Minority Share Acquisitions and Collusion: Evidence from the Introduction of National Leniency Programs*

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Abstract

We address the growing concern that minority shareholding (MS) in rival firms may facilitate collusion, using the introduction of national leniency programs (LPs) as a shock that destabilizes collusive agreements and study their effect on MS acquisitions. Based on data from 63 countries, we find a large and significant increase in horizontal MS acquisitions in the year in which an LP is introduced, but only in countries with effective antitrust enforcement and low levels of corruption. Our findings suggest that firms use MS acquisitions to either stabilize collusive agreements or soften competition in the event that collusion breaks down.

JEL Classification: G34, K21, L41

Keywords: Minority Shareholdings, Collusion, Leniency Programs, Cartel Stability

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1 Introduction

There is a growing concern in recent years about the potential anticompetitive effects of partial cross ownership among rival firms, that is, cases in which firms acquire minority shares (MS) in actual or potential rivals.[1] For instance, a 2014 European Commission white paper argues that "The Commission's experience, the experiences of Member States and third countries, but also economic research show that in some instances the acquisition of a noncontrolling minority stake, such as one firm acquiring a 25% stake in a competitor, can harm competition and consumers" (European Commission, 2014). A similar concern was voiced in a 2008 OECD policy roundtable: "Minority shareholdings and interlocking directorates can have negative effects on competition, either by reducing the minority shareholder's incentives to compete (unilateral effects), or by facilitating collusion (coordinated effects)" (OECD, 2008).

Despite this growing concern, merger regulations do not apply in many countries when the acquisition does not give the acquirer control over the target firm, and in fact, competition authorities often are not even aware of such acquisitions.[2] Moreover, even in countries where competition authorities have the competence to review acquisitions of minority shareholding (e.g., Austria, Canada, Germany, Japan, the U.S., and the UK, see European Commission, 2014), acquisitions, especially those deemed to be "passive", are either granted a de facto exemption from antitrust liability or have gone unchallenged (Gilo, 2000).[3] A case in point is the U.S., where the Federal Trade Commission and the Department of Justice have the competence to review MS acquisitions, but despite that, less than 1% of all MS transactions are challenged and even fewer are blocked (see Nain and Wang, 2018).

The Industrial Organization literature has shown that horizontal MS acquisitions may raise competitive concerns due to unilateral and coordinated effects.[4] Reynolds and Snapp (1986), Bresnahan and Salop (1986), Farrell and Shapiro (1990), and Shelegia and Spiegel (2012) show

[1] There is also a growing concern about common ownership: cases where the same set of shareholders own several competing firms. Recent papers by Azar, Schmalz, and Tecu (2018), and Azar, Raina, and Schmalz (2016) show that airline ticket prices and bank fees are significantly higher when competing firms are held by the same institutional investors, such as Berkshire Hathaway, BlackRock, and Vanguard. Panayides and Thomas (2017) study data from 119 U.S. industries over the period 1997-2014 and find that common ownership by institutional investors (blockholders) is associated with higher industry profitability, due to reduced expenditures. By contrast, Backus, Conlon, and Sinkinson (2018) find no common ownership effect on prices in the US ready to eat cereal industry.

[2] For a comprehensive review of antitrust policies concerning MS acquisitions, see Fotis and Zevgolis (2016).

[3] Gilo (2000) argues that the lenient approach towards passive investments in rivals in the U.S. stems from the courts' interpretation of the exemption for stock acquisitions "solely for investment" included in Section 7 of the Clayton Act.

[4] See European Commission (2013) and O'Brien and Waehrer (2017) for recent literature surveys.

that following an MS acquisition in a rival, the acquirer softens its competitive behavior, because it internalizes some of the competitive externality it imposes on the target.[5] The anticompetitive effects of horizontal MS acquisitions could be even larger if the acquisition gives the acquirer some degree of control over the target firm, because then the acquirer can also soften the target's behavior in addition to its own behavior. In fact, Salop and O'Brien (2000) argue that horizontal MS acquisitions could lead to even less competitive outcomes than full horizontal mergers if the acquirer's control rights substantially exceed its cash flow rights.[6]

Malueg (1992), Dietzenbacher, Smid, and Volkerink (2000), and Gilo, Moshe, and Spiegel (2006) show that MS acquisitions can also facilitate tacit collusion. The reason is that when firms hold MS in rivals, they internalize part of the negative competitive externality that they impose on rivals when they deviate from a collusive agreement. Although MS may also soften competition once a collusive agreement breaks down and hence weaken the incentive to collude, the first effect typically dominates, so firms have a stronger incentive to collude.[7]

Despite the increasing concern about the competitive effects of MS acquisitions, empirical evidence on these effects is still scarce. Dietzenbacher, Smid, and Volkerink (2000) use cross ownership data from the Dutch financial sector to calibrate oligopoly models with constant marginal costs. They conclude that the price-cost margins in the Dutch financial sector are 8% higher in a Cournot model and 2% higher in a differentiated goods, price competition, model than they would be absent cross-ownership. Brito, Ribeiro, and Vasconcelos (2014) propose a methodology to evaluate the unilateral effects of partial cross ownership and apply it to several MS acquisitions in the wet shaving industry. Among other things, they estimate that Gillette's acquisition of a 22.9% nonvoting equity interest in Wilkinson Sword in 1990 had only a negligible negative effect on prices, but a counterfactual acquisition of a 22.9% voting equity would have led to a $2.1\% - 2.7\%$ increase in the price of Wilkinson Sword wet shaving razor blades. Nain and

[5]Interestingly, Farrell and Shapiro (1990) show that in the context of a Cournot model, the acquirer's softer behavior induces rivals to expand their output; if rivals are more efficient than the acquirer, the output shift can actually enhance welfare. Brito, Cabral and Vasconcelos (2014) study the welfare effects of different forms of a divestiture of a firm's partial ownership in a rival.

[6]Foros, Kind, and Shaffer (2011) show that when the acquirer fully controls the target, a partial ownership stake may be more profitable than full ownership because the acquirer chooses a softer stragety for the target than under full ownership. If the two firms compete with a third firm and strategies are strategic complements, the third firm also softens its behavior in a way that may benefit the acquirer.

[7]Malueg (1992) shows in a symmetric Cournot duopoly, in which firms hold the same ownership stakes, v, in one another, that the second effect may dominate the first. But if this were the case, firms would not wish to increase v, so we should not observe such an outcome. While MS typically soften competition, they may also have a bright side. Lopez and Vives (2018) (general oligopoly model with symmetric cross or common ownership structure) and Shelegia and Spiegel (2016) (Bertrand duopoly with asymmetric cross-ownership structure) show that MS in rivals may encourage cost-reducing investments.

Wang (2018) study 774 horizontal MS acquisitions in U.S. manufacturing industries announced in 1980-2010 and find that the acquisitions raised prices by 2% and raised price-cost margins by 0.7%, even after controlling for other factors that may have accounted for these increases.

In this paper, we wish to shed light on the competitive effects of MS acquisitions and in particular, examine whether they facilitate collusion. As far as we know, there is still no empirical evidence on the effects of MS acquisitions on the ability of firms to collude (tacitly or explicitly). Our empirical strategy relies on the fact that it is generally accepted that leniency programs (LP), which reduce or even completely eliminate the fines for cartel members that self-report and hand over evidence to the antitrust authority, can destabilize collusive agreements. Indeed, following the U.S. lead in 1993, many countries have introduced an LP precisely in order to detect existing cartels and deter new collusive agreements.[8] Hence, once an LP is introduced, firms may need to either stabilize their collusive agreements or find a way to soften competition if a collapse of collusion is inevitable; acquiring MS in rivals is one way of doing it. Accordingly, we examine whether the introduction of an LP encourages MS acquisitions.

To this end, we construct a panel data set that covers 63 countries, of which 54 have introduced a national LP between 1990 and 2013. Applying count data models, we find robust evidence that in the year in which a national LP is introduced, there is a large and significant increase in the number and value of horizontal MS acquisitions between firms based in that country. This effect holds, however, only in countries with an effective antitrust enforcement and a low level of corruption. In countries with ineffective antitrust enforcement and/or high levels of corruption, the introduction of an LP has no effect on MS acquisitions, presumably because the LP does not destabilize collusive agreements. We also find that the effect is present when investing in large firms and when the acquired stake gives the acquirer a $10\% - 25\%$ share in the target firm; such stakes are significant in size, but normally do not trigger merger notification.[9] We do not find an effect in the case of cross-border or non-horizontal MS acquisitions.

The idea of using the introduction of an LP as a negative shock to collusive agreements was first used by Sovinsky and Helland (2012). They argue that the 1993 revision of the U.S. LP and its adjustment in 1995 have reduced the gains from collusive relationships in the form of research joint ventures (RJV). They find a significant drop in the probability of joining an RJV after 1993. Dong, Massa, and Zaldokas (2016) show that the introduction of LPs in 63

[8] For a review of LPs in different countries, see OECD (2012) and UNCTAD (2010).

[9] In most countries, merger notification is required only when an MS acquisition results in joint control, i.e., the right to block major decisions within the target (see OECD, 2008).

countries between 1990 and 2012 led to more cartel convictions and lower average gross margins of affected firms, and moreover, was followed by an increase of takeovers and mergers with rivals.[10] In a similar vein, Marx and Zhou (2015) find that the EC's LP, first introduced in 1996, had a significant and robust large positive effect on mergers. They also find that the EC's cartel settlement procedure in 2008, which allows late confessors to obtain fine reductions outside the LP, had a significant large negative effect on mergers, presumably because it lowered the cost of collusion and made mergers less attractive compared to collusion. Unlike the first paper that studies RJV and the last two papers that study mergers and acquisitions, we are interested in the effect of LPs on MS acquisitions as an indirect evidence for the proposition that MS lessens competition.

The remainder of the paper is organized as follows. In Section 2 we discuss our empirical strategy and in Section 3 we present our data. The estimation results are in Section 4 and in Section 5 we show robustness checks. We conclude in Section 6. The Appendix includes a model that illustrates our empirical strategy, model fit tests for the choice of our empirical model, additional information on our data, and some additional robustness checks. An online Appendix includes additional material.[11]

2 Empirical Strategy

Following the pioneering papers of Motta and Polo (2003) and Spagnolo (2004), a large theoretical and experimental literature has emerged which examines the competitive implications of LPs. This literatures shows that by and large, LPs hinder collusion (see Spagnolo and Marvao (2016a) for a recent literature review). The theory has received empirical support. For instance, Levenstein and Suslow (2011), Abrantes-Metz et al. (2013), De (2010), Zhou (2012, 2016), and Hellwig and Hüschelrath (2018), show that the introduction of an LP has a significantly negative effect on the duration of detected cartels, while Miller (2009) finds that the LP introduced in the U.S. in August 1993 enhanced deterrence and detection capabilities.

We will therefore use the introduction of a national LP in a given country as an exogenous shock, which destabilizes collusive agreements between firms located in that country. The idea,

[10] Davies, Ormosi, and Graffenberger (2015) also study the relationship between cartels and mergers, although they examine mergers after cartel breakdowns rather than after the introduction of an LP. Using a pooled sample of 84 European cartels, they find that mergers are more frequent post-cartel breakdown, especially in less concentrated markets. This finding is consistent with the notion that mergers are a substitute for collusive behavior, although they may be also driven by other considerations, such as the need for market restructuring, due to more intense post-cartel competition.

[11] The online appendix is available at https://www.tau.ac.il/~spiegel/papers/MS-OnlineAppendix.pdf.

which we formalize in the Appendix, is that faced with this negative shock, colluding firms may wish to resort to MS acquisitions as a way to stabilize their collusive agreements. Intuitively, once an LP is in place, a given firm i may be worried that rivals will apply for leniency, not necessarily because they prefer to apply, but rather because they fear that firm i will apply first.[12] By acquiring MS stakes in rivals, firm i can reassure rivals that it is not going to apply for leniency, because now it shares the loss to rivals when it applies for leniency. The acquisition then alleviates the rivals' need to apply for leniency and therefore stabilizes the collusive agreement. Firms may in fact wish to acquire MS stakes in rivals even if collusion breaks down once an LP is introduced if the acquisition makes the resulting non-collusive equilibrium less competitive.

Although firms may use MS as a collusive device even before an LP is in place, an MS acquisition is typically costly due to various transaction costs.[13] Consequently, it is reasonable to expect firms to be reluctant to acquire MS in rivals if they have other means to sustain collusion. Since the introduction of an LP destabilizes collusive agreements, it makes firms more willing to acquire MS in rivals. This suggests in turn that the introduction of an LP would be followed by an increase in MS acquisitions in rival firms. If the intention of firms is only to stabilize existing collusive agreements or soften competition once collusion breaks down, we should observe a one-time increase in MS acquisitions following the introduction of an LP. If the intention is to facilitate new collusive agreements, the increase in MS acquisitions should be permanent.

To study the effect of the introduction of an LP on MS acquisitions, we use a panel of 63 countries over the period 1990-2013, and estimate the following count data model:

$$\mathrm{MS_{it}} = \exp(LP_{it}\beta_1 + X_{it}\beta_2 + \xi_i + \xi_t + \varepsilon_{it}),$$

where $\mathrm{MS_{it}}$ is a measure of MS acquisitions of rivals in country i in year t (either the number of MS acquisitions or their aggregate deal value in dollars); LP_{it} is a vector of year dummies for the year in which the LP was introduced in country i and several years before and after the LP

[12] This effect is reminiscent of the "race to the courthouse" effect in Harrington (2008). Harrington (2013) shows that a similar effect arises when cartel members are privately informed about the likelihood of conviction without a cooperating firm. Then, each firm may apply for amnesty, fearing that another firm may believe that the probability of detection is high, and will apply for amnesty first.

[13] Moreover, if the shares are acquired from atomistic shareholders, the acquirer makes no money on the acquired shares due to Grossman and Hart's (1980) free-rider problem and only benefits from an increase in the value of its own firm.

introduction; X_{it} is a vector of macroeconomic and financial markets control variables; ξ_{i} and ξ_{t} are country and year fixed effects; and ε_{it} is the noise term.

In our baseline specification, the vector LP_{it} includes dummies for three years before and three years after the introduction of an LP. The idea is to examine whether there is an anticipation effect before the LP is introduced and whether the LP affects MS acquisitions after the year in which it is introduced. The control group then consists of all years more than three years before or after the LP is introduced. We also examine whether the LP affects MS acquisitions more than three after it is introduced by including dummies for the three years after the LP is introduced. In this specification though we eliminate the year dummies before the LP is introduced as otherwise the control group becomes too small especially for countries that have introduced an LP early on. In this specification the control group then consists of the entire pre-treatment period. In some specifications we interact the dummy for the year in which the LP was introduced with two country-specific indices reflecting the efficacy of antitrust enforcement and the level of corruption in country i. We control for these factors because in countries with ineffective antitrust enforcement and/or high levels of corruption, an LP is unlikely to destabilize collusive agreements, and hence may not trigger the need to resort to MS acquisitions. We therefore expect to see more MS acquisitions following the introduction of LPs only in countries with effective antitrust enforcement and/or low levels of corruption.

We include the vector X_{it} in our estimation to control, at least partially, for various forces that may drive MS acquisitions beside the desire to facilitate collusion.[14] We wish to examine whether the introduction of a national LP has an effect on MS acquisitions even after these additional forces are controlled for.

In general, a count data model could be estimated with a (Quasi-Maximum Likelihood) Poisson model or with a Negative Binomial (NB) model. The Poisson model however is inappropriate for our data since we have significant Poisson overdispersion: when estimated by Poisson, the resulting conditional variance is approximately four times larger than the variance implied by a Poisson distribution. This naturally calls for NB models and the model fit tests presented in the Appendix clearly support this.

A potential source for the observed overdispersion is the fact that 30.48% of all observations in our data are zeros, i.e., country-year pairs without any MS acquisitions.[15] This fraction of

[14] See Meadowcroft and Thompson (1986), Allen and Phillips (2000), Fee, Hadlock, and Thomas (2006), and Parker Ouimet (2013) for papers that examine the driving forces behind MS acquisitions. Jovanovic and Wey (2014) study a model where an MS acquisition is a first step towards a full merger.

[15] For some MS we do not have information on the deal values. Thus, the share of zeros is even larger for the

zeros is higher than assumed by Poisson and even higher than that assumed by NB models. It is possible that at least some of the zeros in our data are false and due to imperfect data reporting, especially in smaller and developing countries. Moreover, it is also likely that data collection has improved over time, meaning that we may have more false zeros in earlier years. We will therefore use a zero-inflated negative binomial (ZINB) model to analyze our data. ZINB is a mixture model which in addition to the count component that estimates the full range of the counts, also contains a binary component that estimates the probability of excess zeros.

The binary component, sometimes called the inflation equation, is conventionally computed using the following logit model:

$$\Pr(\mathrm{MS_{it}} = 0|Z_{it}) = \frac{\exp(Z_{it}\beta)}{1 + \exp(Z_{it}\beta)},$$

where Z_{it} is a vector of variables that do not necessarily coincide with the variables used in the count component (see e.g., Hilbe, 2007, p. 174). In our case, Z_{it} includes time dummies for the periods 1990-1995, 1996-2000, and after 2000; real GDP; real GDP per capita; and the size of the stock market. The last three variables are meant to capture the degree to which the country is developed, since we expect more developed countries to have fewer false zeros.[16] The tests presented in the Appendix indicate that the ZINB model fits the data best.[17]

3 The Data

3.1 Data Description

MS acquisitions

We constructed our data set on MS acquisitions in several steps, outlined in Table A2 in the Appendix. First, we extracted from Thomson One Financial database information on all acquisitions in which the reported final stake is below 50% in 63 countries for the period 1990-2013.[18] Second, we eliminated share buybacks and self-tenders, i.e., acquisitions where the acquirer and target are one and the same. Third, we eliminated acquisitions where the acquirer

aggregate deal value (43.52%).

[16] We also experimented with other variables and other time periods, but the results did not change by much. We also included year fixed effects, but the estimation did not converge; hence we decided to use three time periods instead.

[17] In an online Appendix available at https://www.tau.ac.il/~spiegel/papers/MS-OnlineAppendix.pdf, we also present results for the standard NB models (without zero-inflation). The results are similar to the ZINB models presented in the main text.

[18] In some cases the data set does not report the final stake. We did not take these acquisitions into account to ensure that we only study MS acquisitions.

or target are investors and investment offices according to their primary business description. These acquisitions are likely to be driven by investment considerations, which are unrelated to the issue that we focus on in this paper. We are then left with 47,675 MS acquisitions. Of these, 32,683 are domestic acquisitions, where the acquirer and target are from the same country, and 12,934 are domestic horizontal MS acquisitions, meaning that the listed activities of the acquirer (or its parent company) and the target overlap in at least one 4-digit SIC code. In the other 19,749 domestic MS acquisitions, none of the 4-digit SIC codes of the acquirer and the target overlap, so we classify them as non-horizontal. Finally, of the 12,934 domestic horizontal MS acquisitions in our data, 10,699 are new MS acquisitions, in the sense that the acquirer did not own a previous stake in the target, while 2,235 acquisitions are increases of an already existing MS.[19] MS acquisitions are typically completed quickly: using the Zephyr database by Bureau van Dijk, we find that the median duration from the first rumour of an MS acquisition to its completion over the period 2005-2013 (a total of 60,427 MS transactions) was 0 days with an average duration of just 25 days.[20]

Since we are interested in the effect of MS acquisitions on collusion, we will mostly focus on domestic horizontal MS acquisitions, although we will also consider domestic non-horizontal MS acquisitions and cross-border horizontal and non-horizontal MS acquisitions. Given that the variation in our data is at the country and year level, we aggregate the data by country and year and create two measures of MS acquisitions: the number of MS acquisitions in country i and year t, and the aggregate deal value of MS acquisitions in country i and year t, measured in millions of constant 1990 USD.[21] Figure 1 below shows the annual total number of transactions and aggregate value of MS acquisitions over all countries for the period 1990 and 2013.[22] It is worth noting that the number of MS acquisitions and their aggregate value have an increasing time trend with peaks in 2000 (the dotcom bubble) and in 2009 (the global financial crisis). We control for these trends using time fixed effects.

[19] Unfortunately we do not have the initial ownership data and hence, when we observe firm i acquiring a stake in firm j, we cannot tell if firm j already holds a stake in firm i. However, out of the 12,934 domestic horizontal MS acquisitions in our data over the period 1990-2013, there are only 45 cases in which the target firm acquired later on a stake in the acquiring firm. Since we have 24 years of data, this suggests that cross ownership (two firms hold each other's shares) is uncommon in our data set.

[20] The Thomson One Financial database that we use does not report this data. The reason we still use it is that Zephyr only covers MS transactions from 2004 onward.

[21] The latter were computed using GDP deflator data for the US provided by the International Monetary Fund (IMF), with 1990 as the base year.

[22] With 63 countries and 24 years we should have 1,512 country-year pairs. However several countries in our data set did not exist in 1990. For that reason we have data on the Czech Republic and Slovakia only for 1993-2013; on Lithuania, Estonia, Latvia, and Russia only for 1991-2013; and on Croatia only for 1992-2013. All in all then we have 1,500 country-year pairs.

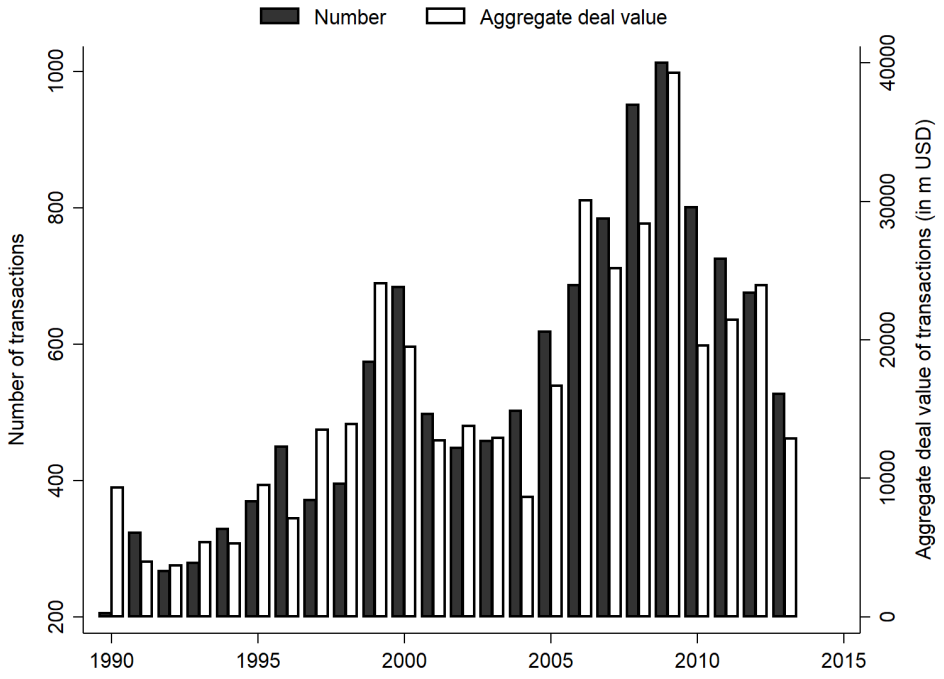

Figure 1: The number and aggregate deal value of MS acquisitions (in million USD, 1990-2013)

Of the 63 countries in our data set, the U.S. accounts for the largest aggregate value of transactions, with about 18% of the total (68,977 million USD out of 380,874 million USD), while Japan has the largest number of acquisitions, followed by the U.S. (1,839 acquisitions in Japan and 1,575 in the U.S. out of a total of 12,934 MS acquisitions). The distributions of the number and aggregate value of MS acquisitions across countries for the period 1990-2013 are presented in Figures A1 and A2 in the Appendix.

Leniency Programs

The first countries to introduce an LP were the U.S. in 1993, South Korea in 1997, and the UK in 1998. After 2000, at least three countries have introduced an LP each year, with a peak in 2004, when nine countries have introduced an LP. Table A3 in the Appendix lists for each country the year in which the LP was introduced. As the table shows, nine countries in our data (Argentina, Hong Kong, Indonesia, Jordan, Nigeria, Oman, Thailand, Venezuela, and Vietnam) did not introduce an LP at least until 2013 when our data ends. Figure 2 shows the distribution of years in which LPs were introduced.[23]

[23]The EU has introduced an LP in 1996 and revised it in 2002 and 2006. In this paper however we only focus on national LP's. Including the EU's LP and its revisions in the regressions does not change our results qualitatively (see the online Appendix for details).

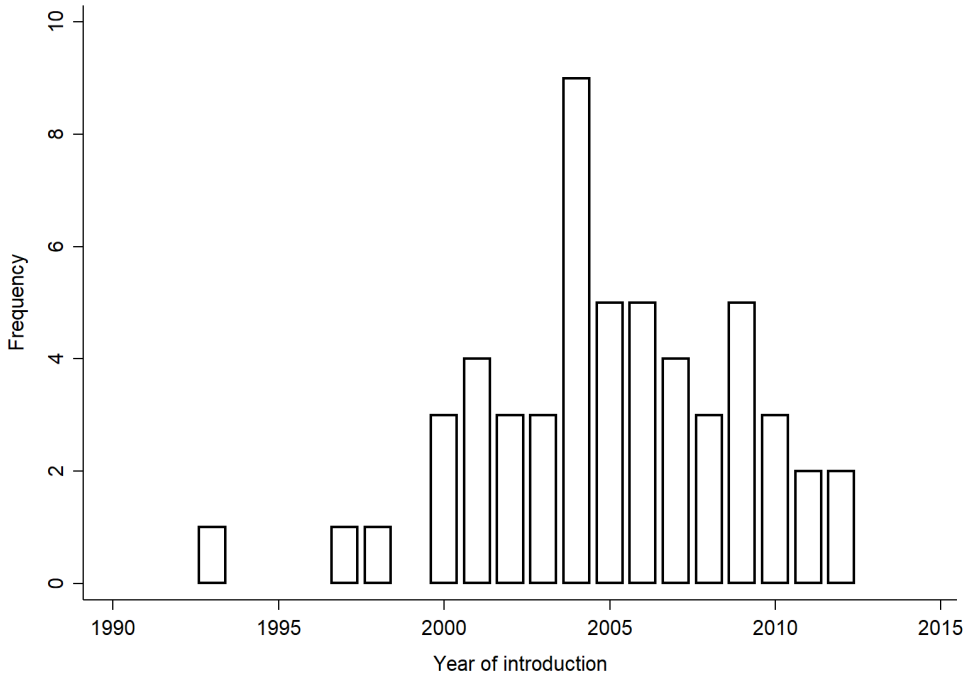

Figure 2: Frequency of the introduction of new national LP (by year)

Effectiveness of LP

While an LP may induce firms to acquire MS in rivals, the effect should be present only in countries with effective antitrust enforcement and low levels of corruption. Otherwise the introduction of an LP should have no effect on the ability of firms to collude and hence should not induce them to acquire MS stakes in rivals. To control for the efficacy of antitrust enforcement, we use the Anti-Monopoly Policy Index (AMPI), provided by the World Economic Forum (WEF).[24] The AMPI is based on a survey of top business executives regarding their perception of the efficacy of antitrust enforcement in their country and varies from 1 (not effective at all) to 7 (extremely effective). The average AMPI values for the countries in our data set are shown in Table A3 in the Appendix. Although the AMPI is based on a single survey question, we chose it over other popular measures, such as the Rating Enforcement (RE) measure published in the Global Competition Review, because of its wide coverage, which allows us to include it for 62 out of 63 countries in our data.[25] Despite its simplicity, the AMPI is highly correlated

[24]The AMPI is published annually in the Global Competition Review and is part of a much broader Global Competitiveness Index (GCI) which can be downloaded at `http://reports.weforum.org/global-competitiveness-report-2014-2015/rankings/` (last accessed on 24 June 2018). For the construction of AMPI, we use the variable "6.03 Effectiveness of anti-monopoly policy."

[25]The RE measure is based on a detailed questionnaire filled by the competition authorities themselves and also considers how local competition counsels, antitrust lawyers and economists, academics, and local journalists

with the RE measure, with a correlation coefficient of 0.7. We therefore believe that the AMPI is a sensible measure of antitrust enforcement.

Since the AMPI is only available from 2006 onwards, we divide countries into two groups, depending on whether their average AMPI's during the 2006-2013 period is above the median for all countries (countries with an effective antitrust enforcement), or below the median (countries with ineffective antitrust enforcement). This classification is justified by the fact that the AMPI scores are stable over time.

We control for corruption using the Corruption Perception Index (CPI), computed annually by Transparency International (TI). The CPI is based on survey-type assessments by analysts, businessmen, and experts and reflects the perceived level of corruption in the public sectors of their country. It rates countries on a 10 points scale, with a higher score reflecting a lower level of corruption.[26] The average CPI values for the countries in our data set are shown in Table A3 in the Appendix. Unfortunately, we do not have CPI scores for all country-year pairs since CPI were originally available for only 28 countries out of the 63 countries in our sample and are available for only 42 countries from 2003 onwards. We therefore exploit the fact that the CPI for each country is stable over time, and as in the AMPI case, classify countries as having either a high or a low level of corruption, depending on whether their average CPI scores are above or below the median for all countries.[27]

Controls

To control for other potential determinants of MS acquisitions, we collected country-specific macroeconomic variables, including GDP growth, real GDP per capita, unemployment rate, inflation rate (based on the GDP deflator index), and the purchasing-power-parity conversion rate (PPPEX). These variables were shown to be potential drivers of mergers and acquisitions (see, e.g., Rossi and Volpin (2003), Di Giovanni (2005) and Erel et al. (2012)). We also include a real GDP variable to control for country size, and the growth rate of the volume of import (IMP) and exports (EXP) of goods and services to reflect year-over-year changes in trade activity. All variables are taken from the World Economic Outlook Database (WEO)

evaluate an agency's performance. Unfortunately, the RE measure is only available for a fraction of the countries used in our analysis.

[26] For further information on the CPI, see http://www.transparency.org/research/cpi/overview (last accessed on 24 June 2017).

[27] In principle, countries also differ with respect to whether cartel enforcement involves criminal sanctions. In practice, however, it is not clear in many countries whether such sanctions are implemented (e.g., Global Legal Group, 2009). Moreover, in the EU, the number of individuals who were successfully prosecuted is still very small (Spagnolo and Marvao, 2016b).

provided by the International Monetary Fund (IMF) and are available for all countries in our data except India and Oman.

In addition to the macroeconomic control variables, we also include in the analysis country-specific financial markets variables from the World Bank's World Development Indicators (WDI). These variables include the total market capitalization of listed firms as a share of GDP to control for the size of the stock market (STOCK); domestic credit to private sector as a share of GDP to control for the availability of credit (CREDIT); total imports and exports as a share of GDP to control for trade activity (TRADE); and the real interest rate to control for the cost of investment (INTEREST). Unfortunately, the financial markets variables (and especially CREDIT and INTEREST) are not available for all country-year pairs and hence when we use them, our sample is reduced from $1,368$ to $1,018$ country-year pairs.

3.2 Descriptive Statistics

Table 1 shows the descriptive statistics of our variables, reported on an annual basis. On average, there are 8.6 national horizontal MS acquisitions per country per year, of which 7.1 are new acquisitions. The average aggregate deal value is 144 million USD per country per year for all acquisitions, and 112 million USD for new acquisitions.[28] Both the number and value of MS acquisitions at the country year level have a large variance. In particular, in 30% of all country-year pairs in our data there are no MS acquisitions, while in other country-year pairs there is a large number and a large value of MS acquisitions. The table also shows a large diversity across countries in terms of the macroeconomic and financial market variables.[29]

At an individual level, the average value of a new domestic horizontal MS acquisition across all countries and years is 29.6 million USD, though the distribution of deal values has a long right tail with a median value of merely 4.7 million USD. In terms of industries, we have at least one MS acquisition in 647 4-digit SIC code industries. Of these, the industries with the largest number of new domestic horizontal MS acquisitions are information retrieval services (3.8% of the total), prepackaged software (3.7%), crude petroleum and natural gas (3.7%), and electric services (2.4%). On a broader level, the core businesses of the involved firms according to Thomson Reuter's industry description are high technology (14.1%), energy and power (13.4%)

[28] We winsorized the deal values at 98.5% because we observed some extreme outliers. Without winsorizing the mean would be 244 millions USD for all acquisitions and 196 million USD for new acquisitions.

[29] Some values in Table 1 are extreme, like the -920.7 GDP growth in Bulgaria in 1991 (immediately after the fall of communism in Eastern Europe), the 27.8% average unemployment rate in South Africa in 2002, the 5,000% inflation rate in Peru in 1990, the 311% of GDP credit in Iceland in 2006, or the -92% real interest rate in Ukraine in 1993 and 94% in Bulgaria in 1996.

and materials (13.4%).[30]

Table 1: Descriptive statistics

	Mean	S.D.	Min	Max	Obs.	Source
Deal characteristics						
Number of MS acquisitions	8.62	19.1	0	189	1,500	Thomson
Number of new MS acquisitions	7.13	15.4	0	151	1,500	Thomson
Aggregate value of MS acquisitions (in million USD)	144	380	0	4225	1,500	Thomson
Aggregate value of new MS acquisitions (in million USD)	112	309	0	3929	1,500	Thomson
Macro variables						
Real GDP	4.85	1.6	0.39	9.24	1.477	IMF
GDP growth	0.03	0.0	-0.23	0.24	1,468	IMF
Real GDP per capita (in million USD)	8.83	1.3	4.59	11.2	1,473	IMF
Unemployment (% of Labor Force)	7.95	4.6	0.03	27.8	1,397	IMF
Inflation (%)	28.3	230	-25.70	5053	1,466	IMF
Purchasing-power-parity conversion rate (PPPEX)	115	530.9	0.00	7,311	1.472	IMF
Volume of exports of goods and services (EXP)	7.58	7.9	-26.6	77.5	1,451	IMF
Volume of imports of goods and services (IMP)	9.81	17.1	-41.6	507	1.453	IMF
Financial market variables						
Credit	73.5	50.9	1.12	311	1.373	WDI
Interest rate (%)	5.89	11.3	-91.7	93.9	1-190	WDI
Stock	59.5	64.9	0.00	606	1,375	WDI
Trade	85.5	65.6	13.8	450	1,437	WDI
Competition policy effectiveness variables						
Anti-Monopoly Policy Index (AMPI, 1-7)	4.51	0.7	2.84	5.77	1476	TI
Corruption Perception Index (CPI, 1-10)	6.25	2.2	2.44	9.48	996	WEF

Notes: All variables reflecting a percentage are scaled to 100 for 100%; values of acquisitions and GDP are measured in constant 1990 million USD; GDP growth and imports and exports are measured in terms of year-over-year percentage changes.

Before moving to the estimation results, we first illustrate in Figure 3 the evolution of the number and aggregate value of domestic horizontal MS acquisitions from three years before the introduction of a national LP to three years after. To make the data comparable across countries, we normalize the data for each country to values between 0 and 1, as follows:

$$MS_{it}^{norm} = \frac{MS_{it} - \min(MS_i)}{\max(MS_i) - \min(MS_i)},$$

where $\min(MS_i)$ and $\max(MS_i)$ are the lowest and highest value of MS_{it} for country i over the sample period.[31] Figure 3 shows that the number of MS acquisitions, as well as their aggregate

[30] Detailed information on the sector definition can be found at:
http://mergers.thomsonib.com/td/DealSearch/help/Macro-Mid.pdf.

[31] Cyprus, Ecuador, Taiwan and Ukraine are not included in the figure since they introduced a national LP only in 2011 and 2012, so we do not have observations on full three years after the LP was introduced (we have data only until 2013).

value, increase as we approach the year in which an LP is introduced (this year is different for different countries) and then decrease. This trend suggests that the introduction of an LP encourages MS acquisitions in rivals. In the next section, we show that this pattern persists even when we control for other factors that may affect MS acquisitions, and use year fixed effects.

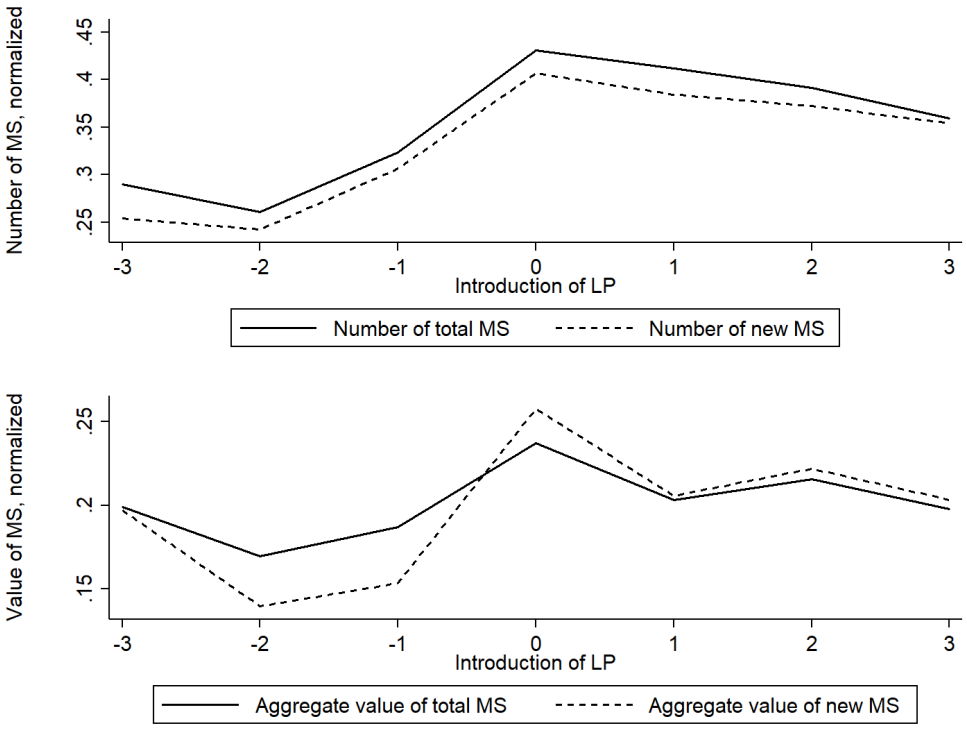

Figure 3: Development of domestic horizontal MS acquisitions in the three years before and after the introduction of national leniency programs (normalized by country, 0-1)

4 Estimation Results

We present our estimation results for the number of domestic horizontal MS acquisitions and their aggregate deal values in Tables 2 and 3 below. The results are obtained from ZINB estimation.[32] In all specifications, we include country and year fixed effects. In most of the paper, we focus on new domestic horizontal MS acquisitions. In the online Appendix we show that the results are very similar when we include increases of already existing MS in rivals.

[32]In the online appendix we report corresponding results from NB and also OLS estimation and in the Appendix IV estimates. The results are very similar to those in Tables 2 and 3.

Number of MS deals and the aggregate deal value

Columns (1) and (2) in Tables 2 and 3 below are our baseline specification. They include dummies for the year in which the LP was introduced, as well as three years before and after the introduction. The idea is to examine whether the number of MS in rivals and the aggregate deal value are larger in these years compared to the control group, which includes four years or more before and after the introduction of the LP. In Column (2), we also include financial market variables. Since these variables are not available for all country-year pairs, the number of observations in Column (2) is lower than in Column (1). The results in both columns are similar and show that the introduction of an LP has a significant effect only in the year in which an LP was introduced (the only exception is the year after the LP is introduced in Column (2) of Table 3). In this year, the number of MS acquisitions and the aggregate deal value are larger than in the control group, i.e., four years or more before and after the introduction of the LP.

To appreciate the magnitude of the LP effect, we now show in Figure 4 the coefficients of the LP dummies in Column (2) in Tables 2 and 3, expressed in terms of percentage changes (the values in the figure equal $100 \times (e^{\beta} - 1)$, where β is the value of the relevant coefficient). The values in the figure show how much larger are the number of MS acquisitions and the aggregate deal value in the year in which the LP was introduced, as well as in each of the three years before and after the introduction, relative to the control group, which includes four years or more before and after the introduction of the LP. The figures show further that the number of new domestic horizontal MS acquisitions is $26\% - 30\%$ larger, and the aggregate deal value is $75\% - 103\%$ larger than they are in the control group.[33] The large effect of the LP in the year in which it is introduced is consistent with the idea that firms acquire MS in rivals in order to stabilize collusive arrangements that were destabilized by the LP or soften competition in the event that collusion will break down.

The fact that we do not see an effect of the LP before the introduction year suggests that firms react to the LP immediately when it is introduced. As mentioned earlier, MS acquisitions can typically be completed very quickly, so firms do not need to start acquiring MS stakes in rivals in advance. Moreover, the fact that we also do not see an effect after the introduction year suggests that the increase in the number of MS acquisitions and in the aggregate deal value

[33]The exponentiated coefficients of 0.23 and 0.26 in Columns (1) and (2) of Table 2 are 1.26 and 1.30, and therefore represent an increase of 26% and 30% in MS acquisitions in the year an LP is introduced. Likewise, the exponentiated coefficients of 0.56 and 0.71 in Columns (1) and (2) of Table 3 are 1.75 and 2.03, which represent an increase of 75% and 103%.

are neither driven by pre-treatment trends, nor by some unobserved country-specific change in the political or legal climate that drives both the introduction of the LP and the decisions of firms to acquire MS in rivals; otherwise we would expect to see a permanent increase in MS acquisitions in rival firms once an LP is in place. In Section 5 we provide further evidence on this by using Lewbel's (2012) instrumental variable approach.

In Column (3) of Tables 2 and 3 below, we examine the last finding further and include in the estimation a dummy "*After LP+3*" which takes the value 1 in all years after LP+3 and 0 otherwise. The idea is to examine whether the LP had a permanent effect on MS acquisitions. To ensure that our control group is sufficiently large, we omit the year dummies before the LP is introduced. Consistent with our earlier findings, the *After LP+3* dummy in Tables 2 and 3 is not significant. Moreover, the effect of LP on MS in Columns (2) and (3) do not differ statistically. A potential reason why the *After LP+3* dummy is not significant is that an LP may deter new cartels from being formed; consequently, firms do not need to acquire MS in rivals after an LP is in place. Yet, firms may still need to stabilize existing collusive agreements or try to soften competition if collusion is going to break down once an LP is introduced; hence they respond to the introduction of an LP by acquiring MS in rivals once the LP is introduced.

In Columns (4) and (5) of Tables 2 and 3 we interact the LP dummy with dummies that control for the efficacy of antitrust enforcement (AMPI) and for the level of corruption (CPI). Since the AMPI and CPI are not available for all country-year pairs, we have fewer observations in Columns (4) and especially in (5) than in the other columns. The results show that the introduction of an LP affects MS acquisitions only in countries with effective antitrust enforcement and low levels of corruption.[34] The effect in these countries is in fact much larger than it is in the entire sample: in the year an LP is introduced, the number of MS acquisitions in these countries is $42\% - 51\%$ larger, while the aggregate deal value is $144\% - 213\%$ larger than they are in other years.[35] These findings are consistent with the idea that when antitrust enforcement is weak or the level of corruption is high, an LP is either unlikely to destabilize collusive agreements or collusion is feasible even without the need to acquire MS stake in rivals. Consequently, firms in such countries do not need to rely on MS acquisitions, and as a result, the introduction of an LP should not have an effect on such acquisitions.

[34]The qualitative results in Columns (4) and (5) do not change if we also add to the regression an *After LP* dummy that is equal to 1 in all years after the LP is introduced (not including the LP year) and is equal to 0 in others, interacted with the Enforcement and the Corruption dummies. The results are shown in the online Appendix.

[35]The exponentiated coefficients of 0.35 in Column (4) and 0.41 in Column (5) are 1.42 and 1.51.

Table 2: ZINB estimations of the number of new domestic horizontal MS acquisitions

	(1)	(2)	(3)	(4)	(5)
LP-3	-0.01	0.02			
	(0.13)	(0.13)			
LP-2	-0.07	-0.09			
	(0.11)	(0.12)			
LP-1	0.05	0.01			
	(0.12)	(0.12)			
LP	0.23**	0.26**	0.21*		
	(0.10)	(0.12)	(0.13)		
LP+1	0.07	0.09	0.03		
	(0.12)	(0.13)	(0.15)		
LP+2	0.11	0.11	0.04		
	(0.13)	(0.14)	(0.19)		
LP+3	0.04	0.03	-0.05		
	(0.12)	(0.13)	(0.19)		
After LP+3			-0.14		
			(0.17)		
LP × Effective Enforcement				0.35***	
				(0.14)	
LP × Ineffective Enforcement				0.01	
				(0.18)	
LP × Low Corruption					0.41**
					(0.18)
LP × High Corruption					-0.26
					(0.46)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes
Financial covariates	No	Yes	Yes	Yes	Yes
F-test on joint significance of covariates	0.00	0.00	0.00	0.00	0.00
R^2	0.68	0.67	0.67	0.67	0.65
Observations	1368	1018	1018	1008	652

Notes: Standard errors clustered at the country level. Inflation equation is reported in the online Appendix. The macroeconomic covariates are GDP, GDP growth, GDP per capita, Unemployment rate, Inflation, PPPEX, IMP and EXP. The financial covariates are CREDIT, INTEREST, STOCK and TRADE. All covariates are lagged by one year. The full estimation outputs are available in the online Appendix of the paper. The reported R^2 is the deviance based R^2 suggested by Cameron and Windmeijer (1996) for count data. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Table 3: ZINB estimations of the aggregate value of new domestic horizontal MS acquisitions

	(1)	(2)	(3)	(4)	(5)
LP-3	0.15	0.10			
	(0.46)	(0.43)			
LP-2	0.01	-0.00			
	(0.32)	(0.36)			
LP-1	-0.23	-0.26			
	(0.35)	(0.40)			
LP	0.56**	0.71**	0.91**		
	(0.29)	(0.29)	(0.41)		
LP+1	0.26	0.56**	0.76**		
	(0.25)	(0.23)	(0.30)		
LP+2	0.30	0.42	0.68		
	(0.27)	(0.26)	(0.44)		
LP+3	0.35	0.29	0.52		
	(0.38)	(0.45)	(0.51)		
After LP+3			0.41		
			(0.47)		
LP × Effective Enforcement				1.14***	
				(0.44)	
LP × Ineffective Enforcement				-0.26	
				(0.48)	
LP × Low Corruption					0.89**
					(0.38)
LP × High Corruption					-0.36
					(0.51)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes
Financial covariates	No	Yes	Yes	Yes	Yes
F-test	0.00	0.00	0.00	0.00	0.00
R^2	0.33	0.35	0.36	0.36	0.36
Observations	1368	1018	1018	1008	652

Notes: Standard errors clustered at the country level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

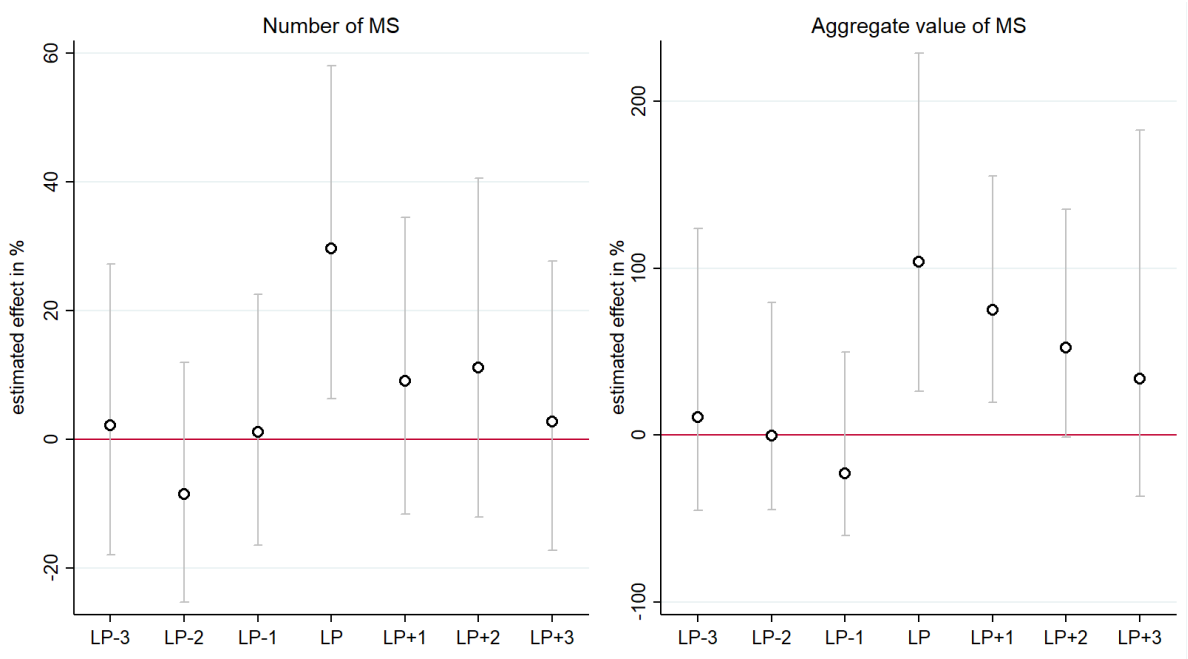

Figure 4: Percentage effect of the introduction of an LP on new domestic horizontal MS with 90% CIs

As the above results show, the introduction of an LP has a much larger effect on the aggregate deal value of MS acquisitions than on their sheer number. The difference between the two is statistically significant and persists even when we use other specifications and other estimations like Negative Binomial, OLS and IV estimations. There are two potential reasons for this: (i) in the year in which an LP is introduced, firms acquire larger stakes in rivals than they do in other years, and hence the average deal value of MS acquisitions is larger, and (ii) in the year in which an LP is introduced, firms acquire MS stakes in larger rivals, which are worth more money. In the next two subsections we therefore study the size of the acquired stakes and the size of targets.

Stake size

To examine the size of MS stakes that firms acquire, we split the acquisitions in our data into three groups. The first group includes acquisitions of small stakes of up to 10%; such acquisitions are typically viewed as passive and do not trigger merger notification. The second group includes acquisitions of medium stakes of $10\% - 25\%$. Although such acquisitions have to be notified in some countries, in practice they are almost never subject to merger investigation (see European Commission, 2016). The third group includes acquisitions of large stakes of $25\% - 50\%$, which are typically no longer considered to be passive and hence attract antitrust

scrutiny (European Commission, 2016).

Table 4 shows the distribution of new domestic horizontal MS acquisitions in terms of their number and their deal value. For each size interval, the table also shows the average and the median size of the target firm in millions of USD. The latter is computed by dividing the dollar value of the acquisition by the size of the acquired stake.

Table 4: Size intervals of new domestic horizontal MS acquisitions by the stake size

Size interval	Number of acquisitions	%	Aggregate deal value in m USD	%	Average size of target in m USD	Median size of target in m USD
0 - 10%	2,217	20.7	35,684	21.1	401	65
10 - 25%	3,928	36.7	59,829	35.5	176	29
25 - 50%	4,554	42.6	73,205	43.4	97	17
Total	10,699	100	168,718	100	201	29

To interpret Table 4, note that if the number of MS acquisitions was uniformly distributed among all stake sizes from 0% to 50%, 20% of all new domestic horizontal MS acquisitions would be of 10% or less, 30% would be in the range of $10\% - 25\%$, and 50% would be in the range of $25\% - 50\%$. Table 4 shows that indeed, the distribution of the number of MS acquisitions is close to uniform.[36] The average stake which is being acquired is 23%. As for the size of targets, Table 4 shows that acquisitions of small stakes of up to 10% are in large firms that are worth on average 401 million USD, acquisitions of medium size stakes of $10\% - 25\%$ are in targets that are worth on average 176 million USD, and acquisitions of large stakes of $25\% - 50\%$ are in targets that are worth on average only 97 million USD. In all three cases, the median is well below the average, implying that the distribution of target sizes is skewed to the right.

In Table 5 we present results from estimating the same specification as in Column (2) in Tables 2, but now we estimate it separately for each of the three size groups. The results show that in the year in which an LP is introduced, there is a significant increase in the number of new domestic horizontal MS acquisitions that involve stakes of $10\% - 25\%$, but not of stakes that are either below 10% or over 25%.[37] These results are consistent with our hypothesis that

[36] If we consider increases of already existing MS stakes in rivals, over 50% of all MS acquisitions are of 10% or less, and over 90% are of no more than 50%. This finding is not surprising given that we restrict attention to final stakes that are under 50%. If we consider the acquirer's final stake, 9% of all acquisitions have a final stake of up to 10%, 36% have a final stake of $10\% - 25\%$ and 55% have a final stake of $25\% - 50\%$. The median size of the initial stake before the acquisition is around 15%.

[37] If we split the MS acquisitions in our data into five groups instead of three: $0\% - 10\%$, $10\% - 20\%$, $20\% - 30\%$, $30\% - 40\%$, and $40\% - 50\%$, we get a significant increase in the number of new domestic MS acquisitions only when the acquired stakes are in the range of $10\% - 20\%$.

once an LP is introduced, firms acquire MS stakes in rivals to stabilize collusive agreements or soften competition in the event that collsuion breaks down. To be effective, the acquired stakes must be large, but if firms are colluding, they prefer to stay "under the radar," and hence they acquire stakes of no more than 25%, which typically do not attract antitrust scrutiny.

Table 5: ZINB estimations of the number of new domestic horizontal MS acquisitions by stake size

	(1)	(2)	(3)
	0-10%	10-25%	25-50%
LP-3	-0.24	0.14	0.13
	(0.23)	(0.20)	(0.11)
LP-2	-0.20	0.01	-0.11
	(0.16)	(0.16)	(0.13)
LP-1	-0.14	0.13	-0.11
	(0.27)	(0.18)	(0.13)
LP	0.14	0.45***	-0.03
	(0.22)	(0.16)	(0.14)
LP+1	0.17	0.03	0.14
	(0.24)	(0.15)	(0.12)
LP+2	0.16	0.15	0.15
	(0.19)	(0.18)	(0.15)
LP+3	0.21	0.21	-0.08
	(0.19)	(0.15)	(0.15)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes
Financial covariates	Yes	Yes	Yes
F-test	0.00	0.00	0.00
R^2	0.57	0.60	0.61
Observations	1018	1018	1018

Notes: Standard errors clustered at the country level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in column 2 of Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Target size

We next turn to the possibility that in the year in which an LP is introduced, firms acquire stakes in larger rivals. As before we measure the size of targets by dividing the value of the acquisition by the size of the acquired stake. We then classify target firms as either small or large, depending on whether their size is below or above the median of all target firms in their country. The results are reported in Table 6, where the dependent variable is the number of

MS acquisitions in small rivals in Columns (1)-(4) and in large rivals in Columns (5)-(8).[38]

Table 6: ZINB estimations of the number of new domestic horizontal MS acquisitions by rival size (below or above median)

	Small Firms				Large Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LP-3	0.10				0.06			
	(0.18)				(0.15)			
LP-2	0.12				-0.01			
	(0.14)				(0.12)			
LP-1	0.16				-0.25			
	(0.15)				(0.15)			
LP	0.00	-0.10			0.37**	0.43**		
	(0.19)	(0.21)			(0.15)	(0.17)		
LP+1	0.10	-0.02			0.34*	0.41*		
	(0.14)	(0.17)			(0.18)	(0.23)		
LP+2	0.08	-0.04			0.17	0.24		
	(0.20)	(0.26)			(0.16)	(0.26)		
LP+3	-0.05	-0.18			0.02	0.10		
	(0.15)	(0.23)			(0.17)	(0.26)		
After LP+3		-0.17				0.11		
		(0.21)				(0.24)		
LP × Effective Enforcement			-0.02				0.46***	
			(0.21)				(0.15)	
LP × Ineffective Enforcement			-0.10				-0.01	
			(0.28)				(0.32)	
LP × Low Corruption				0.18				0.53**
				(0.26)				(0.25)
LP × High Corruption				0.12				-0.50
				(0.35)				(0.41)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Financial covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.61	0.61	0.62	0.60	0.60	0.60	0.61	0.59
Observations	1018	1018	1008	652	1018	1018	1008	652

Notes: Standard errors clustered at the country level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Table 6 shows that in the year in which an LP is introduced, there is a significant increase in the number of MS acquisitions in large rivals, but not in small ones.[39] Column (6) shows

[38]Unfortunately we cannot examine the effect of an LP on the size of the acquiring firm because the data set we use does not report this data.

[39]This finding is consistent with Hellwig and Hüschelrath (2017), who find that large firms are often involved in cartel activity, and with Hoang et al. (2014), who find that large cartel members are most likely to become the chief witness under an LP.

that the effect is present only in the year in which the LP is introduced and one year after, but not in subsequent years, and Columns (7)-(8) show that the effect is present only in countries with an effective antitrust enforcement and low levels of corruption.

Stake size or Target size

Having studied the size of the acquired stakes and the size of the target firms, we now return to the question posed earlier: why does the introduction of an LP have a much bigger effect on the deal value of MS acquisitions than on their sheer number? Is it mainly because firms acquire larger stakes in rivals or because they acquire stakes in larger rivals? To provide an answer, recall from Table 5 that in the year in which an LP is introduced, there is a significant increase in the number of acquisitions of MS stakes in the range $10\% - 25\%$, but not of other stake sizes. Since as we mentioned earlier, the average stake size of MS acquisitions over all years is 23%, it seems that firms do not buy larger MS stakes when an LP is introduced. To confirm this finding, we compute for each country the median stake size acquired in that country over all years, and then repeat the estimation from Table 2, but now separately for acquisitions of above median stakes and below median stakes. The results, presented in Table A4 in the Appendix, show that the introduction of an LP has a significant effect only on the acquisitions of below median stakes, but not of above median stakes.

5 Robustness

Non-Horizontal and Cross-border MS

So far we have shown that the number of new domestic horizontal (DH) MS acquisitions and their aggregate value increase significantly in the year in which an LP is introduced. We now examine the effect of an LP on three additional types of MS acquisitions: (i) new domestic non-horizontal (DNH) MS acquisitions, (ii) new cross-border horizontal (CBH) MS acquisitions, and (iii) new cross-border non-horizontal (CBNH) MS acquisitions. In non-horizontal acquisitions, the acquirer and the target do not have any overlap in their SIC codes and in cross-border acquisitions, they are located in different countries.

If indeed firms acquire MS stakes in rivals in order to stabilize collusive agreements as we hypothesize, then the introduction of an LP should have no effect on non-horizontal MS acquisitions. Likewise, we should expect to see a much weaker effect, if any, in the case of

cross-border MS acquisitions, because then it is not clear which LP - the one in the acquirer's country or the one in the target's country - is relevant, and moreover, it is also not obvious that a domestic competition authority can punish foreign firms.[40] To examine whether this is indeed the case, we re-estimate our baseline specification (Column (2) in Tables 2-3), but now include in the estimation one additional type of MS acquisition (either DNH, CBH, or CBNH):

$$\begin{aligned} \mathrm{MS}_{\mathrm{itg}} = \exp((\mathrm{LP}_{\mathrm{it}} \times \mathrm{DH}_{\mathrm{g}})\alpha_1 + (\mathrm{LP}_{\mathrm{it}} \times (1 - \mathrm{DH}_{\mathrm{g}}))\alpha_2 \\ + \gamma \mathrm{DH}_{\mathrm{g}} + X_{it}\beta + \xi_i + \xi_t + \varepsilon_{itg}), \end{aligned}$$

where subscript g = DH, DNH, CBH, CBNH indicates the type of the MS acquisition, $\mathrm{MS}_{\mathrm{itg}}$ is either the number of MS acquisition or their aggregate value in country i in year t for MS type g, and DH_g is a dummy that takes the value 1 if g = DH and 0 if g = DNH, CBH, CBNH.

The results when $\mathrm{MS}_{\mathrm{itg}}$ is the number of new MS acquisitions are reported in Table 7 below. The results when $\mathrm{MS}_{\mathrm{itg}}$ is the aggregate value of MS acquisitions are similar and are reported in the online Appendix. In Column (1), we include beside DH MS acquisitions, DNH MS acquisitions, in Columns (2)-(3) we include CBH MS acquisitions, and in Columns (4)-(5) we include CBNH MS acquisitions. In the latter two cases which involve cross-border acquisitions, we examine separately cases in which the introduction of an LP is in the target's country (Columns (2) and (4)) and in the acquirer's country (Columns (3) and (5)).

The results show that the introduction of an LP has a significant effect only on DH MS acquisitions, but not on other types of MS acquisitions. This finding provides additional support for our hypothesis that firms react to the introduction of an LP by acquiring MS stakes in rivals in order to stabilize collusive agreements or soften competition in case collusion is going to break down once the LP is in place.

[40] Moreover, Choi and Gerlach (2012) show in a theoretical model that when antitrust authorities in two different countries do not share information, collusion is easier and LPs are less effective when firms operate in both countries than when they operate in only one country.

Table 7: ZINB estimations for the number of new domestic horizontal MS acquisitions, including non-horizontal and cross-border MS acquisitions as control groups (CG)

	(1)		(2)		(3)		(4)		(5)	
CG is:	DNH		CBH (LP in target country)		CBH (LP in acquirer country)		CBNH (LP in target country)		CBNH (LP in acquirer country)	
LP-3 × DH	0..04	(0.14)	0.08	(0.15)	0.02	(0.16)	0.05	(0.18)	0.01	(0.16)
LP-2 × DH	-0.06	(0.17)	-0.04	(0.15)	-0.06	(0.15)	-0.05	(0.22)	-0.07	(0.15)
LP-1 × DH	0.05	(0.13)	0.08	(0.13)	0.07	(0.13)	0.05	(0.11)	0.06	(0.14)
LP × DH	0.30**	(0.13)	0.30**	(0.14)	0.30**	(0.13)	0.27*	(0.14)	0.30**	(0.14)
LP+1 × DH	0.16	(0.14)	0.25*	(0.15)	0.11	(0.14)	0.16	(0.15)	0.11	(0.14)
LP+2 × DH	0.16	(0.16)	0.27*	(0.16)	0.13	(0.16)	0.18	(0.16)	0.13	(0.16)
LP+3 × DH	0.06	(0.16)	0.18	(0.15)	0.05	(0.16)	0.12	(0.15)	0.05	(0.16)
LP-3 × CG	0.01	(0.14)	0.12	(0.13)	0.05	(0.15)	0.31	(0.22)	0.02	(0.14)
LP-2 × CG	0.08	(0.14)	0.13	(0.13)	-0.07	(0.11)	0.04	(0.28)	-0.07	(0.11)
LP-1 × CG	0.05	(0.15)	-0.24	(0.16)	-0.11	(0.15)	0.13	(0.13)	-0.11	(0.14)
LP × CG	0.04	(0.21)	-0.14	(0.14)	-0.03	(0.12)	0.07	(0.16)	-0.02	(0.12)
LP+1 × CG	0.02	(0..17)	-0.11	(0.14)	-0.09	(0.14)	-0.03	(0.17)	-0.10	(0.13)
LP+2 × CG	0.15	(0.18)	-0.20	(0.13)	0.01	(0.14)	0.06	(0.14)	0.02	(0.14)
LP+3 × CG	-0.01	(0.18)	-0.10	(0.12)	-0.14	(0.14)	-0.09	(0.13)	-0.16	(0.14)
DH	-0.39***	(0.07)	0.08	(0.10)	0.61***	(0.17)	0.32***	(0.10)	0.59***	(0.17)
Country FE	Yes		Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes		Yes	
Macro covariates	Yes		Yes		Yes		Yes		Yes	
Financial cov.	Yes		Yes		Yes		Yes		Yes	
F-test	0.00		0.00		0.00		0.00		0.00	
R^2	0.68		0.62		0.65		0.64		0.65	
Observations	2036		2036		2036		2036		2036	

Notes: Standard errors clustered at the country level in parenthesis. Inflation equation appears in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Outliers

One might be concerned that our results are driven, at least partially, by the large number of LP introductions in 2004 or by the fact that many MS acquisitions in our data come from three countries: the U.S., Japan, and Spain. We therefore re-estimate Table 2, but now drop from the sample MS acquisitions from the nine countries that introduced an LP in 2004 (Belgium, Finland, Latvia, Luxembourg, New Zealand, Poland, Romania, South Africa, and Switzerland). We then repeat the exercise by dropping from the sample MS acquisitions from the U.S., Japan, and Spain. The results, presented in Tables A5 and A6 in the Appendix, are by and large similar to those in Table 2: the introduction of an LP still has a significant positive effect on domestic horizontal MS acquisitions only in the year in which the LP is introduced but not in other years. It therefore appears that our results are not driven by specific years or specific countries.

Endogeneity

As mentioned earlier, a potential concern about our empirical strategy is that the introduction of an LP in a given country, as well as the increase in MS acquisitions in that country, may both be driven by some unobserved country-specific changes in the political or legal climate. While in our case this is unlikely to be the case given that the *After LP+3* dummy is not significant, we apply the identification strategy recently proposed by Lewbel (2012) to address this concern.

Lewbel (2012) provides an estimator for linear regression models containing an endogenous regressor, when no outside instruments is available. In a nutshell, the method works by exploiting model heteroskedasticity to construct instruments using the available regressors. As Lewbel (2012) shows, these instruments are particularly valid under assumptions that are satisfied when endogeneity is caused by an unobserved factor that affects both the dependent variable and an explanatory variable.[41] The results of the Lewbel IV estimations are reported in Table A7 in the Appendix.[42] The table suggests that endogeneity is unlikley to be a concern, and moreover, the results are very similar to those obtained from the ZINB estimations that we presented earlier.[43]

Placebo

Finally, we run two types of placebo tests to exclude other possibilities that could drive our results. First, an important assumption for our difference-in-differences estimation is that MS acquisitions in the treatment and in the control group would have developed parallel if no LP was introduced. Since in our case an LP affects MS acquisitions only in the year in which the LP was introduced, the effect is unlikely to be caused by different trends. To formally test the common trend assumption in the pre-treatment period, we randomly assign to each country that introduced an LP a placebo LP year which precedes the actual year of introduction. We then run the specification in Column (2) of our baseline specification in Table 2, using data on the number of new domestic horizontal MS acquisitions, and compare the resulting coefficient of the LP dummy with the true coefficient from Table 2. We repeat this procedure $1,000$ times. Figure 5 shows the distribution of the resulting placebo coefficients and their p-values. The vertical red line represents the value of the coefficient and the p-value of the LP coefficient of

[41] Lewbel (2018) shows that the assumptions required for the proposed estimator can also be satisfied when an endogenous regressor is binary as is the case with our LP dummy.

[42] A technical description of the required assumptions for the Lewbel IV estimation and a brief description on the procedure itself are provided in the online Appendix.

[43] In the online Appendix we additionally present results from OLS regressions which are also very similar.

the actual sample. The placebo coefficients are centered around 0 (the mean is 0.003) and their p-values exceed 10% in 90.6% of the cases and exceed the true p-value in Column (2) in Table 2, which is 0.031, in 96.3% of the cases. This is very close to random chance and suggests that our results are indeed not driven by differences in pre-treatment trends.[44]

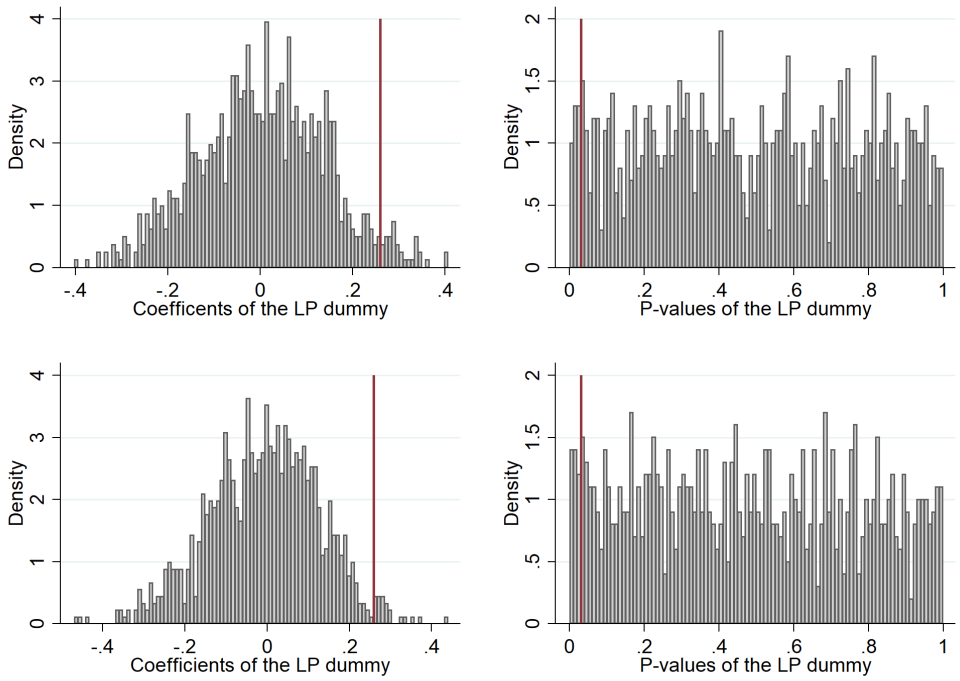

Figure 5: The LP coefficient and its p-value in the placebo tests for the number of new domestic horizontal MS acquisitions. Placebo LPs are either assigned only to pre-treatment years (the top panels) or to all years (the bottom panels)

Another common concern in difference-in-difference estimation is that the standard errors may understate the standard deviation of the estimators due to serial correlation (Bertrand, Duflo and Mullainathan, 2004). Like the previous concern, this concern is also unlikely in our case, because we allow for arbitrary serial correlation by clustering standard errors at the country level. Nonetheless, we formally examine this concern by randomly assigning a placebo LP year to each country in our data, but now assign a placebo LP year to all countries in our data, including those that did not introduce an LP during our sample period. Moreover, we now allow the placebo LP year to be either before or after the actual year in which an LP was introduced. As before, we repeat the procedure $1,000$ times. The coefficients are again centered around 0 (the mean is now -0.008), and the p-values of the LP coefficient exceed 10%

[44]The placebo results for the aggregate value are similar and are provided in the online Appendix.

in 89.2% of the cases and exceeds the true p-values in 96.0% of the cases.[45] As before, the placebo estimates are close to random chance, suggesting that our results are not driven by autocorrelation.

6 Conclusion

We have addressed the growing concern that MS among rival firms might facilitate collusion. Our empirical strategy is based on the idea that LP's destabilize collusive agreements. As a result, firms located in a country that has introduced an LP may have an incentive to acquire MS stake in rivals to stabilize their collusive agreements, or to soften competition if collusion is going to break down anyway. Consistent with this idea, we find robust evidence that the introduction of an LP is followed by a significant increase in the number of horizontal MS acquisitions and in their aggregate value in the relevant country. The effect is large in magnitude: the number of MS acquisitions increases by 30% in the year an LP is introduced while the aggregate deal value increases by 103%. The effect is present, however, only when it comes to domestic horizontal MS acquisitions and only in countries with an effective antitrust enforcement and low levels of corruption, where the LP is indeed likely to destabilize collusive agreements. Moreover, we observe a significant increase in MS acquisitions only in target firms with above-median market capitalization and only when the acquisition involves stakes of $10\% - 25\%$, which are large, but typically do not trigger merger notification, and hence allow the acquisition to stay "under the radar."

As far as we know, our paper is the first to provide evidence for the collusive effect of MS acquisitions. While the theoretical literature has shown that by and large, MS acquisitions facilitate collusion, so far this possibility did not receive an empirical support. Our results suggest that MS acquisitions are potentially anticompetitive, especially when it comes to acquisitions of intermediate levels of MS stakes in large domestic rivals. Hence it may be a good idea for antitrust authorities to review such acquisitions, as is done, to some extent, in some countries such as Austria, Germany, or the UK.

[45] The placebo results for the aggregate value are again similar and provided in the online Appendix.

References

[1] Abrantes-Metz, R., J. Connor and A. Metz (2013), "The Determinants of Cartel Duration," Unpublished Working Paper, New York.

[2] Allen, J. and G. Phillips (2000), "Corporate Equity Ownership, Strategic Alliances, and Product Market Relationships," *The Journal of Finance*, 55, 2791-2815.

[3] Aubert C, P. Rey, and W. Kovacic (2006), "The Impact of Leniency and Whistle-Blowing Programs on Cartels," *International Journal of Industrial Organization*, 24, 1241-1266.

[4] Azar, J., M. Schmalz, and I. Tecu (2016), "Anti-competitive Effects of Common Ownership," *The Journal of Finance*, 73(4), 1513-1565.

[5] Azar, J., S. Raina, and M. Schmalz (2018), "Ultimate Ownership and Bank Competition," Mimeo.

[6] Backus, M., C. Conlon, and M. Sinkinson (2018), "Common Ownership and Competition in the Ready-To-Eat Cereal Industry," Mimeo

[7] Bertrand, M., E. Duflo, and S. Mullainathan (2004), "How Much Should We Trust Differences-In-Differences Estimates?," *The Quarterly Journal of Economics*, 119(1), 249–275.

[8] Brito, D., Ribeiro, R., and H. Vasconcelos (2014), "Measuring Unilateral Effects in Partial Horizontal Acquisitions," *International Journal of Industrial Organization*, 33, 22-36.

[9] Brito, D., Cabral L., and H. Vasconcelos (2014), "Divesting Ownership in a Rival," *International Journal of Industrial Organization*, 34, 9-24.

[10] Bresnahan T. and S. Salop (1986), "Quantifying the Competitive Effects of Joint Ventures," *International Journal of Industrial Organization*, 4, 155-175.

[11] Cameron, A. C., and F. A. G. Windmeijer (1996), "R-squared Measures for Count Data Regression Models with Applications to Health-care Utilization," *Journal of Business and Economic Statistics*, 14(2), 209-220.

[12] Choi, J.P. and H. Gerlach (2012), "Global Cartels, Leniency Programs and International Antitrust Cooperation," *International Journal of Industrial Organization*, 30 (2012), 528-540.

[13] Davies, S., P. Ormosi, and M. Graffenberger (2015), "Mergers after Cartels: How Markets React to Cartel Breakdown," *Journal of Law and Economics*, 58(3), 561-583.

[14] De, O. (2010), "Analysis of Cartel Duration: Evidence from EC Prosecuted Cartels," *International Journal of the Economics of Business*, 17, 33- 65.

[15] Dietzenbacher, E., Smid B., and B. Volkerink (2000), "Horizontal Integration in the Dutch Financial Sector," *International Journal of Industrial Organization*, 18, 1223-1242.

[16] Di Giovanni, J. (2005), "What Drives Capital Flows? The Case of Cross-Border M&A Activity and Financial Deepening," *Journal of International Economics*, 65(1), 127-149.

[17] Dong, A., M. Massa, and A. Zaldokas (2016), "Busted! Now What? Effects of Cartel Enforcement on Firm Value and Corporate Policies," CEPR Discussion Paper DP11470, London.

[18] Erel, I., R. Liao, and M. Weisbach (2012), "Determinants of Cross-Border Mergers and Acquisitions," *Journal of Finance*, 67(3), 1045-1082.

[19] European Commission (2013), Annex I to the Commission Staff Working Document "Towards More Effective EU Merger Control": Economic Literature on Non-Controlling Minority Shareholdings ("Structural links"), SWD(2013) 239 final, Brussels.

[20] European Commission (2014), Commission Staff Working Document Impact Assessment Accompanying the Document White Paper "Towards More Effective EU Merger Control," Brussels, 9.7.2014, SWD(2014) 217 final.

[21] European Commission (2016), "Support Study for Impact Assessment Concerning the Review of Merger Regulation Regarding Minority Shareholdings," Final Report, Brussels.

[22] Farrell, J. and C. Shapiro (1990), "Asset Ownership and Market Structure in Oligopoly," *RAND Journal of Economics*, 21, 275-292.

[23] Fee, C., C. Hadlock, and S. Thomas (2006), "Corporate Equity Ownership and the Governance of Product Market Relationships," *Journal of Finance*, 61, 1217-1251.

[24] Foros, H-J. Kind, and G. Shaffer (2011), "Mergers and Partial Ownership," *European Economic Review,* 55(7), 916- 926.

[25] Fotis P. and N. Zevgolis (2016), *The Competitive Effects of Minority Shareholdings: Legal and Economic Issues*, Hart Publishing.

[26] Gilo, D., (2000), "The Anticompetitive Effect of Passive Investment," *Michigan Law Review*, 99 (2000), 1-47.

[27] Gilo, D., Y. Moshe and Y. Spiegel (2006), "Partial Cross Ownership and Tacit Collusion," *RAND Journal of Economics*, 37, 81-99.

[28] Global Legal Group (2009), "The International Comparatice Guide to: Cartels & Leniency 2009," 2nd Edition.

[29] Grossman, S., and O. Hart (1980), "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation," *The Bell Journal of Economics*, 11(1), 42–64.

[30] Harrington, J. (2013), "Corporate Leniency Programs When Firms Have Private Information: The Push of Prosecution and the Pull of Pre-Emption," *Journal of Industrial Economics*, 61, 1-27.

[31] Harrington, J. (2008), "Optimal Corporate Leniency Programs," *Journal of Industrial Economics*, 56, 215-246.

[32] Hellwig, M. and K. Hüschelrath (2017), "Cartel Cases and the Cartel Enforcement Process in the European Union 2001-2015: A Quantitative Assessment," Antitrust Bulletin, 62(2), 400-438.

[33] Hellwig, M. and K. Hüschelrath (2018), "When Do Firms Leave Cartels? Determinants and the Impact on Cartel Survival," International Review of Law and Economics, 54, 68-84.

[34] Hilbe, J. (2007), *Negative Binomial Regression*, Cambridge University Press.

[35] Hoang, C. T., K. Hüschelrath, U. Laitenberger, and F. Smuda (2014), "Determinants of Self- Reporting under the European Corporate Leniency Program," *International Review of Law and Economics*, 40, 15-23.

[36] Jovanovic D. and C. Wey (2014), "Passive Partial Ownership, Sneaky Takeovers, and Merger Control," *Economics Letters*, 125, 32-35.

[37] Levenstein, M. and V. Suslow (2011), "Breaking Up is Hard to Do: Determinants of Cartel Duration," *Journal of Law and Economics*, 54, 455-492.

[38] Lewbel, A. (2012), " Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models," *Journal of Business and Economic Statistics*, 30, 67-80.

[39] Lewbel, A. (2018), "Identification and Estimation Using Heteroscedasticity Without Instruments: The Binary Endogenous Regressor Case," *Economics Letters*, 165, 10-12.

[40] Long S. and J. Freese (2014), *Regression Models for Categorical Dependent Variables Using Stata*, Third Edition, Stata Press.

[41] Lopez A. and X. Vives (2018), "Overlapping Ownership, R&D Spillovers and Antitrust Policy," Journal of Political Economy, forthcoming.

[42] Malueg, D. (1992), "Collusive Behavior and Partial Ownership of Rivals," *International Journal of Industrial Organization*, 10, 27-34.

[43] Marx, L. and J. Zhou (2015), "The Dynamics of Mergers Among (Ex)Co-Conspirators in the Shadow of Cartel Enforcement," Working Paper, Tilburg.

[44] Meadowcroft, S. and D. Thompson (1986), "Minority Share Acquisitions: The Impact Upon Competition," Commission of the European Communities, Luxembourg.

[45] Motta, M. and M. Polo (2003), "Leniency Programs and Cartel Prosecution," *International Journal of Industrial Organization*, 21, 347-379.

[46] Miller, N. (2009), "Strategic Leniency and Cartel Enforcement," *American Economic Review*, 99(3), 750-768.

[47] Nain, A. and Y. Wang (2018), "The Product Market Impact of Minority Stake Acquisitions," *Management Science*, 64(2), 825-844.

[48] O'Brien, D. and K. Waehrer (2018), "The Competitive Effects of Common Ownership: We Know Less than we Think," Antitrust Law Journal, 81(3), 729-776.

[49] OECD (2008), "Antitrust Issues Involving Minority Shareholdings and Interlocking Directorates," DAF/COMP(2008)30, Paris.

[50] OECD (2012), "Leniency for Subsequent Applicants," Working Party No. 3 on Cooperation and Enforcement, DAF/COMP/WP3(2012)9, Paris.

[51] Panayides M. and S. Thomas (2017), "Commonality in Institutional Ownership and Competition in Product Markets," Mimeo.

[52] Parker Ouimet, P. (2013), "What Motivates Minority Acquisitions? The Trade-Offs between a Partial Equity Stake and Complete Integration," *Review of Financial Studies*, 26, 1021-1047.

[53] Reynolds, R. and B. Snapp (1986), "The Competitive Effects of Partial Equity Interests and Joint Ventures," *International Journal of Industrial Organization*, 4, 141-153.

[54] Rossi, S. and P. Volpin (2004), "Cross-Country Determinants of Mergers and Acquisitions," *Journal of Financial Economics*, 74(2), 277-304.

[55] Salop, S. and D. O'Brien (2000), "Competitive Effects of Partial Ownership: Financial Interest and Corporate Control," *Antitrust Law Journal*, 67, 559-614.

[56] Sovinsky, M. and E. Helland (2012), "Do Research Joint Ventures Serve a Collusive Function," Warwick Economic Research Papers No 1030, Coventry.

[57] Shelegia, S. and Y. Spiegel (2012), "Bertrand Competition When Firms Hold Passive Ownership Stakes in One Another," *Economics Letters*, 114, 136–138.

[58] Shelegia, S. and Y. Spiegel (2016), "Cost-Reducing Investments under Partial Cross-Ownership," Mimeo.

[59] Spagnolo, G. (2004), "Divide et Impera: Optimal Leniency Programs," CEPR Discussion Paper DP4840.

[60] Spagnolo, G. and C. Marvao (2016a), "Cartels and Leniency: Taking Stock of what we Learnt," forthcoming in *Handbook of Game Theory and Industrial Organization*, L. C. Corchón and M. A. Marini (ed.), Edward Elgar, Cheltenam, UK and Northampton, MA

[61] Spagnolo, G. and C. Marvao (2016b), "Should Price Fixers Finally go to Prison? Criminalization, Leniency Inflation and Whistleblower Rewards in the EU," Presentation at the 2016 CRESSE conference, Rhodes, Greece. http://www.cresse.info/uploadfiles/2016_pa5_pr2.pdf

[62] UNCTAD (2010), "The Use of Leniency Programmes as a Tool for the Enforcement of Competition Law Against Hardcore Cartels in Developing Countries," Sixth United Nations

Conference to Review All Aspects of the Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices, 8-12 November 2010, Geneva.

[63] Zhou, J. (2012), "Cartel Duration and Endogenous Private Monitoring and Communication: An Instrumental Variables Approach," Discussion Paper Series of SFB/TR 15 Governance and the Efficiency of Economic Systems No. 369, Mannheim.

[64] Zhou, J. (2016), "The Dynamics of Leniency Application and the Knock-on Effect of Cartel Enforcement," Bruegel Working Paper 2016/02, Brussels.

A Appendix

The Appendix includes a model that motivates our empirical strategy; model fit tests for the choice of our empirical model; additional information on how we constructed our data set; data on the number and deal value of MS acquisitions; cross-country data on the year in which an LP was introduced in each country, the efficacy of antitrust enforcement, and the level of corruption in each country; and some additional robustness checks.

A.1 A theoretical model

The following simple model illustrates the logic of our empirical strategy; it shows that the introduction of an LP may destabilize collusive agreements, whereas the acquisition of MS in rivals may restore them. To this end, we build on the Aubert, Rey, and Kovacic (2006) model of leniency programs and consider an infinitely repeated duopoly, with an intertemporal discount factor $\delta \in (0,1)$. In each period, the two firms can collude, but if they do, they need to communicate with other. Communication is detected by the Competition Authority (CA) with probability ρ, in which case the two firms are convicted and pay a fine F. The gross profit of firm $i = 1, 2$ is π_i^M under collusion, π_i^C under competition, π_i^D when firm i deviates unilaterally from a collusive agreement, and $\underline{\pi}_i$ if firm j deviates unilaterally from a collusive agreement, where $\pi_i^D > \pi_i^M > \pi_i^C \geq \underline{\pi}_i$ and $\pi_i^M + \pi_j^M > \max\left\{\pi_i^D + \underline{\pi}_j, \pi_j^D + \underline{\pi}_i\right\}$. That is, the two firms jointly benefit from collusion, but each firm benefits at the expense of the rival if it deviates from a collusive agreement. The expected fine ρF is not sufficiently large to deter collusion: $\pi_i^M - \pi_i^C > \rho F$ for $i = 1, 2$.

Without an LP and MS, firm i has an incentive to collude only if the infinitely discounted sum of its collusive profits net of the expected cost of fines exceeds the one-time profit from deviation, net of the expected cost of fines, plus the infinitely discounted competitive profit, starting from the next period onward:

$$\frac{\pi_i^M - \rho F}{1-\delta} \geq \pi_i^D - \rho F + \frac{\delta \pi_i^C}{1-\delta}.$$

The incentive constraint can be conveniently rewritten as

$$\delta \geq \delta_i \equiv \frac{\left(\pi_i^D - \rho F\right) - \left(\pi_i^M - \rho F\right)}{\left(\pi_i^D - f\right) - \pi_i^C} = \frac{\pi_i^D - \pi_i^M}{\left(\pi_i^D - \rho F\right) - \pi_i^C}. \qquad \text{((A-1))}$$

As in the classic model of collusion, the right-hand side of (A-1) is the ratio between the gain from deviation, $\pi_i^D - \pi_i^M$, and the gap between the deviation profit, $\pi_i^D - \rho F$, and the competitive profit, π_i^C. Collusion can be sustained only if $\delta \geq \max\{\delta_1, \delta_2\}$, where the firm with the higher δ_i is the maverick firm, i.e., the firm with the more binding incentive constraint.

Under an LP, each firm enjoys a reduced fine f if it fully cooperates with the CA, where $f < \rho F$. Collusion then breaks down, so a firm which applies for leniency might as well deviate, since it will face competition afterwards anyway. The one-period payoff when deviating becomes $\pi_i^D - f$ instead of $\pi_i^D - \rho F$, so the condition for collusion becomes

$$\delta \geq \delta_i^{LP} \equiv \frac{\left(\pi_i^D - f\right) - \left(\pi_i^M - \rho F\right)}{\left(\pi_i^D - f\right) - \pi_i^C}, \qquad i = 1, 2. \tag{(A-2)}$$

Notice that an LP affects matters in this simple setup only by reducing the deviating firm's expected fine from ρF to f. Harrington (2008) refers to this effect as the "Deviator Amnesty Effect." It is easy to see that $\delta_i^{LP} > \delta_i$: an LP hinders collusion. Moreover, if $\delta_i^{LP} > \delta > \delta_i$ for at least one firm, collusion is feasible before an LP is introduced, but breaks down once an LP is in place.

A.1.1 Collusion with minority shareholdings (MS)

Now, suppose that firm 1 holds a passive stake $\alpha_1 < 1/2$ in firm 2 and firm 2 holds a passive stake $\alpha_2 < 1/2$ in firm 1. These stakes give firms a share in their rival's profit, but no control over the rival's decisions. Using y_1 and y_2 to denote the stand-alone values of the two firms, their overall values, including their stakes in rivals, are defined by the following system:

$$V_1 = y_1 + \alpha_1 V_2, \qquad V_2 = y_2 + \alpha_2 V_1.$$

Solving the system, yields

$$V_1(\alpha_1, \alpha_2) = \frac{y_1 + \alpha_1 y_2}{1 - \alpha_1 \alpha_2}, \qquad V_2(\alpha_1, \alpha_2) = \frac{y_2 + \alpha_2 y_1}{1 - \alpha_1 \alpha_2}.$$

Note that each firm puts a larger weight on its own stand alone value than on the rival's stand alone value.[46]

Recalling that the gross profit of firm $i = 1, 2$ is π_i^M under collusion, π_i^C under competition,

[46] Also note that while $V_1(\alpha_1, \alpha_2)$ and $V_2(\alpha_1, \alpha_2)$ sum up to more than $y_1 + y_2$, the share of "real" shareholders (not firms) in these profits is $(1 - \alpha_2) V_1(\alpha_1, \alpha_2) + (1 - \alpha_1) V_2(\alpha_1, \alpha_2) = y_1 + y_2$.

π_i^D when firm i deviates unilaterally from a collusive agreement, and $\underline{\pi}_i$ if firm j deviates unilaterally from a collusive agreement, the values of the two firms under collusion are

$$V_1^M(\alpha_1,\alpha_2)=\frac{\pi_1^M-\rho F+\alpha_1\left(\pi_2^M-\rho F\right)}{1-\alpha_1\alpha_2},\qquad V_2^M(\alpha_1,\alpha_2)=\frac{\pi_2^M-\rho F+\alpha_2\left(\pi_1^M-\rho F\right)}{1-\alpha_1\alpha_2},$$

and their values under competition are

$$V_1^C(\alpha_1,\alpha_2)=\frac{\pi_1^C+\alpha_1\pi_2^C}{1-\alpha_1\alpha_2},\qquad V_2^M(\alpha_1,\alpha_2)=\frac{\pi_2^C+\alpha_2\pi_1^C}{1-\alpha_1\alpha_2}.$$

When firm 1 deviates unilaterally from a collusive scheme, the values of the two firms are

$$V_1^D(\alpha_1,\alpha_2)=\frac{\pi_1^D-f+\alpha_1\left(\underline{\pi}_2-F\right)}{1-\alpha_1\alpha_2},\qquad V_2^D(\alpha_1,\alpha_2)=\frac{\underline{\pi}_2-F+\alpha_2\left(\pi_1^D-f\right)}{1-\alpha_1\alpha_2},$$

and analogously when firm 2 deviates unilaterally. Notice that the deviating firm pays a reduced fine f, while the rival pays the full fine F.

With these values in place, the condition which ensures collusion becomes

$$\frac{\pi_i^M-\rho F+\alpha_i\left(\pi_j^M-\rho F\right)}{(1-\delta)\left(1-\alpha_i\alpha_j\right)}\geq\frac{\pi_i^D-f+\alpha_i\left(\underline{\pi}_j-F\right)}{1-\alpha_i\alpha_j}+\frac{\delta\left(\pi_i^C+\alpha_i\pi_j^C\right)}{(1-\delta)\left(1-\alpha_i\alpha_j\right)},\qquad i=1,2.$$

Using this inequality, the critical discount factor above which firm i is willing to collude is given by

$$\delta\geq\delta_i(\alpha_i)\equiv\frac{\left(\pi_i^D-f+\alpha_i\left(\underline{\pi}_j-F\right)\right)-\left(\pi_i^M-\rho F+\alpha_i\left(\pi_j^M-\rho F\right)\right)}{\left(\pi_i^D-f+\alpha_i\left(\underline{\pi}_j-F\right)\right)-\left(\pi_i^C+\alpha_i\pi_j^C\right)}.\qquad\text{((A-3))}$$

As in the case of δ_i and δ_i^{LP}, the right-hand side of (A-3) is the ratio between the gain from deviation and the gap between the deviation profit and the competitive profit, but now the profits include firm i's share in firm j's profit.

In general, the profits, π_i^M, π_i^D, π_i^C, and $\underline{\pi}_j$ depend on α_i and on α_j because now firms internalize, at least partially, the competitive externality they impose on one another. Hence, the right-hand side of (A-3) potentially depends on α_i in a complex way. To simplify matters, we will assume here that π_i^M, π_i^D, π_i^C, and $\underline{\pi}_j$ are independent of α_i. This holds for instance in the Bertrand model, where both firms have an identical per-unit cost c. Then, $\pi_i^M=\frac{\pi^m}{2}$, $\pi_i^D=\pi^m$, and $\pi_i^C=\underline{\pi}_j=0$, where $\pi^m\equiv Q(p)(p-c)$ is the monopoly profit.

Now, straightforward differentiation establishes that

$$\begin{aligned}
\delta_i'(\alpha_i) \equiv & \frac{\left(\left(\underline{\pi}_j - F\right) - \left(\pi_j^M - \rho F\right)\right)\left[\left(\pi_i^D - f\right) - \pi_i^C - \alpha_i\left(\pi_j^C - \left(\underline{\pi}_j - \rho F\right)\right)\right]}{\left[\left(\pi_i^D - f + \alpha_i\left(\underline{\pi}_j - F\right)\right) - \left(\pi_i^C + \alpha_i \pi_j^C\right)\right]^2} \\
& - \frac{\left(\left(\underline{\pi}_j - F\right) - \pi_j^C\right)\left[\left(\pi_i^D - f + \alpha_i\left(\underline{\pi}_j - F\right)\right) - \left(\pi_i^M - \rho F + \alpha_i\left(\pi_j^M - \rho F\right)\right)\right]}{\left[\left(\pi_i^D - f + \alpha_i\left(\underline{\pi}_j - F\right)\right) - \left(\pi_i^C + \alpha_i \pi_j^C\right)\right]^2} \\
= & \frac{\left(\left(\underline{\pi}_j - F\right) - \left(\pi_j^M - \rho F\right)\right) - \delta_i(\alpha_i)\left(\left(\underline{\pi}_j - F\right) - \pi_j^C\right)}{\left(\pi_i^D - f + \alpha_i\left(\underline{\pi}_j - F\right)\right) - \left(\pi_i^C + \alpha_i \pi_j^C\right)} \\
< & \frac{-\pi_j^M + \rho F_j + \pi_j^C}{\left(\pi_i^D - f + \alpha_i\left(\underline{\pi}_j - F\right)\right) - \left(\pi_i^C + \alpha_i \pi_j^C\right)} < 0,
\end{aligned}$$

where the first inequality follows since $\delta_i(\alpha_i) \leq 1$ and since $\pi_j^C > \underline{\pi}_j - \rho F$, and the second inequality follows because $\pi_j^M - \pi_{ji}^C > \rho F$ for $j = 1, 2$. Hence, MS facilitate collusion by lowering the critical discount factor above which firm i is willing to collude. Intuitively, when firm i acquires an MS in firm j it internalizes the fact that a deviation from a collusive agreement lowers firm j's expected profit in the deviation period from $\pi_j^D - \rho F$ to π_j^C and lowers it in all subsequent periods from $\pi_j^M - \rho F$ to π_j^C.

A.1.2 The reaction of firms to the introduction of an LP

Assuming that firms acquire MS stakes in rivals from atomistic shareholders, they gain from the acquisition only if their own value increases. The reason for this is Grossman and Hart's (1980) well-known free-rider problem: to induce atomistic shareholders to sell their shares, the acquirer must offer them the post-acquisition value of their shares. Hence, the acquirer breaks even on the acquisition. Assuming in addition that the acquisition entails some transaction costs, firms will acquire MS in rivals only if (i) the increase in their own value exceeds the transaction costs, and (ii) firms have no other way to boost their own value. In our simple setup, firms can boost their own values only by shifting the equilibrium from competition to collusion.

There are now few cases that can arise depending on the size of δ.

Case 1: If $\delta \geq \max\{\delta_1, \delta_2\}$, firms can collude before an LP is introduced without having to acquire MS in each other. If, after an LP is introduced, $\delta \geq \max\left\{\delta_1^{LP}, \delta_2^{LP}\right\}$, collusion is still feasible, so firms still do not need to acquire MS in each other. In this case, the introduction of an LP is not followed by MS acquisitions.

Case 2: If $\max\{\delta_1, \delta_2\} \leq \delta < \max\left\{\delta_1^{LP}, \delta_2^{LP}\right\}$, firms are able to collude before an LP is introduced, but not afterwards. Firms may now resort to MS acquisitions to restore their collusive agreements. Assuming without a loss of generality that $\delta_1^{LP} \geq \delta_2^{LP}$ (firm 1 is the industry maverick), there are two possible subcases:

(i) If $\delta < \delta_2^{LP}$, both firms need to acquire MS in each other to sustain collusion.

(ii) If $\delta_2^{LP} \leq \delta < \delta_1^{LP}$, only firm 1 need to acquire an MS in firm 2 to sustain collusion.

In case (i), collusion can be sustained if there exist $\alpha_1 < 1/2$ and $\alpha_2 < 1/2$ such that $\delta \geq \max\{\delta_1(\alpha_1), \delta_2(\alpha_2)\}$. Since $\delta_1'(\alpha_1) < 0$ and $\delta_2'(\alpha_2) < 0$, the condition is satisfied if $\delta \geq \max\{\delta_1(1/2), \delta_2(1/2)\}$. Then, the introduction of an LP is followed by MS acquisitions by both firms, provided that the increase in firm value exceeds the transaction cost associated with MS acquisition.

In case (ii), collusion can be sustained if there exists $\alpha_1 < 1/2$ such that $\delta \geq \delta_1(\alpha_1)$, which is ensured if $\delta \geq \delta_1(1/2)$. When this condition holds, the introduction of an LP is followed by MS acquisitions by firm 1 in firm 2, again provided that the increase in firm 1's value exceeds the transaction cost associated with MS acquisition.

If there do not exist $\alpha_1 < 1/2$ and $\alpha_2 < 1/2$ such that $\delta \geq \max\{\delta_1(\alpha_1), \delta_2(\alpha_2)\}$, collusion cannot be sustained anymore when an LP is introduced even with MS. Given our assumption that π_1^C is independent of α_1 and π_2^C is independent of α_2, firms have no incentive to acquire MS in each other. However, if π_1^C increases with α_1 and π_2^C increases with α_2, the two firms may still wish to acquire MS in each other once an LP is introduced because these acquisitions soften the equilibrium once collusion breaks down.

Case 3: If $\delta < \max\{\delta_1, \delta_2\}$, collusion without MS is not feasible even before an LP is introduced. Consequently, we may see MS stakes even before an LP is introduced if the acquisitions make collusion feasible and boost profits sufficiently or they make the non-collusive equilibrium less competitive. The introduction of an LP may now be followed by an increase in the MS if this is necessary to keep collusion sustainable. However if there do not exist $\alpha_1 < 1/2$ and $\alpha_2 < 1/2$ such that $\delta \geq \max\{\delta_1(\alpha_1), \delta_2(\alpha_2)\}$, firms cannot collude once an LP is introduced and hence have no use for their MS stakes.

A.2 Tests and statistics of the model fit

The following tables report results from model fit tests.[47] Specifically, we compare Poisson, Negative Binomial (NB), zero-inflated Poisson (ZIP) and zero-inflated Negative Binomial (ZINB) models for the number and the value of MS acquisitions. We use the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC), where a lower value means a better model fit. We also report the Likelihood-Ratio (LRχ^2) from boundary likelihood-ratio tests for nested models (Poisson vs NB and ZIP vs ZINB, respectively) and the Vuong test for non-nested models (Poisson vs ZIP and NB vs ZINB, respectively). All tests suggest that the ZINB models fit our data best. The only exception is the BIC statistic which is slightly in favor of the NB model. For this reason we also estimated NB models, but the results do not change (see Tables E1 and E2 in the online Appendix).

Table A1a: Tests and statistics of the model fit for the number of new domestic horizontal MS acquisitions

	AIC	BIC	LRχ^2	Vuong	Poisson
Poisson	6.11	-340			
NB	4.62	-1,855			
ZIP	5.94	-481			
ZINB	4.61	-1,835			
Preferred model	ZINB	NB			Poisson vs. NB
Poisson vs. NB			1,522		
Preferred (p-val.)			NB (0.00)		
Poisson vs. ZIP				3.23	
Preferred (p-val.)				ZIP (0.00)	
NB vs ZINB				1.78	
Preferred (p-val.)				ZINB (0.04)	
ZIP vs ZINB			1,361		
Preferred (p-val.)			ZINB (0.00)		

[47] The program Countfit by Long and Freese (2014) is applied for the computation of tests and fit statistics.

Table A1b: Tests and statistics of the model fit for the number of new domestic horizontal MS acquisitions

	AIC	BIC	LRχ^2	Vuong	Poisson
Poisson	117	113,019			
NB	7.84	1,421			
ZIP	91.82	86,942			
ZINB	7.69	1,298		Preferred model	ZINB
Preferred model	ZINB	ZINB			
Poisson vs. NB			112,000		
Preferred (p-val.)			NB (0.00)		
Poisson vs. ZIP				8.81	
Preferred (p-val.)				ZIP (0.00)	
NB vs ZINB				8.88	
Preferred (p-val.)				ZINB (0.00)	
ZIP vs ZINB			85,651		
Preferred (p-val.)			ZINB (0.00)		

A.3 Data set construction

The following table shows how we constructed the data set that we use in the paper and the number of observations that remained after each step.

Table A2: Construction of the data set on MS acquisitions

Step	Action	Remaining observations
1	All acquisitions in 63 countries during the period 1990-2013, where the final stake remains below 50%	131,188
2	Eliminate all acquisitions for which the final stake is not known	86,432
3	Eliminate share buybacks and self-tenders	78,897
4	Eliminate acquisitions with a sought final stake exceeding 50%	78,538
5	Eliminate acquisitions where the acquirer is an investor	49,253
6	Eliminate acquisitions where the target is an investor	47,675
7	Eliminate cross-border acquisitions	32,683
8	Eliminate non-horizontal acquisitions	12,934
9	Eliminate increases of already existing MS	10,699

A.4 Cross country data

This subsection contains data about the number and deal value of MS acquisitions and also information regarding the year in which an LP was introduced in each country and statistics

about the efficacy of antitrust enforcement and the level of corruption. We begin with the following figures that show the distribution of the number of MS acquisitions and their aggregate deal value by country for the period 1990-2013.

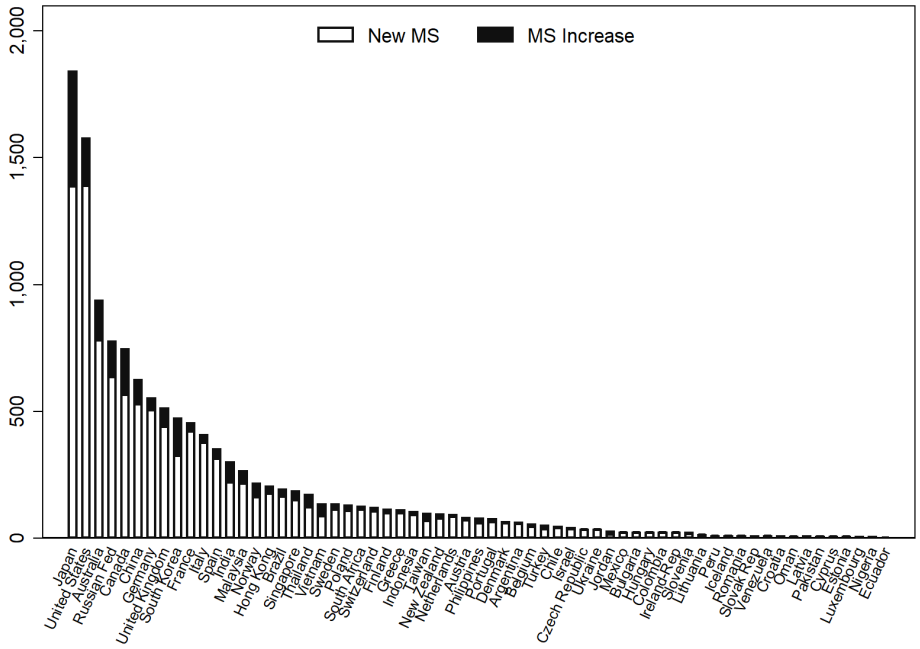

Figure A1: Number of MS acquisitions, new acquisitions and stake increases

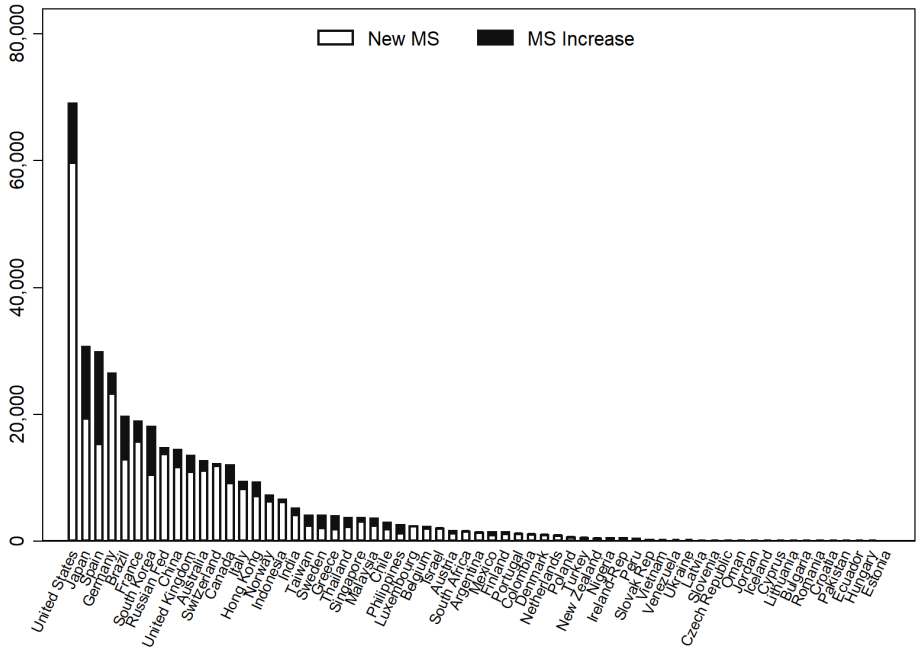

Figure A2: Value of MS acquisitions, in million USD, new acquisitions and share increases

A.5 Leniency programs per country

The next table shows for each country when an LP was introduced (before 2013), if at all. This information is largely taken from Dong et al. (2016). In addition, the table also shows for each country the Anti-Monopoly Policy Index (AMPI) score provided by the World Economic Forum (WEF) and the Corruption Perception Index (CPI) score computed by Transparency International (TI). As mentioned earlier, the AMPI score is on a 1-7 scale, with 7 being the most effective enforcement. The CPI score is on a 1-10 scale, with 10 being the lowest level of corruption.

Table A3: Country-specific information on leniency programs and enforcement

Country	Leniency	AMPI	CPI	Country	Leniency	AMPI	CPI
Argentina	No LP	3.2	.	Luxembourg	2004	5.1	8.5
Australia	2003	5.3	8.6	Malaysia	2010	4.7	.
Austria	2006	5.2	7.8	Mexico	2006	3.5	3.4
Belgium	2004	5.2	6.9	Netherlands	2002	5.8	8.8
Brazil	2000	4.5	3.7	New Zealand	2004	5.5	9.4
Bulgaria	2003	3.3	3.8	Nigeria	No LP	3.9	.
Canada	2000	5.1	8.8	Norway	2005	5.4	8.7
Chile	2009	4.9	.	Oman	No LP	4.4	.
China	2008	4.1	3.3	Pakistan	2007	3.9	.
Colombia	2009	4.0	.	Peru	2005	4.0	.
Croatia	2010	3.7	3.9	Philippines	2009	3.7	.
Cyprus	2011	4.7	6.1	Poland	2004	4.2	4.6
Czech Republic	2001	4.5	4.6	Portugal	2006	4.5	6.3
Denmark	2007	5.4	9.5	Romania	2004	3.7	3.4
Ecuador	2011	3.0	.	Russian Fed	2007	3.3	2.4
Estonia	2002	4.6	6.2	Singapore	2006	5.3	.
Finland	2004	5.7	9.4	Slovak Rep	2001	4.2	4.2
France	2001	5.3	6.9	Slovenia	2010	4.2	6.1
Germany	2000	5.5	7.9	South Africa	2004	5.3	.
Greece	2006	4.0	4.3	South Korea	1997	4.7	4.8
Hong Kong	No LP	4.2	.	Spain	2008	4.5	6.3
Hungary	2003	4.1	5.0	Sweden	2002	5.7	9.2
Iceland	2005	4.8	9.0	Switzerland	2004	5.1	8.8
India	2009	4.7	3.0	Taiwan	2012	5.0	.
Indonesia	No LP	4.6	.	Thailand	No LP	4.1	.
Ireland-Rep	2001	5.0	7.7	Turkey	2009	4.6	3.9
Israel	2005	4.5	.	Ukraine	2012	3.1	.
Italy	2007	3.8	4.6	United Kingdom	1998	5.4	8.3
Japan	2005	5.3	7.1	United States	1993	5.3	7.5
Jordan	No LP	4.4	.	Venezuela	No LP	2.8	.
Latvia	2004	4.0	4.1	Vietnam	No LP	.	.
Lithuania	2008	3.8	4.8				

A.6 Additional tables

Table A4 shows ZINB estimations for the number of new domestic MS acquisitions, separately for acquisitions of small stakes which are below the median stakes acquired in a given country, and large stakes which are above the median. Tables A5-A6 are the counterparts of Tables 2 and 3 in the text: in Table A5 we omit countries that introduced an LP in 2004, and in Table A6, we omit countries with the largest MS activity. The two tables show that the results in Tables 2 and 3 are not driven by specific years or specific countries.

Table A4: ZINB estimations of the aggregate value of new domestic horizontal MS acquisitions by stake size (below or above median)

	Small Stakes				Large Stakes			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LP-3	-0.04				0.16			
	(0.18)				(0.11)			
LP-2	-0.01				-0.14			
	(0.16)				(0.12)			
LP-1	0.11				-0.16			
	(0.15)				(0.13)			
LP	0.41***	0.37**			-0.01	-0.01		
	(0.15)	(0.17)			(0.14)	(0.15)		
LP+1	0.11	0.07			0.13	0.12		
	(0.15)	(0.18)			(0.12)	(0.16)		
LP+2	0.14	0.09			0.16	0.14		
	(0.16)	(0.22)			(0.15)	(0.20)		
LP+3	0.18	0.13			-0.07	-0.08		
	(0.16)	(0.24)			(0.14)	(0.20)		
After LP+3		-0.09				-0.05		
		(0.20)				(0.17)		
LP × Effective Enforcement			0.50***				0.09	
			(0.16)				(0.14)	
LP × Ineffective Enforcement			0.08				-0.32	
			(0.26)				(0.25)	
LP × Low Corruption				0.55***				0.22
				(0.21)				(0.16)
LP × High Corruption				-0.58**				-0.45
				(0.27)				(0.36)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Financial covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.59	0.59	0.60	0.58	0.64	0.64	0.64	0.62
Observations	1018	1018	1008	652	1018	1018	1018	652

Notes: Standard errors clustered at the country-level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Table A5: ZINB estimations of the number of new domestic horizontal MS acquisitions (countries dropped if LP was introduced in 2004)

	(1)	(2)	(3)	(4)	(5)
LP-3	0.01	0.03			
	(0.14)	(0.14)			
LP-2	-0.01	-0.01			
	(0.12)	(0.13)			
LP-1	0.05	0.03			
	(0.13)	(0.13)			
LP	0.19*	0.22*	0.16		
	(0.11)	(0.13)	(0.14)		
LP+1	0.12	0.15	0.09		
	(0.13)	(0.14)	(0.17)		
LP+2	0.10	0.09	0.01		
	(0.15)	(0.16)	(0.20)		
LP+3	-0.02	-0.05	-0.12		
	(0.13)	(0.14)	(0.21)		
After LP+3			-0.13		
			(0.17)		
LP × Effective Enforcement				0.28**	
				(0.14)	
LP × Ineffective Enforcement				0.01	
				(0.19)	
LP × Low Corruption					0.33*
					(0.20)
LP × High Corruption					-0.27
					(0.42)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes
Financial covariates	No	Yes	Yes	Yes	Yes
F-test	0.00	0.00	0.00	0.00	0.00
R^2	0.67	0.65	0.65	0.66	0.61
Observations	1164	875	875	865	532

Notes: Standard errors clustered at the country-level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

Table A6: ZINB estimations of the number of new domestic horizontal MS acquisitions (countries with the largest MS activity dropped)

	(1)	(2)	(3)	(4)	(5)
LP-3	-0.06	-0.05			
	(0.15)	(0.14)			
LP-2	-0.13	-0.07			
	(0.13)	(0.13)			
LP-1	-0.01	0.02			
	(0.13)	(0.12)			
LP	0.19*	0.22*	0.13		
	(0.10)	(0.12)	(0.14)		
LP+1	-0.06	-0.05	-0.15		
	(0.10)	(0.11)	(0.13)		
LP+2	-0.01	-0.03	-0.15		
	(0.12)	(0.14)	(0.18)		
LP+3	-0.08	-0.06	-0.20		
	(0.12)	(0.13)	(0.19)		
After LP+3			-0.26		
			(0.18)		
LP × Effective Enforcement				0.36***	
				(0.13)	
LP × Ineffective Enforcement				0.02	
				(0.18)	
LP × Low Corruption					0.40**
					(0.16)
LP × High Corruption					-0.27
					(0.25)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes
Financial covariates	No	Yes	Yes	Yes	Yes
F-test	0.00	0.00	0.00	0.00	0.00
R^2	0.66	0.66	0.66	0.67	0.66
Observations	1296	958	958	948	592

Notes: Standard errors clustered at the country-level in parenthesis. Inflation equation is reported in the online Appendix. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.

A.7 Lewbel (2012) instrumental variable approach

To apply the Lewbel (2012) approach we replace the dependent variable with its logarithm to allow a comparison of the coefficients from the Lewbel IV with those from the ZINB estimations.[48] Instead of using separate dummies for each of the three years before and after the LP is introduced we now group the three before and the three after LP dummies so that we only have to instrument for the three variables LP, LP-1 to LP-3, and LP+1 to LP+3.

As Lewbel (2012) shows the model is identified if the errors from a regression of the endogenous variable on covariates from the main model are heteroskedastic and the variance of these errors is correlated with at least some of the covariates but not with the covariances of these errors and the second stage errors. We test the heteroskedasticity requirement based on the residuals of the first stage regression, using a modified Wald statistic for groupwise heteroskedasticity as well as the Koenker (1981) version of the Breusch-Pagan test for heteroskedasticity. The tests lead us to reject the null hypotheses of constant variance and homoskedasticity as can be seen in Table A7. Table A7 also shows that the Kleibergen-Paap F-statistic suggests that the generated instruments are sufficiently strong to identify the LP variables as the Stock and Yogo critical values are exceeded, except of Column (5) which cannot be interpreted. Moreover, the instruments are not correlated with the error term as shown by the Hansen J test.

The results are robust to these specifications and the effect of an LP introduction on the number of MS acquisitions yields similar estimates as the ZINB estimations. Nonetheless, the Durbin-Wu-Hausman test does not point towards an endogeneity issue as it fails to reject the null hypothesis of the LP introduction being exogenous.[49]

[48] Hence, zeros drop out in the estimation. However, the results are similar when alternative transformations of zero values are applied, e.g., adding small values to the dependent variable before computing logs.

[49] We also ran the same models as OLS which had very similar results. They are reported in in Extra Tables section of the online Appendix.

Table A7: Lewbel (2012) IV estimation of the log-number of new domestic horizontal MS acquisitions

	(1)	(2)	(3)	(4)	(5)
LP-1 to LP-3	0.07	0.05			
	(0.07)	(0.08)			
LP	0.26***	0.20***			0.13
	(0.06)	(0.08)			(0.10)
LP+1 to LP+3	0.06	0.08			
	(0.06)	(0.08)			
LP×Efficient Enforcement			0.18**		
			(0.08)		
LP×Inefficient Enforcement			0.13*		
			(0.07)		
LP×High Corruption				0.24**	
				(0.11)	
LP×Low Corruption				0.13	
				(0.11)	
After LP					-0.14
					(0.16)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Macroeconomic covariates	Yes	Yes	Yes	Yes	Yes
Financial covariates	No	Yes	Yes	Yes	Yes
First-stage Wald test for group heteroskedasticity (p-val.)	0.00	0.00	0.00	0.00	0.00
First-stage Koenker score test for heteroskedasticity (p-val.)	0.00	0.00	0.00	0.00	0.00
Kleibergen-Paap F stat.	24.26	11.92	66.97	97.94	3.67
Stock-Yogo weak ID test critical values (10%).	10.74	10.74	10.89	10.89	10.89
Hansen J stat. (p-val.)	0.49	0.67	0.12	0.03	0.53
Durbin-Wu-Hausman test for endogeneity (p-val.)	0.54	0.86	0.34	0.43	0.74
Observations	951	739	731	495	739

Notes: Standard errors corrected for using generated instruments and robust to heterokedasticity in parenthesis. All LP variables are instrumented using Lewbel's (2012) heteroskedasticity based IV approach (LP, LP-1 to LP-3, LP+1 to LP+3, LP×Enforcement variables, LP×Corruption Variables, and After LP). Estimation is done by GMM. The macroeconomic and financial covariates are as in Table 2. $^{***}p < 1\%$, $^{**}p < 5\%$, $^{*}p < 10\%$.