitors accurate cost information (i.e. full dispersion).

The results of our experiment are twofold. First, we show that the unit costs as calculated by the cost accounting system serve as a focal point for price-setting. Second, and more importantly, we provide evidence for our hypothesis that the effect of the ease of cooperation on firm profits is moderated by the dispersion of accurate cost information in the market. Specifically, firm profits are significantly higher if ease of cooperation is high than if ease of cooperation is low if both competitors rely on accurate cost information and thus have the same focal point. However, if only one competitor has accurate cost information, profits do not differ between high and low ease of cooperation.

Anecdotal and survey evidence show that the output of the cost accounting system serves as an important focal point for price-setting. Although common focal points are a crucial determinant for successful tacit collusion, the influence of variation in the accuracy of the cost accounting system

on cooperative price-setting has not yet been contemplated. Our contribution is to show that this unique characteristic of accounting information leads to results that differ from those one should expect when only considering the variation in collusion-facilitating factors. Thus, accounting information does not only shape pricing decisions but also has the potential to alter market interactions. Our study is also the first to shed insights into the role of internal focal points for initiating and sustaining tacit collusion.

Our study also has implications for regulators as we show that regulating that firms should collect accurate cost information, which often happens in public utilities industries, can instigate (tacit) collusion rather than limit such behavior. As collusion is hampered by the presence of different focal points, it seems better to delegate the decision about the cost accounting system to the firms and to turn to other measures to avoid tacit collusion such increasing the number of competitors by stimulating entry. Delegating the decision about the cost accounting system to the firms can also help regulators to detect (tacit) collusion as one may expect that colluding firms invest in well-developed costing systems.

Finally, our study also questions the common argument that a higher degree of competition will lead to investment in more accurate cost accounting systems (Hansen 1998). Although the positive relationship between competition and investments in better accounting systems seems to be widely accepted, previous studies provide highly inconsistent results (Libby and Waterhouse 1996; Williams and Seaman 2001). Our results may offer a lens through which to interpret this inconsistency as we show that investments in better cost accounting systems are also useful for collusive price-setting.

II. BACKGROUND LITERATURE AND HYPOTHESIS DEVELOPMENT

2.1 Focal Points, Coordination and Tacit Collusion

Traditional game theory assumes that the solution of a game is independent of how strategies are labeled for the players. Thus, focal points, which can be described as a strategy that is more prominent, conspicuous, or salient than others, are treated as "strategically irrelevant" and are not analyzed explicitly (Harsanyi and Selten 1988).[1] However, numerous studies show that focal points help people to better coordinate their actions than traditional game theory predicts (Bardsley et al. 2009; Mehta et al. 1994a, 1994b; Schelling 1960; Sugden 1995). Schelling's (1960) study was one of the first and most famous to demonstrate the importance of focal points for coordinating actions. In that study, participants were asked to choose some place in New York, to which to go in the hope of meeting the other. Any place is as good as any other, provided both choose it. Given that the game possesses an infinite number of equilibrium location-pairs, we might expect the odds of successful coordination to be quite low. Nonetheless, the majority of the participants choose the same place (i.e. Grand Central Station) and the degree of coordination was much higher than conventional game theory predicts. In this problem, Grand Central Station is a focal point as this place is more salient than a lot of other places.

The impact of focal points on coordinating actions cannot be neglected and has already been incorporated in analytical models of equilibrium selection (see for instance Bacharach and Bernasconi 1997; Sugden 1995). However, while focal points improve coordination and can increase social welfare, focal points can also facilitate collusion and harm social welfare (Scherer 1970). Using data from the US-credit card market during the 1980's, Knittel and Stango (2003) shows that nonbinding price ceilings, which serve as external focal points, increase the probability that firms engage in tacit collusion. This study extends the work of Knittel and Stango (2003) by proposing that cost information, which is internal to the firm, serves as a focal point for price setting and that dispersion of various types of cost information among competitors will influence the effect of collusion-facilitating factors.

[1] In the normal form of a pure coordination game, the n strategies of each player are symmetrical with one another; correspondingly, there are n symmetrical Pareto-efficient pure-strategy Nash equilibria. In traditional game theory, each Nash equilibrium is treated as a candidate 'solution' which implies that the pure-strategy equilibria cannot be distinguished from one another.

2.2 Accounting Information for Price Setting

Despite the unambiguous economic prediction that the profit-maximizing price is equal to the marginal cost, surveys find that most firms price their products based on full-cost-based methodologies (Govindarajan and Anthony 1983; Guilding et al. 2005; Maher et al. 2004). The main reasons for the reliance on the output of cost accounting system for pricing decisions are the simplicity of such pricing decisions and the high cost of collecting information about marginal costs.[2] While some studies have found that pricing errors related to the use of full-cost methodologies disappear through characteristics of competitive markets such as market feedback (Kachelmeier 1996; Waller et al. 1999) or the presence of better-informed competitors (Briers et al. 1999), recent analytical and experimental studies report that the reverse is true. Al-Najjar et al. (2008), for instance, shows that price competition with product differentiation reinforces managers' predisposition to rely on full-cost-based methodologies. In an experimental study, Cardinaels et al. (2008) shows that the persistence of pricing errors in price competition with product differentiation depends on whether the leader or the follower is the better-informed player. Taken together, although reliance on cost information is not consistent with prescriptions from economic theory, full-cost pricing is a persistent observation and researchers need to investigate how this changes market interactions.

An important characteristic of cost accounting systems is that the allocation of the costs to the cost object can be done in different ways which leads to different focal points for price-setting. Practitioners and researchers often make a distinction between methodologies that allocate costs based on volume-related drivers (i.e.volume-based costing) and methodologies that allocate costs based on the activities that are consumed by the cost objects (i.e. activity-based costing) (Kaplan and Cooper 1998). In general, volume-based costing methods are less accurate than activity-based costing methods in a sense that the use of volume-based costing methods leads to overcosting of high-volume products (i.e. standardized products) and undercosting of low-volume products (i.e. customized products).

[2] We agree that the cost-argument is also valid for the use of full-cost pricing methodologies as the development of accurate cost accounting systems such as Activity Based Costing systems causes a lot of monetary and non-monetary costs.

Price-setters have a tendency to focus on certain prices (i.e. focalism) and the chosen focal price can often be explained by loss aversion (Tversky and Kahneman 1991). In the experiment of Abbink and Brandts (2008), for instance, competitors often choose a price that will never lead to a loss, irrespective of the competitors' prices. A similar reasoning holds when price-setters rely on accounting information for setting prices. Cardinaels et al. (2004), for instance, shows that price-setters do not set prices lower than the less accurate unit cost despite the fact that market feedback informs them to do so. Although a price lower than the less accurate unit cost leads to an accounting loss rather than an economic loss, the combination of loss aversion and the tendency to rely on focal points for price-setting instigates them to focus too much on the output of less accurate cost accounting systems. Relying on the importance of focalism for setting prices, we hypothesize as follows:

H1: Cost information serves as a focal point for price setting.

2.3 Tacit Collusion and Dispersion of Cost Information

Previous studies have extensively reported about the determinants of tacit collusion or ease of cooperation between competitors. A first important determinant is the degree to which firms can monitor each other's behavior (Levenstein and Suslow 2006). Increased monitoring of the actions of the competitor(s) makes it easier to detect cheating and will weaken the incentive to cheat (Carpenter et al. 2009). As setting prices is the action in price-setting games, our experiment will manipulate ease of cooperation by varying price observability (unobservable versus observable prices). History of cooperation is another important determinant of the ease of cooperation (Levenstein and Suslow 2006). Initiating tacit collusion causes set-up costs and firms will only initiate tacit collusion if the future profits from (tacit) collusion are sufficiently high. Firms that have a common history have lower set-up costs and are more likely to cooperate than firms that do not have competed with each other in the same market. Varying the common history of both firms will be our second manipulation of the ease of cooperation. A general finding is that market profits and profits of individual competitors are higher when ease of cooperation is high compared to the situation when ease of cooperation is low. In the following paragraphs, we argue that this result depends on the dispersion of cost information within the market. [3]

[3] The implication for designing experiments in which subjects have to rely on (often) imperfect cost information for price-setting in competitive markets is that subjects do not have full information about the demand functions and the underlying

Cost information can differ in accuracy and coexistence of accurate and less accurate cost information in an economy is not unlikely as the decision to adopt accurate costing systems is driven by the firm-specific incentive and information environment. Mishra and Vaysman (2001), for instance, show analytically that not implementing an accurate costing system can be rational as managers can use the accurate information to advance their own interest at the disadvantage of the owner's interest. Decisions to invest in accurate cost information, on the other hand, are not always fully rational and are also driven by imitation and herding behavior (Malmi 1999). Thus, situations in which both competitors rely on the same accurate information (i.e. full dispersion of accurate cost information) and in which only one of the competitors relies on accurate cost information (i.e. partial dispersion of accurate cost information) are possible.

Competitors that both rely on accurate cost information have the same focal points. As previous studies show that common focal points improve coordination and tacit collusion, we expect that the ease of cooperation between competitors will influence profits as predicted by economic theory (Knittel and Stango 2003; Mishta et al. 1994). In other words, firms will obtain higher profits if they can easily cooperate with each other compared to the situation in which ease of cooperation is low. Firms that both rely on accurate cost information will thus charge higher prices if they can easily cooperate with each other. If ease of cooperation is low, on the other hand, the mutual reliance on accurate cost information can instigate a price war as both firms better know how much they can undercut each other's price in order to obtain a positive profit. Taken together, variations in the ease of cooperation lead to profit differences as predicted by economic theory (Tirole 1988).

If only one of both firms relies on accurate cost information (i.e. partial dispersion) while the other firm relies on less accurate cost information, focal points differ. When ease of cooperation is high, partial dispersion of accurate cost information hampers coordination on high prices as considered from the accurate unit cost. The lack of coordination and the distorted price-setting of the competitor that relies on less accurate cost information will reduce market profits and especially the profits of the better-informed competitor (Cardinaels et al. 2008). A price war in case of low ease of cooperation is also unlikely as the spiral in which competitors undercut each other's prices until the unit cost will stop at the point where the price equals the unit cost as reported by the less

---

cost structure of the firm. Indeed, in practice, managers especially obtain knowledge about their underlying cost structure by means of their (imperfect) cost information. In price competition experiments in the spirit of experimental economics, subjects are often fully informed as they are provided with a table showing profit as a function of their own price and the price(s) of their competitor(s). Such a table "summarizes" information about demand functions and cost structure. Subjects in such experiments are also asked to choose a price but they do not have to figure out which costs might be relevant for the pricing decision (see for instance Abbink and Brandts 2008; Selten and Apesteguia 2005). The consequence of the increased mundane realism in accounting experiments vis-à-vis experiments in the style of experimental economics is that comparisons with equilibrium concepts should be interpreted with care. Comparing differences in observed behavior under different conditions often leads to more meaningful conclusions.

accurate costing system.[4] Taken together, partial dispersion of accurate cost information weakens the profit-increasing effect of factors that facilitate tacit collusion and weakens the profit-decreasing effect of factors that stimulate severe price competition between competitors. Consequently, variation in ease of cooperation will lead to lower profit differences in case of partial dispersion of accurate cost information than in case of full dispersion of accurate cost information. This leads to our second hypothesis:

> **H2**: The effect of ease of cooperation on profits is moderated by the dispersion of accurate cost information.

Insert Figure 1 About Here

III. EXPERIMENTAL DESIGN

We use a 2 X 2 experimental design and vary the ease of cooperation (high versus low) and dispersion of accurate cost information (partial dispersion versus full dispersion) between subjects. 370 participants (185 dyads) compete in 12 rounds of pricing decisions for two product markets that have similar direct costs but very different overhead costs. We use a von Stackelberg model of price competition which implies that one participant (i.e. the leader) takes his price decisions before the other participant (i.e. the follower) (Cardinaels et al. 2008). It is important to mention that the timing of the decision-making is the only difference between leader and follower. Our experimental scenario does not attribute a higher degree of market power to the leader and participants are also informed that both leader and follower face the same cost structure. By using a sequential way of decision-making, we increase the (competitive as well as cooperative) interactions between participants while keeping the duration of the experiment limited. We kept pairs of players fixed to approximate the world outside the laboratory, where firms interact with the same firms for multiple periods.

[4] Note that this mechanism is only valid for the product market that is overcosted by the volume-based costing system (unit $cost_{VBC}$ > unit $cost_{ABC}$). In the product market that is undercosted by the volume-based costing system (unit $cost_{VBC}$ < unit $cost_{ABC}$), the better-informed competitor will not set lower prices than his unit cost. As a result, profits in this market will in the worst case be equal to the profits that are obtained in case of a price war. Remark that full dispersion of accurate information will lead to a price war in both markets if ease of cooperation is low.

3.1 Model of Price Competition

As the two product markets of our price competition model are similar with respect to direct costs but differ in the amount of overhead costs, participants can increase profits by setting different prices in market A and B. Total profits can thus be considered as a reflection of the participant's performance. Sales volume in both markets is represented by a differentiated demand function (equation 1a, 1b and 1c).[5] In such a demand function, sales volume is more influenced by the own price than by the competitor's price. The demand and cost functions are exactly the same as in Cardinaels et al. (2008) and are given below. The subscripts L and F refer to the leader and follower, respectively.

Sales Volume Market A	$Q_{a\,L\,(F)} = 5500 - 3.00\,P_{a\,L\,(F)} + 1.05\,P_{a\,F\,(L)}$	(1a)
Sales Volume Market B	$Q_{b\,L\,(F)} = 2325 - 1.25\,P_{b\,L\,(F)} + 0.30\,P_{b\,F\,(L)}$	(1b)
Total Sales Volume	$Q_{tot\,L\,(F)} = Q_{a\,L\,(F)} + Q_{b\,L\,(F)}$	(1c)

The direct costs of goods sold are represented by a simple, linear function (equation 2a, 2b, and 2c) while a complex, quadratic function is used for representing the indirect costs or overhead costs (equation 3a, 3b, and 3c). As can be derived from the coefficients of the cost functions, market A has a lower direct cost, but the much higher indirect cost for market A leads to a higher total cost for market A than for market B (the fixed overhead costs are higher for market A than for market B, the decreasing linear component is smaller for market A than for market B and the quadratic coefficient is higher for market A than for market B).

Direct Costs

Market A	$C_{a\,L\,(F)} = 630\,Q_{a\,L\,(F)}$	(2a)
Market B	$C_{b\,L\,(F)} = 710\,Q_{b\,L\,(F)}$	(2b)
Total	$C_{tot\,L\,(F)} = C_{a\,L\,(F)} + C_{b\,L\,(F)}$	(2c)

[5] Al-Najjar et al. (2008) show analytically that the use of full-cost pricing methodologies (instead of pricing based on marginal costs) is reinforced by the dynamics of the differentiated price competition while market forces eradicate the use of full-cost pricing in monopoly, perfectly competitive markets, and Bertrand duopolies with undifferentiated demand functions. Thus, although providing participants with full-cost information deviates from standard economic theory, it is an equilibrium outcome for the particular model of price competition that we use.

Overhead Costs

Market A $OH_{a\,L(F)} = 1{,}750{,}000 - 410\,Q_{a\,L(F)} + 0.25\,Q_{a\,L(F)}^2$ (3a)

Market B $OH_{b\,L(F)} = 700{,}000 - 515\,Q_{b\,L(F)} + 0.14\,Q_{b\,L(F)}^2$ (3b)

Total $OH_{tot\,L(F)} = OH_{a\,L(F)} + OH_{b\,L(F)}$ (3c)

Equation (4a) shows the total profit function of a participant while equations (4b) and (4c) shows the prices and profits in the Nash Equilibrium (NE) for leaders and followers. Because of the second-mover advantage, followers can obtain a slightly higher profit than leaders.

Profits and Equilibrium Outcomes

Total profits $Profit_{tot\,L(F)} = Q_{a\,L(F)}\,P_{a\,L(F)} + Q_{b\,L(F)}\,P_{b\,L(F)} - C_{tot\,L(F)} - OH_{tot\,L(F)}$ (4a)

NE leader $P_{a\,L} = 1{,}848.2$; $P_{b\,L} = 1{,}348.0$; $Profit_{tot\,L} = 777{,}215.8$ (4b)

NE follower $P_{a\,F} = 1{,}834.4$; $P_{b\,F} = 1{,}337.3$; $Profit_{tot\,F} = 790{,}998.0$ (4c)

3.2 Manipulations

Ease of Cooperation

We manipulate ease of cooperation in two different ways. Our first way of manipulating ease of cooperation hinges on the notion that increased monitoring of the competitor's actions makes cheating (i.e. secret price-cutting) less likely and facilitates collusion (Stigler 1964). Consequently, ease of cooperation is manipulated by varying the observability of the competitor's prices. In one half of the conditions, participants can observe the competitor's prices in both markets (i.e. ease of cooperation is high), while the participants cannot observe the competitor's prices in the other half of the conditions (i.e. ease of cooperation is low).[6]

[6] Observable prices can also be considered as a communication device between competitors (Fouraker and Siegel 1963). Anectdotal evidence and analytical models show that communication between competitors facilitates collusion (Genesove and Mullin 2001; Kandori and Matsushima 1998).

Contrary to our expectation, some studies have shown that the publication of specific information about the competitors actions can increase competitiveness of markets (Vega-Redondo 1997; Huck et al. 2000).[7] Although this would work against our hypothesis, we also manipulate the ease of cooperation by varying the market history. In this perspective, Levenstein and Suslow (2006) argue that (tacit) collusion is more likely if competitors have a common history in the market. In one half of the conditions a common history in the market is manipulated by giving participants starting prices while in the other half of the conditions participants do not receive starting prices and are told that they have to set prices for products that are introduced into the market for the first time. Remark that participants can observe the prices of their competitor in the conditions in which we vary the presence of starting prices. Thus, we have three treatments of ease of cooperation: easy to cooperate (ETC, i.e. participants can observe each other's prices and have starting prices), unobservable prices (UP, i.e. participants cannot observe each other's prices but have starting prices), no starting prices (NSP, i.e. participants can observe each other's prices but have no starting prices). In our analyses, we will compare easy to cooperate with unobservable prices and no starting prices separately.

Dispersion of Accurate Cost Information

The accuracy of the participant's private cost report is manipulated by using either a volume-based allocation method (VBC) (i.e. less accurate) or an activity-based allocation method (ABC) (i.e. accurate). The volume-based allocation method uses total volume to calculate the overhead costs per unit of volume. As no difference is made between a product from Market A or Market B, the indirect costs per unit of volume is the same in both markets. The activity-based allocation method first assigns the total indirect costs to three activities (order processing, software installation and delivery) and then assigns the total costs per activity to the product markets. The calculation of the overhead costs per unit of volume for the volume-based allocation method and for the activity-based allocation method can be found in Appendix 1. Panel A of Table 1 shows the actual overhead costs per unit as well as the overhead costs per unit as calculated by using the volume-based and activity-based allocation method. It is clear that the activity-based allocation method provides a much better

[7] There are some notable differences between the settings that are studied in Vega-Redondo (1997) and Huck et al. (2000) and our setting. First, both studies consider a market with 4 players while we are using a duopolistic market. Second, Vega-Redondo (1997), which focuses on a quantity setting game, and Huck et al. (2000), which extends the findings of Vega-Redondo (1997) for a price setting game, focus on the difference between individual information about the competitors' actions versus aggregate information about the competitors' actions. In the former setting, each competitor perfectly observes the action of each other competitor. In the latter setting, each competitor observes the average of the actions of the other competitors. In a duopolistic setting, there is no difference between the variations that are studied in Vega-Redondo (1997) and Huck et al. (2000). Given the overwhelming evidence for the importance of monitoring the actions of a competitor for initiating and sustaining (tacit) collusion, we believe that observable (unobservable) prices will facilitate (hamper) collusion.

reflection of the perfect unit cost for both markets than the volume-based allocation method. Also note that the unit cost for both allocation methods differs (i.e. 1,477 (VBC) versus 1,586.1 (ABC) for Market A and 1,557 (VBC) versus 1,201.8 (ABC)). Consequently, the cost allocation method will lead to different focal points for price setting. Appendix 2 shows the cost report that participants receive before the first round. This cost report is updated at the end of each round. The dispersion of accurate cost information in the market is manipulated by providing one player (leader or follower) with accurate information (i.e. partial dispersion) or by providing both players (leader or follower) with accurate information. As mentioned above, competitors have different (similar) focal points for price setting under partial (full) dispersion of accurate information.

Insert Table 1 About Here

Overview

Panel B of Table 1 shows an overview of our experimental manipulations. In the ETC-conditions (i.e. Game A, B, and C) participants can observe each other's prices and have starting prices. Game D, E, and F are the conditions in which competitors cannot observe each other's prices but have starting prices (i.e. UP), while Game G, H, and I are the conditions where without starting prices but with observable prices of the competitor (i.e. NSP). Game A, B, D, E, G, and H (C, F, and I) are the conditions with partial (full) dispersion of accurate cost information.

3.3 Experimental Procedures

Participants were master students recruited from a management accounting course at a large West-European university and have knowledge about cost allocations and pricing decisions. Participants were randomly assigned to one of the experimental conditions and to the role of leader or follower. The average age of the participants was 21.5 years and we do not find statistical differences between conditions nor between leaders and followers with respect to age and number of courses in accounting, economics or strategy. The experiment was organized during different sessions that have 24 to 36 participants. Communication during the experiment was strictly forbidden. The experiment lasted on average 50 minutes. Participants receive a course credit for participation and the best performing leader and follower of each condition receive a gift coupon of 15 EUR.

As in Cardinaels et al. (2008), participants were assigned the role of a price competitor in the distribution of portable PC's. The case informs participants that customers in market A order slightly less expensive products (lower cost of goods sold), but require much more support than customers in market B. Less accurate cost information is labeled as 'volume-based costing' and participants are told that overhead costs are allocated based on sales volume. Accurate cost information is labeled as 'activity-based costing' and participants are instructed that overhead costs are first assigned to activities and then to market A or market B. Participants should be able to infer the quality of their cost reports from the labels 'volume-based costing' and 'activity-based costing'. Participants are also instructed that they face the same cost structure as their competitor.

The sequence of play in each round is as follows. Both leader and follower observe their private cost report during ten seconds. Next, the leader sets his prices for the two markets (followers are instructed to wait). Subsequently, the follower sets his prices while leaders are instructed to wait. Depending on the experimental condition, the follower can observe the prices of the leader before he has to make his price decisions.[8] Markets clear after the price decisions of the follower and both players observe their updated private cost report as long as they want. At the end of each round, participants always observe the total profits of his competitor. The observation of the competitor's prices, however, is dependent upon the experimental condition. Participants also observe their own prices in both markets and total profits as well as the total profits of the competitor of the last six rounds. The observation of the competitor's prices of the last six rounds is dependent upon the experimental condition. Appendix 2 contains a screenshot of the private cost report.

3.4 Manipulation Checks

An ex-post questionnaire was used to assess whether randomization over experimental conditions was successful and to ensure that participants understand the task and attended to the manipulations. The questions were answered on a scale from 0 to 100. The means of questions about the clarity of the experimental procedure and clarity of the price setting game are significantly larger than the midpoint of 50 and do not differ between experimental conditions or between leaders and followers. Questions about the motivation to participate in the experiment, the enjoyment with the game and the realism of the game have an average score that is larger than 50 and these averages do not differ between experimental conditions nor between leaders and

[8] Making prices unobservable can alter the sequential model of price competition into a simultaneous model of price competition. However, Huck and Muller (2000) provide experimental evidence for the fact that the physical timing of decisions serves as the most important equilibrium selecting device. As a result, making prices unobservable does not threaten the comparability between the different manipulations.

followers. Cost accounting knowledge was assessed with three questions related to activity based costing. Participants scored significantly higher than 50 on the average of these three questions and responses do not differ between experimental conditions nor between leaders and followers

We also assessed the validity of our experimental manipulations . To make sure that subjects have correct insights in the accuracy of their cost information we asked three questions: (1) “The costs per unit that were reported in my cost report were an accurate reflection of the real costs per unit” , (2) “The cost report provided me with a clear picture about which market was more costly”, and (3) “My cost report provided an accurate estimation of the total costs of each market”. Participants with accurate cost information scored significantly higher on the average of these three questions than participants that have less accurate cost information at their disposal ($t=6.35$, $p<0.01$). In the conditions with partial dispersion of accurate cost information, participants with accurate cost information have a significantly higher average on the three questions than participants with less accurate cost information ($t=6.27$, $p<0.01$) If leaders and followers have both accurate cost information at their disposal, we do not find a significant difference between leaders and followers ($t=0.002$, $p>90$). Taken together, we find a significant difference for questions about quality of cost information if players have different types of cost information, while no significant differences are found if both players have accurate cost information.

The questions with respect to ease of cooperation between competitors are as follows (1) “My price strategy was focused on increasing my own profits as much as possible” and (2) “I wanted to obtain higher profits than my competitor”. The average of these two questions is significantly lower if participants can easily cooperate with each other compared to the situation where participants cannot easily cooperate with each other ($t=2.10$, $p<0.05$) In summary, the results of our ex-post tests give us some comfort that experimental procedures were understood and that randomization and manipulations were successful.

IV. RESULTS

4.1 Descriptive Statistics

The descriptive statistics about market profits, leader and follower profits, prices for market A and B, unit costs for market A and B and some other variables are reported in Table 2. Note that the unit costs are the unit costs as reported by the cost accounting methodology. At first blush, one can conclude that profits do not really differ between the different ease of cooperation-treatments in case of partial dispersion of accurate cost information while under full dispersion profits are higher in the ETC-treatment than in the UP-treatment or the NSP-treatment.

Insert Table 2 About Here

4.2 Cost Information as a Focal Point

To test the first hypothesis, we consider price-setting behavior in market B. The reason for this choice is that the unit cost as reported by the two cost accounting methodologies is much more different for market B than for market A (1,557 (VBC) versus 1,201.8 (ABC) for market B; 1,477 (VBC) versus 1,586.1 (ABC) for market A). If cost information is used as a focal point for price setting then we expect lower prices in market B for players with accurate cost information than for players with less accurate cost information, ceteris paribus.

In a first series of analyses, we compare the price level of market B between different players. Considering all conditions of our experiment, we observe a significant lower price in market B when participants have accurate cost information compared to when participants have less accurate information (1596.84_{ABC} versus 1680.13_{VBC}; $t=5.83$, $p<0.01$). Testing this difference within each ease of cooperation-treatment separately leads to the same conclusion (see Table 3). We also analyzed the price level in market B for conditions with partial dispersion and full dispersion of accurate information separately. For the conditions with partial dispersion of accurate cost information, we find that the price in market B is lower for players with accurate cost information than for players with less accurate cost information (1642.56_{ABC} versus 1680_{VBC}; $t=2.35$, $p<0.05$). For conditions with full dispersion, we compare the price level in market B between leaders and followers, which both have accurate cost information at their disposal. No differences are observed

between leaders and followers ($1538.45_{Leaders}$ versus $1556.47_{Followers}$; t=0.57, p>0.50). Analyzing the differences between conditions with partial and full dispersion of accurate cost information within each ease of cooperation-treatment does not alter our inferences (see Table 3, Panel A).

Insert Table 3 About Here

In a second series of analyses, we analyze in more detail how price setting in market B differs between conditions with partial and full dispersion of accurate cost information. Figure 2 shows scatterplots that compare price setting in market B between conditions with partial and full dispersion of accurate cost information. The X-axis (Y-axis) of the scatterplots contains the price in market B of the leader (follower). For ease of exposition, we compare each condition with partial dispersion (i.e. either only leader or only follower has accurate information) separately with the condition in which both leader and follower have accurate cost information (i.e. full dispersion). If cost information is used as a focal point and if full dispersion of accurate cost information improves coordination between competitors, then we expect a higher concentration of points in the lower left corner of the scatterplots if both competitors have accurate cost information, ceteris paribus. Close inspection of the scatterplots confirms our expectation although there seems to be some differences between the ease of cooperation-treatments.

Insert Figure 2 About here

We also quantified the scatterplots by calculating the number of dyads in which both competitors have a price level in market B that is smaller than 1650, which is the starting price in the ETC-treatment and the UP-treatment. We label this variable 'Coordination'. Consistent with the hypothesis that cost information is a focal point and that full dispersion of accurate cost information improves coordination, we expect a higher value of Coordination for full dispersion than for partial dispersion. Within each ease of cooperation-treatment, we find that the value of Coordination is significantly higher if both competitors have accurate cost information than if only one of both competitors has accurate cost information ($21.03_{Partial}$ versus 46.30_{Full}, t=2.89, p<0.01 for ETC; $5.87_{Partial}$ versus 22.61_{Full}, t=2.21, p<0.05 for UP; $52.38_{Partial}$ versus 86.76_{Full}, t=5.03, p<0.01 for NSP) (see Table 3, Panel B). As a robustness check, we calculated the number of dyads in which both competitors have a price level in market B that is smaller than 1450, which is a price level that is

closer to the optimal price level (i.e. 1348 (1337.3) for leaders (followers)). We label this variable 'Coordination2'. For the ETC-treatment and the NSP-treatment, we observe a significantly higher value for Coordination2 if both competitors have accurate information than if only one of both competitors has accurate information ($0.03_{Partial}$ versus 0.16_{Full}, t=2.35, p<0.05 for ETC; $0.16_{Partial}$ versus 0.65_{Full}, t=5.96, p<0.01 for NSP). We do not find a statistical difference at conventional significance level for the UP-treatment ($0.01_{Partial}$ versus 0.04_{Full}, t=1.35, p>0.15) (see Table 3, Panel B).

To summarize, our results show that internal cost information is used as a focal point for price setting in competitive markets. Furthermore, we provide preliminary evidence that dispersion of accurate cost information within a market improves coordination between competitors for setting prices. In the next section, we extend this result by showing the profit consequences of improved coordination.

4.3 Ease of Cooperation and Dispersion of Accurate Cost Information

In this section, we provide formal tests for Hypothesis 2. For all our tests, we will collapse both variations of partial dispersion of accurate cost information (i.e. only leader accurate information or only follower accurate information). As such, we obtain a 2 (partial versus full dispersion of accurate information) X 2 (easy to cooperate versus unobservable prices/no starting prices) experimental design.[9] We will first test our hypothesis by using market profits (i.e. sum of profits of leader and follower). In the second and third part of this section, we will analyze profits of individual players. In the second part, partial dispersion of accurate cost information is operationalized by giving the competitor less accurate cost information.[10] In the third part, partial dispersion is operationalized by giving the focal player less accurate cost information.[11] As both operationalizations can be considered as partial dispersion of accurate cost information, our inferences should be the same for both operationalizations.

[9] Inferences do not change is we consider both variations of partial dispersion of accurate information as separate. Doing so leads to a 3 (only leader accurate information, only follower accurate information, leader and follower accurate information) X 2 (easy to cooperate versus unobservable prices/no starting prices) experimental design.

[10] For the Easy to Cooperate-condition, we use data from leaders in game A, followers in game B, and leaders and followers in game C. For the UnobservablePrices-condition, we use data from leaders in game D, followers in game E, and leaders and followers in game F. for the NoStartingPrices-condition, we use data from leaders in game G, followers in game H, and leaders and followers in game I. Note that all the players have accurate information.

[11] For the Easy to Cooperate-condition, we use data from followers in game A, leaders in game B and leaders and followers in game C. For the UnobservablePrices-condition, we use data from followers in game A, leaders in game E, and followers and leaders in game F. For the NoStartingPrices-condition, we use data from followers in game G, leaders in game H, and leaders and followers in game I. Note that the players in the conditions with partial dispersion have less accurate cost information.

Market Profits

Hypothesis 2 predicts that the effect of ease of cooperation is moderated by the dispersion of accurate cost information. Consistent with the underlying reasoning for this effect, we expect that the difference between conditions with full dispersion of accurate information will be larger than the difference between conditions with partial dispersion of accurate cost information. An ANOVA-analysis provides support for our hypothesis as we find a significant interaction effect for both manipulations of ease of cooperation ($F=9.52$, $p<0.01$ for ETC versus UP; $F=8.39$, $p<0.01$ for ETC versus NSP). Analysis of the simple effects shows that market profits do not significantly differ in case of partial dispersion of accurate cost information ($t=0.77$, $p>0.44$ for ETC versus UP; $t=0.24$, $p>0.80$ for ETC versus NSP), while market profits in case of full dispersion of accurate cost information are significantly larger if competitors can easily cooperate with each other than if cooperation between competitors is difficult ($t=4.24$, $p<0.01$ for ETC versus UP; $t=3.66$, $p<0.01$ for ETC versus NSP). (see Table 4 and Figure 3)

Insert Table 4 and Figure 3 About Here

Partial Dispersion with Competitor Less Accurate Information

As shown in Panel A of Table 5 and in Panel A of Figure 3, we find a significant interaction effect between ease of cooperation and dispersion of accurate cost information ($F=8.74$, $p<0.01$ for ETC versus UP; $F=14.75$, $p<0.01$ for ETC versus NSP). Follow-up analyses of these interaction effects demonstrate no significant profit differences between ease of cooperation-treatments in case of partial dispersion ($t=0.42$, $p>0.60$ for ETC versus UP; $t=0.38$, $p>0.70$ for ETC versus NSP), but a significantly higher profit if ease of cooperation is high than if ease of cooperation is low ($t=4.48$, $p<0.01$ for ETC versus UP; $t=4.95$, $p<0.01$ for ETC versus NSP). Analyzing for leaders and followers separately leads to similar results (results not reported). These results support our theory that the use of cost information with different types of accuracy leads to different results than those that economic theory predicts.

Insert Table 5 and Figure 4 About Here

Partial Dispersion with Focal Player Less Accurate Information

In this section, partial dispersion refers to the situation in which the competitor has accurate information while the focal player has less accurate information. Note that the conditions with full dispersion are the same as in the previous section. Panel C of Figure 4 displays the profits for the different conditions. As reported in Table 6, we find a significant interaction effect between ease of cooperation and dispersion of accurate information ($F=8.52$, $p<0.01$ for ETC versus UP; $F=9.65$, $p<0.01$ for ETC versus NSP). Analysis of the simple effects shows no significant differences between conditions that have partial dispersion of accurate cost information ($t=0.78$, $p>0.40$ for ETC versus UP; $t=0.85$, $p>0.35$ for ETC versus NSP), and a significant difference in the predicted direction between conditions with full dispersion of accurate cost information ($t=4.77$, $p<0.01$ for ETC versus UP; $t=5.12$, $p<0.01$ for ETC versus NSP). Analyzing leader and follower separately leads to the same conclusions (results not reported). Taken together, we find consistent evidence for our hypothesis that the use of cost accounting information for pricing decisions leads to deviations from the predictions one is inclined to make when solely relying on the variation in ease of cooperation.

Insert Table 6 About Here

4.4 Supplemental Analyses

In this section, we report additional analyses to show that the differences between the conditions with full dispersion of accurate information are driven by the dynamics as predicted by economic theory. Furthermore, we unravel the differences between the two manipulations of low ease of cooperation. We close this section with an analysis of the results over time.

Economic theory predicts that (tacit) collusion will lead to higher profits than competition because prices in the former condition are above the unit cost level. As a result, (tacit) collusion should lead to higher profit margins than competition. We calculate the profit margin as the ratio of the total profit over total revenues and find a significantly higher profit margin if cooperation is easy ($t=4.51$, $p<0.01$ for ETC versus UP; $t=4.97$, $p<0.01$ for ETC versus NSP). Thus, the underlying dynamics in the conditions with full dispersion of accurate information are consistent with the predictions of economic theory.

Results in 4.3 and untabulated results of leaders and followers show that the significance of the interaction effect is somewhat smaller for leaders than for followers when contrasting ETC with UP. For the contrast between ETC and NSP, results for leaders and followers are nearly identical. In order to unravel variations in behavior of leaders and followers between the ease of cooperation-treatments, we analyze three additional metrics. First, we report results about the prices in market A. As the optimal price of market A is higher than the starting price and as cooperation between competitors is especially useful to increase and maintain high prices, the price level in market A can improve our understanding of the price-setting behavior. Second, we will compute two metrics with respect to undercutting and overpricing of the previous price of the competitor. A large undercut, which is considered as a competitive act, is a price decrease of more than 5% compared to the previous price of the competitor and a close overpricing, which is a cooperative act, is a price increase of less than 5% compared to the previous price of the competitor. As shown in Figure 5, the average price level of leaders in market A in the UP-treatment (1,691.31) does not differ from the leader's (cooperative) price setting in the ETC-treatment (1,731.95; $t=1.10$, $p>0.40$) and is significantly higher than the average price in the NSP-treatment (1,631.19; $t=2.05$, $p<0.05$). Followers in the UP-treatment, on the other hand, set significantly lower prices in market A than follower's in the ETC-treatment (1,716.76 versus 1,648.06; $t=2.50$, $p>0.01$). Followers' prices do not differ between the UP- and NSP-treatment (1,648.06 versus 1,649.17; $t=0.20$, $p>0.80$). Comparing the overpricing and undercutting data shows that leaders in the ETC-treatment use a close overpricing to a significantly higher extent than leaders in the NSP-treatment (7.22 close overpricings in the ETC-treatment versus 3.76 close overpricings in the NSP-treatment; $t=2.15$, $p<0.05$) while leaders in the NSP-treatment use a large undercut to a significantly higher extent (2.56 large undercuts in the ETC-treatment versus 4.53 large undercuts in the NSP-treatment; $t=1.90$, $p<0.10$). Taken together, the somewhat smaller interaction for leaders in the ETC-UP contrast is because leaders in the UP-treatment are rather cooperative. However, as they are matched with competitive followers, their cooperative intentions do not result in high profits. Due to the fact that prices remain unobservable during the entire experiment, leaders cannot show their cooperative intentions to the followers. Future research can investigate to what extent leaders are willing to pay a cost to show their cooperative intentions or to what extent leaders are willing to publicly post their prices. The strong effects in the NSP-treatment are the result of an interaction between competitive leaders and competitive followers.

Insert Figure 4 About here

We also analyzed the results over time by splitting up the experiment in three periods: rounds 1-4, rounds 5-8, and rounds 9-12. We repeat our main analyses for each period and find that all the interaction effects are significant for rounds 1-4 and rounds 5-8 (results not reported). Also the significance of the simple effects is consistent with our expectations for these periods. For rounds 9-12, we find that one interaction effect borders on statistical significance although the significance levels of the simple effects are consistent with our expectations. In general, significance of the interaction effects is somewhat smaller in the last four rounds of the experiment.[12]

[12] End-of-period play is one possible explanation for this result. However, Abbink and Brandts (2008) show that behavior in competitive price-setting games evolves over time: focal points guide price-setting decisions in the first half, while imitation of successful decisions drives behavior in the second half of their experiment. Note that the experiment of Abbink and Brandts (2008) lasted for 50 rounds. It could thus be that the somewhat smaller significance levels are driven by a change in price-setting strategy. Specifically, competitors with less accurate cost information start imitating the price-setting behavior of the competitor with accurate cost information as the latter should obtain at least slightly higher profits if he follows his accurate cost information. In other words, using cost information as a focal point for price-setting is a necessary condition for observing a switch to imitating the behavior of the best-performing player. This theory can also explain the link between our study and Cardinaels et al. (2008). In Cardinaels et al. (2008), the leader-follower distinction was the focus of the study and followers were provided with a justification to 'imitate' a player that is expected to perform better. Given their dominant position, the leaders are more inclined to follow their own cost information. By paying more attention to the leader-follower distinction, the phase in which cost information is used as a focal point by both players has been omitted. Note that a switch to an imitation strategy assumes that there are no external shocks that change the cost structure. External shocks will increase the reliance on the own cost information and thus emphasize the importance of (internal) focal points for price-setting behavior. Nevertheless, future research can explicitly consider the evolution of price-setting behavior in order to reconcile our study and the study of Cardinaels et al. (2008).

V. CONCLUSION

To summarize, our study is motivated by the fact that reliance on full-cost information for setting prices is pervasive in practice, but such information can differ in accuracy between competitors which generates different focal points for setting prices. Relying on the importance of common focal points for collusive price-setting, we predict that the role of well-known collusion facilitating factors is weakened when competitors rely on cost information that differs in accuracy. We use an experiment to study the role of dispersion of accurate cost information for collusive pricing. Consistent with prior research, we find that the output of the cost accounting system is an important focal point for setting prices. Turning to the key question of the present study, we find that dispersion of accurate cost information in an industry influences the role of collusion-facilitating factors in the way we predict. Specifically, when all competitors rely on accurate cost information, profits are higher when collusion is easy to obtain than when collusion is difficult. On the contrary, when competitors rely on different types of cost information, no profit differences are observed between variations in collusion-facilitating factors.

Our results contribute to a better understanding of the role of accurate cost information for initiating and sustaining tacit collusion. Previous studies report that tacit collusion is highly prevalent in a variety of industries and identify a wide range of factors that facilitate or hamper collusion (Levenstein and Suslow 2006). Although a wealth of anecdotal examples and descriptive surveys suggest that most firms price their products based on the output of the cost accounting system, the role of cost information in general and the variation in accuracy of cost information in particular for collusive pricing has not been examined. Our findings suggest that variation in the accuracy of cost information weakens the role of well-known collusion-facilitating factors. In other words, cost accounting systems shape reality and are not just a toy of the accounting department. To the best of our knowledge, this study is also the first to show the role of internal focal points for collusive price-setting.

Our results can be of interest to regulators and designers of competition policy. Regulators often force public utilities companies to invest in accurate cost information and ,by doing this, they create common focal points for price setting. As public utilities companies often compete in environments that facilitate collusion, it seems that regulating the type of cost information that companies should collect will stimulate collusion rather than competition. Deregulating the type of cost information that companies should collect seems to be a better solution as this makes it more likely that companies end up with cost accounting systems that vary in accuracy. To detect collusion, regulators can monitor the investment in cost information as collusive pricing is more likely to be

observed when the different competitors invest in accurate cost accounting systems. Our results can also explain why mandatory posting of prices and profits can facilitate collusion and why some firms voluntary post their prices and profits. Specifically, when competitors rely on accurate cost accounting information, mandatory posting of prices and profits facilitates detection of cheating and instigates collusion. The future profits of collusion can also explain why firms voluntary post prices and profits after being involved in a price war.

Our study also offers an explanation for the inconsistent findings about the influence of competition on the accuracy of the cost accounting system. While it is commonly believed that more accurate cost accounting systems are especially useful in highly competitive environment, our results show that the reverse is true and suggest that accurate accounting systems are also useful to establish and sustain collusive pricing.

Like always, one has to be careful when extrapolating experimental findings to field settings. In our experimental market, competitors have the same underlying cost structure, whereas in a lot of naturally occurring markets cost structures differ between competitors. However, collusion is much more likely if competitors have the same underlying cost structure as collusive pricing is often the only way to obtain reasonable profits. Second, participants in our experiment cannot invest in accurate cost accounting systems nor can they try to soften the competition via communication or posting their prices. Future research might examine how these additional complexities, either in isolation or in concert with each other, affect our results. Taken together, recognizing the importance of cost information for (tacit) collusion opens up a host of new issues that are worth investigating.

CITED REFERENCES

Abbink, K., and J. Brandts. 2008. 24. Pricing in Betrand Competition with Increasing Marginal Costs. *Games and Economic Behavior* 63: 1-31.

Al-Najjar, N., S. Baliga, and D. Besanko. Market Forces Meet Behavioral Biases: Cost Misallocation and Irrational Pricing. *RAND Journal of Economics* 39(1): 214-237.

Bacharach, M., and M. Bernasconi. 1997. The Variable Frame Theory of Focal Points: An Experimental Study. *Games and Economic Behavior* 19: 1-45.

Bardsley, N., J. Mehta, C. Starmer, and R. Sugden. 2009. Explaining Focal Points: Cognitive Hierarchy Theory versus Team Reasoning. *The Economic Journal* 120: 40-79.

Briers, M., C. Chow, N. Hwang, and P. Luckett. 1999. The effect of alternative types of feedback on product-related decision performance: a research note. *Journal of Management Accounting Research* 11: 75-92.

Cachon, G.P., and C.F. Camerer. 1996. Loss-Avoidance and Forward Induction in Experimental Coordination Games. *The Quarterly Journal of Economics* 111(1): 165-94.

Cardinaels, E., F. Roodhooft, and L. Warlop. 2004. The Value of Activity-Based Costing in Competitive Pricing Decisions. *Journal of Management Accounting Research* 16:133-148.

Cardinaels, E., F. Roodhooft, L. Warlop, and G. Van Herck. 2008. Competitive Pricing in Markets with Different Overhead Costs: Concealment or Leakage of Cost Information. *Journal of Accounting Research* 46(4): 761-784.

Carpenter, J., S. Bowles., H. Gintis, and S-H Hwang. 2009. Strong reciprocity and team production: theory and evidence. *Journal of Economic Behavior and Organization* 71(2): 221-232.

Crawford, V.P. 2004. Theory and Experiment in the Analysis of Strategic Interaction. In *Advances in Behavioral Economics*, edited by C.F. Camerer, G. Loewenstein, and M. Rabin. Princeton University Press.

Foster, G., and M. Gupta. 1994 Marketing, Cost Management and Management Accounting. *Journal of Management Accounting Research* 6: 44-77.

Fouraker, L.E., and S. Siegel. 1963. *Bargaining Behavior*. New York: McGraw-Hill.

Fudenberg, D., and J. Tirole. 1991. *Game Theory*. Cambridge: MIT Press.

Genesove D., and W.P. Mullin.2001. Rules, communication, and collusion: narrative evidence from the Sugar Institute Case. *American Economic Review* 91(3): 379-398.

Govindarajan, V., and R. Anthony. 1983. How firms use cost data in pricing decisions. *Management Accounting* 76: 37-39.

Guilding, C., C. Drury, and M. Tayles. 2005. An empirical investigation of the importance of cost-plus pricing. *Managerial Auditing Journal* 20(2): 125-137.

Hansen, S.C. 1998. Cost Analysis, Cost Reduction, and Competition. *Journal of Management Accounting Research* 10: 181-203.

Harsanyi, J.C., and R. Selten. 1988. *A General Theory of Equilibrium Selection in Games*. MIT press: Cambridge.

Huck, S., H.-T. Normann, and J. Oechssler. 2000. Does information about competitors' actions increase or decrease competition in experimental oligopoly markets. *International Journal of Industrial Organization* 18:39-57.

Kachelmeier, S.J. 1996. Do Cosmetic Reporting Variations Affect Market Behavior? A Laboratory Study of the Accounting Emphasis on Unavoidable Costs. *Review of Accounting Studies* 1: 115-140.

Kandori, M., and H. Matsushima. 1998. Private Observation, Communication, and Collusion. *Econometrica* 66(3): 627-652.

Kaplan, R.S., and R. Cooper. 1998. *Cost and Effect*. Boston, Massachusetts: Harvard Business School Press.

Knittel, C.R., and V. Stango. 2003. Price Ceilings as Focal Points for Tacit Collusion: Evidence from Credit Cards. *American Economic Review* 93(5): 1703-1729.

Kreps, D.M. 1990*. A Course in Microeconomic Theory*. Harvester Wheatsheaf: London.

Levenstein, M.C., and V.Y. Suslow. 2006. What Determines Cartel Success?. *Journal of Economic Literature* 154: 43-95.

Libby, T., and J.H. Waterhouse. 1996. Predicting Change in Management Accounting Systems. *Journal of Management Accounting Research* 8: 137-150.

Maher, M., C. Stickney, and R.L. Weil. 2004. *Managerial* Accounting 8th Edition. Mason, OH: South-Western.

Malmi, T. 1999. Activity-based costing diffusion across organizations: an exploratory empirical analysis of Finnish firms. *Accounting, Organizations and Society* 24:649-672.

Mehta, J., C. Starmer, and R. Sugden. 1994a. The Nature of Salience: An Experimental Investigation of Pure Coordination Games. *American Economic Review* 84(3): 658-673.

Mehta, J., C. Starmer, and R. Sugden. 1994b. Focal Points in Pure Coordination Games: and Experimental Investigation. *Theory and Decision* 36: 163-158.

Mishra, B., and I. Vaysman. 2001. Cost System Choices and Incentives – Traditional vs. Activity-Based Costing. *Journal of Accounting Research* 39(3): 619-641.

Schelling, T. 1960. *The Strategy of Conflict*. Harvard University Press: Cambridge.

Scherer, R.M. 1970. *Industrial Market Structure and Economic Performance*. Chicago: Rand McNally.

Selten, R., and J. Apesteguia. 2005. Experimentally Observed Imitation and Cooperation in Price Competition on the Circle. *Games and Economic Behavior* 51: 171-192.

Stigler, G. 1964. A Theory of Oligopoly. *Journal of Political Economy* 72(1): 44-61.

Sugden, R. 1995. A Theory of Focal Points. *The Economic Journal* 105(430): 533-550.

Tirole, J. 1988. *The Theory of Industrial Organization*. Cambridge: MIT Press.

Tversky, A., and D. Kahneman. 1991. Loss aversion in riskless choice: a reference-dependent model. *Quarterly Journal of Economics* 106(4): 1039-1061.

Vega-Redondo, F. 1997. The evolution of Walrasian behavior. *Econometrica* 65: 375-384.

Waller, W., B. Shapiro, and G. Sevcik. 1999. Do cost-based pricing biases persist in laboratory markets?. *Accounting, Organizations and Society* 24: 717-739.

Williams, J.J., and A.E. Seaman. 2001. Predicting change in management accounting systems: national culture and industry effects. *Accounting, Organizations, and Society* 26: 443-460.

Overview of the Experimental Design

Table 1 provides an overview of the experimental design. Panel A shows the unit costs that are shown under a less accurate, which is labeled in the experiment as "Volume-Based Costing, or accurate, which is labeled as "Activity Based Costing, cost report in comparison to the actual costs at the start of the experiment (e.g. for the leader using the initial prices used in the Easy to Cooperate-treatments and the Unobservable Prices-treatments: $P_{a\,L}$=1650; $P_{b\,L}$=1710; $P_{a\,F}$ =1645; $P_{b\,F}$=1706). Panel B shows our experimental treatments and the type of information that each player received.

Panel A: Unit Cost Accurate/Less Accurate Treatments Versus Actual Cost[13]

Type of cost	*Actual Cost* Market A versus B	*Less Accurate* cost report Market A versus B	*Accurate* cost report Market A versus B
Direct cost per unit	630.0 < 710.0	630.0 < 710.0	630.0 < 710.0
Indirect cost per unit	**927.8 > 583.9** (Equations 3a and 3b)	**847.0 = 847.0** (Appendix A)	**956.1 > 491.8** (Appendix A)
Total unit cost 'U'	1,557.8 > 1,293.9	1,477.0 < 1,557.0	1,586.1 > 1,201.8

Panel B: Overview of the Experimental Treatments

	Partial Dispersion				Full Dispersion	
	Only Leader ABC		Only Follower ABC		Leader and Follower ABC	
Easy To Cooperate	GAME A		GAME B		GAME C	
	Leader ABC	Follower VBC	Leader VBC	Follower ABC	Leader ABC	Follower ABC
Unobservable Prices	GAME D		GAME E		GAME F	
	Leader ABC	Follower VBC	Leader VBC	Follower ABC	Leader ABC	Follower ABC
No Starting Prices	GAME G		GAME H		GAME I	
	Leader ABC	Follower VBC	Leader VBC	Follower ABC	Leader ABC	Follower ABC

[13] Adapted from Cardinaels et al. (2008)

Descriptive Statistics

Table 3 reports the descriptive statistics separated by ease of cooperation-condition (easy to cooperate (Panel A), unobservable prices (Panel B), no starting prices (Panel C)), dispersion-condition (partial, full) and player-type (leader, follower). Price A and Price B are the average prices set by the players in the market A and market B. Coordination (Coordination2) is the percentage of leaders and followers that both have set a price lower than 1650 (1450). Profit is the average profit of each player over the 12 rounds of the experiment. Unit Cost A and Units Cost B is the unit cost as reported by the cost system of each player (i.e. VBC or ABC). Profit Margin is calculated as the ratio of profit over total revenues (=revenues in market A and B). Market Profit is the sum of the profit of leader and follower.

Panel A: Easy to Cooperate (ETC)

	Partial Dispersion				Full Dispersion	
	GAME A		GAME B		GAME C	
	Leader	Follower	Leader	Follower	Leader	Follower
Subjects	21	21	21	21	18	18
Price A	1,680.21	1,675.61	1,673.31	1,676.31	1,731.95	1,716.76
	(84.92)	(94.76)	(59.36)	(63.83)	(88.39)	(80.64)
Price B	1,659.73	1,662.11	1,717.32	1,692.20	1,616.30	1,588.21
	(117.76)	(100.52)	(48.04)	(70.67)	(116.75)	(112.56)
Coordination	30.16		11.90		46.30	
	(45.98)		(32.44)		(49.98)	
Coordination2	5.16		0		16.20	
	(22.16)		(0)		(36.93)	
Profit	525,237.26	505,022.21	487,767.32	521,235.83	566,040.69	592,601.04
	(98,736.44)	(76,578.96)	(88,799.75)	(94,464.27)	(89,035.59)	(81,589.85)
Unit Cost A	1,585.14	1,472.21	1,491.84	1,591.38	1,593.39	1,573.28
	(47.84)	(49.57)	(32.51)	(32.51)	(38.02)	(43.78)
Unit Cost B	1,201.34	1,552.21	1,571.84	1,204.56	1,205.55	1,195.19
	(24.65)	(49.57)	(32.51)	(16.74)	(19.57)	(22.53)
Profit Margin	10.70	10.29	9.99	10.59	11.69	11.95
	(2.18)	(1.81)	(1.84)	(2.00)	(2.01)	(1.75)
Market Profit	1,030,259.47		1,009,003.15		1,158,641.73	
	(170,750.57)		(165,507.40)		(163,092.81)	

Panel B: Unobservable Prices (UP)

	Partial Dispersion				Full Dispersion	
	GAME D		GAME E		GAME E	
	Leader	Follower	Leader	Follower	Leader	Follower
Subjects	22	22	22	22	21	21
Price A	1,686.78	1,686.31	1,698.68	1,673.32	1,691.31	1,648.06
	(86.95)	(80.80)	(68.96)	(69.68)	(68.42)	(66.57)
Price B	1,665.22	1,716.97	1,709.86	1,672.62	1,642.58	1,621.83
	(121.99)	(57.06)	(87.00)	(133.37)	(142.88)	(145.66)
Coordination	4.17		7.58		22.62	
	(20.02)		(26.51)		(41.92)	
Coordination 2	0		2.27		3.97	
	(0)		(14.93)		(19.56)	
Profit	526,279.00	477,979.76	476,147.84	497,947.32	465,082.44	445,483.70
	(125,119.94)	(133,062.73)	(116,831.37)	(155,054.39)	(164,284.14)	(134,883.37)
Unit Cost A	1,596.05	1,502.29	1,507.39	1,592.61	1,609.93	1,576.55
	(75.83)	(46.90)	(55.04)	(69.30)	(80.50)	(62.05)
Unit Cost B	1,206.95	1,582.29	1,587.39	1,205.19	1,214.08	1,196.92
	(39.04)	(46.90)	(55.04)	(35.71)	(41.47)	(31.99)
Profit Margin	10.57	9.86	9.80	9.92	9.50	8.91
	(2.48)	(2.69)	(2.34)	(3.32)	(3.45)	(2.60)
Market Profit	1,004,258.76		974,095.17		910,566.14	
	(185,891.61)		(178,286.14)		(227,080.20)	

Panel C: No Starting Prices (NSP)

	Partial Dispersion				Full Dispersion	
	GAME A		GAME B		GAME C	
	Leader	Follower	Leader	Follower	Leader	Follower
Subjects	18	18	17	17	17	17
Price A	1748.96	1733.72	1696.07	1715.34	1631.19	1649.17
	(140.96)	(130.19)	(99.00)	(115.90)	(107.49)	(103.76)
Price B	1534.77	1584.80	1671.26	1605.94	1386.77	1382.75
	(146.98)	(155.29)	(130.46)	(128.04)	(123.80)	(114.08)
Coordination	64.81		39.22		86.76	
	(47.87)		(48.94)		(33.97)	
Coordination2	24.07		7.35		64.71	
	(42.85)		(26.16)		(47.91)	
Profit	531681.59	463959.21	471417.89	541440.23	378069.18	421190.41
	(253387.67)	(244471.79)	(143651.36)	(152876.38)	(206798.10)	(176426.0)
Unit Cost A	1595.10	1492.09	1495.91	1593.56	1530.52	1533.03
	(88.01)	(97.28)	(66.68)	(72.10)	(61.29)	(54.63)
Unit Cost B	1206.36	1572.09	1575.91	1205.62	1173.15	1174.42
	(45.31)	(97.28)	(66.68)	(37.11)	(31.55)	(28.11)
Profit Margin	11.04	9.54	9.73	11.04	7.58	8.45
	(5.27)	(5.15)	(3.04)	(3.59)	(4.05)	(3.71)
Market Profit	995640.80		1011543.77		799259.59	
	(490349.39)		(282367.94)		(365053.55)	

Cost Information as a Focal Point

Table 3 reports the results for Hypothesis 1. Panel A contains the comparisons with respect to the price in market A. Panel B contains the comparisons for Coordination and Coordination2. ***, **, and * denote significance at the 1%, 5%, and 10% respectively.

Panel A: Comparisons and Statistical Tests for Price B

	Overall			Partial Dispersion			Full Dispersion		
	ABC	VBC	t-value	ABC	VBC	t-value	ABC	VBC	t-value
All Conditions	1,596.85	1,680.13	5.83***	1,642.56	1,680.13	2.35**	1,538.45	1,556.47	0.57
Easy To Cooperate	1,641.95	1,689.72	2.68***	1,675.96	1,689.72	0.69	1,616.30	1,588.23	0.74
Unobservable Prices	1,650.99	1,713.41	3.43***	1,668.92	1,713.41	2.03**	1,621.83	1,642.58	0.47
No Starting Prices	1,478.39	1,626.80	4.74***	1,569.34	1,626.80	1.68*	1,382.75	1,386.77	0.1

Panel B: Comparisons and Statistical Tests for Coordination and Coordination2

	Coordination			Coordination2		
	Partial Dispersion	Full Dispersion	t-value	Partial Dispersion	Full Dispersion	t-value
Easy To Cooperate	21.03	46.30	2.89***	2.58	16.20	2.35**
Unobservable Prices	5.87	22.62	2.21**	1.14	3.97	1.36
No Starting Prices	52.38	86.76	5.03***	15.95	64.70	5.96***

TABLE 4:

Hypothesis 2 (Market Profits)

Table 4 reports the results for Hypothesis 2 for market profits as dependent variable. Panel A contains the Anova results and simple effects analysis for the contrast between Easy To Cooperate (ETC) and Unobservable Prices (UP). The Anova results and simple effects analysis for the contrast between Easy To Cooperate (ETC) and No Starting Prices (NSP) are reported in Panel B.

Panel A: Results for Easy To Cooperate (ETC) versus Unobservable Prices (UP)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$6.28*10^{11}$	2.09*1011	6.30	<0.01
Error	121	$4.02*10^{12}$	3.32*1010		
Corrected Total	124	$4.65*10^{12}$			

Factor	Df	SS	F	p-value
Dispersion	1	$2.44*10^{10}$	0.73	0.39
Ease of Cooperation	1	$5.18*10^{11}$	15.59	<0.01
Dispersion x Ease of Cooperation	1	$3.16*10^{10}$	9.52	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.77	>0.40
B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	4.24	<0.01

Panel B: Results for Easy To Cooperate (ETC) versus No Starting Prices (NSP)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$1.15*10^{12}$	$3.84*10^{11}$	4.57	<0.01
Error	121	$9.09*10^{12}$	$8.41*10^{10}$		
Corrected Total	124	$1.02*10^{13}$			

Factor	Df	SS	F	p-value
Dispersion	1	2.54*1010	0.30	0.58
Ease of Cooperation	1	8.46*1011	10.06	<0.01
Dispersion x Ease of Cooperation	1	7.06*1011	8.39	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.24	0.80
B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	3.66	<0.01

Hypothesis 2 (Individual Profits)

Table 5 reports the results for Hypothesis 2 with individual profits as dependent variable. Panel A and B (C and D) report the results when partial dispersion of accurate information is operationalized by giving the competitor (focal player) less accurate information. Panel A en C contain Anova-results and simple effects analysis for the contrast between Easy To Cooperate (ETC) and Unobservable Prices (UP). Anova-results and simple effects analysis for the contrast between Easy To Cooperate (ETC) and No Starting Prices (NSP) is reported in Panel B and D.

Panel A: Results for Easy To Cooperate versus Unobservable Prices (Competitor Less Accurate Info)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$3.02*10^{11}$	$1.01*10^{11}$	6.77	<0.01
Error	160	$2.38*10^{12}$	$1.49*10^{10}$		
Corrected Total	163	$2.68*10^{12}$			

Factor	Df	SS	F	p-value
Dispersion	1	5,668,112.44	0.00	0.98
Ease of Cooperation	1	$1.86*10^{11}$	12.53	<0.01
Dispersion x Ease of Cooperation	1	$1.30*10^{11}$	8.74	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.42	0.67
B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	4.48	<0.01

Panel B: Results for Easy To Cooperate versus No Starting Prices (Competitor Less Accurate Info)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$6.19*10^{11}$	$2.06*10^{11}$	8.96	<0.01
Error	143	$3.29*10^{12}$	$2.30*10^{10}$		
Corrected Total	146	$3.91*10^{12}$			

Factor	Df	SS	F	p-value
Dispersion	1	$5.94*10^{10}$	2.58	0.11
Ease of Cooperation	1	$2.53*10^{11}$	10.99	<0.01
Dispersion x Ease of Cooperation	1	$3.40*10^{11}$	14.75	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.38	0.70

B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	4.95	<0.01

Panel C: Results for Easy To Cooperate versus Unobservable Prices (Focal Player Less Accurate Info)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$3.34*10^{11}$	$1.11*10^{11}$	8.49	<0.01
Error	160	$2.10*10^{12}$	$1.31*10^{10}$		
Corrected Total	163	$2.43*10^{12}$			

Factor	Df	SS	F	p-value
Dispersion	1	$3.81*10^{10}$	2.90	<0.10
Ease of Cooperation	1	$2.09*10^{11}$	15.97	<0.01
Dispersion x Ease of Cooperation	1	$1.12*10^{11}$	8.52	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.78	0.44
B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	4.76	<0.01

Panel D: Results for Easy To Cooperate versus No Starting Prices (Focal Player Less Accurate Info)

Anova results

Source	Df	SS	MS	F	p-value
Model	3	$5.83*10^{11}$	$1.94*10^{11}$	9.03	<0.01
Error	143	$3.08*10^{12}$	$2.15*10^{10}$		
Corrected Total	146	$3.66*10^{12}$			

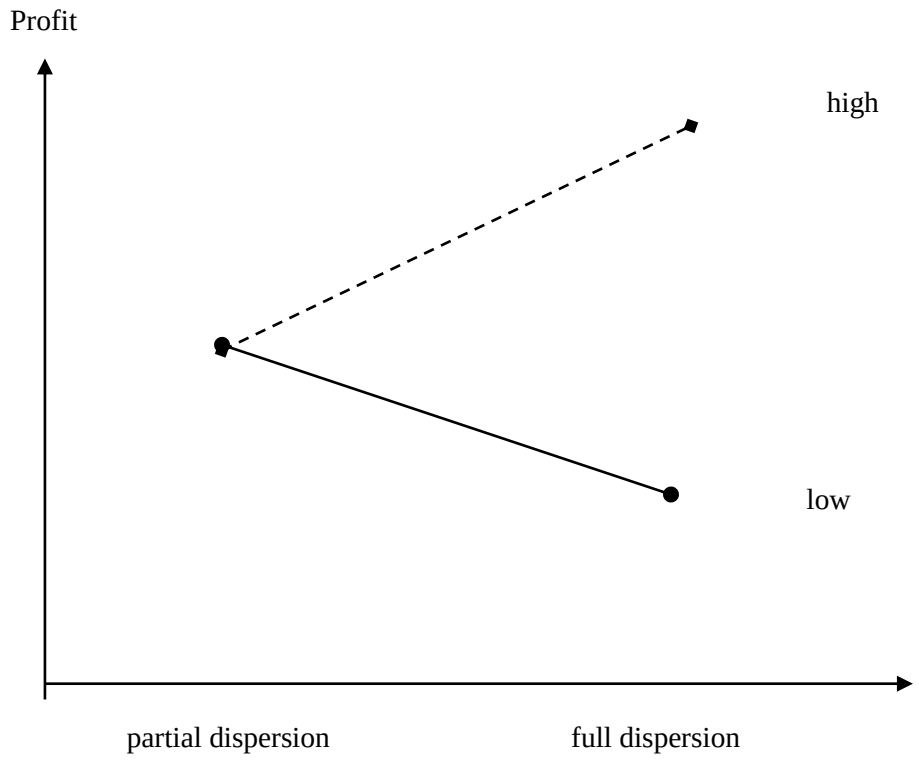
Factor	Df	SS	F	p-value
Dispersion	1	$2.05*10^{9}$	0.10	0.76
Ease of Cooperation	1	$3.97*10^{11}$	18.44	<0.01
Dispersion x Ease of Cooperation	1	$2.08*10^{11}$	9.65	<0.01

Simple Effects

Test	prediction	t-stat	p-value
A: Effect of ease of cooperation with partial dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	0.85	0.39
B: Effect of ease of cooperation with full dispersion of accurate cost information	$\mu_{low} < \mu_{high}$	5.12	<0.01

Expected Effects

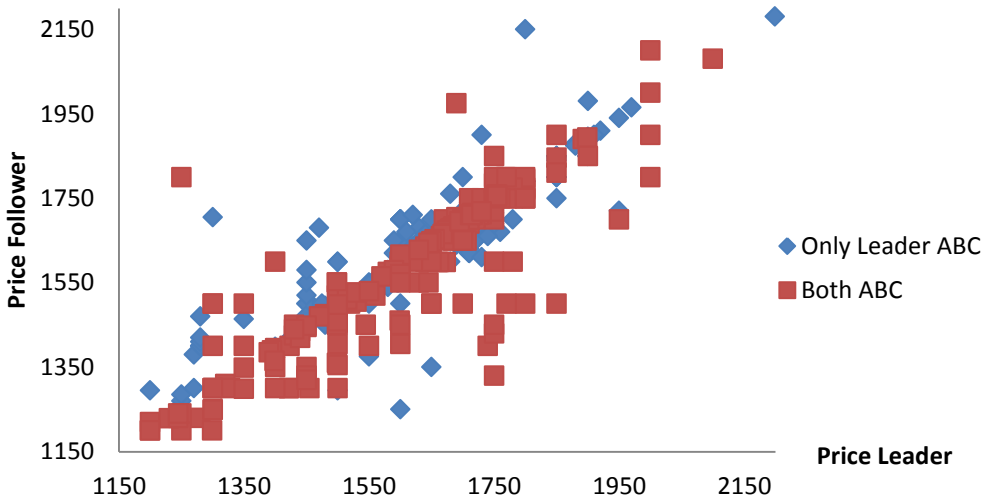
Figure 1 shows the expected effects based on Hypothesis 2. Partial dispersion implies that only one of both competitors has accurate cost information, full dispersion implies that both competitors have accurate cost information. 'High' refers to the treatment in which competitors can easily cooperate and 'Low' refers to the treatment in which competitors cannot easily cooperate.



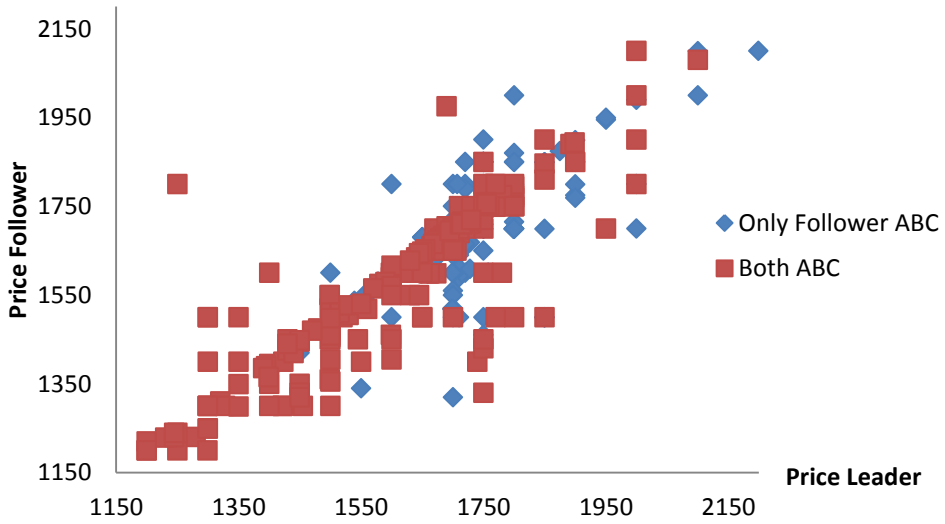
Scatterplots of Price Setting in Market B

Figure 2 presents the scatterplots that show price setting in market B. Panel A and B (C and D) [E and F] are the scatterplots for the Easy To Cooperate (Unobservable Prices) [No Starting Prices] treatment. Panel A, C, and E (B, D, and F) compare the price setting of the condition in which only the leader (follower) has accurate information with the condition in which both leader and follower have accurate information. The X-axis always refers to the price of the leader, the Y-axis refers to the price of the follower.

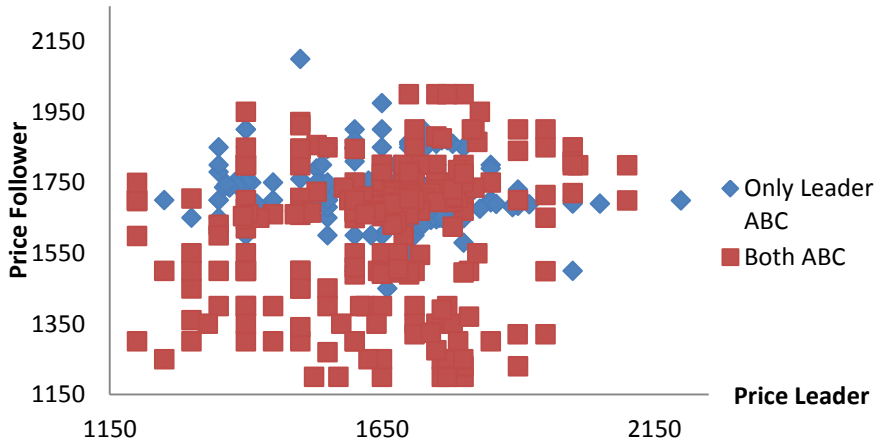
Panel A: Easy To Cooperate – Only Leader ABC



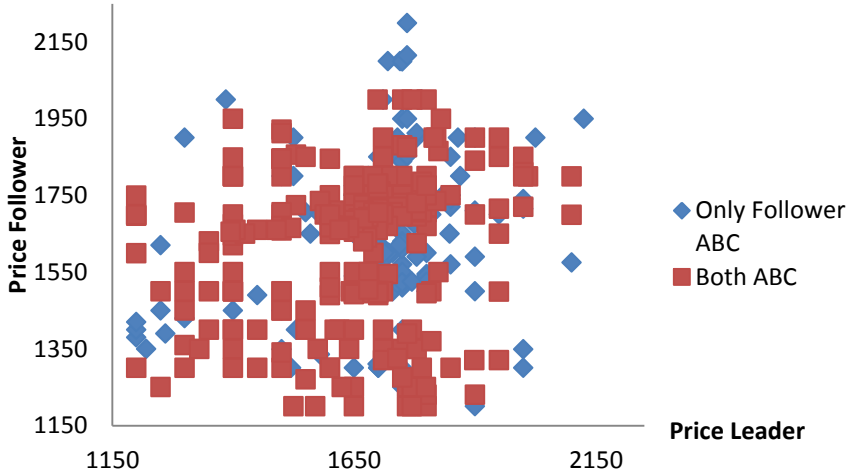
Panel B: Easy To Cooperate – Only Follower ABC



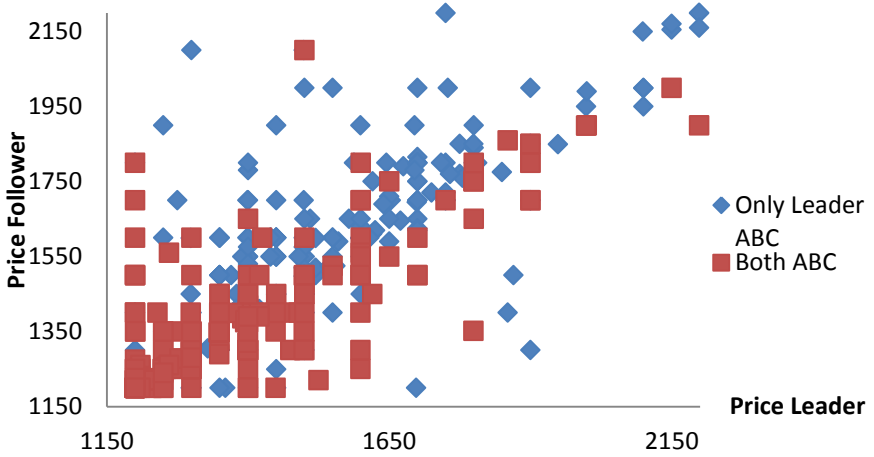
Panel C: Unobservable Prices – Only Leader ABC



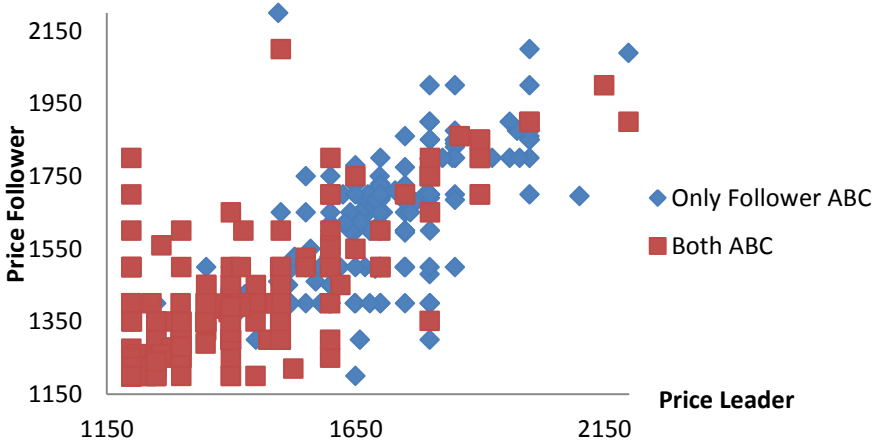
Panel D: Unobservable Prices – Only Follower ABC



Panel E: No Starting Prices – Only Leader ABC

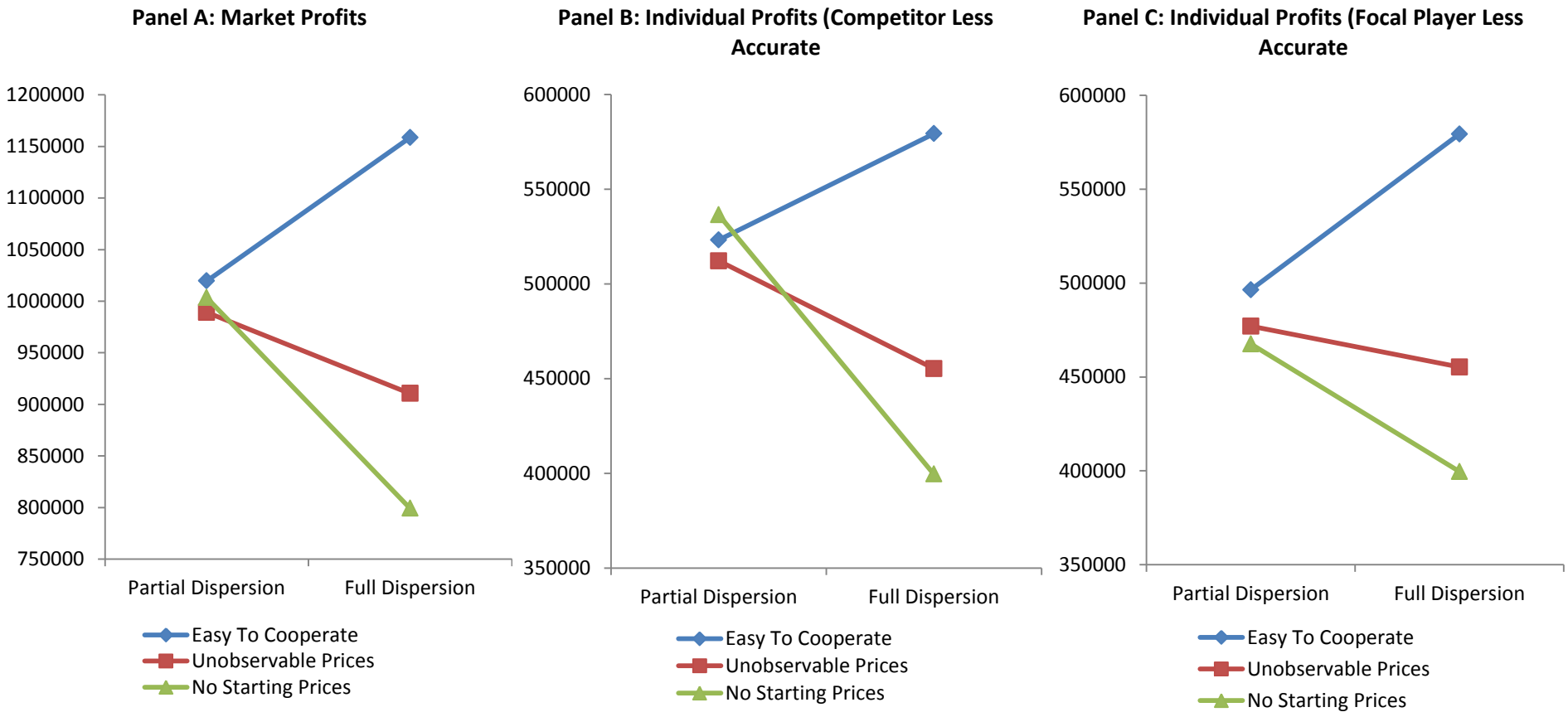


Panel F: No Starting Prices – Only Follower ABC



Market Profits & Individual Profits

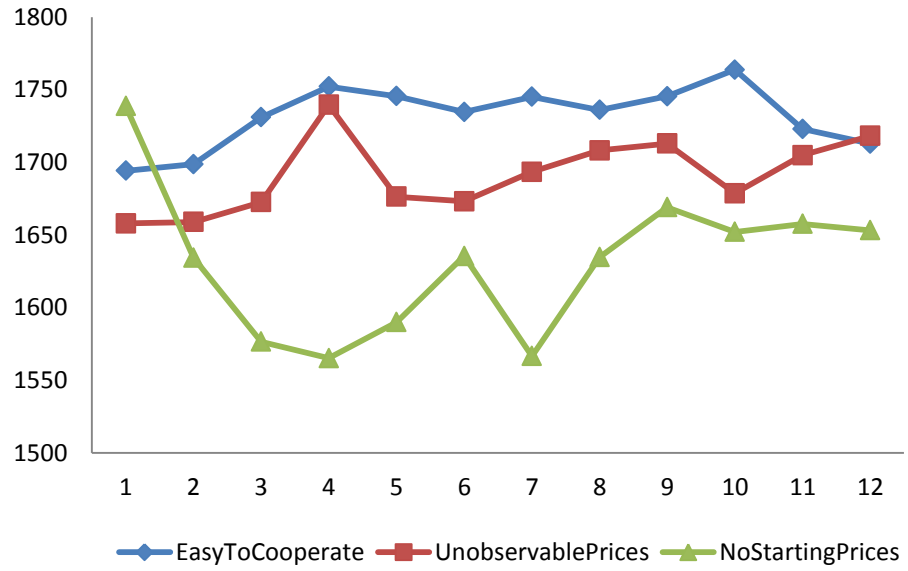
Figure 3 presents the graphical representation for the tests of Hypothesis 2. Panel A present the graph for market profits, Panel B and C for individual profits.



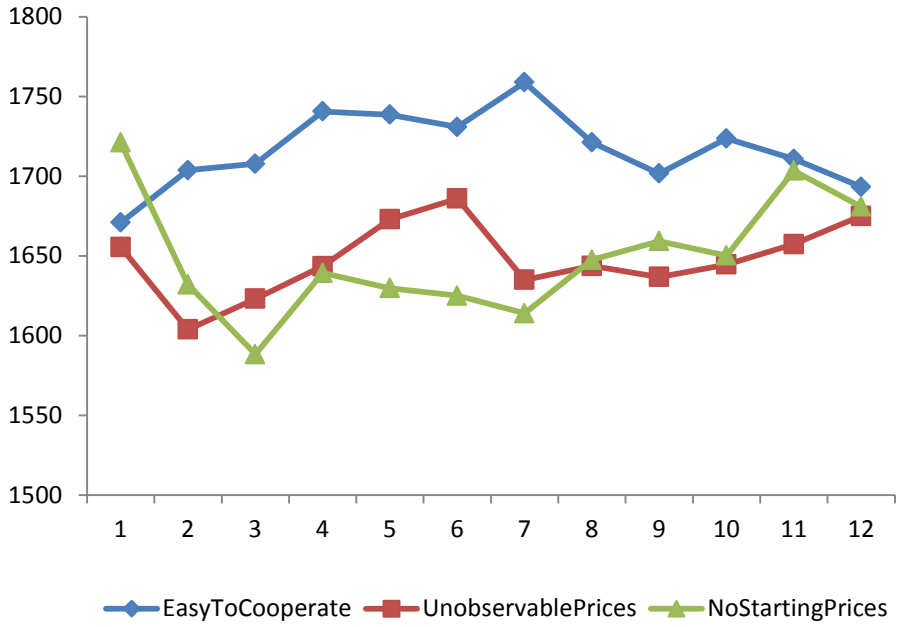
Prices in Market A

Figure 4 presents the graphical representations of the prices in market A. Panel A (B) presents the prices in market A of the leaders (followers).

Panel A: Prices in Market A Leaders



Panel B: Prices in Market A Followers



Allocation Method for Accurate and Less Accurate Cost Reports

We allocate the costs for the leader using the initial prices of the ETC- and UP-treatment ($P_{a\,L}$=1650; $P_{b\,L}$=1710 for the leader and $P_{a\,F}$ =1645; $P_{b\,F}$=1706 for the follower). The total indirect cost, calculated via equation 3c, is then equal to 2,521,118. A less accurate cost report uses sales volume (Qa and Qb, calculated via equations 1a and 1b) to allocate this total indirect cost to the two product markets. Accordingly, the two product markets have the same amount of indirect costs per unit of volume. A more accurate cost report divides this overhead into three categories, which represent respectively 35%, 40% and 25% of the total indirect cost. Overhead in these categories are then assigned by assuming cost drivers, in which market A always uses more of the cost driver per unit of sales volume than market B. As a result, the cost per unit volume is higher for market A than for market B.

Low-quality cost report

Total indirect cost = 2,521,118	Cost driver market A Qa: 2,277.25		Cost driver market B Qb: 699.3	
Indirect costs allocated to markets	$\frac{2{,}277.25*2{,}521{,}118}{2{,}277.25+699.3}$	1,928,815	$\frac{699.3 \times 2{,}521{,}118}{2{,}277.25+699.3}$	592,302
	Per unit of volume:	**847.0**	=	**847.0**

High-quality cost report

Total indirect cost = 2,521,118		Cost drivers market A	Cost drivers market B
Split up:	882,391.3 (35% of tot. indir. cost)	0.15 x Qa: 341.6	0.07 x Qb: 49.0
	1,008,447.2 (40% of tot. indir. cost)	2.30 x Qa: 5237.7	1.20 x Qb: 839.2
	630,279.5 (25% of tot. Indir. cost)	0.07 x Qa: 159.4	0.04 x Qb: 28.0

Indirect Costs Allocated to Markets	$\frac{341.6 \times 882{,}391.3}{341.6 + 49.0}$	771,790	$\frac{49.0 \times 882{,}391.3}{341.6 + 49.0}$	110,601
	$\frac{5{,}237.7 \times 1{,}008{,}477.2}{5237.7 + 839.2}$	869,189	$\frac{839.2 \times 1{,}008{,}477.2}{5237.7 + 839.2}$	139,258
	$\frac{159.4 \times 630{,}279.5}{159.4+28.0}$	536,191	$\frac{28.0 \times 630{,}279.5}{159.4+28.0}$	94,088
		2,177,171		343,947
	Per Unit of Volume	**956.1**		**491.8**

[14] Adapted from Cardinaels et al. (2008)

Appendix 2[15]

Screenshot of Private Cost Report and Information about the Competitor

The tables show what participants can observe during each round. They can always observe information about the previous six rounds of play. Only players in de UnobservablePrices-treatment do not observe the prices of the competitor in the two markets. The figures are calculated based on the initial prices of Experiment 1($P_{a\,L}$=1650; $P_{b\,L}$=1710 for the leader and $P_{a\,F}$ =1645; $P_{b\,F}$=1706 for the follower). A less accurate cost report is introduced as 'volume based costing' while a more accurate cost report is introduced as 'activity based costing'. For the latter costing method, we identify three activities (order processing, software installations and delivery). The costs of these activities are allocated to the markets by three activity drivers (number of orders, installations and deliveries).

Historical Information

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Price Market A						
Price Market B						
Total Profits						
Price Market A (Competitor)						
Price Market B (Competitor)						
Total Profits (Competitor)						

VBC [***ABC***] Report

	market A	margin	market B	margin	Total	Margin
Price	1650		1710			
Sales Volume	2277		699		2977	
Revenues	3757463		1195803		4953266	
Cost of goods sold	1434668	38.2%	496503	41.5%	1931171	39.0%
Indirect costs*	1928815	51.3%	592302	49.5%	2521118	50.9%
Indirect costs*	***2177171***	***57.9%***	***343947***	***28.8%***		
	#	***costs***	***#***	***costs***		
Order processing	***341.6***	***771790***	***49.0***	***110601***		
Software installation	**5237.7**	**869189**	**839.2**	**139258**		
Delivery	**159.4**	**536191**	**28.0**	**94088**		
Profits	*393980*	*10.5%*	*106988*	*8.9%*	500977	10.1%
Profits	***145624***	***3.9%***	***355353***	***29.7%***		
Unit cost	1477.0		1557.0			
Unit cost	***1586.1***		***1201.8***			

* are allocated using sales volume as a cost driver
[#: respectively the number of orders, software installations and deliveries]

Report about your competitor

Price market A	1645
Price market B	1706
Total profit	500639

[15] Adapted from Cardinaels et al. (2008)