Corporate Governance and Antitrust Behavior*

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Abstract

Theoretical research shows that not only potential profits from price fixing but also management incentives problems may be related to a firm's decision to participate in a cartel. Consequently, certain corporate governance mechanisms may facilitate or prevent collusive agreements. In this paper, we use a sample of 1,612 observations on 225 U.S. cartelist firms from 1986 to 2010 to empirically investigate the relation between the probability of participating in a cartel and various corporate governance and other firm and market characteristics. Our results show that large, mature, low-growth firms in concentrated industries are most likely to participate in a cartel. Although a few corporate governance mechanisms are significantly related to the probability of participating in a cartel, we do not find an overall positive or negative relation between corporate governance and cartelistic behavior. We find the growth rates of cartel firms to be significantly higher in terms of market value, sales, employees, and PPE compared to a set of matched control firms. Hence, cartelists seem to match their higher growth rates in sales and market value by higher investments to cover up that their growth stems from price fixing agreements. Finally, we find that during the period of collusive behavior CEOs and top executives exercise a significantly higher fraction of their exercisable options than CEOs and executives in comparable firms.

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1. Introduction

In October 1996, Archer Daniels Midland (ADM) pled guilty to criminal price fixing with respect to sales of lysine and agreed to pay a USD 70 million fine. The three Japanese and Korean main co-conspirators already pled guilty in August 1996 and all four companies settled civil suits filed by harmed lysine buyers by paying a sum of USD 45 million in July 1996. The lysine cartel was formed in 1992 upon the large-scale entry of ADM into the market in 1991 and a subsequent 18-month price war presumably resulting in zero profits or even losses for lysine producers. The lysine cartel was precedent-setting in several ways. For example, it was virtually the first antitrust case to employ the Congressionally-mandated guidelines for imposing fines on felons (Connor, 2001) including, for example, much higher fines than the previously USD 10 million statutory limit prescribed by the Sherman Act as amended in 1990. The civil settlements made in the lysine case and the related citric acid case, in which ADM was involved as well, were among the highest ever made until the end of the 1990s, a total of approximately USD 245 million.[1]

As of the 1990s, antitrust authorities generally started to pay more attention to collusive behavior of firms engaging in price fixing agreements (i.e., cartels). In the early 2000s, worldwide corporate penalties for firms participating in such cartels stabilized at or above $2 billion per year (Connor and Helmers, 2007). More than 40% of those penalties can be attributed to settlements in private suits. The remaining 60% are mainly fines imposed by U.S. and European Union antitrust authorities. Connor and Helmers (2007) define a cartel as follows: "A cartel is an association of legally independent firms that aims to raise their joint profits through explicit agreements. Hard-core cartels aim to control prices or restrict supply (or both)."

[1] For more information on the lysine cartel and its criminal prosecution, see Connor (2001) and White (2001). The lysine cartel even made it to the big screen and is featured in the movie "The Informant!" directed by Steven Soderbergh and starring Matt Damon.

Previous theoretical research shows that not only potential profits from price fixing but also management incentives problems may be significantly related to the decision of a firm to participate in a cartel (e.g., Spagnolo, 2005; Levenstein and Suslow, 2006). Spagnolo (2005) adds managerial incentives schemes to a supergame-theoretical model of dynamic competition and shows that when managers have a preference for smooth time paths of profits and when their contracts have capped incentive provisions (e.g., common bonus plans or termination contracts with substantial incumbency rates), manager-led firms can sustain collusive agreement at lower discount factors. His model shows that even though income smoothing is costly, shareholders tolerate this cost as they are compensated by higher collusive profits.

Buccirossi and Spagnolo (2008) show based on a classical model of repeated oligopoly that the stability of tacit collusive agreements is expected to be positively correlated with performance-based incentives provided to top management. In general, there are mainly two problems cartels have to overcome to succeed: cheating and the entry of new firms (Levenstein and Suslow, 2006). If a firm deviates from a collusive agreement (e.g., by lowering prices), the resulting additional earnings have to be disclosed in the firm's financial statements. Suspicious partner cartelists are likely to detect those exceptional earnings and could react by starting a price war which will then result in lower profits and stock prices. Moreover, a price war can be indicative of a prior collusive agreement and draw attention from antitrust authorities. The resulting (future) costs may be so large in present value terms that defection from collusive behavior is not attractive. Another big challenge for cartels is that other firms enter the industry and destroy the collusive equilibrium. Thus, successful cartels are often located in concentrated industries which facilitate collusive conduct (Bolotova, Connor, and Miller, 2008).

The decision to form a cartel is typically taken at the very top level of the firms' hierarchy (Harrington, 2006) and then implemented by the intermediate management (Spagnolo,

2005). Hence, the same corporate entities which are at the center of the recent corporate governance discussions, i.e., the CEO and top management team and the board of directors, are directly involved in potential collusive price fixing agreements of their firms. Thus, the question arises whether corporate governance is significantly related to the probability that a firm participates in a cartel. Specifically, certain corporate governance structures may facilitate or prevent collusive agreements and membership in a hard-core cartel. For example, a high concentration of power at the top level, a weak board of directors, or strong pay-for-performance incentives provided to top managers (Spagnolo, 2005) may facilitate participation in a cartel. To the best of our knowledge, there is no empirical literature so far that investigates the relation between firm-level corporate governance and cartelistic behavior.

This paper aims at filling this gap by investigating the relationship between the probability that a firm participates in a cartel and various firm characteristics, market concentration, and corporate governance mechanisms. Moreover, we investigate the relation between cartel membership and firm performance as measured by Tobin's Q, return on assets (ROA), and stock excess returns as measured by an alpha from a Carhart (1997) four-factor model. Given the recent evidence of a significant effect of product market competition on the relation between corporate governance and firm performance (e.g., Allen and Gale, 2000; Giroud and Mueller, 2010, 2011) and the expected relation between collusive conduct and market concentration and therefore competition, we account for both corporate governance and competition in this analysis. Further, we investigate whether cartelist firms attempt to cover up their conspirative actions. We use an empirical framework introduced by Kedia and Philippon (2009), who investigate cover up actions by firms involved in fraudulent accounting. Specifically, we investigate whether cartelist firms differ significantly from non-cartelists in their growth dynamics of market values, sales, employment, and investments. Finally, we investigate whether insider trading is significantly higher during the cartel period. This would indicate that CEOs,

or other managers and directors, know about the collusive agreement in their firms and attempt to exploit the stock prices possibly inflated by the cartel agreement. It could also be an indicator that CEOs attempt to get rid of their exercisable options as long as the cartel is undiscovered and prices are presumably higher.

We use data on a sample of 1,612 firm-years on 225 U.S. firms participating in a hard-core cartel between 1986 and 2010. We define a cartel firm-year as year in which the given cartelist has been involved in price fixing. The starting point and duration of the cartels in our sample are determined by the antitrust authorities.[2] We compare these cartelist firm-year observations to a set of matched control firms. The set of control firms consists of size- and industry-matched firms which are drawn from the complete Compustat universe with non-cartel years of firms that appear at some time in the cartel sample being excluded.

Our results show that larger and more mature firms and firms which experienced a relatively low sales growth over the last few years are more likely to participate in a cartel. Also, more concentrated, i.e., less competitive product markets, seem to facilitate collusive agreements to fix prices and are positively related to the probability that a firm participates in a cartel. As for the corporate governance measures, we do not find an overall clear positive or negative relation between what is generally considered to be good corporate governance in the literature and the probability of being part of a cartel. However, several of the individual corporate governance mechanisms are significantly related to the probability of participating in a cartel. For example, the E-Index is significantly negatively related to the probability that a firm participates in a cartel. As a higher E-Index indicates stronger takeover protection, a possible explanation for this finding is that firms, which are better protected from the market of corporate control, worry less about profitability and therefore are less likely to participate in a cartel. Further, we find that firms which have a high fraction of busy directors in their board

[2] As the majority of other empirical studies on cartels, our sample is subject to a selection bias as we are only able to consider discovered and indicted cartels (e.g., see Connor, 2010).

are more likely to participate in a cartel. These directors are usually known as low-attention directors. On the other hand, sitting on many boards increases the probability of connection with other firms.

With respect to the valuation effect of cartel membership, we find cartel firm-years to be associated with a significantly higher Tobin's Q. This finding is consistent with Levenstein and Suslow (2006) and Connor (2010) who argue that the expected payoff from participating in a cartel is positive: Collusive agreements are of advantage to shareholders as profits will increase if not detected. And even if detected and convicted, penalties usually correspond to the overcharges resulting from above market prices and therefore result in a zero sum game. The high incidence of recidivists maybe considered as additional evidence in support of this conjecture (Connor, 2010). Consistent with Habib and Ljungqvist (2005), we also find a positive relation between product market competition and firm value. Griffith (2001) argues that the direction of the effect that product market competition should have on firm value is ambiguous. On the one hand, competition lowers a firm's profits and thus reduces incentives to exert effort (i.e., the Schumpeterian effect). On the other hand, it reduces agency costs and therefore increases incentives to exert effort. In our sample, the latter effect seems to outweigh the former. These results, however, do not hold when corporate governance variables are accounted for. We find no significant relation between cartel membership and ROA and between cartel membership and alpha. Moreover, we find that cartel firms do not differ significantly from their size and industry matched peers with respect to their investment behavior as proxied by CAPX, R&D, and acquisition spending.

Our results also show that the growth rates of cartel firms are significantly higher in terms of market value, sales, employees, and PPE during the cartel period compared to the firms in the control groups. Hence, cartelists seem to match their higher growth rates in sales and market values by higher investments in employees and PPE to cover up that their growth

stems from price fixing agreements. Finally, we find that during the period of collusive behavior CEOs and top executives exercise a significantly higher fraction of their exercisable options than CEOs and executives in comparable firms. This could be an indicator that not just the CEO but also the executives are part or at least are informed about the price fixing agreements.

The remainder of the paper is organized as follows. Section 2 describes the sample and variables. Section 3 reports the results from the empirical analysis. Section 4 concludes.

2. Data and variables

2.1 Sample selection

This section gives a description of the data and variables used in this study. We use the cartel data of Connor (2010), a hand collected sample of 648 international hard-core cartels whose members where subject to government or private legal actions. The dataset comprises the firms' names, the country of incorporation, the market(s) and continent(s) on which collusion and price fixing took place, the lead jurisdiction, the duration of the collusive agreement, and – if known – the fines (including leniency) and the estimated overcharges. The information is collected from different sources, mainly filings, documents, reports, and press releases from the antitrust authorities. Another source of information are newspaper and magazine articles which are available through search engines like Factiva or LexisNexis. For more details on the method of data collection we refer to Connor (2010).

We define a cartel firm-year as year in which the given cartelist has been involved in price fixing. The starting point and duration of the cartels in our sample is determined by the antitrust authorities. As a simple check of the appropriateness of this classification, we report the yearly return on assets (ROA) over a symmetric window of five years around the year which has been determined as the starting point of the cartel in Figure 1. In fact, the figure

shows that profitability monotonously decreases over the five years before a firm enters into a cartel and then nearly monotonously increases over the subsequent five years. Like most other empirical studies on cartels, we are only able to consider discovered and indicted cartels. Thus, our study may suffer from a sample selection bias. Connor and Helmers (2007) estimate that only approximately 10% to 30% of all price-fixing conspirations are discovered.

The starting point of our sample consists of all 819 U.S. cartel members included in the above dataset. We exclude all cartels which started before 1986 and all firms which are not covered by Compustat which substantially reduces sample size to 225 firms. Overall, we obtain data on 1,612 firm-year observations of these 225 different firms. Recidivism is known as a major problem in cartel enforcement (Connor, 2010). Thus, 68 out of our 225 firms attempted more than once to increase profits through explicit price agreements. In some of the multivariate analyses, we also include stock returns from the Center for Research in Security Prices (CRSP). In some of our analyses, we merge the 225 firms to the RiskMetrics Governance and Directors databases (formerly Investors Responsibility Research Center (IRRC)), Standard and Poor's ExecuComp database, and Thomson Financial's CDA/Spectrum database, which further reduces samples size. Data on firms that have been named in federal class action securities fraud lawsuits stem from the Stanford Law School Securities Class Action Clearinghouse (securities.standford.edu). The clearing house maintains an index of fillings from 1996 onwards. 553 of the firms appearing in this index (with a total of 718 firm-years) are also in our sample of cartelist and matched firms.

2.2 The control group of matched firms

Since our sample of cartelists consists of only 1,612 cartel firm-years and the full-set of non-cartelists in Compustat consists of more than 249,000 firm-years, we would compare a relatively small sample of cartel firm-years to a very large sample of possibly hardly comparable control firm-years. To compare our cartelist firm-years to a smaller sample of compara-

ble firm-years, we follow the approach of Kedia and Philippon (2009). Specifically, for every cartelist, we create a group of non-cartelists which operate in the same two-digit SIC industry and which are located in the same total assets quintile in the year before the collusive agreement started. If the collusive agreement was already set up at the start of our sample period, we use the first cartel firm- year in our sample to form the corresponding control group. Even though our industry and size matching algorithm aims at matching the cartelists to equally sized firms within the same industry, the cartelists often are the largest firms in their industry. This makes intuitively sense as substantial market power is necessary to be able to influence (i.e., fix) prices. To cope with this problem, we use the natural logarithm of total assets as control variable in our regressions. The matched sample includes a total of 1,612 cartel firm-years of 225 cartelists and 3,472 control firms (52,818 firm-years).

2.3 Variable definition

To measure corporate governance, we use a large set of individual corporate governance mechanisms stemming from different data sources. First, to account for the firms' anti-takeover protection, we use the Entrenchment Index (E-Index) proposed by Bebchuk, Cohen, and Ferell (2009) which concentrates on the six most important provisions included in the well-known G-Index (Gompers, Ishii, and Metrick, 2003).[3,4] A high E-Index (or G-Index) implies more takeover defenses and therefore lower shareholder rights as the managers are better protected from the market for corporate control. The data is obtained from the RiskMetrics Governance database. Since data is only available for every second or third year, we follow previous research (e.g., Gompers, Ishii, and Metrick, 2003) and assume that the firms' governance attributes as reported in a given RiskMetrics series remain unchanged until publication of the subsequent series.

[3] The six provisions included in the E-Index are dummy variables for a staggered board, limitations on amending bylaws, limitations on amending the charter, a supermajority requirement to approve a merger, golden parachutes, and poison pills.

[4] In fact, we find the results to be slightly weaker when we use the G-Index instead of the E-Index in unreported robustness tests.

In addition to the E-Index, we include five variables related to the board of directors: board size (Yermack, 1996), the percentage of directors who are independent outsiders (Rosenstein and Wyatt, 1990), the percentage of directors who attend less than 75% of the board meetings (Adams and Ferreira, 2009), a dummy variable whether the CEO is also the chairman of the board and the only inside director on the board (Adams, Almeida, and Ferreira, 2005), and a dummy variable whether a majority of the outside directors holds three or more directorships (Fich and Shivdasani, 2006). Data on all five variables is obtained from the RiskMetrics Directors database. Two additional corporate governance variables which measure CEO ownership and CEO power are obtained from the ExecuComp database: the percentage of shares owned by the CEO (Mehran, 1995) and CEO centrality (Bebchuk, Cremers, and Peyer, 2011). Bebchuk, Cremers, and Peyer (2011) use as a proxy for CEO centrality the CEO's pay slice. The CEO's pay slice is computed as the percentage of the total compensation of the top five executives that goes to the CEO. Finally, we attempt to account for the ownership structure and include the ownership by blockholders who hold more than 5% of the firm's equity (Shleifer and Vishny, 1986). This variable is obtained from Thomson Financial's CDA/Spectrum database.

To analyze the CEO's trading activities we obtain data on CEO option exercises from ExecuComp. The value realized from options exercised is calculated as the total value realized from options exercised over the total value realizable from options with the latter being calculated as the sum of the value realized from options exercised and the value of exercisable options. As an alternative measure, we also use the number of options exercised over the number of all exercisable options (Kedia and Philippon, 2009).

The financial data is obtained from Compustat and CRSP. As a measure of product market competition we use the Herfindahl-Hirschman Index (HHI). The HHI is computed as

the sum of the squared market shares of all firms in a given industry. Firms are assigned to an industry by their full 4-digit SIC industry codes. In order to deal with the known shortcomings of the HHI (e.g., Masulis, Wang, and Xie, 2007) we use for robustness tests the competition measure proposed by Titman and Wessels (1988), i.e., the industry median ratio of selling expenses over sales. We measure firm value by the simple approximation to Tobin's Q often used in the literature (e.g., Agrawal and Knoeber, 1996; Gompers, Ishii, and Metrick, 2003) and defined as total assets minus the book value of equity plus the market value of equity over total assets. As a proxy for firm age we use the natural logarithm of the number of years since a company is first included in the CRSP database. We calculate the annual alpha of the firms by conducting a 24-month rolling window regression of the Carhart (1997) four-factor model:

$$R_t^{Ex} = \alpha + \beta_1 \times MKT_t + \beta_2 \times SMB_t + \beta_3 \times HML_t + \beta_4 \times UMD_t + \varepsilon_t ,$$

where R_t^{Ex} is the excess return of the stock, *MKT* is the market return in excess of the risk-free rate, *SMB* is the size factor, *HML* the book-to-market factor and *UMD* is the momentum factor. The abnormal return is the intercept (alpha) of the above regression. We use the annualized December returns as regression input. Bolotova, Connor, and Miller (2008) explain that concentrated markets are usually characterized by high barriers to entry and exit and thatfirms in those markets are confronted with high fixed costs. We therefore include capital expenditure over total assets in our analysis. We further use the following financial variables: firms size (log of total assets), leverage, research and development expenditures scaled by sales (R&D), return on assets (ROA), the past three year growth in sales, and a dummy variable whether the firm pays a dividend. We winsorize several of our financial variables at the 1st and 99th level: leverage, Tobin's Q, R&D/Sales, ROA, the percentage of block ownership, and the percentage of shares owned by the CEO.

To analyze the growth dynamics of our cartelists, we calculate growth rates of market value, sales, employees, property, plant and equipment (PPE), the ratio of capital expenditures

to PPE, and labor productivity (sales per employee). The growth rates are the one year log differences. We winsorize all growth variables to an interval of -1 and 1. Furthermore, we adjust the growth variables of the cartelists by subtracting the mean of the corresponding control group, which consists of all firms which operate in the same two-digit SIC industry and are in the same total asset quintile the year before the collusive agreement starts.

2.4 Descriptive statistics

Table 1 provides descriptive statistics of the main variables for the cartelists and the control group of matching firms. The results show that cartel firms operate in more concentrated markets than the control firms. This finding is expected as collusive agreements are easier to make and maintain in more concentrated markets where a relatively small number of firms have a relatively large market power. Consistently, cartel firms are larger, older, and more profitable than the firms in the control group. Mean Tobin's Q is slightly higher for the control firms-years than for the cartel firm-years, but the median of the cartelists is higher. Table 1 gives mixed indications whether firms which commit antitrust agreements have a better corporate governance structure than our control firms. For example, cartel firm-years are characterized by a lower E-Index, higher block ownership, more independent boards, a higher incidence of a combined CEO-chairman position, but also smaller CEO ownership, larger boards, and more busy directors on the board. Hence, it is important to investigate the relationship between collusive conduct and corporate governance in a multivariate setup.

3. Empirical Results

3.1 Antitrust behavior and corporate governance

We first investigate whether there are certain firm characteristics which are significantly related to the probability of a firm engaging in price fixing agreements. We estimate a probit model with a dummy variable which equals one for all years in which an identified cartelist

firm was involved in price fixing as dependent variable. As the duration of the cartel in our sample is determined by the antitrust authorities and therefore depends on the evidence found in their investigations, we exclude all firm-years of identified cartelist firms in which these firms – to our knowledge – were not engaged in collusive agreements from the sample of control firms. Hence, the sample includes all firm-years of cartelist firms in which they were presumably involved in price fixing and all firms from our matched control group with available data on Compustat which never appear in our dataset of cartelist firms. In unreported robustness checks, we additionally include the last firm-year of cartelist firms before the price fixing effectively started in our analysis to account for a potential time lag between the decision making process and negotiations to form a cartel and the actual price fixing. Including these additional (cartel) years in general strengthens the significance of our results. All regression specifications include industry and year fixed effects to account for potential omitted variables which are industry or year specific. We classify industries based on the first two digit of the SIC industry codes.[5]

In the first specification, we include a number of financial variables as independent variables. These variables include the natural logarithm of total assets to control for firm size, the HHI to control for competition in the firms' (main) industry, and sales growth over the past three years to take growth opportunities into account. Moreover, we account for the entry fixed costs in a market by including capital expenditures over total assets. As additional control variables, we include leverage, firm age, return on assets, R&D expenditures, and a dummy variable whether the firm is paying a dividend. In the second specification, we additionally include the full set of corporate governance variables as outlined above. In the third specification, we additionally include CEO centrality as a measure of CEO power. The inclusion of

[5] In unreported robustness tests, we use the Fama and French (1997, FF) industry classifications. We assign firms to the 12 FF industries by matching the SIC codes to the 12 FF industries using the conversion tables provided on Kenneth French's website. Our results remain virtually unchanged when using this alternative industry classification.

this variable results in a further reduction in sample size. In the last specification we include a dummy variable if a firm was indicted for security fraud in the given year.

Table 2 reports the results. The coefficients on total assets and the dividend dummy variable are positive and significant. The coefficient on firm age is always positive, however, significant only in the first two specifications. In contrast, the coefficients on past sales growth and R&D/sales are always negative and significant. Hence, larger and more mature firms seem to be more likely to participate in a cartel than young growth firms. As expected, the positive and significant coefficient on the HHI shows that cartel firms are more likely to be active in concentrated industries which facilitates collusive agreements to fix prices. These findings are consistent with Connor (2010) who shows that most of the cartel members are international conglomerates which have a division operating in industrial goods (e.g., manufacturing sector, chemical intermediates, or non-metallic minerals). These are typically highly concentrated industries. The coefficient on CAPX/total assets, our proxy for fixed costs, points into the expected direction in specifications 2 to 4, however, is not significant.

As for the governance measures, the results show that the coefficient on the E-Index is negative and significant at the 1% level. A higher E-Index indicates stronger takeover protection. Hence, a possible explanation for this finding may be that better protected firms worry less about profitability and therefore are less likely to participate in a cartel. Busy boards are positively related to the probability of participating in a cartel. Sitting on different boards gives directors the opportunity to connect with other firms. The coefficient on CEO centrality is negative and significant indicating a flat hierarchy at the top level of the cartel firms. This finding contradicts the hypothesis that cartel firms have a powerful CEO. The coefficient on the combined CEO-chairman variable, another measure of CEo power, is insignificant.

3.2 Antitrust behavior and security fraud

One could expect that firms participating in collusive behavior have incentives to conceal the conspiracy. This could lead to artificial accounting that requires restatements or even leads to lawsuits for security fraud. We merge our sample with a list of companies which have been named in federal security fraud lawsuits. 553 firms in our sample have been named in a federal security fraud lawsuit (718 fraud firm-years). Out of our 225 cartelists, 60 have been indicted for security fraud in 79 firm-years. The correlation coefficient between the variables measuring the number of cartel memberships of a firm and a variable measuring the number of indictions for security fraud is 0.19 and significant at the 1% level. We also investigate the relation between cartel membership and security fraud in a multivariate framework by including a dummy variable whether a firm is indicted for securities fraud in a given year in our probit estimations in Column 5 of Table 2. In fact, the fraud dummy variable is positive and significant and the 1% level.

3.3 Antitrust behavior, corporate governance, and firm performance

In this section, we investigate the relationship between collusive agreements and different measures of firm performance. The three measures of firm performance we use, are Tobin's Q as a measure of firm valuation, ROA as a measure of operating performance, and an alpha from a 24-months rolling window regression based on a Carhart (1997) four-factor model as a measure of stock price performance. We estimate two types of regressions. The first includes only a dummy variable for cartel firm-years and financial control variables as explanatory variables, the second type additionally includes corporate governance control variables. As before, we exclude non-cartel years of the cartelist firms from the analysis. All regressions include industry- and year-fixed effects. Since the observations for one specific firm (for different years) are clearly not independent (within correlation), we compute cluster-

robust standard errors and treat each firm as a cluster. The set of financial control variables is based on previous research (e.g., Yermack, 1996; Gompers, Ishii, and Metrick, 2003).

The results are reported in Table 3. Most importantly, the results in the first column show that cartel firm-years are characterized by a significantly higher Tobin's Q. Also, competition as measured by the industry concentration index, has a positive effect on firm value. This finding may be surprising at first sight. However, Griffith (2001) argues that the direction of the effect that product market competition should have on firm value is ambiguous as competition lowers a firm's profits and thus reduces incentives to exert effort (i.e., the Schumpeterian effect) but on the other hand it reduces agency costs and therefore increases incentives to exert effort. In fact, the sparse previous literature on the valuation effect of competition finds contradicting results. Habib and Ljungqvist (2005) report a positive relation between product market competition and firm value and Beiner, Schmid, and Wanzenried (2011) find a negative relation between competition and firm value. In Column 2, only two of the nine corporate governance variables have significant coefficients. Consistent with previous research, the coefficient on the E-Index is negative and significant indicating a lower valuation for firms with stronger anti-takeover protection and weaker shareholder rights (e.g., Bebchuk, Cohen. and Ferrell, 2009; Cremers and Ferrell, 2012). The coefficient on board size is also negative and significant confirming previous research (e.g., Lipton and Lorsch, 1992; Jensen, 1993; Yermack, 1996) that larger boards are less effective and less effective monitors. The coefficients on the other governance variables show, with the exception of the coefficient of busy board, the expected signs but are not significant.

The results in Column 3 with ROA as dependent variable show that controlling for other firm characteristics and industry effects, cartel-firms years are characterized by a lower profitability which might be one of the reasons for participating in a cartel in the first place. When corporate governance variables are accounted for, the coefficient on cartel years turns insig-

nificant, however. Moreover, the results in Column 4 show that the coefficient on the E-Index is not significant anymore. However, there is evidence of a positive and concave relation between CEO ownership and profitability and a positive relation between block ownership and profitability. The coefficient on the busy board variable is positive and significant which seems surprising as previous research indicates a negative relationship between board busyness and profitability (Fich and Shivdasani, 2006).

In Columns 5 and 6, with alpha as dependent variable, the coefficients on the cartel dummy variable are insignificant. Hence, the risk-adjusted returns do not seem to differ between cartel and control firm-years.

3.4 Antitrust behavior and investment and hiring decisions

Kedia and Philippon (2009) find that firms committing accounting fraud hire and invest more than comparable firms during the periods when they misreport. They argue that firms try to cover the poor productivity by hiring and investing as if productivity was high. In this section, we investigate whether the investment behavior differs between cartelist firms and non-cartelist firms and we focus on the dynamics of employment and investment.

In a first step, we regress three alternative measures related to the firms' investment behavior on the cartel dummy variable and a number of financial control variables including Tobin's Q and past sales growth to proxy for growth opportunities, the HHI to proxy for competition on the product markets, firm age and size to proxy for the firms' maturity, the dividend dummy to proxy for the availability of internal funds which makes it unlikely that a firm is capitally constrained, and leverage. The results are reported in Table 4. The three measures for a firm's investment behavior that we use are CAPX/total assets (Column 1), R&D/sales (Column 2), and money spent on acquisitions divided by the market capitalization (Column 3). As the value of all three dependent variables is equal to zero for a nontrivial fraction of our

sample, while it is roughly continuously distributed over positive values, we account for this censoring of the dependent variable by estimating tobit regressions. Most importantly, the results show that the coefficients on the cartel dummy variable in all columns are insignificant indicating that cartel firms do not have higher capital expenditures and invest more in risky R&D or acquisitions than other firms. We interpret this as evidence that the cartelists' investment behavior, controlling for various financial characteristics of the firms, do not significantly differ between cartelist firms and control firms.

The coefficients on the financial controls indicate that both, better growth opportunities as measured by Tobin's Q and more competition are associated with higher investments in R&D and CAPX. Also, younger firms invest significantly more in all three, CAPX, R&D, and acquisitions. R&D investments are significantly higher for smaller firms. In contrast, larger firms have higher expenses for acquisitions. Leverage is negatively related to R&D expenditures and acquisitions. This makes sense as highly leveraged firms may be less willing and able to undertake risky investments in R&D. Finally, the negative coefficients on R&D/sales and CAPX/total assets in all columns in which they are included indicates that the different type of investments are considered as substitutes for each other.

To compare the dynamics of hiring and investment for cartelists during the period of collusive agreements, we follow the framework of Kedia and Philippon (2009). The variables we consider to proxy for firm growth are the growth rate of the market value and the growth rate of the firms' sales. To capture hiring decisions, we use the growth rate of the number of employees. To analyze investment decisions, we calculate the growth rate of PPE and the growth rate of the ratio of CAPX to PPE. We use the growth rate of sales per employee as a measure of labor productivity. Finally, we use the growth rate of ROA to analyze the profitability during the cartel period. We adjust the growth variables by subtracting the mean of the corresponding control group. We estimate the following OLS regression specification:

$$g_{it} = \alpha + \beta^{before2} 1_{before2} + \beta^{during} 1_{during} + \beta^{after2} 1_{after2} + u_{it}$$

where $1_{before2}$ and 1_{after2} are dummy variables indicating the two last years before the cartel period and the two subsequent years after the cartel period ends, respectively. A positive and significant β^{during} implies that cartel firms grew faster than comparable firms in their industry and in the same total assets quintile. $\beta^{before2}$ and β^{after2} capture the growth dynamics two years before and two years after the cartel period, respectively. The standard errors are clustered at the firm level. To investigate changing growth dynamics, we also test for differences between the following coefficients: $\beta^{before2} = \beta^{during}$ and $\beta^{after2} = \beta^{during}$.

The results are reported in Table 5. The results indicate that the growth rates of cartel firms are significantly higher (1% level) in terms of market value, sales, employees, and PPE during the cartel period compared to the firms in the control groups. The null hypothesis that $\beta^{after2} = \beta^{during}$ can be rejected at the 1% level for the growth rate of market value, the growth rate of sales, and the growth rate of employees and at the 5% level for the growth rate of PPE. As expected, the coefficients of the after2 dummy variables in Columns 1 to 3 are negative, however, insignificant. The cartel firms do not differ in terms of labor productivity and profitability from the firms in their control groups.

It appears that the cartel firms were growing faster during the period of collusive agreement. As expected, cartelists exhibit a higher growth of sales (4.6%) during the cartel period. This result indicates that cartelists successfully fixed prices. However, we do not only observe a growth in sales, additionally, the growth of market value of the cartelists is about 3.5% higher during the cartel period. It seems that cartelists match their higher growth rates in sales and market values by higher investments in employees and PPE to cover up that their growth stems from price fixing agreements. After the cartels are discovered and firms are in-

dicted by antitrust authorities their growth rates do not differ anymore from the ones of their industry and size matched peers.

3.5 CEO's insider trading activity

In this section we examine whether insider trading is significantly higher during the cartel period. This would indicate that CEOs, or other managers and directors, know about the collusive agreement in their firms and attempt to exploit the stock prices possibly inflated by the cartel agreement. It could also be an indicator that CEOs attempt to get rid of their exercisable options as long as the cartel is undiscovered and prices are presumably higher. We estimate the following tobit regression which is also based on Kedia and Philippon (2009):

$$y_{it} = \alpha + \beta^{before} 1_{before} + \beta^{during} 1_{during} + \beta^{after} 1_{after} + \theta_t + \gamma x_{it-1} + u_{it}$$

where 1_{before} is an indicator variable for the time period preceding the cartel, 1_{during} is an indicator variable for the years in which the cartel was active, and 1_{after} is an indicator variable for the years after the cartel. For our matched control firms all three dummy variables take on values of zero in all sample years. The dependent variable, y_{it}, is the value realized from option exercises over the value of exercisable options. Alternatively, we use the number of option exercises over the number of options exercisable. The control variables (x_{it-1}) include past stock price performance, and Tobin's Q, the number of options outstanding, and the average value of options exercised in all firms in the same two-digit SIC industry. All of these variables are lagged by one year. We also include year dummy variables (θ_t).

Panel A of Table 6 reports the results of this analysis for the CEO and Panel B for the top 5 executives. The results in Panel A indicate that CEOs of cartel firms in general generate more value from option exercises than CEOs from comparable firms in their industry during the cartel period. Further, it shows that the CEOs of our cartel firms exercise more options during the cartel period than after or before the collusive agreement. The magnitude of this

effect is around 9 to 10%. This result is stable across all four specifications. The results for the top 5 executives in Panel B are similar and show that the top 5 executives generate more value from options exercises during the cartel period than the top 5 executives of comparable firms. These results suggest that not just the CEO, but also the top executives are informed about the antitrust agreements.

4. Conclusion

Using a data sample of 225 U.S. firms, which participated in hard-core cartels between 1986 and 2010, we empirically analyze the relation between corporate governance and various other firm characteristics and the probability of being engaged in collusive conduct. We compare the cartelists to a set of size- and industry-matched control firms. Our results show that larger and more mature firms and firms which experienced a relatively low sales growth are more likely to participate in a cartel. Also, our results confirm prior research which has identified certain industry characteristics, most importantly highly concentrated product markets, which facilitate collusive agreements (e.g., Bolotova, Connor, and Miller 2008). With respect to the corporate governance measures we cannot identify an overall positive or negative relationship between the probability of being part in a cartel and what is typically considered to be good or bad corporate governance in the literature. However, we find that some of our governance measures are statistical significantly related to price fixing agreements. For example, we find a negative relationship between the E-Index (a measure for takeover protection) and the likelihood to participate in a cartel. Further, we find that firms which have a high fraction of busy directors in their board are more likely to participate in a cartel.

We find evidence of a positive valuation effect of cartel membership. This finding is consistent with Levenstein and Suslow (2006) and Connor (2010) who argue that collusive agreements are beneficial to shareholders as profits will increase if not detected. And even if detected and convicted, penalties usually correspond to the overcharges resulting from above

market prices and therefore result in a zero sum game. This result, however, does not hold when corporate governance variables are accounted for. We find no significant relation between cartel membership and ROA and between cartel membership and alpha. Moreover, we find that cartel firms do not differ significantly from their size and industry matched peers with respect to their investment behavior as proxied by CAPX, R&D, and acquisition spending.

We also investigate whether cartelist firms attempt to cover up their conspirative actions. We find that the growth rates of cartel firms are significantly higher in terms of market value, sales, employees, and PPE during the cartel period compared to the firms in the control groups. Hence, cartelists seem to match their higher growth rates in sales and market values resulting from price fixing by higher investments in employees and PPE which correspond to and justify their growth. Finally, we find that during the period of collusive behavior CEOs and top executives exercise a significantly higher fraction of their exercisable options than CEOs and executives in comparable firms. This could be an indicator that not just the CEO but also the executives are part or at least are informed about the price fixing agreements.

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Table 1: Descriptive statistics

The table reports descriptive statistics for the cartel firms and the matched control group. For every cartelist, we create a control group of non-cartelist firms which share the first two digits of the SIC code and are in the same total assets quintile at the end of the year before the collusive agreement started. Firm-years in which cartelist firms, i.e., firms that at one point in time during our sample period are part of a cartel agreement, are not participating in a cartel, are excluded from this analysis. All variables are defined in Section 2.2 of the main text. The equality of means is tested using a standard *t*-test and the equality of medians using a Wilcoxon signed rank test. ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

	Cartelists				Control firms				Differences			
	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev	Obs.	Difference Mean		Difference Median	
Competition (HHI)	0.2662	0.1974	0.2082	1,585	0.2149	0.1580	0.1798	52,805	0.0513	***	0.0394	***
Leverage	0.6701	0.6532	0.2172	1,578	0.6212	0.5878	0.4872	51,161	0.0489	***	0.0654	***
Total Assets	61,499	6,826	191,168	1,587	6,984	577	38,731	51,258	54,515	***	6,249	***
R&D/Sales	0.0278	0.0038	0.0637	1,612	0.1696	0.0000	0.7943	52,818	-0.1418	***	0.0038	
Dividend (dummy)	0.8133	1.0000	0.3898	1,612	0.5579	1.0000	0.4966	52,818	0.2553	***	0.0000	***
ROA	0.0421	0.0424	0.0867	1,584	-0.0221	0.0285	0.3251	51,102	0.0642	***	0.0139	***
Past sales growth	0.2160	0.1444	0.5128	1,483	1.1334	0.1719	23.0277	43,687	-0.9174		-0.0274	***
CAPX/total assets	0.0511	0.0442	0.0402	1,539	0.0613	0.0416	0.0752	47,822	-0.0102	***	0.0026	
Firm age	35.1443	32.0000	24.9282	1,379	16.9995	12.0000	16.2506	38,514	18.1448	***	20.0000	***
Q	1.8758	1.4246	1.3676	1,476	1.9981	1.3690	2.3357	45,379	-0.1223	**	0.0556	***
Alpha (annual)	0.0397	0.0369	0.2565	1,312	0.0603	0.0371	0.3816	34,820	-0.0207	*	-0.0002	
G-Index	9.5083	9.0000	2.6728	1,082	9.0860	9.0000	2.7261	16,637	0.4224	***	0.0000	***
E-Index	2.0147	2.0000	1.3932	1,089	2.2667	2.0000	1.3730	16,799	-0.2521	***	0.0000	***
Shares CEO	0.0130	0.0012	0.0429	1,080	0.0243	0.0030	0.0600	16,748	-0.0113	***	-0.0018	***
Block Ownership	0.6174	0.6343	0.2072	1,274	0.4854	0.4899	0.2922	33,831	0.1321	***	0.1444	***
Board size	11.2550	11.0000	2.9154	796	9.4841	9.0000	2.9338	10,975	1.7709	***	2.0000	***
% Indep. outsiders	0.7099	0.7500	0.1555	796	0.6813	0.7143	0.1768	10,975	0.0286	***	0.0357	***
Combined CEO-chairman	0.8618	1.0000	0.3453	796	0.7387	1.0000	0.4394	10,975	0.1231	***	0.0000	***
Attendance problems	0.0157	0.0000	0.0414	796	0.0184	0.0000	0.0500	10,975	-0.0026		0.0000	
Busy board	0.3995	0.0000	0.4901	796	0.1763	0.0000	0.3811	10,975	0.2232	***	0.0000	***
CEO Centrality	0.3587	0.3716	0.1221	895	0.3575	0.3604	0.1311	11,717	0.0012		0.0112	
Market value (growth rate)	0.0715	0.0869	0.3778	1,431	0.0654	0.0840	0.4811	42,396	0.0061		0.0029	
Sales (growth rate)	0.0738	0.0656	0.1800	1,532	0.1079	0.0827	0.2974	46,948	-0.0341	***	-0.0171	***
Number of employees (growth rate)	0.0170	0.0069	0.1620	1,455	0.0497	0.0239	0.2524	41,814	-0.0328	***	-0.0170	***
PPE (growth rate)	0.0582	0.0348	0.2008	1,509	0.0923	0.0475	0.3115	46,618	-0.0341	***	-0.0127	***
CAPX / PPE (growth rate)	-0.0066	0.0004	0.3636	1,448	-0.0137	-0.0028	0.4728	42,858	0.0071		0.0031	
Sales per employee (growth rate)	0.0546	0.0505	0.1583	1,453	0.0529	0.0485	0.2593	41,241	0.0017		0.0021	
ROA (growth rate)	-0.0066	0.0137	0.8023	1,185	-0.0085	0.0093	0.8459	31,207	0.0019		0.0044	
Value realized / exercisable value (CEO)	0.2117	0.0730	0.3019	922	0.1881	0.0000	0.2947	13,560	0.0237	**	0.0730	***
Value realized / exercisable value (Top 5)	0.2253	0.1436	0.2562	847	0.2158	0.1145	0.2612	11,621	0.0095		0.0291	***

Table 2: Probit regressions of cartel dummy variable on financial and corporate governance variables for the sample of cartelist and matched control firms

The table reports the results from probit regressions of a dummy variable whether a firm participates in a cartel agreement in this respective year on a number of financial and corporate governance variables for the sample of cartelist firms and matched control firms. To match cartelists to control firms, we create a group of all non-cartelist firms for every cartelist, which share the first two digits of the SIC code and are in the same total asset quintile at the end of the year before the collusive agreement started. We exclude all firms from the analysis that are neither a cartelist nor a control firm. Firm-years in which cartelist firms, i.e., firms that at one point in time during our sample period are part of a cartel agreement, are not participating in a cartel are excluded from this analysis. In all four specifications, we include year- and industry-fixed effects (not reported for space reasons). Industry classification is based on the first two digit of the SIC code. *z*-statistics are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

Dependent variable: Cartel dummy variable								
	(1)		(2)		(3)		(4)	
Constant	-5.278	***	-4.952	***	-4.817	***	-4.788	***
	(-28.479)		(-13.891)		(-11.784)		(-11.713)	
Competition (HHI)	0.313	***	0.381	**	0.479	***	0.470	***
	(3.418)		(2.502)		(2.733)		(2.680)	
Leverage	0.120		0.073		0.091		0.121	
	(1.470)		(0.409)		(0.435)		(0.574)	
ln(Total Assets)	0.361	***	0.488	***	0.508	***	0.502	***
	(30.172)		(17.805)		(15.653)		(15.427)	
R&D/sales	-0.311	**	-1.273	**	-1.239	**	-1.256	**
	(-2.026)		(-2.487)		(-2.162)		(-2.192)	
Dividend (dummy)	0.123	***	0.198	***	0.206	**	0.211	**
	(2.878)		(2.601)		(2.308)		(2.364)	
ROA	0.541	**	0.725	*	0.671		0.781	
	(2.433)		(1.742)		(1.325)		(1.537)	
Past sales growth	-0.096	***	-0.171	**	-0.157	**	-0.158	**
	(-3.356)		(-2.490)		(-2.155)		(-2.155)	
CAPX/total assets	-0.259		0.994		0.773		0.729	
	(-0.683)		(1.187)		(0.768)		(0.724)	
ln(Firm age)	0.057	***	0.035		0.024		0.026	
	(3.334)		(0.902)		(0.551)		(0.600)	
E- Index			-0.108	***	-0.071	***	-0.070	***
			(-4.855)		(-2.642)		(-2.609)	
Shares CEO			-1.146	*	-0.292		-0.257	
			(-1.772)		(-0.403)		(-0.355)	
Block Ownership			0.002		0.003		0.010	
			(0.010)		(0.015)		(0.050)	
ln(Board size)			0.033		0.010		-0.007	
			(0.240)		(0.067)		(-0.045)	
% Indep. outsiders			0.039		0.244		0.249	
			(0.203)		(1.130)		(1.149)	
Combined CEO-chairman			0.097		-0.052		-0.056	
			(1.299)		(-0.587)		(-0.635)	
Attendance problems			-0.337		0.201		0.259	
			(-0.557)		(0.306)		(0.393)	
Busy board			0.191	***	0.201	***	0.201	***
			(3.111)		(2.777)		(2.781)	
CEO Centrality					-0.859	***	-0.829	***
					(-3.451)		(-3.324)	
Fraud Dummy							0.400	***
							(2.766)	
Obs.	33,157		8,700		5,557		5,557	
Pseudo r-squared	0.307		0.372		0.363		0.365	

Table 3: Regression of Tobin's Q, ROA, and alpha on a cartel dummy and controls

The table reports the regression results from OLS regressions of Tobin's Q (Columns 1 and 2), ROA (Columns 3 and 4), and alpha (Columns 5 and 6) on a dummy whether a firm participates in a cartel agreement in the respective year and a set of control variables. To match cartelists to control firms, we create a group of all non-cartelist firms for every cartelist, which share the first two digits of the SIC code and which are in the same total asset quintile at the end of the year before the collusive agreement started. We exclude all firms from the sample that are neither a cartelist nor a control firm. Also, firm-years in which cartelist firms, i.e., firms that at one point in time during our sample period are part of a cartel agreement, are not participating in a cartel, are excluded from this analysis. All six specifications include year- and industry-fixed effects (not reported for space reasons). Industry classification is based on the first digit of the SIC code. The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different year-observations for one specific firm). ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

Dependent variable:	Q		Q		ROA		ROA		Alpha		Alpha	
	(1)		(2)		(3)		(4)		(5)		(6)	
Constant	2.788	***	2.745	***	-0.001		-0.054	**	0.168	***	-0.061	
	(13.805)		(7.608)		(-0.082)		(-2.184)		(4.396)		(-1.269)	
Cartel dummy	0.268	***	0.116		-0.010	*	0.004		-0.004		0.001	
	(2.778)		(0.865)		(-1.775)		(0.802)		(-0.449)		(0.105)	
Competition (HHI)	-0.416	***	-0.207		0.011		0.002		-0.038	**	0.002	
	(-3.464)		(-1.382)		(1.183)		(0.250)		(-2.546)		(0.080)	
Leverage	-0.181		-1.033	***	-0.213	***	-0.141	***	-0.135	***	-0.133	***
	(-0.999)		(-3.008)		(-6.620)		(-6.271)		(-7.198)		(-6.342)	
ln(Total Assets)	-0.027		0.106	***	0.025	***	0.009	***	0.003	*	0.010	***
	(-1.166)		(2.584)		(12.152)		(3.684)		(1.751)		(2.986)	
R&D/sales	0.303	***	0.703	***	-0.106	***	-0.152	***	-0.003		0.057	***
	(8.413)		(4.521)		(-19.974)		(-8.013)		(-0.555)		(3.635)	
Dividend (dummy)	-0.045		0.078		0.022	***	0.029	***	-0.006		0.005	
	(-0.923)		(0.915)		(5.903)		(5.728)		(-0.932)		(0.463)	
Past sales growth	0.008	*	0.481	***	-0.000	**	0.025	***	0.000		0.095	***
	(1.929)		(6.348)		(-2.412)		(5.698)		(0.860)		(7.192)	
CAPX/total assets	1.626	***	2.750	***	-0.008		0.153	***	0.320	***	0.214	**
	(4.934)		(3.830)		(-0.201)		(3.083)		(5.928)		(2.097)	
ln(Firm age)	-0.162	***	0.009		0.006	***	0.008	***	-0.018	***	-0.004	
	(-7.003)		(0.197)		(3.415)		(2.812)		(-5.272)		(-0.703)	
E-Index			-0.067	***			0.001				-0.001	
			(-3.077)				(0.380)				(-0.505)	
Shares CEO			1.578				0.224	***			-0.117	
			(0.805)				(2.596)				(-0.544)	
Shares CEO squared			-2.651				-0.438	*			0.685	
			(-0.486)				(-1.692)				(0.970)	
Block Ownership			0.234				0.083	***			0.145	***
			(1.346)				(5.838)				(5.879)	
ln(Board size)			-0.299	*			0.012				-0.018	
			(-1.924)				(1.306)				(-1.036)	
% Indep. outsiders			0.207				0.013				-0.022	
			(1.075)				(1.120)				(-0.820)	
Combined CEO-chairman			-0.045				-0.004				0.005	
			(-0.794)				(-1.165)				(0.548)	
Attendance problems			-0.318				-0.033				-0.108	
			(-0.708)				(-1.012)				(-1.493)	
Busy board			0.098				0.007	*			-0.003	
			(1.379)				(1.863)				(-0.362)	
Obs.	33,284		8,965		33,387		8,966		31,188		8,950	
r-squared	0.145		0.249		0.283		0.248		0.047		0.099	

Table 4: Tobit regressions of CAPX, R&D expenditures, and acquisition expenses on a cartel dummy and controls

The table reports the regression results from tobit regressions of CAPX/total assets (Column 1), R&D/sales (Column 2), and expenses for acquisitions/market capitalization (Column 3) on a dummy variable whether a firm participates in a cartel agreement in the respective year and a set of control variables. To match cartelists to control firms, we create a group of all non-cartelist firms for every cartelist, which share the first two digits of the SIC code and which are in the same total asset quintile at the end of the year before the collusive agreement started. Firm-years in which cartelist firms, i.e., firms that at one point in time during our sample period are part of a cartel agreement, are not participating in a cartel, are excluded from this analysis. All three specifications include industry and year fixed effects (not reported for space reasons). Industry classification is based on the first digit of the SIC code. ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

Dependent variable:	CAPX	R&D	Acquisitions
	(1)	(2)	(3)
Constant	0.080 ***	1.118 ***	-612.175 ***
	(17.386)	(11.967)	(-24.763)
Cartel dummy	0.001	0.043	-17.089
	(0.671)	(1.254)	(-1.115)
Q	0.001 ***	0.055 ***	-7.417 ***
	(7.996)	(21.082)	(-4.331)
Competition (HHI)	-0.007 ***	-0.110 ***	83.171 ***
	(-3.887)	(-2.978)	(4.730)
Leverage	-0.001	-0.201 ***	-26.696 **
	(-1.408)	(-10.414)	(-2.291)
ln(Total Assets)	-0.000	-0.048 ***	54.311 ***
	(-0.127)	(-11.101)	(25.326)
Dividend (dummy)	-0.001	-0.224 ***	13.457 *
	(-0.810)	(-15.337)	(1.939)
Past sales growth	0.000 ***	0.000	0.165
	(2.651)	(0.737)	(1.256)
ln(Firm age)	-0.004 ***	-0.037 ***	-13.142 ***
	(-13.317)	(-5.599)	(-4.241)
R&D/sales	-0.004 ***		-85.381 ***
	(-10.000)		(-10.144)
CAPX/total assets		-1.822 ***	-570.769 ***
		(-13.342)	(-9.315)
Obs.	33,284	33,284	31,567
LR chi-squared	13,025.96	14,875.69	2,485.88
Prob. > chi-squared	0.000	0.000	0.000

Table 5: Adjusted growth dynamics for the cartel firms

The table reports the regression results from OLS regressions of adjusted growth dynamics. The dependent variables are growth rates (one year log differences) relative to the mean of a control group. For every cartelist, we create a control group by selecting all firms which operate in the same two-digit SIC Industry and which are in the same total asset quintile the year before the collusive agreement started. Before2, during and after2 are dummy variables. Before2 takes the value of 1 for the two years preceding the cartel, during indicates the cartel time and after2 takes the value of 1 for the two years after the cartel. The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different year-observations for one specific firm). The table also reports the *p*-values of a Wald test, testing the hypothesis that β^{during} equals $\beta^{before2}$ and β^{during} equals β^{after2}. ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

Dependent variable:												
	Growth of market value		Growth of sales		Growth of employees		Growth of PPE		Growth of CAPX/ PPE		Growth of sales per employee	Growth of ROA
Constant	0.003		-0.019	**	-0.012		-0.023	**	0.007		-0.001	-0.006
	(0.330)		(-2.121)		(-1.519)		(-2.263)		(0.960)		(-0.127)	(-0.542)
Before2	0.010		0.001		0.016		0.015		-0.041	**	-0.013	-0.002
	(0.544)		(0.118)		(1.414)		(1.033)		(-2.062)		(-1.288)	(-0.051)
During	0.035	***	0.046	***	0.029	***	0.054	***	-0.007		0.009	-0.033
	(2.734)		(4.466)		(3.351)		(4.596)		(-0.601)		(1.559)	(-1.621)
After2	-0.028		-0.001		-0.009		0.017		0.003		-0.003	0.015
	(-1.363)		(-0.045)		(-0.668)		(1.243)		(0.121)		(-0.289)	(0.353)
Obs.	3,251		3,414		3,279		3,344		3,159		3,266	2,755
r-squared	0.003		0.012		0.006		0.011		0.001		0.092	0.001
Before2=During	0.212		0.000	***	0.274		0.006	***	0.095	*	0.036 **	0.483
During=After2	0.004	***	0.000	***	0.003	***	0.014	**	0.693		0.234	0.322

Table 6: Tobit regression of the value realized from options exercised and the number of options exercises of the CEO and the top 5 executives

Panel A of the table reports the regression results from tobit regressions of the value realized from options exercised over the value of exercisable options of the CEO (Column 1-3) and the number of options exercised over total exercisable options of the CEO (Column 4) on three dummy variables indicating the pre-cartel, cartel and post-cartel time and a set of control variables. Before is a dummy variable for the years preceding the cartel. During is a dummy for the cartel period. After indicates the years following the cartel. All three dummies are zero for the firms of our matched control group. To match cartelists to control firms, we create a group of all non-cartelist firms for every cartelist, which share the first two digits of the SIC code and which are in the same total asset quintile at the end of the year before the collusive agreement started. We exclude all firms from the sample that are neither a cartelist nor a control firm. We control for options outstanding, past stock performance, Tobin's Q and average industry exercises which is calculated as the average option exercise for all firms in the same two-digit SIC industry with data on ExecuComp in that year. All control variables are lagged by one year. All regressions include year fixed effects. Panel B reports the results of similar tobit regressions where the dependent variables are the value realized from options exercises over the value of exercisable options of the top 5 executives (Column 1-3) and the number of options exercised over total exercisable options of the top 5 executives (Column 4). The *t*-statistics are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5%, 10% level.

Panel A: Dependent variable:	Value realized from options exercised over the value of exercisable options - CEO			Number of options exercised over total exercisable options - CEO
	(1)	(2)	(3)	(4)
Constant	0.210 ***	0.114 ***	-0.175 ***	-0.149 ***
	(8.608)	(3.686)	(-5.419)	(-6.750)
Before	0.052 **	0.051 **	0.045	0.033
	(2.220)	(2.074)	(1.377)	(1.398)
During	0.088 ***	0.097 ***	0.092 ***	0.048 ***
	(4.305)	(4.719)	(3.874)	(2.856)
After	0.045 **	0.039 *	0.046 *	0.031 *
	(1.986)	(1.721)	(1.958)	(1.868)
Average industry exercises		0.427 ***	0.491 ***	0.768 ***
		(5.149)	(4.837)	(8.234)
options outstanding			0.000	-0.000
			(0.824)	(-1.592)
Past year returns			-0.003	0.002
			(-0.811)	(1.079)
Q			0.021 ***	0.026 ***
			(7.570)	(12.853)
Obs.	15,888	14,898	9,173	10,539
LR chi-squared	334.11	273.82	267.99	448.12
Prob. > chi-squared	0.000	0.000	0.000	0.000

Table 6 – Continued

Panel B: Dependent variable:	Value realized from options exercised over the value of exercisable options – Top 5						Number of options exercised over total exercisable options – Top 5	
	(1)		(2)		(3)		(4)	
Constant	0.238	***	0.094	***	0.124	***	0.031	
	(17.433)		(5.123)		(4.171)		(0.202)	
Before	0.015		0.013		0.021		0.014	
	(1.182)		(0.995)		(1.151)		(1.093)	
During	0.024	**	0.030	**	0.046	***	0.017	*
	(2.022)		(2.479)		(3.291)		(1.768)	
After	0.015		0.013		0.018		0.019	
	(0.853)		(0.761)		(0.965)		(1.412)	
Average industry exercises			0.370	***	0.388	***	0.671	***
			(7.216)		(5.556)		(10.915)	
options outstanding					0.000		-0.000	***
					(0.785)		(-2.969)	
Past year returns					-0.002		0.001	
					(-1.077)		(0.592)	
Q					0.012	***	0.016	***
					(7.491)		(13.990)	
Obs.	13,547		12,586		6,331		6,641	
LR chi-squared	191.84		218.79		203.16		505.57	
Prob. > chi-squared	0.000		0.000		0.000		0.000	

Figure 1: Yearly return on assets around the year of cartel formation
The figure illustrates the mean of the yearly return on assets (ROA) of cartelist firms over a symmetric window of five years around the year which has been determined as the starting point of the cartel.