

# CARTEL BREAKDOWN AND MINORITY SHARE ACQUISITION

Niklas S. Dürr <sup>\*</sup>, Jan C. Rönn <sup>†</sup>

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Non-controlling, minority shareholdings are increasingly being criticized by both academic literature, as well as competition authorities. This is due to the fact that the anticompetitive dimension of such shareholdings is being recognized more and more. In this paper, we empirically investigate the relationship between cartels, particularly their breakdown and the acquisition of such minority shares. We find that in the year a cartel breaks down, the minority share acquisition activity increases compared to a matched control group with companies that are not in cartels or compared to other time periods. Given the recognized collusion facilitating character of minority shares, our preliminary results suggest that competition authorities should carefully monitor minority share acquisitions after a cartel breakdown, as they might be a sign of ongoing collusion in the industry.

**JEL Class:** C13; C23; D22; G34; K21; L22; L41;

**Keywords:** Cartel breakdown, minority shares, tacit collusion

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<sup>\*</sup> ZEW Centre for European Economic Research and MaCCI Mannheim Centre for Competition and Innovation, P.O. Box 10 34 43, D-68034 Mannheim, Germany. E-mail: duerr@zew.de.

<sup>†</sup> ZEW Centre for European Economic Research, P.O. Box 10 34 43, D-68034 Mannheim, Germany. E-mail: p-roenn@zew.de.

## 1 Introduction

Non-controlling minority shareholding (MS) acquisitions<sup>1</sup> in rival firms have increasingly gained attention by both researchers and regulators. For example, the European Commission (European Commission, 2014) as well as the OECD (OECD, 2008) have expressed their concerns that horizontal MS acquisitions can have negative effects on competition by either reducing the incentives to compete (unilateral effects), or by facilitating collusion (coordinated effects). In both cases, competition and consumers are potentially harmed. However, only a small number of minority share acquisitions are reviewed by authorities, and of those which are reviewed, only few raised the concern of competition authorities. Additionally, non-controlling minority shareholdings are completely out of scope of EU Merger Regulation. This is in stark contrast to the theoretical economic literature about minority shareholdings, which claims significant unilateral, as well as coordinated effects on prices and the facilitation of collusion. This raises the question; are minority share acquisitions not taken seriously enough by competition agencies? Furthermore, it remains an open question as to whether the theoretical effects that economic literature talks about can be found on a significant level when applied to real life scenarios.

In this paper, we aim at answering this question by relating MS acquisitions to cartels and cartel breakdowns. When a cartel ends, cartel members might look for other possibilities to soften competition, and might therefore use minority shares to accomplish this goal. With the previously mentioned coordinated and unilateral effects at work, this can be a promising direction for decision makers on the firm level. For this purpose, we empirically evaluate the MS acquisitions behavior both during, and after a cartel.

We use an empirical approach to find out whether MS acquisitions increase after the breakdown of a cartel. For this purpose, we construct a panel data set for Europe (i.e. the EU 27), covering the years 2000 to 2017. Our dataset holds information on the cartel duration with the end date of the cartel, MS acquisitions, and firm characteristics. We construct the dataset by merging company data from the Bureau van Dijk Orbis Database<sup>2</sup>, minority share acquisitions from the Bureau van Dijk Zephyr<sup>3</sup> database, as well as cartel information published on the EC's online

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<sup>1</sup> We define minority shares as less than 50 per cent of voting rights. These are only reviewed by competition agencies above 25 per cent in most European jurisdictions like for example the UK, Germany or Austria. In the US only acquisitions above 10 per cent have to be reported at all.

<sup>2</sup> <https://www.bvdinfo.com/en-gb/our-products/data/international/orbis>

<sup>3</sup> <https://www.bvdinfo.com/en-gb/our-products/data/specialist/zephyr>

platform<sup>4</sup>. In order to identify the effect of a cartel breakdown on minority share acquisitions, we use matching methods to find a suitable control group for firms in cartels. We then apply fixed effects regressions on the matched sample. As in any other contribution on cartels, we have to make the strong assumption that we include all cartels in our treatment group. Obviously this assumption is violated as there are always undetected cartels in certain industries. This leads to a situation where firms in the control group might actually be part of an undetected cartel, and should therefore not be in the control group. However, this “diluted” control group would bias our estimates only downward so that we obtain conservative estimates that would be even stronger if all cartels truly would be detected.

In contrast to the prior literature, this paper estimates and suggests that firms use minority share acquisitions in order to stabilize tacit collusion after the cartel broke down. If firms use minority share acquisitions in this way, it would strengthen the theoretical findings of minority shares having coordinated effects, and that they are viewed as an efficient tool for stabilization of tacit collusion by firms.

In the following chapter we present relevant prior literature on minority stakes in detail. Next, we describe our data, how we manipulated it, as well as our identification strategy. Finally, we present our results from the fixed effects estimations and discuss implications of our findings.

## **2 Literature**

From a theoretical side, Reynolds and Snapp (1986) showed that in a static Cournot model with homogeneous goods, small MS acquisitions can lead to unilateral effects of higher prices and lower outputs. Malueg (1992) extends their analysis to an infinitely repeated game to show that MS acquisitions have a collusion stabilizing effect if the demand is convex. For a non-convex demand the effect is ambiguous because the deviator receives lower dividends when cheating from its acquisitions. On the other hand, by softening the competition the unilateral effects of MS acquisitions soften the punishment and thereby facilitating deviation.

Flath (1992) analyses the effects of MS acquisitions in a Bertrand setting with differentiated goods. Shelegia and Spiegel (2012) extend Flath (1992) by incorporating asymmetric marginal cost. Gilo et al. (2006) derive necessary and sufficient conditions for MS acquisitions to facilitate collusion in an infinitely repeated Bertrand setting. First, they prove that an increase in the stake of a rival never hinders collusion. Second, they prove that an increase in the stake

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<sup>4</sup> <http://ec.europa.eu/competition/antitrust/cases/index.html>

facilitates collusion if each firm in the industry holds shares of at least one other firm, and the firm most likely to deviate holds at least an indirect stake in the acquired firm. Additionally, they show that a symmetric increase of all firms in the share of other firms facilitates collusion, as well as any change that makes the industry more symmetric.

From an empirical point of view three papers stand out. Dietzenbacher et al. (2000) analyzes the effect of cross-shareholdings on the price-cost margin in the Dutch financial sector. Under the assumption of a Cournot market they find that the observed cross-shareholding pattern increases the price-cost margin by up to 8 percent. Under the assumption of a differentiated Bertrand market with asymmetric cost, they estimate an increase in the price-cost margin of up to 6 percent.

Davies et al. (2015) uses event survival analyses to test if mergers after cartel breakdown are used to facilitate tacit collusion. They find that for 84 European cartels between 1990 and 2012, the merger activity is much higher right after cartel breakdown, compared to before and long after. This is especially true in markets where the collusion ended naturally before it was detected, and in markets with low concentration. They propose that this is the case because using mergers to facilitate tacit collusion is only the second best option to implement the collusive outcome after a cartel. However, when a cartel broke down or could not be sustained, some firms used a merger to facilitate tacit collusion. They acknowledge that these mergers could in part be just an efficient market consolidation under the new conduct. Additionally, they use event study analyses to strengthen their claim that some mergers are perceived to facilitate collusion. They do so by showing that mergers in the early years after cartel breakdown are more value-enhancing for the acquiring firms than in comparable merger cases.

Heim et al. (2017) analyzes the effect of an introduction of a national leniency program on the volume of change of minority shareholdings. They use data from 1990 to 2013 from 63 countries in a zero-inflated, negative, binomial model with time fixed effects to show that the volume increases significantly in the year of introduction if there is an effective antitrust policy and little corruption. This can be interpreted as MS being used to stabilize cartels because introduction of LP is seen as a shock to cartel stability.

### 3 Econometric Approach

#### 3.1 Estimation strategy

The hypothesis is that after a negative shock in the industry, like the end of a cartel, firms might look for alternatives to soften competition. In order to find out whether more MS acquisitions were conducted during the time a cartel was in place or after a cartel ended, we estimate the following equation on a matched sample<sup>5</sup>.

$$MSA_{it} = \alpha + \beta_1 \times CF_{u-cd} + \sum_{i=0}^3 (\gamma_i \times CF_{u+i}) + X_{it}\beta_2 + \theta_{it} + \varepsilon_{it} \quad (1)$$

The dependent variable, minority share acquisition  $MSA_{it}$  equals unity if firm  $i$  acquired minority shares at time  $t$ . This variable is regressed on dummy variables for cartel firms  $CF$  interacted with different points in time. The year a cartel ends is indicated with  $u$  and the cartel duration in years is given by  $cd$ . Accordingly, the first variable is equal to one for all years a firm was in a cartel. The summation sign creates four variables for each year after the cartel broke down one dummy variable for the participating firm.  $X_{it}$  includes the control variables,  $\theta_i$  the firm fixed effects as well as time fixed effects and  $\varepsilon_{it}$  represents the error term. We consider a cartel breakdown is an exogenous event to MS acquisition. We believe that this is a fair assumption as the alternative explanation of a cartel member leaving a cartel to buy minority shares, makes, in economic terms, no sense as the acquisition of minority shares can only be a second best strategy to soften competition. A cartel would be a much better vehicle for that purpose. We can therefore interpret the relation between cartel breakdown and the MS acquisition as a causal effect.

### 4 Data

The database we use for our empirical analysis makes use of three different data sources. For constructing a firm year panel data set we include data on the EU 27 countries for the years 2000 to 2017. Our primary data sources are the cartel information published on the EC's online platform and the Bureau van Dijk Zephyr database. The EC postings are used to identify cartels in the EU 27 along with the respective cartel members and the duration and end date of the cartel. The Zephyr database holds information on mergers and acquisitions, but also on MS acquisitions of firms worldwide. We consider all acquisitions with a final stake of below 50 percent as minority shares. To obtain additional information on the cartel firms and to construct

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<sup>5</sup> We explain the matching procedure in detail in Section 5.1

a control group of firms not in (detected) cartels, we additionally merge this information with the Bureau van Dijk Orbis data base.

**Table 1: Summary statistics**

	mean	sd	min	max
Firm acquired minority shares	0.02	0.14	0.00	1.00
Firm acquired minority shares NACE 1	0.01	0.11	0.00	1.00
Firms is in a cartel	0.07	0.26	0.00	1.00
Firm left cartel this year	0.02	0.13	0.00	1.00
Firm left cartel one year ago	0.02	0.14	0.00	1.00
Firm left cartel two years ago	0.02	0.14	0.00	1.00
Firm left cartel three years ago	0.02	0.14	0.00	1.00
Large company	0.25	0.43	0.00	1.00
Very large company	0.65	0.48	0.00	1.00
Age of the company	49.81	48.36	0.00	408.00
Fixed assets, billion USD	4.60	19.52	-5.28	235.73
EBIT margin	3.41	15.33	-127.18	157.28
Year of leniency introduction	0.02	0.15	0.00	1.00
Year	2010.61	3.80	2000.00	2017.00
Germany	0.13	0.34	0.00	1.00
France	0.07	0.25	0.00	1.00
Great Britain	0.38	0.48	0.00	1.00
Italy	0.06	0.24	0.00	1.00
Sweden	0.08	0.27	0.00	1.00
Rest EU 27	0.29	0.45	0.00	1.00

# Observations: 13,331

Table 1 summarizes our data set that includes 13,331 observations on 1,286 firms. Two percent of firms acquired MS within the years 2000 to 2017; that is 156 firms. Half of these MS acquisitions affected firms that shared the first NACE Code digit with the acquiring firm. Seven percent of the firms were in a cartel while 25 percent of firms classified as very large companies and 65 percent as large companies where we apply the Bureau van Dijk Orbis definitions. The age of the firms was on average, nearly 50 years and the fixed assets totaled 4.6 billion USD. In terms of countries represented, Great Britain is leading the list with 38 percent of the detected cartels. This figure is followed by 13 percent German cartels.

## 5 Results

### 5.1 Matching

In order to cope with problems arising from selection bias, we construct a control group of firms that is comparable to our treatment group which are firms that have been part of a cartel. We

do so by applying propensity score matching (PSM). PSM is a balancing score that assigns a probability of receiving treatment (being part of a cartel) by estimating a Probit model, Caliendo and Kopeinig (2008) provide an overview. PSM matching rests on the following assumptions. First, only observable and included variables determine selection into the treatment group (“selection on observables”). Second, given the selection of these observables, selection into treatment is random (“conditional independence assumption”). Third, a large enough sample size is required to ensure enough “common support” which is simply saying that every treated firm finds a suitable matching partner. If these conditions were fulfilled, we could directly compare the difference in the dependent variable between these groups to obtain the treatment effect. However, as we cannot fully fulfil the first assumption as there is not sufficiently enough data available on firms, we use PSM only for the purpose to construct our dataset on which we will perform our regression analyses.

The results of the Probit model are shown on the left side in Table 6 in the Annex. We regress the categorical variable of cartel membership on the following control variables; size of the firm (medium, large, and very large), the firm’s age, the fixed assets, and profitability measured as the EBIT margin. For the size of the company we use the definition from Bureau van Dijk’s Orbis database<sup>6</sup>. In case of the firm’s age, total assets, and profitability, we calculate the average over the observation period to make the measures more robust towards extreme values. This selection of control variables is driven by data availability. For these set of controls, most companies feature a value.

We apply nearest neighbors matching with replacement, meaning that one control company can serve as a neighbor for several treated companies. Given our large sample, this still leaves us with sufficiently enough control companies. Furthermore, we focus on the two nearest neighbors for every cartel firm<sup>7</sup>. As mentioned above, a necessary condition is the common support. A general approach is to delete treated companies whose propensity score is larger than the maximum and smaller than the minimum of the control group (Caliendo and Kopeinig,

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<sup>6</sup> Companies on Orbis are considered to be very large when they match at least one of the following conditions: Their Operating Revenue exceeds 100 million EUR (130 million USD), their total assets exceed 200 million EUR (260 million USD), the number of employees is greater than 1,000 and they are listed. Companies on Orbis are considered to be large when they match at least one of the following conditions: Their Operating Revenue exceeds 10 million EUR (13 million USD), their total assets exceed 20 million EUR (26 million USD), the number of employees is greater than 150 and they are not considered ‘very large’. Companies on Orbis are considered to be medium sized when they match at least one of the following conditions: Their Operating Revenue exceeds 1 million EUR (1.3 million USD), their total assets exceed 2 million EUR (2.6 million USD), the number of employees is greater than 1, and it is not considered ‘very large’ or ‘large’.

<sup>7</sup> Increasing the size of our control group with more neighbors does not change our results.

2008). However, in our case we have such a good coverage of control firms due to our very large sample size that we don't need to delete treated companies due to this criterion.

Table 1 provides an overview of the matching quality. The left side of the table shows the means and the respective t-tests before the matching. As shown by the t-tests, the treatment and control group differ significantly before matching. So, firms in cartels are significantly different from other firms. As shown on the right side of Table 1, after the matching procedure these differences are no longer statistically different. So, conditional on these control variables, the treatment and control group only differ in terms of cartel membership. Simply speaking in a world that consisted only of these observables, allocation of the treatment would be random. As this is obviously not the case, we do not interpret these differences here directly, but rather use this obtained database as basis for our regression analyses. As we performed a matching technique with replacement, we only choose 817 firms in the control group that receive a respective weighting. With the weighting applied, the control group then consists out of 866 observations.

**Table 1: Mean difference tests after matching**

	Before Matching			After Matching		
	Control group	Cartel firms	Results of t-test on mean difference	Selected Control Group (2NB)	Cartel firms	Results of t-test on mean difference
Medium company	0.31	0.09	(11.01)***	0.09	0.09	(-0.14)
Large company	0.36	0.25	(5.51)***	0.25	0.25	(0.00)
Very large company	0.21	0.64	(-18.13)***	0.64	0.64	(0.16)
Age	24.08	46.04	(-11.30)***	47.96	46.04	(0.68)
Fixed assets in billions	2.56	4.56	(-4.87)***	3.80	4.56	(-0.72)
EBIT margin	5.62	2.72	(5.15)***	2.96	2.72	(0.30)
# Observations	35,370	433	35,803	866 (817)	433	1,299

## 5.2 Estimation

In this section we present the results of our baseline specification presented in section 3.1. We estimate the model as a Panel Probit model, a linear panel model with random effects, and a linear panel model with fixed effects. The dependent variable in this table is a dummy variable indicating whether the respective firm acquired at least one MS in a given year. We regress this indicator variable on the time a firm was in a cartel and on each year following the cartel time separately. In the panel Probit model shown in the first two columns, the cartel time is negatively significant on the ten percent level. This finding is weak evidence that while firms are a member of a cartel, they don't need other means to stabilize (tacit) collusion. Most



interesting however, is that minority share acquisitions increase precisely in the year in which a firm leaves a cartel or the cartel breaks down. This finding is significant at the ten percent level in the Probit estimation and significant on the five percent level in the linear models presented in columns three to six. The most saturated model is shown in column six. In this model, the probability of a firm acquiring MS increases by 2.6 percent in the year it leaves the cartel, if compared to firms that are not in a (detected) cartel, or to points in time before the firm under consideration entered the cartel, or four years after leaving it. Regardless of the model specification, this effect is positive and significant. In our preferred model (6), this effect can still get observed in the second year after the firm left the cartel. Here the effect is decreased to 1.6 percent and is significant only on the ten percent level. Interestingly, in this saturated model all the other control variables are not significant anymore.

**Table 2: Estimation results any minority share acquisition**

<b>Dependent variable:</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
Firm acquired minority stakes	Panel Probit	Panel Probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firm in a cartel	-0.2854* (0.1612)	-0.3294* (0.1918)	-0.0083 (0.0059)	-0.0062 (0.0077)	-0.0035 (0.0056)	0.0019 (0.0077)
Firm left cartel this year	0.5919*** (0.2034)	0.5423*** (0.2038)	0.0275** (0.0122)	0.0258** (0.0126)	0.0258** (0.0115)	0.0262** (0.0125)
Firm left cartel one year ago		0.0029 (0.1945)		0.0099 (0.0104)		0.0163* (0.0098)
Firm left cartel two years ago		-0.2729 (0.2368)		-0.0045 (0.0084)		0.0007 (0.0090)
Firm left cartel three years ago		-0.0088 (0.2324)		0.0059 (0.0103)		0.0118 (0.0107)
Age of the company	0.0014* (0.0008)	0.0015* (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0092*** (0.0033)	0.0082 (0.0080)
Fixed assets, billion USD	0.0128*** (0.0015)	0.0129*** (0.0015)	0.0015*** (0.0003)	0.0015*** (0.0003)	-0.0005 (0.0007)	-0.0009 (0.0008)
EBIT margin	-0.0026 (0.0032)	-0.0027 (0.0033)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	0.0000 (0.0001)
Year of leniency introduction	-0.0240 (0.1677)	0.1464 (0.1859)	-0.0009 (0.0092)	0.0088 (0.0114)	0.0035 (0.0093)	0.0106 (0.0116)
Constant	-7.5446*** (0.4514)	-7.4094*** (0.4638)	0.0121** (0.0058)	0.0191** (0.0082)	-0.3506** (0.1359)	-0.3128 (0.3360)
R <sup>2</sup> overall			0.0808	0.0807	0.0023	0.0022
Wald chi	445.6504	453.9376	188.3439	187.9766		
F-Test					3.0504	2.7858
# Observations	13,812	13,331	13,812	13,331	13,812	13,331
# Firms	1,286	1,286	1,286	1,286	1,286	1,286

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.

As a robustness check, in Table A2 in the Annex we do not include the time the firm was in the cartel. The main result that MS acquisitions increase in the year the cartel breaks down prevail. However, in this specification the significance level decreases to the ten and five percent level respectively. Additionally, we performed a placebo test where we randomly determine the year a cartel ended in. We show the results in Table A4 and Table A5 in the Appendix. As expected, none of the cartel dummies are significant. This placebo test suggests that in the year a cartel broke down, actually more MS acquisitions took place.

In Table 4 the dependent variable is no longer whether the firms acquired any MS, but rather whether the firm acquired a competitor. Firms are considered to be competitors if they share the same first digit in their NACE Code. Here as well the results that have been found are confirmed on slightly lower confidence levels.

**Table 3: Estimation results minority share acquisition on common first digit NACE Code**

<b>Dependent variable:</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
Firm acquired minority stakes on first digit NACE Code Level	Panel Probit	Panel Probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firm in a cartel	-0.1263 (0.1688)	-0.1034 (0.2017)	-0.0021 (0.0051)	0.0016 (0.0069)	0.0013 (0.0048)	0.0074 (0.0071)
Firm left cartel this year	0.5473** (0.2150)	0.4671** (0.2134)	0.0235** (0.0115)	0.0211* (0.0119)	0.0223** (0.0109)	0.0216* (0.0118)
Firm left cartel one year ago		-0.0604 (0.2218)		0.0046 (0.0085)		0.0091 (0.0086)
Firm left cartel two years ago		-0.1527 (0.2765)		-0.0022 (0.0075)		0.0010 (0.0077)
Firm left cartel three years ago		-0.0141 (0.2480)		0.0032 (0.0079)		0.0070 (0.0082)
Age of the company	0.0011 (0.0008)	0.0012 (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0066** (0.0030)	0.0095 (0.0066)
Fixed assets, billion USD	0.0130*** (0.0015)	0.0130*** (0.0015)	0.0013*** (0.0002)	0.0013*** (0.0002)	-0.0001 (0.0008)	-0.0003 (0.0008)
EBIT margin	-0.0031 (0.0034)	-0.0035 (0.0036)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)
Year of leniency introduction	-0.1178 (0.2254)	0.0074 (0.2506)	-0.0057 (0.0075)	-0.0018 (0.0088)	-0.0027 (0.0075)	-0.0005 (0.0089)
Constant	-7.4148*** (0.3570)	-7.3761*** (0.3860)	0.0083* (0.0045)	0.0128** (0.0062)	-0.2569** (0.1248)	-0.3801 (0.2788)
R <sup>2</sup> overall			0.0735	0.0719	0.0013	0.0013
Wald chi	575.0591	585.2605	143.8797	136.9226		
F-Test					1.9651	1.7645
# Observations	13,812	13,331	13,812	13,331	13,812	13,331
# Firms	1,286	1,286	1,286	1,286	1,286	1,286

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.

## **6 Summary and Conclusions**

The results we have obtained thus far show that firms are more likely to acquire MS in the year after a cartel breakdown. These preliminary results also hold whether we restrict the MS acquisitions to competitors on the first digit of the NACE Code. In the next steps we will further investigate how the acquiring and acquired firm are connected, be it on secondary or third NACE Code or through indirect links i.e. sub companies or other entrepreneurial constructs. Given that MS between firms are seen more and more critical, our preliminary results suggest that even after a cartel brakes down, (tacit) collusion might continue and is facilitated by the acquisition of minority shares.

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## Annex

**Table A1: Probit estimation for PSM**

Probit estimation	Before matching		After matching	
	Cartel firm		Cartel firm	
Medium company	0.2159	(1.75)	-0.0964	(-0.32)
Large company	0.4990***	(4.26)	-0.1111	(-0.39)
Very large company	0.9895***	(8.54)	-0.1024	(-0.36)
Age	0.0050***	(8.40)	0.00011	(0.13)
Fixed assets	0.0000***	(5.15)	0.0000*	(2.18)
EBIT margin	-0.0082***	(-4.55)	-0.0010	(-0.36)
Constant	-2.9857***	(-26.78)	-0.3125	(-1.12)
McFadden $R^2$	0.122		0.003	
LR $\chi^2$	476.35		5.105	
$p > \chi^2$	0.00		0.530	
# Observations	35,803		1,250	

*t* statistics in parentheses, \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A2: Estimation results any minority share acquisition without cartel duration**

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Firm acquired minority stakes	Panel Probit	Panel Probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firms in a cartel						
Firm left cartel this year	0.3984** (0.1793)	0.3340* (0.1860)	0.0216* (0.0118)	0.0216* (0.0127)	0.0233** (0.0114)	0.0274** (0.0128)
Firm left cartel one year ago		0.1036 (0.1823)		0.0117 (0.0099)		0.0157* (0.0094)
Firm left cartel two years ago		-0.1875 (0.2379)		-0.0030 (0.0086)		0.0001 (0.0090)
Firm left cartel three years ago		0.0633 (0.2156)		0.0073 (0.0094)		0.0113 (0.0095)
Age of the company	0.0015* (0.0008)	0.0015* (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0092*** (0.0033)	0.0083 (0.0079)
Fixed assets, billion USD	0.0128*** (0.0015)	0.0129*** (0.0015)	0.0015*** (0.0003)	0.0015*** (0.0003)	-0.0005 (0.0007)	-0.0009 (0.0008)
EBIT margin	-0.0024 (0.0032)	-0.0025 (0.0033)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	0.0000 (0.0001)
Year of leniency introduction	-0.0270 (0.1677)	0.1591 (0.1852)	-0.0006 (0.0092)	0.0092 (0.0114)	0.0036 (0.0093)	0.0105 (0.0116)
Constant	-7.6645*** (0.4517)	-7.5477*** (0.4614)	0.0091* (0.0054)	0.0168** (0.0077)	-0.3557*** (0.1366)	-0.3157 (0.3344)
$R^2$ overall			0.0805	0.0804	0.0023	0.0022
Wald chi	436.3113	441.8143	188.3639	187.6463		
F-Test					3.2202	2.9122
# Observations	13,812	13,331	13,812	13,331	13,812	13,331
# Firms	1,286	1,286	1,286	1,286	1,286	1,286

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.

**Table A3: Estimation results minority share acquisition on common first digit NACE Code**

<b>Dependent variable:</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
Firm acquired minority stakes on first digit NACE Code Level	Panel Probit	Panel Probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firms in a cartel						
Firm left cartel this year	0.4631** (0.1924)	0.4035** (0.1988)	0.0220* (0.0112)	0.0222* (0.0120)	0.0232** (0.0109)	0.0262** (0.0121)
Firm left cartel one year ago		-0.0266 (0.2053)		0.0041 (0.0080)		0.0066 (0.0079)
Firm left cartel two years ago		-0.1239 (0.2757)		-0.0026 (0.0077)		-0.0013 (0.0077)
Firm left cartel three years ago		0.0106 (0.2300)		0.0028 (0.0072)		0.0050 (0.0073)
Age of the company	0.0011 (0.0008)	0.0012 (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0066** (0.0030)	0.0098 (0.0066)
Fixed assets, billion USD	0.0130*** (0.0015)	0.0130*** (0.0015)	0.0013*** (0.0002)	0.0013*** (0.0002)	-0.0001 (0.0008)	-0.0003 (0.0008)
EBIT margin	-0.0031 (0.0034)	-0.0034 (0.0036)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)
Year of leniency introduction	-0.1181 (0.2259)	0.0133 (0.2508)	-0.0056 (0.0074)	-0.0019 (0.0088)	-0.0028 (0.0075)	-0.0009 (0.0090)
Constant	-7.4673*** (0.3541)	-7.4223*** (0.3723)	0.0076* (0.0043)	0.0134** (0.0062)	-0.2550** (0.1240)	-0.3913 (0.2769)
R <sup>2</sup> overall			0.0735	0.0719	0.0013	0.0013
Wald chi	561.1146	575.1217	143.7190	136.8968		
F-Test					2.0733	1.8408
# Observations	13,812	13,331	13,812	13,331	13,812	13,331
# Firms	1,286	1,286	1,286	1,286	1,286	1,286

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.

**Table A4: Placebo estimation results any minority share acquisition**

<b>Dependent variable:</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
Firm acquired minority stakes	Panel probit	Panel probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firms is in a cartel (Random)	-0.2798* (0.1587)	-0.2704 (0.1739)	-0.0096 (0.0063)	-0.0103 (0.0078)	0.0040 (0.0077)	0.0135 (0.0137)
Firm left cartel this year (Random)	-0.1747 (0.2186)	-0.1859 (0.2321)	-0.0042 (0.0077)	-0.0055 (0.0085)	0.0044 (0.0074)	0.0129 (0.0112)
Firm left cartel one year ago (Random)		-0.1554 (0.2778)		-0.0071 (0.0086)		0.0113 (0.0130)
Firm left cartel two years ago (Random)		-0.1389 (0.2871)		-0.0049 (0.0091)		0.0128 (0.0134)
Firm left cartel three years ago (Random)		-0.2317 (0.2769)		-0.0063 (0.0076)		0.0092 (0.0093)
Age of the company	0.0022*** (0.0008)	0.0022*** (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0097*** (0.0034)	-0.0152 (0.0173)
Fixed assets, billion USD	0.0141*** (0.0015)	0.0145*** (0.0016)	0.0015*** (0.0003)	0.0015*** (0.0003)	-0.0005 (0.0007)	-0.0009 (0.0008)
EBIT margin	-0.0020 (0.0030)	-0.0022 (0.0032)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	0.0000 (0.0001)
Year of leniency introduction	0.0516 (0.1765)	0.2956 (0.1945)	-0.0006 (0.0092)	0.0116 (0.0122)	0.0040 (0.0093)	0.0133 (0.0125)
Constant	-7.3530*** (0.4266)	-7.2424*** (0.4411)	0.0173** (0.0068)	0.0336*** (0.0110)	-0.3757*** (0.1415)	0.6867 (0.7379)
R <sup>2</sup> overall			0.0815	0.0818	0.0023	0.0038
Wald chi	487.1829	443.1032	201.2923	189.7845		
F-Test					3.1227	2.7708
# Observations	13,812	13,079	13,812	13,079	13,812	13,079
# Firms	1,286	1,285	1,286	1,285	1,286	1,285

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.

**Table A5: Placebo estimation results any minority share acquisition**

<b>Dependent variable:</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>
Firm acquired minority stakes	Panel probit	Panel probit	Panel OLS	Panel OLS	Panel OLS with FE	Panel OLS with FE
Firms is in a cartel (Random)						
Firm left cartel this year (Random)		-0.1079 (0.2515)		-0.0024 (0.0072)		0.0026 (0.0079)
Firm left cartel one year ago (Random)		-0.1017 (0.2662)		-0.0004 (0.0083)		0.0046 (0.0089)
Firm left cartel two years ago (Random)		-0.1918 (0.2749)		-0.0023 (0.0079)		0.0018 (0.0085)
Firm left cartel three years ago (Random)	-0.1248 (0.2183)	-0.1354 (0.2278)	-0.0002 (0.0079)	-0.0002 (0.0082)	0.0023 (0.0078)	0.0037 (0.0084)
Age of the company	0.0014* (0.0008)	0.0014* (0.0008)	0.0000 (0.0000)	0.0000 (0.0000)	0.0097*** (0.0034)	-0.0150 (0.0173)
Fixed assets, billion USD	0.0128*** (0.0015)	0.0131*** (0.0015)	0.0015*** (0.0003)	0.0015*** (0.0003)	-0.0005 (0.0007)	-0.0009 (0.0008)
EBIT margin	-0.0024 (0.0031)	-0.0026 (0.0033)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	0.0000 (0.0001)
Year of leniency introduction	-0.0184 (0.1695)	0.2047 (0.1935)	-0.0005 (0.0092)	0.0117 (0.0122)	0.0039 (0.0093)	0.0134 (0.0125)
Constant	-7.6021*** (0.4455)	-7.4271*** (0.4614)	0.0106* (0.0056)	0.0271*** (0.0100)	-0.3719*** (0.1401)	0.6852 (0.7359)
R <sup>2</sup> overall			0.0803	0.0805	0.0023	0.0038
Wald chi	459.0146	426.6274	188.8196	178.0890		
F-Test					3.2192	2.9045
# Observations	13,812	13,079	13,812	13,079	13,812	13,079
# Firms	1,286	1,285	1,286	1,285	1,286	1,285

Robust standard errors clustered at firm level in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Dummies are included for country, year, size of the company, and year of leniency introduction.