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# Merger externalities in oligopolistic markets

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ABSTRACT

We evaluate the external effects of 183 large mergers at the market level by assessing the impact on the main competitors of the merging firms. Using synthetic control groups and difference in difference estimation, we find that the return on assets of rival firms increases significantly after a merger. The size of the effect varies strongly with market characteristics and the intensity of competition.



## 1. Introduction

In models of oligopolistic competition, a large horizontal merger imposes two externalities on the market: a positive externality due to the reduction of the number of competitors (the market power effect) and a negative externality due to the optimal reallocation of the merging firms' productive assets (the efficiency effect). Thus, not only the merging firms, but also the non-merging rivals are affected. The net externality on the market depends on the relative strength of these two antipodal forces, but should, under fairly general conditions, be positive: with quantity competition or price

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competition with differentiated goods, the merged entity finds it – absent substantial efficiency gains – optimal to reduce its production (Deneckere and Davidson, 1985; Farrell and Shapiro, 1990). In the new equilibrium the rivals sell a higher quantity at a higher price, which is clearly profitable.

A sizeable number of empirical studies evaluate the impact of mergers on market prices (Section 2.2 reviews the literature) and most find some evidence for higher post-merger prices, which are indicative of increased market power. Thus the link between mergers and market externalities described in the paragraph above has been empirically corroborated in a number of merger case studies and a number of industries. However, the conclusions of these articles do not extend beyond the particular market under investigation and their methodologies exhibit significant differences. The contribution this article aims to make is to establish a link between merger externalities and rival firms for a large number of merger cases and industries, using a unified evaluation framework.

Extending the analysis of merger externalities to many cases entails a number of conceptual and practical issues. In case studies of particular mergers, detailed data on the relevant markets, market conditions, rival firms as well as pre- and post-merger data on prices are usually available. Reliable data on these indicators are indispensable to an accurate assessment of merger effects, but collecting them for a sizeable sample of mergers is practically impossible.

We tackle this problem by relying on data collected by the European Commission (EC) in the course of market investigations conducted during merger reviews. The EC routinely publishes a competitive assessment and a delineation of the relevant markets in its decisions on notified mergers. The publicly available decision documents of the reviews include the identities of the main competitors, the geographic extent of the markets and various structural market characteristics we employ in the analysis. The list of the most important competitors in the product markets concerned by the merger provides us with a set of firms that are most likely affected by merger's externality. We link these firms to accounting data such that we can compare their return on assets in the periods before and after the merger.

Thus the data from the merger reviews on the one hand solves the problem of identifying the firms which were affected by the change in market structure due to a merger. On the other hand, it also helps us to find a set of firms that were not affected and are therefore eligible to function as a control group. To this end, we exploit the fact that the EC also assesses the extent of the relevant geographic market concerned by the merger. We use this information to construct a valid counterfactual by selecting control observations from outside the mergers' geographic scope.[1]

The use of correctly identified merger rivals and uncontaminated control groups permits us to provide causal estimates of the size of merger externalities in a cross-industry

[1] Previous studies on the effect of mergers on rivals' prices were able to delineate the relevant market by focusing on industries characterized by many different local markets – e.g. hospitals (Dafny, 2009) or banks (Prager and Hannan, 1998) – such that some non-merging firms were merger rivals and some were not. This approach is not feasible in a cross-industry study.

study. Our findings are compatible with the predictions of Cournot and differentiated-goods Bertrand competition: competitors experience an average increase of around 0.7 percentage points in their profit-to-assets ratio, which is substantial given an average, pre-merger profit to asset ratio of almost 4 percent.

This strongly suggests that market power effects significantly outweigh efficiency effects for the mergers in the sample. We further decompose this average effect via the most important aspects of the competitive environment the merger takes place in. In particular, we find that mergers leading to very large market shares in some product markets, mergers in markets with a low elasticity of demand, mergers that primarily affect national markets, mergers with a high market share of the target, and a low number of competitors lead to a large positive profit externality on rivals. Moreover, by looking at the time dynamics, we find that most of the effects materialize fairly soon, mostly already in the first year after consummation of the merger. This is another indication that the observed effects are due to a preponderance of market power over efficiency effects, which would take more time to manifest.

The remainder of the article is structured as follows: Section 2 discusses the theoretical frame and related empirical literature, Section 3 is concerned with the creation of the dataset, a number of methodological issues in the estimation of causal effects and the empirical approach. Results are presented in Sections 4 and 5 concludes.

## 2. Literature

### *2.1. Theoretical frame*

Theory posits that the impact of a merger on the equilibrium in an oligopoly is the balance of the anti-competitive market power effect (Stigler, 1950) and the pro-competitive efficiency effect (Williamson, 1968). Mergers that do not entail any effects other than reducing the number of competitors will generally raise prices (Deneckere and Davidson, 1985; Perry and Porter, 1985). For the Cournot model, Farrell and Shapiro (1990) show that there exists a critical level of efficiency gains – modeled via a reduction of marginal cost – such that the pre-merger equilibrium is restored. Werden (1996) and Froeb and Werden (1998) derive similar conditions for a merger to be consumer welfare enhancing under the assumptions of Bertrand competition with differentiated goods and Cournot competition respectively. These conditions are more likely to be violated in the Bertrand case if pre-merger markups and diversion ratios (i.e. the share of demand for one product, that will be recaptured by the other after a price increase) are high and in the Cournot case if market shares are high and the elasticity of demand is low.

The intuition for these results is that if pre-merger markups are high, the elasticity of demand must be low, indicating low substitution possibilities. Conversely, price reductions following mergers are more likely in markets with higher elasticity of demand, because a given price reduction will lead to a larger gain in market shares. Therefore prices are likely to increase after a merger – benefiting rivals – if a market is highly

concentrated and if there is little possibility for substitution. In the empirical part, we try to capture these predictions from stylized models as well as widen the analysis to other plausible predictions.

First, we look at the increase in market share of the combined firm due to the merger, that is at the size of the market share of the target firm.[2] We hypothesize that the larger this share, the larger will be unilateral effects due to the merger because the diversion ratio will be higher, and the more we expect prices and therefore rival profits to increase post-merger.

Second, as shown by e.g. Brouwer (2008) a merger of two relatively efficient firms, i.e. with large market shares, raises price more than a merger between two relatively inefficient firms. This implies that the effect of concentration on prices should dependent on the level of concentration resulting from the merger. Thus, we calculate the maximum combined market share post-merger across all affected product markets. We hypothesize that these maximum market shares across product markets have price and therefore rival profit increasing effects, since monopolization or severe dominance in some product markets preclude effective competition in these segments leading to larger unilateral effects. An example might help the intuition. Compare two mergers, 1 and 2, each giving rise to an average combined market share of 50 percent across two product markets, A and B. Merger 1 results in 50 percent market share in both product markets, merger 2 results in a market share of 10 percent in product market A and 90 percent in product market B. Using only average market shares would lead us to expect equal effects of the mergers on rival profits but masks the near monopolization of product market B in merger 2. We explicitly account for this by using the maximum combined market share across product markets to measure (near) monopolization of some segments and the ensuing larger unilateral effects. We expect that the larger this share, the more rival profits go up post-merger.

Third, the elasticity of demand affects merger effect predictions in essentially all oligopoly models, with larger price increasing effects to be expected if the demand elasticity is lower. Because we do not directly observe the elasticities of demand in our sample, we use the pre-merger profitability of acquirers as a proxy. High profitability is very likely to be the result of a low firm specific elasticity of demand that the firms face.[3] We expect that the larger initial profits, the more rival profits go up post-merger.

Fourth, we look at the share of affected product markets that are national in scope. As mentioned, the EU Commission very carefully defines product and geographic markets before investigating the merger, with the standard test being the 'SSNIP' (small but significant non-transitory increase in price)-test. This test essentially defines relevant markets according to likely substitution away from the product after a price increase, with little substitution leading to narrow, e.g. national, markets. We therefore expect

[2] One could also interpret this share as a measure for the intensity of treatment due to the merger. See e.g. Angrist and Imbens (1995) for an econometric analysis of treatment intensity.

[3] An alternative interpretation of large profits would be superior efficiency of the firm, however these efficiency rents should be competed away over time.

**Table 1**
Expected effects on externality.

| Variable | Expected sign | Reason |
|---|---|---|
| Target share | $> 0$ | Higher treatment intensity |
| Highest share | $> 0$ | Near monopolization |
| Initial profits | $> 0$ | Small elasticity of demand |
| National markets | $> 0$ | Few possibilities for substitution |
| Competitor count | $< 0$ | Remaining competition |

that a larger share of national product markets leads to a higher externality on rival profits, since substitution possibilities are more limited.

Finally, we look at the number of competitors identified by the EC (i.e. including firms we do not have data on) and remaining after the merger. Clearly, we expect a larger positive externality on rivals if their number is small, since remaining competition intensity is lower.[4]

Table 1 sums up the hypothesized effects of the merger and market characteristics discussed above.

### *2.2. Related empirical studies*

There are a number of studies that use matching to create a credible counterfactual and difference in difference estimation to establish causality in the evaluation of mergers: for example, Ornaghi (2009) and Szücs (2014) find that firms decrease their R&D activities after mergers. Egger and Hahn (2010) find that the consolidation of the Austrian banking sector led to significantly improved cost performance. These studies employ propensity score matching to pair merging firms with non-merging control firms. In the present study we use a more flexible synthetic control group approach (Abadie and Gardeazabal, 2003), which is discussed in greater detail in Section 3.3.

While there is a large literature analyzing the direct effects of mergers on the insiders (e.g. Banerjee and Eckard, 1998; Gugler et al., 2003; Mueller, 1997 provides an overview), there are few studies that attempt to capture the impact on rivals. These studies either focus on the effect of the merger on market prices or the stock market performance of rivals.

The latter group was pioneered by two studies: Eckbo (1983) and Stillman (1983) look at the stock returns of rivals in horizontal mergers and find no evidence for anti-competitive effects. More recent studies use the reaction of rivals' stocks to distinguish pro- and anti-competitive mergers and evaluate the optimality of merger control decisions (Duso et al., 2013, 2007). They find that rivals accrue significant positive abnormal returns in response to a merger announcement (Clougherty and Duso, 2009), which is consistent with an increase in market power.

[4] Of course, an additional reason why market power may increase after a merger in an oligopoly with few firms is that pro-collusive behavior may be facilitated.

The effect of mergers on market prices is studied in the banking industry (Focarelli and Panetta, 2003; Prager and Hannan, 1998), the airline industry (Kim and Singal, 1993), the health care industry (Dafny, 2009), gasoline stations (Hastings, 2010; Houde, 2012), parking markets (Choné and Linnemer, 2012), and various consumer product industries (Ashenfelter and Hosken, 2010). Using different methodological approaches, all these studies find some evidence for price increases after mergers in the industry. This points to a preponderance of market power effects over efficiency effects to the benefit of rivals. See also Weinberg (2008) for a survey of nine studies on the price effects of horizontal mergers finding that most mergers examined resulted in price increases of both merging and rival firms.

It can, however, be argued that both strands of literature suffer from various shortcomings. Studies based on stock market data can only assess the markets' expectations about the effects on rivals, which do not need to be accurate, and they also strongly rely on the assumption that markets are informationally efficient. Critical perspectives on event-studies are provided by McAfee and Williams (1988) and Fridolfsson and Stennek (2005). The studies on price effects – while innovative in their way of identifying causal effects (e.g. recently Houde, 2012 and Choné and Linnemer, 2012) – are restricted to specific mergers or specific markets.

This study aims to fill some of the gaps by (i) assessing the net externality of mergers on rivals based on reliable, ex-post measures in (ii) a large sample containing mergers in many different industries, using (iii) carefully constructed control groups in the estimation of causal effects. Our aim is thus to provide a broader picture on merger effects in oligopolies and to draw conclusions for competition policy.

## 3. Data and methodology

In this section we describe how the dataset on competitors was created and discuss our approach to measuring the external effects of mergers.

### *3.1. Constructing the dataset*

To construct the dataset, we combine information on mergers that underwent the scrutiny of European competition law[5] between 1990 and 2007 with firm-level information on the firms involved in these mergers.

From a total of 183 merger decisions,[6] we record the names of 573 rival firms identified by the EC. These rivals are the main competitors of the merging firms in the product markets affected by the merger. Roughly 60 percent of the mergers in the sample were

[5] The EC investigates mergers with a 'community dimension', defined as a set of financial thresholds. Details can be looked up at http://ec.europa.eu/competition/mergers/legislation/legislation.html.

[6] Merger-level data was gathered from the official decisions of the European Commission, available at http://ec.europa.eu/competition/mergers/cases/.

approved subject to conditions and obligations, while the remainder was cleared unconditionally. Almost a third of the cases went to an in-depth phase 2 investigation. The mergers resulted in a mean (averaged across product markets), post-merger market share of merging firms of around 39 percent. We also collect information on the area of economic activity affected by the merger (the NACE code(s)). In all mergers in the sample the affected product markets were found to be either national or EU-wide in scope; since world-wide product markets would contradict the identification strategy proposed below, we leave them out of the analysis. Almost two thirds of the individual product markets were found to be national in scope while the remainder of markets were EU-wide.

We merge the rival firms to balance-sheet data from the Thomson Reuters Worldscope database, providing yearly accounting data on income, assets, debt and market capitalization. Profitability is calculated as net income divided by total assets, Tobin's $q$ is the sum of market capitalization and total debt divided by total assets. All monetary variables are CPI-adjusted to 2005 USD and converted to logs.

We also merge the rival firms to the SDC Platinum database, which contains data on all mergers worldwide with a transaction value of at least 1 million USD. We use this information in Sections 4.1.2 and 4.1.3 in order to control for subsequent mergers among rivals, which could potentially confound our findings.

### *3.2. Identification*

To identify the effect of a merger on the rivals in the relevant market, we need to define a counterfactual, i.e. we need to make an assumption on what would have happened in absence of the merger. With that achieved, we can then estimate the causal effect using difference in difference methods. Previous studies trying to estimate the effect of mergers on the affected firms have usually opted for firm-level matching (e.g. Egger and Hahn, 2010; Ornaghi, 2009) or IV approaches (e.g. Dafny, 2009; Houde, 2012) to control for selection into the treatment group. When evaluating the effect of mergers on merging firms, this is appropriate. However, when evaluating the effects on merger rivals this approach does not seem entirely appropriate: firms do not self-select into being merger rivals. Moreover it seems more fitting to define treatment at the market level instead of the firm level, that is, to compare the group of merger rivals with a suitable control group of unaffected firms. This is the case because the externality of a merger affecting a market is not a treatment of the individual rival firm, but affects all rivals as a group.

For each merger the sample contains data on between 1 and 12 rival firms (3.13 on average). These firms are directly exposed to the external effect of the merger and are assigned to the treatment market. To generate control markets we proceed as follows: first, we identify the 4-digit NACE sectors that were affected by the merger (as per the EC's product market assessment) and only consider firms in these industries in the construction of control markets. Thus, only markets with the same economic activity are considered as potential control group. Next we identify national markets that were not affected by the merger as per the EC's geographic market assessment: if the geographic market was

found to be national in scope, we exclude the affected nation from the pool of potential controls; if the market was found to be EU-wide, we exclude all European nations from the pool of potential controls.[7] In addition, we also exclude the nations of origin of the rival firms from the pool to make sure that control groups are unaffected by second-order effects. This geographic approach to identifying the external effect of mergers on rivals entails that mergers with world-wide relevant markets cannot be evaluated, since no national markets can reliably be assumed to be unaffected. For this reason, the sample only contains mergers where markets are either national or EU-wide.[8]

Thus the set of potential control markets for a merger is the cross product of the industry[9] affected by the merger and the set of all countries that were not affected by the merger. For these unaffected markets and for the market of merger rivals, we calculate the weighted average return on assets (firm profitability weighted by firm assets), which is the basis for finding suitable control markets.[10]

### *3.3. Synthetic control markets*

To generate the counterfactual, we do not employ a traditional control group approach (i.e. every treated observation is assigned one non-treated observation), but instead use the concept of synthetic control groups (Abadie et al., 2010; Abadie and Gardeazabal, 2003).[11] The intuition behind this approach is that – instead of a singular control observation – an algorithm selects a weighted basket of control observations, such that the pre-treatment dynamics of the treated observation are best approximated by the dynamics of this synthetic control unit. This approach has the advantage, that the characteristics of the treated unit can be approximated by an arbitrary linear combination of all available controls, which allows for a better fit than a single control unit. Furthermore, even if only few potential controls are available, there usually exists a weighted average that will reasonably well approximate the treated unit.

We start out by aggregating all rivals in a given merger to form the treated market, weighing the individual firms by their total assets. The synthetic control market is created by finding all eligible control markets according to the criteria described above (same economic activity but outside merger's geographic scope) and exclude those, where the

[7] Sometimes the EC provides different market sizes or is undecided between two market definitions, because market extent is not material for the decision. In these cases, the largest market definition was retained to ensure that controls are chosen from an unaffected area.

[8] In around 20 percent of mergers scrutinized by the EC, the geographic markets are found to be world-wide.

[9] If a merger affects more than one industry, we pool the firms in all industries concerned.

[10] We additionally calculate the dispersion of firm profits, the mean value of Tobin's $q$ and the Herfindahl–Hirschman index, which are used to extend the set of matching covariates in a robustness check presented in Section 4.1.1.

[11] In a previous version of this article, we utilized a 1:1 propensity score matching algorithm to match merger rivals with control firms and obtained qualitatively similar results.

available data are insufficient.[12] On average, there are 15.77 potential control markets for every group of rival firms.

The algorithm then finds the weighted linear combination of these markets, which minimizes the difference in profitability (the outcome variable) to the treated market over the entire pre-merger period. Thus, a basket of related (same economic activity) but unaffected (outside the merger geographic scope) markets is selected, such that the profitability of the merger rivals is best approximated in the periods $t-3$, $t-2$ and $t-1$ leading up to the merger. By matching on profits in these periods individually, not only the level of profits, but also the pre-merger evolution of profits in the treated market is approximated.[13] This is an essential point in order for the common trends assumption – which is central to all estimation of treatment effects involving matched control groups – to be plausibly fulfilled. On average, the algorithm assigns positive weights to 9.24 markets, such that the average synthetic market is constructed from more than 9 real markets.

More formally, let $J$ be the number of available control markets in a given merger ($J$ is 15.77 on average in the data) and $W$ a $J \times 1$ vector with nonnegative weights summing up to one. Further, let $X_1$ be a $3 \times 1$ vector containing the average profitability of rivals in periods $t-3$, $t-2$ and $t-1$, and $X_0$ a $3 \times J$ matrix containing the same information for the potential control markets. The problem of constructing a synthetic control group is then solved by calculating the optimal weighting matrix $W^*$, such that the difference in profitability in all pre-merger periods between treated and control group, $(X_1 - X_0 \times W)^T(X_1 - X_0 \times W)$, is minimized. The elements of $W^*$, denoted by $(w_1^*, \ldots, w_J^*)$, are then the weights assigned to the individual control markets and the synthetic control market is calculated as a weighted linear combination.[14]

### *3.4. An example*

In May 2005, Novartis AG, a Swiss medical company, notified the EC of its intent to acquire Hexal AG, a German producer of generic medications. The Commission found that their business activities overlap in 33 product markets (many of which related to the production of immunosuppressants and antihistamines) in numerous member states. The Commission identified a total of 34 different competitors and found that the parties' average market share after the merger would amount to 45 percent across all product markets, with an average increase of 7 percent due to the merger. Since the transaction raised concerns in three national markets (Denmark, Germany and Poland), the Com-

[12] We require pre-treatment data on the outcome variable for matching and post-treatment data on the outcome for evaluation.

[13] In a robustness check in Section 4.1.1 we employ further matching covariates in an effort to further improve the accuracy of the matching procedure. Specifically, we match on the dispersion of profits, the average Tobin's $q$ of firms and the HHI in addition to the outcome variable, profitability.

[14] This exposition neglects that in the case of multiple matching covariates – as used in the robustness check in Section 4.1.1 – , an additional weighing matrix for the covariates needs to be estimated. Abadie et al. (2010) contains a more general description of the synthetic control algorithm.

mission required the companies to divest the rights to produce and sell specific drugs in these countries. Subject to these conditions, the merger was cleared.

We were able to link nine of the competitors identified by the EC to accounting data (Actavis, Teva, Schering-Plough and Beiersdorf, among others).[15] These companies are headquartered in eight different countries.

The algorithm creating the synthetic control group commences by assigning the rival companies to a fictional 'market' and identifying all firms in the sample which are active in the industry concerned by the merger (NACE C.21.20 – Manufacture of pharmaceutical preparations). We find 1192 firms, which are assigned to 43 different national markets. We then calculate the mean profits (weighted by assets) for the national markets and the rival market, resulting in a panel of 44 markets observed from 1989 to 2010. The next step is to identify which of these markets are suitable for a control group. We exclude the nations of the merging parties (Switzerland and Germany) as well as those of the competitors (Finland, Germany, Hungary, Iceland, Israel, Poland, Switzerland and the US) to ensure that the control group is not directly or indirectly affected by the merger. Finally, we check the data availability on the outcome (mean profitability) in the pre- and post-treatment periods and exclude markets with missing data. This leaves us with 31 potential control markets.

Since the merger took place in 2005, the years 2002–2004 are the pre-merger period relevant for matching. The next step is to approximate the evolution of profitability of the rivals (the treatment market) with those of the control markets over the 2002–2004 period to the greatest extent possible, using both the profits of control markets in the 2002–2004 period. Through numerical minimization of the squared prediction errors, all potential control markets are assigned optimal weights to create a synthetic control market, that is, a fictional linear combination of actual markets, that best approximates the treated market. In this specific example, all of the 31 markets receive positive weights, with the Indian, Italian, Slovenian and Belgian markets being the main constituents.

The resulting control group tracks the evolution of rival profits very precisely in the pre-merger period: the average absolute difference between the two groups amounts to .008 percentage points. In the evaluation period (2006–2010), the profits of the synthetic control market remain similar to those in the matching period, while the rival profits increase significantly, such that the average absolute difference between the groups rises to 2.57 percentage points.

### *3.5. Estimation*

Once we have constructed the control markets, the estimation sample consists of a panel of 183 markets with mergers, observed in periods $[-3, -1]$ before the transaction

[15] The discrepancy of competitors identified by the EC and competitors linked to firm-level data is owed to the fact that the data contain only stock-market listed firms. In an unreported robustness check we assess whether our findings depend on the number of firms matched and find that this is not the case, i.e. that results are robust to constraining estimation to cases with few or many matched competitors.

and [1, 5] after, as well as 183 synthetic control markets observed over the same period of time. Thus the maximum number of observations per unit in the panel is 8, while the average number of observations is 7.41, due to data limitations.

We then apply a DiD estimator to the dataset, such that the average treatment effect on the treated (ATT) is estimated as the difference between both the before and after periods and the treatment and control group. Formally, we estimate

$$\begin{aligned}\Pi_{m,t} = \alpha + \text{treated}_m + \text{post}_t + (\text{treated}_m \times \text{post}_t) \\ + \varepsilon_{m,t} \quad (+\text{treated}_m \times \text{post}_t \times \xi_{m,t}),\end{aligned} \tag{1}$$

where $\Pi_{m,\,t}$ designates the average profits of firms in market $m$ at time $t$, $\text{treated}_m$ indicates the treatment group (the market of merger rivals) and $\text{post}_t$ indicates the evaluation period, $t > 0$. In the regressions, $\text{treated}_m$ should ideally be small and insignificant, as this would indicate that the synthetic control group approach succeeds in leveling systematic differences between treated and non-treated units. $\text{post}_t$ measures any systematic post-merger trend in profitability, that is common to treated and non-treated markets.

The interaction $\text{treated}_m \times \text{post}_t$ is the average treatment effect on the treated, while $\varepsilon_{m,\,t}$ is an error term. The term in brackets, $(\text{treated}_m \times \text{post}_t \times \xi_{m,\,t})$, is an additional interaction of the treat-post indicator with the variables of interest $\xi_{m,\,t}$, including the target's average market share, the combined firm's maximum market share, the initial profits of the merging firms, the share of markets which are national in scope and the number of identified competitors (see Section 2.1). Since we also include the ATT term (treated × post), the $\xi$-interactions can be interpreted as deviations from the average effect.

The estimation of treatment effects over time is achieved in a very similar setting, by using separate indicator variables for the specific post-periods. Thus, to measure period-specific treatment effects we estimate

$$\Pi_{m,t} = \alpha + \text{treated}_m + \sum_{i=1}^{5} \mathbb{1}_{t=i} + \left( \sum_{i=1}^{5} \mathbb{1}_{t=i} \times \text{treated}_m \right) + \varepsilon_{m,t}. \tag{2}$$

To evaluate the time dynamics of the interaction with merger and market characteristics, we multiply the period-specific treatment indicators with the $\xi_{m,\,t}$'s. We again include the ATT term $(\text{treated}_m \times \text{post}_t)$, such that the $\xi_{m,\,t}$ interactions can be interpreted as deviations from the average effect:

$$\begin{aligned}\Pi_{m,t} = \alpha + \text{treated}_m + (\text{treated}_m \times \text{post}_t) + \sum_{i=1}^{5} \mathbb{1}_{t=i} \\ + \left( \sum_{i=1}^{5} \mathbb{1}_{t=i} \times \text{treated}_m \times \xi_{m,t} \right) + \varepsilon_{m,t}.\end{aligned} \tag{3}$$

Eqs. (2) and (3) analyze the time profile of treatment effects. We would expect market power effects to materialize fairly soon, while achieving efficiency gains should take some

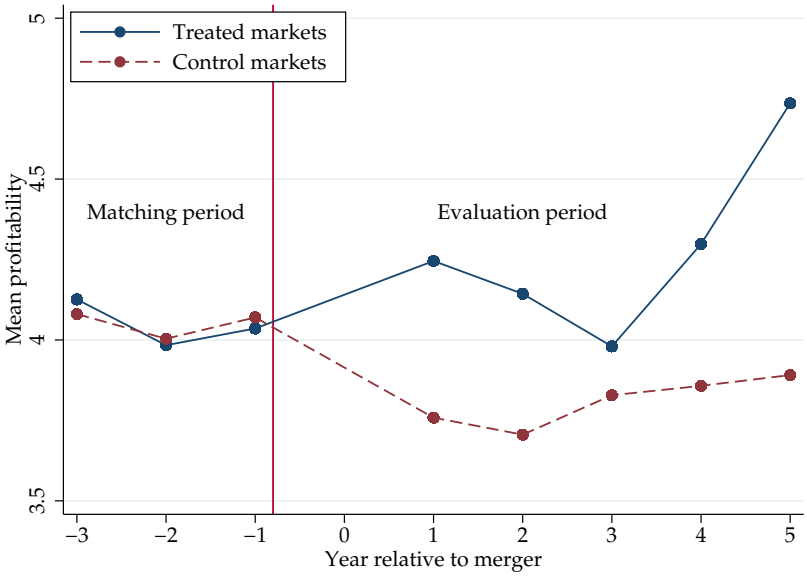


**Fig. 1.** Profitability of merger rivals and control groups.

time. Note that Eqs. (2) and (3) are identical, except for the last term in brackets in Eq. (3), i.e. the $\xi_{m,\,t}$ interactions. This is because the period-specific treatment effects in Eq. (2), $(\sum_{i=1}^{5} \mathbb{1}_{t=i} \times \text{treated}_m)$, sum up to the $(\text{treated}_m \times \text{post}_t)$ term in Eq. (3).

### *3.6. Summary statistics*

The evolution of profits of treatment and control markets is illustrated in Fig. 1. During the matching period (three years before the merger up to one year before the merger), the average absolute difference of the profitabilities of treated and control markets is less than 0.03 percentage points. This difference is insignificant on average as well as in the individual time periods. In the evaluation period (the five years after the merger), we see that this gap has widened: while the profits in markets affected by mergers seem to be trending upwards in most periods, those of the control markets have declined slightly.

To gain an intuition for whether the increased difference during the evaluation period is due to arbitrary divergence or indicative of systematic merger externalities, we compare the gap between treatment and control profitabilities observed in the data with gaps obtained from placebo treatments. To this end, we randomly assign an average of 3.13 'fake rivals' (excluding the actual rivals) to each of the 183 merger cases (numbers were chosen to reflect the actual sample). We then construct control groups and contrast the evolution of profits between the two groups as described above. We repeat this process 150 times. If the gap between treated and control markets observed in Fig. 1 is a random development, we would expect many of the random gaps to be larger.

Fig. 2 compares the gap obtained from the actual data with those from the placebo treatments. While almost all gaps lie in a narrow corridor of around ± .3 in the matching

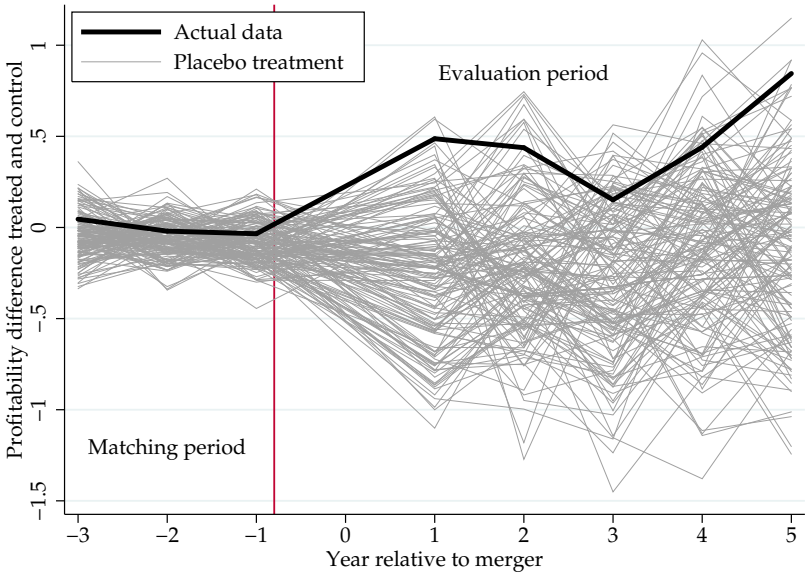


**Fig. 2.** Profitability difference in actual and placebo treatments.

period, their standard deviation more than triples in the evaluation period. For the actual treatment, the gap increases from −.003 to more than 0.45 percentage points in the evaluation period, which is the highest positive effect across all trials over the evaluation period. Thus, the treatment effect on markets with actual mergers is like an upper envelope of the placebo runs. This indicates that the increased gap between merger rivals and control markets appears to reflect a causal effect due to merger externalities and is not an arbitrary trend.

Table 2 provides summary statistics and definitions of the variables employed in the analysis, Table 3 provides correlation coefficients.

Table 3 shows that the correlations between the variables measuring merger and market characteristics are of modest size and significance ($p$-values reported in parentheses). The two highest correlations are found for average target and highest combined market share (which correlate by construction) and highest share and national markets (which are also intuitively correlated). With values of .51 and .32, these correlations do not give rise to econometric concern. Interestingly and in line with expectations, the number of competitors (where a higher value indicates more competition) correlates negatively with all other indicators (where higher values indicate less competition).

## 4. Results

Table 4 presents the results on estimating Eq. (1). The first column simply displays the average treatment effect on the treated (i.e. on rival markets), columns (2) to (6) add further variables of interest (target share; highest share; initial profits; national markets;

**Table 2**
Summary statistics and variable definitions.

Outcome and matching variables

| | Mean | SD | Median | Min | Max | Description |
|---|---|---|---|---|---|---|
| Profitability | 4.27 | 3.02 | 4.05 | −8.97 | 15.74 | Net income divided by total assets, averaged over all rivals using total assets as weight |
| Profit dispersion | 4.44 | 2.27 | 3.88 | 0.64 | 10.51 | Standard deviation of firm profits in a market |
| Tobins $q$ | 1.29 | 0.70 | 1.05 | 0.28 | 3.63 | Market capitalization plus total debt, divided by total assets, averaged over all rivals |
| HHI | 0.35 | 0.15 | 0.32 | 0.08 | 0.78 | Sum of squared market shares (based on sales) in a market |

Merger and market characteristics

| | Mean | SD | Median | Min | Max | Description |
|---|---|---|---|---|---|---|
| Target share | 17.99 | 13.43 | 16.25 | 0 | 85 | Mean market share of the merger target across all affected product markets |
| Highest share | 64.63 | 27.08 | 64.40 | 2 | 100 | Maximum combined market share after the merger across all affected product markets |
| Initial profits | 5.54 | 6.84 | 4.21 | −19.54 | 35.54 | Profitability (calculated as above) of the merging firms in the year before the merger |
| National markets | 0.65 | 0.40 | 0.86 | 0 | 1 | Share of affected product markets that are national in scope |
| Competitor count | 2.54 | 1.75 | 2.33 | 0 | 10 | Average number of rival firms identified by the EC per product market |

*Notes:* Data on outcome and matching variables are obtained from the Thomson Reuters Worldscope database; data on merger and market characteristics were collected from the EC's official decision documents.

**Table 3**
Correlations.

| Variables | Target share | Highest share | Initial profits | National markets |
|---|---|---|---|---|
| Highest share | 0.51 | | | |
| | (0.00) | | | |
| Initial profits | 0.11 | 0.19 | | |
| | (0.23) | (0.03) | | |
| National markets | 0.14 | 0.32 | 0.18 | |
| | (0.08) | (0.00) | (0.03) | |
| Competitor count | −0.14 | −0.29 | −0.16 | −0.15 |
| | (0.07) | (0.00) | (0.06) | (0.05) |

and competitor count) in turn to look whether the average effect can be explained and disentangled by these measures of competition intensity, with column (7) presenting a 'horse race' of the importance of these variables by including all of them. Generally, the equation is well specified since the treated dummy is insignificant in all specifications,

**Table 4**
Average treatment effects and interactions.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | 0.068 | 0.068 | 0.068 | 0.068 | 0.068 | 0.068 | 0.068 |
| | (0.223) | (0.222) | (0.221) | (0.218) | (0.222) | (0.223) | (0.217) |
| Post | −0.220 | −0.219 | −0.219 | −0.219 | −0.217 | −0.220 | −0.219 |
| | (0.204) | (0.203) | (0.202) | (0.199) | (0.203) | (0.204) | (0.198) |
| Treated ∗ post | 0.702** | 0.601* | −0.313 | 0.300 | −0.113 | 1.091*** | −1.012 |
| | (0.289) | (0.341) | (0.428) | (0.308) | (0.350) | (0.346) | (0.618) |
| Target share | | 0.021** | | | | | −0.005 |
| | | (0.010) | | | | | (0.012) |
| Highest share | | | 0.018*** | | | | 0.016** |
| | | | (0.005) | | | | (0.007) |
| Initial profits | | | | 0.154*** | | | 0.132*** |
| | | | | (0.021) | | | (0.024) |
| National markets | | | | | 1.396*** | | 0.668* |
| | | | | | (0.315) | | (0.391) |
| Competitor count | | | | | | −0.136* | 0.097 |
| | | | | | | (0.073) | (0.101) |
| Constant | 3.873*** | 3.871*** | 3.871*** | 3.870*** | 3.866*** | 3.871*** | 3.870*** |
| | (0.158) | (0.157) | (0.157) | (0.154) | (0.157) | (0.158) | (0.153) |
| Observations | 2712 | 2612 | 2644 | 2555 | 2692 | 2692 | 2482 |
| $R^2$ | 0.01 | 0.01 | 0.01 | 0.04 | 0.02 | 0.01 | 0.04 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

such that treated and non-treated market profitabilities do not significantly differ in the matching period. The negative coefficients on the post-dummies are insignificant in all specifications.

Column (1) estimates a significant ATT of .702 percentage points on average over the five years after the mergers. This constitutes an economically important effect if one considers that the average profitability of rival firms before the mergers is almost 4 percentage points. Thus, mergers on average entail a nearly 18 percent profitability increase for rival markets. In what follows, we show that this average effect masks important differences in effects across mergers depending on the variables measuring competition intensity.

Column (2) analyzes the question whether the average market share of the merger target – which can be interpreted as a measure of treatment intensity – plays a role for the externality on rivals. We indeed find that larger target market shares increase profits of rival markets over-proportionally in the five years after the merger, consistent with unilateral effects being larger. The ATT remains, however, significant at .601 percentage points indicating that other factors are more important than target share.

Column (3) investigates whether it is extreme mergers, i.e. mergers that lead to very high market shares in at least one product market as identified by the EC, that are responsible for observed treatment effects. Indeed, the inclusion 'Highest share' completely wipes out ATT as measured by the dummy 'Treated ∗ Post'. It appears that most of the

measured average anti-competitive effects of mergers can be attributed to mergers that lead to very large market shares in some product markets. For example, we estimate that the profit externality of mergers on rival markets is around 1.8 percentage points for the 15 percent of mergers which lead to at least one product market with 100 percent market share of the combined firm.[16]

Column (4) repeats the same exercise using the initial profits of the merging parties as a proxy for the elasticity of demand. Again, the average treatment effect becomes insignificant as most of the profit externality co-varies with initial profitability: the larger initial profits of merging firms the larger the positive externality on rival markets. At the median value of initial profits of 4.23 percent, rival markets enjoy an externality of .65 percentage points on their profitability. Since the distribution of initial profits is skewed to the right, many markets are affected more strongly: at the 75th percentile of the distribution initial profits are at 9.74 percent and the externality rises to 1.5 percentage points.

Column (5) uses the share of national markets affected by the merger as judged by the EC. The larger this share, the larger the profit externality. At the sample median of 65 percent national markets, the effect on profits in rival markets is .91 percentage points, while a merger that affects only national markets increases rival profitability by 1.4 percentage points. This is consistent with the view that substitution possibilities are limited in national markets particularly when a merger further reduces choice.

Column (6) analyzes the effects of the number of competitors remaining after the merger. We estimate that an additional competitor reduces the profit externality on the market of rivals by .14 percentage points, such that 8 remaining competitors would eliminate the positive externality altogether.

Finally, column (7) presents the results of a 'horse race' of effects of the variables. 'Highest share', 'Initial profits' and 'National markets' remain positive and significant, while 'Target share' and 'Competitor count' lose significance. This suggests that the variables concerning merger and market characteristics measure different relevant aspects of the competitive environment a merger takes place in.

Summarizing, 'extreme' mergers, i.e. mergers leading to very large market shares in some product markets, mergers in markets with a low elasticity of demand, and mergers that primarily affect national markets lead to a large positive profit externality on rival markets. Moreover, there is evidence that the 'treatment intensity' due to the merger, i.e. the market share of the target, as well as the number of (remaining) competitors are crucial in understanding the competitive effects of mergers. Thus, we can disentangle the estimated average treatment effect with variables measuring the most important aspects of the competitive environment the merger takes place.

[16] Of course, we would expect that these mergers are only cleared with (structural) remedies, so that this never happens. The fact, however, that we measure such large externalities indicates that these remedies have not been completely effective in maintaining effective competition.

**Table 5**
Treatment effects over time.

| | ATT | Target share | Highest share | Initial profits | National markets | Competitor count |
|---|---|---|---|---|---|---|
| Treated | 0.069 | 0.068 | 0.068 | 0.068 | 0.068 | 0.069 |
| | (0.224) | (0.223) | (0.222) | (0.219) | (0.222) | (0.223) |
| $t+1$ | −0.311 | −0.354 | −0.389 | −0.302 | −0.309 | −0.329 |
| | (0.315) | (0.291) | (0.301) | (0.277) | (0.293) | (0.292) |
| $t+2$ | −0.319 | −0.254 | −0.333 | −0.369 | −0.343 | −0.440 |
| | (0.316) | (0.291) | (0.302) | (0.277) | (0.293) | (0.293) |
| $t+3$ | −0.211 | −0.122 | −0.131 | −0.241 | −0.155 | −0.165 |
| | (0.323) | (0.297) | (0.308) | (0.282) | (0.299) | (0.299) |
| $t+4$ | 0.012 | −0.199 | −0.069 | 0.011 | −0.047 | 0.007 |
| | (0.341) | (0.311) | (0.325) | (0.294) | (0.313) | (0.313) |
| $t+5$ | −0.229 | −0.139 | −0.114 | −0.125 | −0.196 | −0.097 |
| | (0.362) | (0.328) | (0.344) | (0.310) | (0.330) | (0.332) |
| Treated ∗ post | | 0.602* | −0.325 | 0.295 | −0.116 | 1.091*** |
| | | (0.341) | (0.428) | (0.309) | (0.351) | (0.347) |
| Treated∗($t$+ 1) | 0.560 | 0.015 | 0.018*** | 0.124*** | 1.122** | −0.182 |
| | (0.446) | (0.016) | (0.007) | (0.039) | (0.506) | (0.120) |
| Treated∗($t+2$) | 0.647 | 0.013 | 0.018*** | 0.160*** | 1.437*** | −0.045 |
| | (0.447) | (0.017) | (0.007) | (0.039) | (0.506) | (0.121) |
| Treated∗($t+3$) | 0.808* | 0.021 | 0.018*** | 0.164*** | 1.398*** | −0.121 |
| | (0.457) | (0.017) | (0.007) | (0.040) | (0.517) | (0.122) |
| Treated∗($t$+ 4) | 0.621 | 0.040** | 0.019*** | 0.162*** | 1.460*** | −0.170 |
| | (0.482) | (0.018) | (0.007) | (0.043) | (0.551) | (0.128) |
| Treated∗($t+5$) | 0.965* | 0.019 | 0.019** | 0.184*** | 1.737*** | −0.172 |
| | (0.512) | (0.019) | (0.008) | (0.051) | (0.589) | (0.134) |
| Observations | 2712 | 2612 | 2644 | 2555 | 2692 | 2692 |
| $R^2$ | 0.01 | 0.02 | 0.02 | 0.04 | 0.02 | 0.01 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Column (1) reports the ATTs over time; columns (2)–(6) interact the time-specific ATTs with the target share, highest share, initial profits, national markets and competitor count variables respectively.

We did not yet analyze another important dimension, namely the time dynamics of merger effects. One could argue that market power effects should materialize fairly soon after the consummation of the merger, since only price coordination between acquirer and target needs to be achieved. Efficiency effects, on the other hand, may take time: firm productive assets need to be integrated in a sometimes turbulent post-merger phase to achieve e.g. economies of scale or scope; it must be decided which departments should work together, who will be the (surviving) managers, which operations to close down etc. Sometimes projected efficiency gains ('synergies') never materialize, not only in such well known disastrous mergers as Daimler/Chrysler or AOL/Time Warner. Table 5 therefore looks at the time profile of externality effects on rival markets by interacting our variables of interest with yearly time dummies until five years after the mergers. We first look at the ATT over time (Eq. (2)) in column 1 and then add interactions with the variables describing the competitive environment (Eq. (3)).

**Table 6**
Matching on additional market characteristics.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | 0.061 | 0.061 | 0.061 | 0.061 | 0.064 | 0.061 | 0.061 |
| | (0.229) | (0.228) | (0.228) | (0.224) | (0.227) | (0.228) | (0.223) |
| Post | −0.444** | −0.442** | −0.443** | −0.443** | −0.435** | −0.443** | −0.442** |
| | (0.209) | (0.208) | (0.208) | (0.204) | (0.208) | (0.208) | (0.203) |
| Treated ∗ post | 0.999*** | 0.852** | −0.108 | 0.318 | 0.184 | 1.603*** | −0.552 |
| | (0.296) | (0.350) | (0.438) | (0.314) | (0.361) | (0.355) | (0.611) |
| Target share | | 0.023** | | | | | −0.005 |
| | | (0.010) | | | | | (0.012) |
| Highest share | | | 0.020*** | | | | 0.013** |
| | | | (0.005) | | | | (0.007) |
| Initial profits | | | | 0.168*** | | | 0.143*** |
| | | | | (0.021) | | | (0.023) |
| National markets | | | | | 1.388*** | | 0.666* |
| | | | | | (0.329) | | (0.386) |
| Competitor count | | | | | | −0.220*** | 0.013 |
| | | | | | | (0.076) | (0.098) |
| Constant | 3.837*** | 3.835*** | 3.835*** | 3.835*** | 3.828*** | 3.836*** | 3.835*** |
| | (0.162) | (0.161) | (0.161) | (0.158) | (0.161) | (0.161) | (0.157) |
| Observations | 2378 | 2303 | 2325 | 2280 | 2358 | 2358 | 2217 |
| $R^2$ | 0.01 | 0.02 | 0.02 | 0.05 | 0.02 | 0.02 | 0.05 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Column (1) finds that treatment effects are sizeable already in the first two years after the merger (at .56 and .65 respectively), however insignificantly so. They keep rising to .97 five years after the merger and are significant in periods 3 and 5. Looking at the co-variates measuring competitive intensity, the evidence that merger effects materialize already in the first years after the mergers is more clearcut. When disentangling the average effect using the competition variables highest share, initial profits, and national markets in columns (3) to (5), all effects are already sizeable and significant in the first year after the consummation of the mergers. For the other two variables target share and competitor count (columns (2) and (6)), effects are also as expected, but insignficantly so. This is again indicative that we actually measure a preponderance of market power effects over efficiency effects for large horizontal mergers.[17]

### *4.1. Robustness checks*

In Tables 6–10 we perform a number of robustness tests of our main results. We refine the matching procedure by matching control markets not only on the pre-merger profitability criterion but also on other covariates, we control for rivals involved in mergers

[17] Another indication of market power effects is that, in unreported results, we find that rivals' sales growth exceeds that of the merging firms in the post-merger periods. Thus, their market shares are likely to rise (compare Gugler and Siebert, 2007).

**Table 7**
Controlling for rivals involved in mergers.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | −0.011 | −0.017 | −0.017 | −0.017 | −0.016 | −0.019 | −0.016 |
| | (0.255) | (0.252) | (0.252) | (0.248) | (0.254) | (0.253) | (0.247) |
| Post | −0.359 | −0.355 | −0.355 | −0.355 | −0.356 | −0.354 | −0.356 |
| | (0.236) | (0.234) | (0.234) | (0.229) | (0.235) | (0.234) | (0.228) |
| Treated ∗ post | 0.501 | 0.158 | −0.698 | −0.041 | −0.104 | 1.261*** | −0.994 |
| | (0.334) | (0.396) | (0.496) | (0.352) | (0.400) | (0.405) | (0.719) |
| Target share | | 0.031*** | | | | | −0.000 |
| | | (0.012) | | | | | (0.014) |
| Highest share | | | 0.020*** | | | | 0.022*** |
| | | | (0.006) | | | | (0.008) |
| Initial profits | | | | 0.180*** | | | 0.162*** |
| | | | | (0.023) | | | (0.027) |
| National markets | | | | | 1.010*** | | −0.157 |
| | | | | | (0.367) | | (0.459) |
| Competitor count | | | | | | −0.275*** | −0.067 |
| | | | | | | (0.086) | (0.121) |
| Constant | 3.866*** | 3.862*** | 3.862*** | 3.862*** | 3.864*** | 3.860*** | 3.861*** |
| | (0.180) | (0.178) | (0.179) | (0.175) | (0.180) | (0.179) | (0.175) |
| Observations | 2154 | 2086 | 2113 | 2032 | 2146 | 2146 | 1979 |
| $R^2$ | 0.00 | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.04 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

in the evaluation period, we shorten the estimation window to three years after the mergers, and finally we relax the industry and the geographic constraint imposed in the matching procedure.

*4.1.1. Controlling for additional market characteristics*

Table 6 matches control markets not only based on market profitability, but also on the dispersion of profits, the HHI, and the average Tobins $q$ of control markets. This should allow an even better mimicking of the level and the dynamics of profits in the treatment market before the mergers. Indeed, although losing some 15 percent of the sample due to the increased data requirements, we obtain more significant results. The main conclusions remain unaltered.

*4.1.2. Controlling for rivals involved in mergers*

Table 7 tackles a potentially very important problem, namely confounding events in the evaluation period. The most obvious confounding event in merger analysis is that merging firms engage in sequential mergers, i.e. merging in year $t$ and again in $t$+1 and/or $t$+2, etc. Thus, it would not be appropriate to attribute the whole merger effect, say in year $t$+3, to the first merger but it may be that the subsequent mergers also account for parts of the effect. Our situation is insofar different in that we analyze the effect of a merger on rival markets, nevertheless it may be that mergers systematically subsequently

**Table 8**
Shortening the estimation window.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | −0.013 | −0.014 | −0.015 | −0.019 | −0.014 | −0.017 | −0.018 |
| | (0.252) | (0.250) | (0.250) | (0.245) | (0.252) | (0.251) | (0.244) |
| Post | −0.398 | −0.399 | −0.399 | −0.401 | −0.398 | −0.400 | −0.402 |
| | (0.256) | (0.253) | (0.254) | (0.248) | (0.256) | (0.255) | (0.247) |
| Treated ∗ post | 0.513 | 0.442 | −0.629 | −0.080 | 0.024 | 1.084** | −1.069 |
| | (0.361) | (0.445) | (0.570) | (0.391) | (0.455) | (0.457) | (0.850) |
| Target share | | 0.018 | | | | | −0.009 |
| | | (0.014) | | | | | (0.017) |
| Highest share | | | 0.020*** | | | | 0.027*** |
| | | | (0.007) | | | | (0.009) |
| Initial profits | | | | 0.181*** | | | 0.165*** |
| | | | | (0.027) | | | (0.032) |
| National markets | | | | | 0.818* | | −0.172 |
| | | | | | (0.446) | | (0.551) |
| Competitor count | | | | | | −0.198* | −0.101 |
| | | | | | | (0.104) | (0.145) |
| Constant | 3.866*** | 3.863*** | 3.865*** | 3.860*** | 3.866*** | 3.862*** | 3.859*** |
| | (0.178) | (0.177) | (0.177) | (0.173) | (0.178) | (0.178) | (0.172) |
| Observations | 1746 | 1701 | 1719 | 1663 | 1740 | 1740 | 1627 |
| $R^2$ | 0.00 | 0.01 | 0.01 | 0.03 | 0.00 | 0.00 | 0.04 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

trigger mergers of rivals. To account for this possibility, Table 7 drops a rival from the sample, if this rival was involved in a merger subsequently to the analyzed merger, in that and all following years.

Specifically, we match the rival firms in the sample to the SDC Platinum database and check for rival merger activity in the evaluation period. If, for example, we find that a rival was itself involved in a merger in $t + 3$, we include that rival in the estimation sample in $t + 1$ and $t + 2$, but drop it from $t + 3$ onwards.

In so doing, we lose around 20 percent of the sample. While the ATT remains positive it loses significance. However, the main results with respect to the covariates measuring the competitive environment remain valid.

### *4.1.3. Shortening the estimation window*

An additional and related concern may be that the fairly long evaluation period of 5 years may exacerbate the danger that other events than the original merger determines the profitability of rival markets. In the above robustness check we controlled for rivals being themselves involved in a merger and excluded those rivals subsequently. However, there may be many additional unobserved and unobservable events we cannot control for. Therefore, Table 8 – in addition to excluding rivals that are involved in mergers themselves – shortens the post-treatment window to $t + 1$ to $t + 3$. This reduces the size

**Table 9**
Control groups from different industries.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | 0.144 | 0.139 | 0.141 | 0.141 | 0.144 | 0.143 | 0.134 |
| | (0.171) | (0.168) | (0.168) | (0.166) | (0.170) | (0.170) | (0.162) |
| Post | −0.374** | −0.369** | −0.371** | −0.370** | −0.374** | −0.373** | −0.364** |
| | (0.156) | (0.153) | (0.153) | (0.151) | (0.154) | (0.155) | (0.147) |
| Treated ∗ post | 0.687*** | 0.508* | −0.784** | 0.238 | −0.201 | 1.418*** | −1.354*** |
| | (0.220) | (0.260) | (0.312) | (0.233) | (0.265) | (0.263) | (0.469) |
| Target share | | 0.022*** | | | | | −0.016* |
| | | (0.008) | | | | | (0.009) |
| Highest share | | | 0.026*** | | | | 0.030*** |
| | | | (0.004) | | | | (0.005) |
| Initial profits | | | | 0.153*** | | | 0.129*** |
| | | | | (0.015) | | | (0.017) |
| National markets | | | | | 1.598*** | | 0.672** |
| | | | | | (0.238) | | (0.299) |
| Competitor count | | | | | | −0.248*** | −0.079 |
| | | | | | | (0.056) | (0.079) |
| Constant | 3.757*** | 3.754*** | 3.755*** | 3.755*** | 3.757*** | 3.756*** | 3.751*** |
| | (0.121) | (0.119) | (0.119) | (0.117) | (0.120) | (0.120) | (0.114) |
| Observations | 3446 | 3281 | 3361 | 3258 | 3411 | 3411 | 3132 |
| $R^2$ | 0.01 | 0.02 | 0.03 | 0.05 | 0.03 | 0.02 | 0.07 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

of the sample by another 20 percent. While target share loses significance, all main results hold up.

### *4.1.4. Relaxing the industry constraint*

In the main results, we require the synthetic control groups to be constructed from firms active in the same 4-digit NACE industry that is concerned by the merger. This seems reasonable insofar, as firms in the same industry will typically face similar demand conditions and experience similar shocks and therefore provide a good counterfactual. While we are very careful to select control firms that are outside the focal mergers' geographic scope, this could still be a source of bias. We therefore conduct a robustness test, in which the synthetic control groups are constructed from industries other than that of the merger. Since this considerably relaxes the data constraints of the matching procedure, it also permits us to expand the estimation sample by more than a quarter.[18]

The results are not strongly affected by this (Table 9). All findings from the main specification remain qualitatively unchanged and significant. Quantitatively, the ATT coefficient remains virtually identical. Some of the interaction coefficients (target share, highest share, initial profits and competitor count) change moderately, but these changes

[18] Keeping the sample constant, i.e. only relaxing the industry constraint without allowing additional mergers in the sample, yields virtually identical results. We therefore present the results in the larger sample.

**Table 10**
No geographic matching constraints.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated | 0.076 | 0.076 | 0.076 | 0.077 | 0.077 | 0.077 | 0.077 |
| | (0.218) | (0.218) | (0.216) | (0.213) | (0.217) | (0.218) | (0.212) |
| Post | −0.502** | −0.500** | −0.501** | −0.498** | −0.495** | −0.500** | −0.497** |
| | (0.199) | (0.198) | (0.197) | (0.195) | (0.198) | (0.199) | (0.193) |
| Treated ∗ post | 0.922*** | 0.766** | −0.160 | 0.534* | 0.065 | 1.294*** | −1.206** |
| | (0.282) | (0.332) | (0.410) | (0.302) | (0.338) | (0.338) | (0.597) |
| Target share | | 0.022** | | | | | −0.005 |
| | | (0.010) | | | | | (0.012) |
| Highest share | | | 0.019*** | | | | 0.020*** |
| | | | (0.005) | | | | (0.007) |
| Initial profits | | | | 0.155*** | | | 0.126*** |
| | | | | (0.021) | | | (0.023) |
| National markets | | | | | 1.484*** | | 0.841** |
| | | | | | (0.305) | | (0.385) |
| Competitor count | | | | | | −0.133* | 0.129 |
| | | | | | | (0.072) | (0.099) |
| Constant | 3.903*** | 3.902*** | 3.903*** | 3.900*** | 3.897*** | 3.902*** | 3.899*** |
| | (0.154) | (0.154) | (0.153) | (0.151) | (0.153) | (0.154) | (0.150) |
| Observations | 2820 | 2710 | 2752 | 2653 | 2800 | 2800 | 2575 |
| $R^2$ | 0.01 | 0.02 | 0.02 | 0.04 | 0.02 | 0.01 | 0.05 |

*Notes:* Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

are counteracted by opposite changes in the average effect, treated × post, so the net effect should be modest.

#### *4.1.5. Relaxing the geographic constraint*

In the main specification, we impose rather strict geographic matching criteria to ensure uncontaminated control groups: we exclude all markets in which the EC identified relevant competitors from control groups and, if the EC found the geographic market to be EEA-wide, we exclude all European nations. The results in Table 10 show, that allowing for controls from within the mergers' geographic scope does not qualitatively alter the findings.

## 5. Conclusion

This article attempts to empirically quantify the changes in firm performance brought about by a change in the structure of an oligopolistic market. The changes in market structure in our sample were due to horizontal mergers in the sector, i.e. a transition from an $n$ player oligopoly to an $n-1$ player oligopoly. These mergers were large enough to meet the notification criteria of the EC, which identifies the relevant competitors and the geographic extent of the market. We exploit this information by confining measurement to the identified competitors, which are directly affected by the merger and using the

geographic market definition as a delineation criterion for the choice of the (synthetic) control group. One crucial contribution of this paper is to construct uncontaminated control groups by using only controls that are unaffected by the merger, since they operate outside the relevant market as defined by the EC. Moreover, in a series of robustness tests, we take care that other confounding events during the evaluation period, such as a rival being himself involved in a merger, do not drive our main results. Thus this is the first paper to measure the externalities of mergers on rivals in a cross-section of industries.

Standard oligopoly models (i.e. Cournot competition or Bertrand competition with differentiated goods) predict that mergers mostly benefit the non-merging parties: while the merging firms reduce their combined output in order to raise the market price, competitors gain market shares. In the new equilibrium a higher market price prevails, resulting in higher profits for competitors. We utilize this basic prediction from standard oligopoly theory to identify the net effect of market power and efficiencies.

Our results are consistent with these predictions: we find that rival markets (non-merging firms that are active in the same product market) become significantly more profitable relative to the synthetic control groups after an acquisition in the industry. We not only estimate the 'average treatment effect on the treated' but undertake an effort to disentangle this effect and explain it by the most important aspects of the competitive environment the merger takes place in. In particular, we find that the average effect masks important distributional characteristics. 'Extreme' mergers, i.e. mergers leading to very large market shares in some product markets, mergers in markets with a low elasticity of demand, and mergers that primarily affect national markets lead to a large positive profit externality on rival markets. Moreover, there is evidence that the 'treatment intensity' due to the merger, i.e. the market share of the target, as well as the number of (remaining) competitors are crucial in understanding the competitive effects of mergers. Thus, we can explain the estimated average treatment effect with variables measuring the most important aspects of the competitive environment of the merger. Moreover, we find that most of the effects materialize fairly soon after the merger, which is again indicative of market power effects outweighing efficiency effects in large horizontal mergers.

These findings are important in at least two respects. From the point of view of economic theory, our evidence suggests that the predictions of standard IO models appear to describe well the mechanics of real-world oligopoly markets. We find that the competitive environment (elasticity of demand, number of competitors and the geographic scope of the affected markets) as well as merger characteristics (market share of the target, (near) monopolization of specific product markets due to the merger) have the predicted effects. Conversely, from the point of view of competition policy enforcement, it appears that there is still much room for improvement. In line with previous research on the issue (e.g. Duso et al., 2013), our findings suggest that merger remedies are not entirely effective in tackling anticompetitive effects. Competition policy should take a closer look at mergers that lead to the near monopolization of specific product markets, leaving little room for remaining effective competition.

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## References

Abadie, A., Diamond, A., Hainmueller, J., 2010. Synthetic control methods for comparative case studies: Estimating the effect of Californias tobacco control program. J. Am. Stat. Assoc. 105 (490).
Abadie, A., Gardeazabal, J., 2003. The economic costs of conflict: A case study of the basque country. Am. Econ. Rev. 93 (1), 113–132.
Angrist, J.D., Imbens, G.W., 1995. Two-stage least squares estimation of average causal effects in models with variable treatment intensity. J. Am. Stat. Assoc. 90 (430), 431–442.
Ashenfelter, O., Hosken, D., 2010. The effect of mergers on consumer prices: Evidence from five mergers on the enforcement margin. J. Law Econ. 53 (3), 417–466.
Banerjee, A., Eckard, E.W., 1998. Are mega-mergers anticompetitive? evidence from the first great merger wave. RAND J. Econ. 29 (4), 803–827.
Brouwer, M.T., 2008. Horizontal mergers and efficiencies: Theory and anti trust practice. Eur. J. Law Econ. 26 (1), 11–26.
Choné, P., Linnemer, L., 2012. A treatment effect method for merger analysis with an application to parking prices in Paris. J. Ind. Econ. 60 (4), 631–656.
Clougherty, J., Duso, T., 2009. The impact of horizontal mergers on rivals: gains to being left outside a merger. J. Manag. Stud. 46 (8), 1365–1395.
Dafny, L., 2009. Estimation and identification of merger effects: An application to hospital mergers. J. Law Econ. 52 (3), 523–550.
Deneckere, R., Davidson, C., 1985. Incentives to form coalitions with Bertrand competition. RAND J. Econ. 16 (4), 473–486.
Duso, T., Gugler, K., Szücs, F., 2013. An empirical assessment of the 2004 EU merger policy reform. Econ. J. 123 (572), F596–F619.
Duso, T., Neven, D.J., Röller, L.-H., 2007. The political economy of European merger control: Evidence using stock market data. J. Law Econ. 50 (3), 455–489.
Eckbo, B., 1983. Horizontal mergers, collusion, and stockholder wealth. J. Financ. Econ. 11 (1), 241–273.
Egger, P., Hahn, F.R., 2010. Endogenous bank mergers and their impact on banking performance: Some evidence from Austria. Int. J. Ind. Organ. 28 (2), 155–166.
Farrell, J., Shapiro, C., 1990. Horizontal mergers: An equilibrium analysis. Am. Econ. Rev. 80 (1), 107–126.
Focarelli, D., Panetta, F., 2003. Are mergers beneficial to consumers? evidence from the market for bank deposits. Am. Econ. Rev. 93 (4), 1152–1172.
Fridolfsson, S., Stennek, J., 2005. Why mergers reduce profits and raise share prices – A theory of preemptive mergers. J. Eur. Econ. Assoc. 3 (5), 1083–1104.
Froeb, L.M., Werden, G.J., 1998. A robust test for consumer welfare enhancing mergers among sellers of a homogeneous product. Econ. Lett. 58 (3), 367–369.
Gugler, K., Mueller, D., Yurtoglu, B., Zulehner, C., 2003. The effects of mergers: An international comparison. Int. J. Ind. Organ. 21 (5), 625–653.
Gugler, K., Siebert, R., 2007. Market power versus efficiency effects of mergers and research joint ventures: evidence from the semiconductor industry. Rev. Econ. Stat. 89 (4), 645–659.
Hastings, J.S., 2010. Vertical relationships and competition in retail gasoline markets: Empirical evidence from contract changes in Southern California. Am. Econ. Rev. 100 (3), 1277–1279.
Houde, J.-F., 2012. Spatial differentiation and vertical mergers in retail markets for gasoline. Am. Econ. Rev. 102 (5), 2147–2182.
Kim, E., Singal, V., 1993. Mergers and market power: Evidence from the airline industry. Am. Econ. Rev. 83 (3), 549–569.
McAfee, R.P., Williams, M.A., 1988. Can event studies detect anticompetitive mergers? Econ. Lett. 28 (2), 199–203.
Mueller, D., 1997. Merger policy in the united states: A reconsideration. Rev. Ind. Organ. 12 (5), 655–685.
Ornaghi, C., 2009. Mergers and innovation in big pharma. Int. J. Ind. Organ. 27 (1), 70–79.

Perry, M., Porter, R., 1985. Oligopoly and the incentive for horizontal merger. Am. Econ. Rev. 75 (1), 219–227.
Prager, R., Hannan, T., 1998. Do substantial horizontal mergers generate significant price effects? evidence from the banking industry. J. Ind. Econ. 46 (4), 433–452.
Stigler, G.J., 1950. Monopoly and oligopoly by merger. Am. Econ. Rev. 40 (2), 23–34.
Stillman, R., 1983. Examining antitrust policy towards horizontal mergers. J. Financ. Econ. 11 (1), 225–240.
Szücs, F., 2014. M&A and R&D: Asymmetric effects on acquirers and targets? Res. Policy 43 (7), 1264–1273. http://dx.doi.org/10.1016/j.respol.2014.03.007.
Weinberg, M., 2008. The price effects of horizontal mergers. J. Compet. Law Econ. 4 (2), 433.
Werden, G.J., 1996. A robust test for consumer welfare enhancing mergers among sellers of differentiated products. J. Ind. Econ. 44 (4), 409–413.
Williamson, O.E., 1968. Economies as an antitrust defense: The welfare tradeoffs. Am. Econ. Rev. 58 (1), 18–36.