Spillovers of PE investments

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Abstract

We investigate in this paper a primary potential impact of leveraged-buyout transactions (LBOs): the effects of LBOs on the peers of the LBO target in the same industry. Using a data sample based on US LBO transactions between 1985 and 2016, we investigate the impact of the peer firms in the aftermath of the transaction, relative to non-peer firms. To account for potential endogeneity concerns, we employ a network-based instrumental-variable approach. Based on this analysis, we find support for the proposition that LBOs do indeed matter for peer firms' performance and corporate strategy relative to non-peer firms. Our study supports a learning-factor hypothesis: peers gain by learning from the LBO target to improve their operational performance. Conversely, we find no evidence for the conjecture that peers lose due to the increased competitiveness of the LBO target firm.

Keywords: LBO spillovers, peer effects, IV approach

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1 Introduction

The impact of private equity (PE) investment on their target firms has attracted a lot of attention (see e.g. Hotchkiss et al. (2021) and Lerner et al. (2011)). Private equity investors are very active in changing the business model, the financial structure, the corporate governance (see Acharya et al. (2013)) and hence the competitive position of the target firm. Consequently, PE involvement is very likely to have effects on industry peers' behavior and market performance (see Bernstein et al. (2017) and Aldatmaz and Brown (2020)).

One aspect of this effect, namely "the LBO effect on product-market competition", has been addressed by early studies, such as Chevalier (1995a), who showed that leverage increases associated with LBOs led to softer product-market competition in this industry. Subsequently, several studies have addressed the potential mechanism of LBO deals on industry peers (see e.g. Oxman and Yildirim (2011)). However, this discussion has also shown that the effect of PE investment into an industry on competitors is potentially blurred by endogeneity issues (see Hsu et al. (2010a)). The observed effect of PE involvement might be driven by the fact that PE investment into an industry might reflect the fact that the PE investment is driven by underlying (unobserved) industry dynamics and/or signal the PEs private information on future industry development (see, e.g., Slovin et al. (1991) and Harford et al. (2016)). These two mechanisms might overshadow the causal effect of PE investment in the target firm on peer firms.

We aim to carve out the effect of PE involvement on industry competitors. We use a broad sample consisting of 272 US LBO deals, 1249 industry peers, and 1765 non-peers in the 1985 to 2016 period. The peer groups are defined as competitors by Marketline - an independent agency, while non-peers are normal public firms. On this basis we investigate the differential effect of the pre- and post-LBO-deal effect on individual industry peers and their performance. In the first step, our ordinary least squares (OLS) estimate reveals support for our learning hypothesis: the peers of LBO firm adjust their firms accordingly and improve their performance operationally. We adopt a two-stage instrumental-variable approach to account for potential endogeneity (based on signaling and selection) concerns. For this, we use the network relationship between the PE fund managers and the management board of potential target firms as an instrumental variable (IV).

By doing so, we confirm our findings from the OLS regressions and thereby also clearly reject the competition-based channel which would imply that peers perform worse

in the aftermath of the LBO. However, to the contrary, we find in our IV regressions that operational performance improves across a number of measures. Hence, our results, along with the IV regressions lend support for our learning hypothesis. The findings regarding the signalling-cum-investment theory which suggests the signalling of positive developments of the industry through the LBO and an inducement of expansionary investment decisions, are mixed. We find that peers invest more, but at the same time, they reduce their leverage.

Our analysis is related to different branches of the literature. First, our analysis relates to studies investigating the effects of LBOs on the respective industry and industry peers. Starting with Slovin et al. (1991) a substantial number of studies have addressed the spillover effects of LBOs into the target's industry. Hsu et al. (2010b) compare the differential financial and operative performance differences between targets and peers in the aftermath of an LBO. They find that targets outperform peers in a number of dimensions. Oxman and Yildirim (2011) find a positive announcement effect of LBO for the rivals of LBO targets and relate this to a private information channel through which LBO signal the overall undervaluation in the respective industry. Relatedly, Harford et al. (2016) investigate the subsequent acquisitions, alliances, investments, and other governance changes. Rather than looking to the level of the individual peer, Bernstein et al. (2017) investigate the industry effects of LBOs by revealing a positive growth effect following the LBO in the respective industry concerning employment and productivity (see also Aldatmaz and Brown (2020)). The main contribution of our analysis to this literature is to address the potential endogeneity concerns in this branch of the literature, based on a careful instrumental variable approach using a network-based argument of target and peer selection.

Second, we aim to contribute to the literature on the interaction between LBOs, capital structure, and product market competition. Several early theoretical studies have investigated the competition effects of LBOs. Brander and Lewis (1986a) show in a theoretical industrial-organization model that higher leverage leads firms to act more aggressively in the product market with adverse effects on the market shares of their peers (see also Bolton and Scharfstein (1990) and Maksimovic (1988)). In the first empirical paper analyzing the effects of LBOs on the business model of LBO target companies' competitors, Chevalier (1995c) shows that LBOs in the supermarket industry lead to overall price changes in the respective industry. In a subsequent analysis Chevalier (1995b) shows that the market

structure is affected in the aftermath of an LBO. Campello (2006), in turn, shows that capital structure affects rivals but does so differently across the business cycle (see also Campello (2003) on the effects of capital structure on product market performance). More recently, Grieser et al. (2022) use a spatial econometrics approach to identify complementarities in capital structures in an industry. We contribute to this strand of the literature by investigating the impact of the increased leverage of the LBO target on the peer firms in the same industry.

Third, by turning to the LBO peer effects in the same industry, our analysis also adds further insights to the literature studying the effects of private equity investments on stakeholders and society. In this context, a number of papers have looked into the effects of LBOs on employment. For instance, Davis et al. (2014) show, for a US sample, that buyouts lead to modest net job losses but large increases in gross job creation and destruction. Wright et al. (2009) provide a mixed picture on the basis of a UK sample, stressing that the employment effects may vary across different types of LBOs (see also Olsson and Tåg (2017)). Furthermore, numerous studies have provided a nuanced view of LBO's effects on innovation and technological progress. While Kortum and Lerner (2001) and Lerner et al. (2011) draw a rather positive or at least a non-negative picture Cumming et al. (2020) present evidence that firms file fewer patents and receive fewer citations following a public-to-private deal. Using an instrumental-variable approach, Truong (2022) shows a private equity deal materially fosters innovation of the target firm over the four years following the investment. We complement this literature by studying the causal impact of LBOs on industry peers' performance.

The paper is organized as follows: after this introduction, section 2 comprises a short discussion of our analysis's hypotheses. In section 3, we outline our data; we provide some critical descriptive statistics in our data set in section 4. Section 5 contains our principal analysis, followed by a robustness analysis (section 6). Section 7 concludes.

2 Hypotheses

To initiate our analysis, we derive several hypotheses in this section, which we test against data in the upcoming sections. We postulate three different theories: the signaling-cum-investment hypothesis, the learning hypothesis, and the competition hypothesis. Broadly

speaking, while the former two hypotheses let us expect a positive effect of LBOs on rivals'/ peers' performance and investment, the competition hypothesis points in the direction of a negative performance effect of LBOs for the rivals/ peers in the same industry.

The signaling-cum-investment hypothesis builds on the notion of information transfer in the course of the LBO. In early work, Slovin et al. (1991) proposed that private equity firms convey private information about the target and the industry by undertaking the LBO.

This should lead to immediate consequences regarding the valuation of the industry peers. Still, it also may induce them to undertake potential operational measures, such as higher levels of investments and debt financing.

Akhigbe and Martin (2000) have made a similar argument in the course of cross-border acquisitions. Hence, we conjecture:

Hypothesis 1 *LBOs in an industry signal the potential of this industry leading peer firms to expand investments in the aftermath of the LBO.*

The learning-hypothesis builds on the idea that the adoption of new organizational structures and corporate governance structure in a particular industry initiates a learning process and hence spills over to other firms in the same industry (see e.g. Bris et al. (2008) and Albuquerque et al. (2019)). Such spillovers have been mainly observed in the course of cross-border mergers and acquisitions (see Martynova and Renneboog (2010)). We conjecture that similar learning processes take place in the course of PE-backed LBOs with

Hypothesis 2 *Private-equity-backed LBOs that lead to organizational structure and governance changes within the target firm induce learning spillovers to other firms in the respective industry, leading us to expect to observe improved operational performance with the peer firms in the industry of the LBO target.*

The competition hypothesis rests on two grounds. The first mechanism is based on the notion that LBOs are associated with improvements in cost efficiencies with the target firm (see Bernstein and Sheen (2016)) as well as with more capital expenditures and an overall corporate growth path (see Boucly et al. (2011)). While investments lead to an immediate market share expansion, improvements in cost efficiencies imply an indirect expansion of market share as all standard models of competition in the industrial organization literature

suggests (see e.g. Tirole (1988) as well as Belleflamme and Peitz (2015) and for an explicit analysis Grupp et al. (2015)).

The second mechanism operates through the leverage decision of the private equity firm aiming to increase the debt ratios for its target firms substantially. This increase in leverage has been shown in theoretical work to potentially induce a more aggressive behavior of the target firm in the product markets (see Brander and Lewis (1986b), Maksimovic (1988) and Bolton and Scharfstein (1990)) implying negative competition effects for the respective product market rivals with regard to market share as well as profits. This theoretical work has been complemented by empirical research (see in particular, Chevalier (1995c) as well as Chevalier (1995b)) and Campello (2003)) showing the potential of negative product market repercussions on industry peers due to LBO target leverage increases.

We summarize this in

Hypothesis 3 *An LBO in an industry will intensify the degree of competition in the respective industry with a negative effect on the operative performance of peers of the target firm due to higher cost efficiency of the target firm and its higher leverage ratio leading to more aggressive product market behavior.*

We test these hypotheses against data in the subsequent analysis. To do so, we first outline the data set our analysis rests on before describing our primary methodology and the results emerging from our empirical strategy.

3 The data set

3.1 Data sources

Our hand-collected sample consists of 286 full LBOs. To construct a sample of LBO transactions, we use the Factset database. To obtain the sample we checked 733 LBOs completed between January 1, 1985 and December 31, 2016 in the United States from the Factset database. In the first step, we select all M&A transactions classified as "leveraged buyout". For this study, we keep only deals undertaken by an acquirer whose business description includes "PE" or by a financial sponsor. Furthermore, we exclude deals after which the acquirer holds a company stake of less than 50 percent and microcap ones

whose transaction value is smaller than USD300 Millions. We are interested in companies that were public at the time of data collection to ensure better information availability. However, only 272 of those met the criteria for a full LBO, i.e., the company had to be a stand-alone public corporation when the transaction occurred. Thus, we decided to exclude divisional spin-offs from a public parent company because of severe differences in corporate governance between a subsidiary and a standalone company. To check whether a company belong to the group of LBOs we did a one-on-one check for every single transaction in Nexis Uni. We collected the financial data from Compustat merged obtain through Wharton Research Data Services (WRDS). The database contains fundamental data from US and Canadian companies. The excerpt used for this analysis has 577,380 observations of 40,636 different companies and 60 variables. The first observation in this dataset is from the fiscal year 1950 and the latest one from the fiscal year 2021. The Compustat database was used in order to evaluate how key performance indicators (KPIs) differ between peer companies of a target of an LBO or going-private transaction.

The BoardEx database contains information on board structures as well as detailed profiles of individual officers and directors of companies across the globe. BoardEx has been employed in many recent studies (Chidambaran et al. 2011, Engelberg et al. 2013). The biographical data includes educational details, current and previous employment, appointments, and characteristics. Our interest focuses on directors' experiences; therefore, BoardEx enables us to compute firm's centrality measures derived from directors' networks through universities and private organizations.

A crucial feature in the construction of the counterfactual is the selection of a valid control group. Private equity may select only certain types of companies to finance. This selection may affect operating performance, financial constraints, and bankruptcy. In addition, companies, at least to a certain extent, influence whether or not they receive private funding. To overcome this selection and self-selection effect, we extract an independent peer list for each target from Marketline (Zamborsky and Larsen 2019) instead of performing a matching procedure on observable characteristics. On average, each LBO target has five peers operating in the same country. The non-peer group contains public firms that remain listed in the exchange after the investment year. The peer and non-peer group are assigned pseudo-investment year similar to that of their target counterpart. We keep maximum five and ten companies that show up in the Boardex database and have

information within 5 years before and after the pseudo- investment year for peer and non-peer group respectively. Finally, we obtain 1249 peers and 1765 non-peers besides 272 full LBOs.

3.2 Descriptive statistics

In the first step of our empirical analysis, we present some descriptive statistics before turning to a more detailed multivariate analysis in the next section.

We split the descriptive analysis into three steps. In the first one, we provide initial insights on the characteristics of the target firms. Next, we provide a comparison of LBO sample with the non-LBO group. This allows us to gain insights into the determinant of the going-private process. Furthermore, we compare the evolution of main firm characteristics between the subsamples to investigate the potential role of these dynamics on the delisting process. In the third step, given the notion of our analysis that direct peers seem to obtain significantly more profound improvement, we distinguish firm variables for peer and non-peer firms. The multivariate analysis expands the descriptive analysis. We describe the main variables we use in this analysis in Table 1 below.

Insert Table 1 about here

3.2.1 LBO sample

Figure 1 gives an overview of the time structure of our LBO sample. Our sample is concentrated with LBOs in the middle of the first decade and the early portion of the second decade of the 21st century. The level of buyout activities is consistent with the development of the overall PE market and shows a similar cyclicality. For a description of the PE market development, see Kaplan (2009). Three years before the 2008 financial crisis account for almost half of the deals (112). The number of deals quickly recovered after sharply shrinking during the crisis (5 and 7). However, it could only reach half of the pre-crisis level (18 deals on average for the next five years).

Insert Figure 1 about here

Figure 2 contains the economical geographic conposition of the samples. Almost 60% of target firms operates in 20 largest economic areas in the US (146), categorized in four largest groups. New York-Newark-Bridgeport (NY-NJ-CT-PA) constitutes the largest market, accounting for more than one-third of all transactions in these areas. In general, larger economic areas with a higher number of companies serving as targets for acquisitions tend to have more transactions.

Insert Figure 2 about here

Finally, Figure 3 presents the breakdown of the sample by industries aggregated to the Fama French 12-industry portfolio classification. In line with the study from Strömberg (2007) showing that PE deals do not only take place in old and declining industries but also in "high-tech" sector, we find that buyouts take place in a wide range of industries which include sectors from the "old" and "new economy". Most transactions occur in the field of Business Equipment consisting of Computers, Software, and Electronic Equipment followed by companies operating in other services, which comprise Mines, Constructions, Transportation, Hotels, Bus Services, and Entertainment. The two largest industries contain almost 45% of buyout deals.

Insert Figure 3 about here

3.2.2 LBO versus non-LBO sample

Figure 4 provides the descriptive statistics for the comparison between the LBO sample and the non-LBO firms to dissect how the LBOs differed from the other firms and, in particular, to investigate how they developed absolutely and relatively in the aftermath of the LBO. The analysis focuses on the following firm characteristics: firm's profitability, debt ratio, ROA, sales' growth, capital expenditures' growth, employee productivity, and operating EPS.

The main findings are that firms that are LBO targets are significantly larger and more profitable compared to their counterparts in the control group. The spread on these two dimensions are wider after 2000. In addition, our comparison of means indicates that

target firms were also, on average, better in a number of dimensions. This is the case with respect to operating EPS. In addition, our univariate comparisons suggest that firms belong to the non-LBO group have significantly lower leverage, measured by debt ratio, and need less access to capital. There are clear-cut patterns in the differences in the growth path of firms in the two different subsamples. The growth rate in sales and CAPEX is lower than in the control group, indicating that initial differences between the subsamples became larger over time.

Insert Figure 4 about here

Figure 5 reveals, at the time of the buyout, differences between the two subsamples: firms that remain on the exchange (the non-LBO firms) and those delisted in the course of an LBO deal.

Targets tend to be larger, more profitable, and possess higher growth rates in terms of sales and CAPEX compared to their non-target counterparts. While the size gap remains the same, the profitability gap shrinks right after the buyout. The operating EPS of LBO targets fluctuates dramatically post buyout, whereas non-target firms witness a sharply steady increase and peak at one and half times highest in the 10^{th} year. Not surprisingly, the debt ratios of two groups are almost identical at the announcement year, yet that of the LBO targets surge and remain higher post-buyout as the buyout nature. Non-target firms even reduce this ratio after their rivals are targeted. Only after eight years does the gap reduce.

Insert Figure 5 about here

All this suggests that changes after the LBO and hence the development of the firms differ for the two types of firms. This indicates that firm dynamics seem to affect the delisting process.

3.2.3 Peer versus non-peer sample

Figure 6 and 7 delineate potential differences in firm characteristics between peers and non-peer firms of the LBO target firms. These figures reveal that industry peers differ

significantly from non-peers in several dimensions. First and foremost, we observe that peers are markedly larger than non-rival firms. Furthermore, they are more profitable and achieve higher sales growth and operating EPS. The same patterns occur across different industries. In major industries, rival companies generate higher profits and lower losses. In addition, they are less leveraged and experience higher growth rates. The operating EPS of peers are remarkably higher than those of the targets in manufacturing, chemicals and allied products, and consumer durables. Noticeably, the rivals are more similar to the targets than are the non-rivals.

Insert Figures 6 and 7 about here

Overall, this fits quite nicely into the general prediction: PE investors prioritize targeting the rivals over the non-rival public firms in the absence of the LBO targets. To separate this effect from the pure selection effect, we need to control for firm characteristics in a multivariate analysis.

Table 2 summarizes the main differences between peer and non-peer firms, It reveals the fact that the two type of firms are different in a number of dimensions such as size and number of employees, beside the six dependent variables. This insight is consistent with figure 6 and 7. For this reason, we include the respective firm-level size and number of employees in the subsequent analysis as control variables.

Insert Table 2 about here

4 Methodology

We start our analysis with a standard OLS approach in which our peer dummy is the key variable of interest. We regress this variable on several key operational performance and governance variables in a cross-sectional regression.

In addition, we control for a set of fixed effects, leading to the following regression equation:

$$y_{i,t} = \beta_0 + \beta_{OLS} Peer_{i,t} + X_{i,t}^{'}\phi + \delta_t + \delta_s + \delta_a + \delta_{s,t} + \omega_{i,t} \quad (1)$$

where $y_{i,t}$ denotes the six dependent variables, $Peer_i$ is a dummy variable that equals 1 if the firm i is the peer of the LBO target, $X'_{i,t}$ is a vector of firm characteristics such as size and number of employees, and ϕ denotes the vector of parameters associated with $X'_{i,t}$, while δ_t represents year fixed effects, δ_s industry fixed effects, δ_a economic area fixed effects, and $\delta_{s,t}$ industry-year fixed effects. The reported standard errors are both heteroskedasticity robust and have been adjusted for clustering at the firm level. The fixed effects account for unobserved time-invariant differences across industries, economic areas, and years. While these regressions provide some insights, they may suffer from endogeneity problems. Most notably, there might be omitted variable biases (e.g., stemming from unobserved industry prospectives), which may drive the performance of the peers as well as the very fact that they are peers of the target of an LBO. To overcome these issues, we undertake an instrumental-variable approach based on network-theory considerations, following thereby studies in the literature on mergers and acquisitions (see e.g. El-Khatib et al. (2015)).

An instrumental-variable approach for our problem requires us to identify a variable that correlates with the peer dummy but does not independently (i.e., beyond the peer-dummy mechanism) affect the operational performance and governance variables.

The main underlying idea is that close connections between the directors of the peer firms and other directors (i.e., of peer and non-peer firms as well as of the acquirer and the LBO target) increase the likelihood of becoming a peer firm. Being more in the center of the network makes it more likely that the firm becomes a peer. Furthermore, highly-connected directors (via education and/or social ties) are more likely to end up in the same industry, making their firms more likely to become peers/competitors. The underlying network idea of our analysis is depicted in Figure 8. For instance, our peer firm 3 has three connections, while the non-peer firm 7 has two.

Insert Figures 8 about here

At the same time, since the ties between directors stem from the past, they should not directly affect the firms' recent performance; we should expect the exclusion restriction to hold.

Employing BoardEx data we construct a social network of directors of U.S. firms and

calculate degree and eigenvector centrality measures for all individuals connected in each subnetwork. Each sub-network contains peers, non-peers, LBO, and the acquirer. The number of director connections is then aggregated at the firm level. For syndicated deals with multiple acquirers, we sum up the connections the peer (vs. non-peer) has with these acquirers. The link between any two firms represents the number of director connections founded on joint educational backgrounds or shared memberships in non-business organizations, such as clubs, charities, and universities. We focus on non-workplace connections since they are more likely to capture informational flows while being unrelated to firm performance.

Figure 9 illustrates this procedure for the educational ties.

Insert Figures 9 about here

Following Cohen et al. (2008) and Kang et al. (2018), we consider a connection to be formed if it satisfies three conditions simultaneously: First, both directors must be working at the target and acquirer at the year of consideration. Second, they must have obtained their degrees from the same university or had their membership in the same organization. Third, they must have spent at least two years at that organization before the year of consideration. The last condition ensures that there was sufficient time for both directors to engage in meaningful social interactions within the same time.

Two common measures of centrality are constructed: degree and eigenvector centrality (see Proctor and Loomis (1951), Sabidussi (1966), Freeman (1977), Bonacich (1972)) Degree is the number of direct ties an individual has with other individuals in the network. The more connections the individual holds, the more central this individual is in the network:

$$D_i = \sum_{i \neq j} X_{ij}$$

where X_{ij} equal one for presence of a social connection between i and j. Consider Figure 8, Firm A is directly linked to firm C and the acquirer, and thus has a degree of 2. Firm C is linked only to firm A and B and the target, and thus has a degree of 3.

Eigenvector centrality is a measure of the importance of an individual in the network. It takes into account the extent to which an individual is connected with other highly connected individuals.

Eigenvector centrality is calculated by finding the principal Eigenvalue of the adjacency matrix that represents this network. The eigenvector E_i is determined by satisfying

$$\lambda E = E^{'} * A * E,$$

where E is an Eigenvector of the matrix of connections A, and λ is its associated eigenvalue. E_i is taken as the elements of eigenvector E associated with $A's$ principal eigenvalue λ. These network measures are then used here as instrumental variables (IV).

In our IV approach we follow the empirical approach of Goetz et al. (2016). In stage zero of the IV approach we regress the peer dummy on our network measures

$$Pr(Peer = 1|X)_{i,t} = \alpha + \beta_1 degree_{i,t} + (\beta_2 eigenvector_{i,t}) + X_{i,t}^{'}\phi + \delta_t + \delta_s + \delta_a + \delta_{s,t} + \varepsilon_{i,t} \tag{2}$$

with $Peer_{i,t}$ denoting the observed peer dummy in our data sample, while the index i stands for the firms in our sample and t denotes the time index. Our sample comprises observations of peers and non-peers exclusively. $Peer_{i,t}$ takes value of 1 for peers and 0 for non-peers. $Degree_{i,t}$ and $eigenventor_{i,t}$ are the centrality measures of firm i in the subnetwork containing the LBO and its related acquirer, peers, and non-peers at time t. We also include control variables $X_{i,t}^{'}$ since the PE decision to acquire a specific firm might vary positively with its size and number of employees, such that PE investors are more attracted to larger and more matured firms than smaller ones. The set of fixed δ effects and error terms $\varepsilon_{i,t}$ are describe as in Equation 1. We then use probit model to estimating Equation 2 to construct the instrumental variable, namely $Peer\_IV_{i,t}$.

Table 4 presents regression results on the degree to which degree centrality accounts for the probability a firm is a peer in an LBO network. As noted above, we employ a probit model to construct the instrumental variable since the dependent variable is bounded between zero and one. Column 1 of Table 4 provides average marginal effects from the probit estimation that we use in our zero-stage to construct the time-varying instrumental variables. To create this predicted value, we use the coefficient estimates from column 7 of Table 4 to obtain the projected probability $Peer\_IV_{i,t}$.

We use this $Peer\_IV_{i,t}$ variable as the instrument for actual probability $Peer_{i,t}$ (0 or 1) in our first-stage regression. With this elaborate procedure we aim to carve out the effect of the exogenous variation of our IV variables on the likelihood of a firm becoming

a peer. Hence, based on this instrument we can determine the exogenous component of observed probability and we can assess the impact of spillover effect on peer's operational performance. Moreover, we also use our instrumental variable in reduced form analyses. The first-stage regression is as follows:

$$Peer_{i,t} = \alpha + \alpha_1 Peer\_IV_{i,t} + X_{i,t}^{'}\phi + \delta_t + \delta_s + \delta_a + \delta_{s,t} + \tau_{i,t} \tag{3}$$

In the second and last step, we regress this predicted value $\hat{Peer}_{i,t}$ (by using the coefficients resulting from Eq. 3 on our dependent variables to infer the coefficient of interest.

$$y_{i,t} = \beta_0 + \beta_1 \hat{Peer}_{i,t} + X_{i,t}^{'}\phi + \delta_t + \delta_s + \delta_a + \delta_{s,t} + \mu_{i,t} \tag{4}$$

The coefficient of interest is hence the β_1 coefficient in the last equation. Using Eqs. 3 and 4 provides us with the reduced form of our approach.

5 Main results

We test our hypotheses by applying our methodology to the data. We start with the OLS regressions first. We include a whole array of fixed effects to control for unobserved heterogeneity across years, industries as well as for time-varying effects across industries.

Insert Table 3 about here

We find positive effects on the operational performance of the peer firm (such as profitability, return-on-assets, as well as operational earning-per-share). Hence, we can state that at least our initial findings do not support the competition hypothesis which would have called for the opposite signs for the operational-performance coefficients. Similarly, our results do not support the signalling hypothesis given that our findings do not suggest any significant changes at the level of investment (CAPEX growth) and the corporate strategy of the peers (debt ratios). In contrast, we observe positive and significant effects of the peer dummy on the operational performance variables such as profitability, earning-per-share from operations, and return-on-assets. The results are highly significant and point toward strong learning effects.

These findings may be affected by endogeneity factors leading to biased estimators. First, PE acquirers choose which firm to buy based on their skills and privately obtained information. For instance, assume that PE acquirers fosters target's performance, and also assume that they take into account the potential contradicting competition versus spillover effect on peer companies, OLS will produce a downward-biased estimate of the influence of PE on peers. We address this issue with our network-based IV approach.

In Table 3, we display the centrality measure's effect on the likelihood of becoming a peer firm (stage 0). The coefficients of the centrality measures are statistically significant, with the economically sensible sign. This is true for all models, particularly the last one, the most elaborate one, containing firm-level controls and a whole battery of fixed effects; it includes industry- and year-fixed effects as well as industry-year and economic area fixed effects.

Insert Table 3 about here

Before we turn to our final results depicted in Table 5, which contains the results of the first and second step of the IV regression, a discussion of the economic and statistical validity of the IV seems in order.

First, regarding the underlying economic mechanisms we aim to depict a hierarchy from the point of view of the private equity firm. This informational hierarchy implies that better connected firms are more likely to be acquired. We thereby follow Fuchs et al. (2021), who argue that educational ties between fund managers and CEOs of target companies play a (positive) role in sourcing deals and winning competitive transactions. Given that a private equity firm targets a particular industry, it chooses the better-connected firms first. Having better connections is correlated with having a higher likelihood of being a peer firm. Furthermore, our IV also captures post-LBO information flows; better connections make it more likely that information flows from the target firm will occur.

Second, concerning the relevance of the instrumental variable, we can state from Table 4 that the F-statistic in the first-stage regression is above rule-of-thumb level of 10. This supports the highly statistically significant coefficient on degree centrality in stage zero, which coefficient also has the correct sign. Hence our degree centrality measure appears to be a relevant and sufficiently strong instrument.

Third, a potential concern could be the potential endogeneity of the IV. The decision to attend a university or join a social organization is independent of the firm's situation at the time the LBO takes place. Fund managers may actively investigate the CEOs of potential acquisition candidates through alumni networks. Similarly, peers' directors can extract information about the deal and restructuring activities implemented at the target if they are in the network. As a result of their fiduciary responsibility, CEOs or directors, however, must operate the firm on behalf of shareholders. The directors can only capture and verify latest information from their fellow graduates in the network, but not extract it for their private benefits.

Insert Table 4 about here

Insert Table 5 about here

The results of our first stage (see Table 5) confirm our assumption that the IV disentangles the exogenous variation from the endogenous *Peer* variable very well. The coefficients are all positive and highly statistically significant. Note that the coefficients vary slightly across the different specifications. They are based on somewhat slightly data samples containing slightly different numbers of observations, depending on the respective left-hand-side variables.

The results from the second stage of our IV approach as displayed in Table 5 confirms very strongly our previous findings regarding our second and third hypotheses: the coefficients of the profitability measures are now all statistically (highly) significant and positive. They clearly support our learning hypothesis and reject the competition hypothesis. The peers' performance does not deteriorate as a consequence of the LBO, meaning that the competitive effects of the LBOs do not materialize. Our results, however, do point in the direction of our learning hypothesis. Controlling for selection effects has – compared to the OLS results – even strengthened our findings.

Concerning our first hypothesis, the signalling-cum-investment hypothesis, our findings are somewhat mixed. Whereas we observe a negative effect on debt ratios, which argues against the signaling effect, the positive and statistically significant effect on CAPEX

growth clearly supports the notion that peers perceive the LBO in their industry as a positive signal of the potential of the industry and decide to invest. Note that these two effects found using our IV approach are quite different from our OLS estimations: both coefficients were not statistically significantly different from zero for the OLS.

6 Robustness

In order to check the sensitivity of our findings we conducted various robustness checks. In the baseline model, each connection has an equal weight. One may argue that an extra connection to the acquirer is more powerful than that to another peer or non-peer firms. Therefore, we rank the important of each firm types in the network following this order: acquirer (4) $>$ target (3) $>$ peer (2) $>$ non-peer (1) with the corresponding node weight in parenthesis. The weight for each connection is equivalent to the average of two node weights. For instance, a connection between a peer and acquirer has an value of 3, whereas the link between that peer and an non-peer firm has an value of 1.5. We then apply the similar algorithm in the baseline model to these new weighted graphs. Table 6 shows consistent results as our baseline model. The significant level and coefficient signs remain unchanged. However, the coefficient magnitude shrinks for profitability, ROA, and operating EPS.

To rule out threats that distort the exclusion restriction, we exclude a list of the top 10 universities attended by the majority of directors in our sample before computing the networks and their corresponding centrality measures. One may argue that the directors can signal themselves by attending to the most prestigious universities and that firms tend to appoint directors from top universities. In unreported tests we find robust results consistent with Table 5 and 6.

Insert Table 6 about here

~

7 Conclusion

This paper addresses the spillover effects from leveraged-buyout deals to competitors in the same industry; it uses data from a large sample of U.S. LBOs over many years. We sought to contribute to the overall analysis of the effects of LBO deals and to answering the underlying question: to what extent do private equity firms undertaking the LBO deals create value for investors by actually improving overall value (due to learning), or are they partially extracting it at the expense of other stakeholders and competitors. Concerning the LBO effects on competitors, we do not find any evidence for this channel. On the contrary, we find evidence that the operational performance of the peers improves in the aftermath of an LBO. Hence, we find evidence for a learning channel and reject the competition mechanism.

We view our main contribution, however, to be methodological. To overcome endogeneity issues about the selection of the LBO target – and hence, the peers of the LBO target – we undertake a network-based instrumental-variable approach. We find that our network-based instruments are strong and allow us to analyze the endogeneity-plagued analysis of the causal link between LBOs and their effects on the behavior and performance of the peer firms.

There are several implications from our findings: First and foremost, our results undermine the hypothesis that private equity firms extract value at the expense of other economic agents – in this case, the immediate competitor of the LBO target. This result is additional evidence supporting the effect of private equity LBOs as being in the domain of welfare improvements. Second, our study points to the particular role of networks in LBO transactions and related industries.

However, there are limitations to our empirical analysis. Although we employ a novel identification strategy that enables us to determine the net impact of PE investments on a competitor's operational outputs in a more precise manner than previous studies, it has to be left for future research to investigate the precise mechanism of information transmission and detailed operational changes at peer level. Thus, our study highlights the necessity for a more precise identification strategy in future research.

References

Acharya, V. V., O. F. Gottschalg, M. Hahn, and C. Kehoe (2013). Corporate governance and value creation: Evidence from private equity. *The Review of Financial Studies 26*(2), 368–402.

Akhigbe, A. and A. D. Martin (2000). Information-signaling and competitive effects of foreign acquisitions in the us. *Journal of Banking & Finance 24*(8), 1307–1321.

Albuquerque, R., L. Brandão-Marques, M. A. Ferreira, and P. Matos (2019). International corporate governance spillovers: Evidence from cross-border mergers and acquisitions. *The Review of Financial Studies 32*(2), 738–770.

Aldatmaz, S. and G. W. Brown (2020). Private equity in the global economy: Evidence on industry spillovers. *Journal of Corporate Finance 60*, 101524.

Belleflamme, P. and M. Peitz (2015). *Industrial organization: markets and strategies*. Cambridge University Press.

Bernstein, S., J. Lerner, M. Sorensen, and P. Strömberg (2017). Private equity and industry performance. *Management Science 63*(4), 1198–1213.

Bernstein, S. and A. Sheen (2016). The operational consequences of private equity buyouts: Evidence from the restaurant industry. *The Review of Financial Studies 29*(9), 2387–2418.

Bolton, P. and D. S. Scharfstein (1990). A theory of predation based on agency problems in financial contracting. *The American economic review*, 93–106.

Bonacich, P. (1972). Factoring and weighting approaches to status scores and clique identification. *Journal of mathematical sociology 2*(1), 113–120.

Boucly, Q., D. Sraer, and D. Thesmar (2011). Growth lbos. *Journal of Financial Economics 102*(2), 432–453.

Brander, J. A. and T. R. Lewis (1986a). Oligopoly and financial structure: The limited liability effect. *The American Economic Review*, 956–970.

Brander, J. A. and T. R. Lewis (1986b). Oligopoly and financial structure: The limited liability effect. *The American Economic Review*, 956–970.

Bris, A., N. Brisley, and C. Cabolis (2008). Adopting better corporate governance: Evidence from cross-border mergers. *Journal of Corporate Finance 14*(3), 224–240.

Campello, M. (2003). Capital structure and product markets interactions: evidence from business cycles. *Journal of financial economics 68*(3), 353–378.

Campello, M. (2006). Debt financing: Does it boost or hurt firm performance in product markets? *Journal of Financial Economics 82*(1), 135–172.

Chevalier, J. A. (1995a). Capital structure and product-market competition: Empirical evidence from the supermarket industry. *The American Economic Review*, 415–435.

Chevalier, J. A. (1995b). Capital structure and product-market competition: Empirical evidence from the supermarket industry. *The American Economic Review*, 415–435.

Chevalier, J. A. (1995c). Do lbo supermarkets charge more? an empirical analysis of the effects of lbos on supermarket pricing. *The Journal of Finance 50*(4), 1095–1112.

Cohen, L., A. Frazzini, and C. Malloy (2008). The small world of investing: Board connections and mutual fund returns. *Journal of Political Economy 116*(5), 951–979.

Cumming, D., R. Peter, and M. Tarsalewska (2020). Public-to-private buyouts and innovation. *British Journal of Management 31*(4), 811–829.

Davis, S. J., J. Haltiwanger, K. Handley, R. Jarmin, J. Lerner, and J. Miranda (2014). Private equity, jobs, and productivity. *American Economic Review 104*(12), 3956–90.

El-Khatib, R., K. Fogel, and T. Jandik (2015). Ceo network centrality and merger performance. *Journal of Financial Economics 116*(2), 349–382.

Freeman, L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 35–41.

Fuchs, F., R. Füss, T. Jenkinson, and S. Morkoetter (2021). Winning a deal in private equity: Do educational ties matter? *Journal of Corporate Finance 66*, 101740.

Goetz, M. R., L. Laeven, and R. Levine (2016). Does the geographic expansion of banks reduce risk? *Journal of Financial Economics 120*(2), 346–362.

Grieser, W., C. Hadlock, J. LeSage, and M. Zekhnini (2022). Network effects in corporate financial policies. *Journal of Financial Economics 144*(1), 247–272.

Grupp, M., C. Rauch, M. P. Umber, and U. Walz (2015). The influence of leveraged buyouts on target firms' competitors.

Harford, J., J. R. Stanfield, and F. Zhang (2016). How does an lbo impact the target's industry? *Available at SSRN 2489300*.

Hotchkiss, E. S., D. C. Smith, and P. Strömberg (2021). Private equity and the resolution of financial distress. *The Review of Corporate Finance Studies 10*(4), 694–747.

Hsu, S., A. V. Reed, and J. Rocholl (2010a). Competitive effects of private equity investments. In *AFA 2011 Denver Meetings Paper*.

Hsu, S., A. V. Reed, and J. Rocholl (2010b). Competitive effects of private equity investments. In *AFA 2011 Denver Meetings Paper*.

Kang, J.-K., W.-L. Liu, A. Low, and L. Zhang (2018). Friendly boards and innovation. *Journal of Empirical Finance 45*, 1–25.

Kortum, S. and J. Lerner (2001). Does venture capital spur innovation? In *Entrepreneurial inputs and outcomes: New studies of entrepreneurship in the United States*. Emerald Group Publishing Limited.

Lerner, J., M. Sorensen, and P. Strömberg (2011). Private equity and long-run investment: The case of innovation. *The Journal of Finance 66*(2), 445–477.

Maksimovic, V. (1988). Capital structure in repeated oligopolies. *The RAND Journal of Economics 19*(3), 389–407.

Martynova, M. and L. Renneboog (2010). Spillover of corporate governance standards in cross-border mergers and acquisition. In *The Law and Economics of Corporate Governance*. Edward Elgar Publishing.

Olsson, M. and J. Tåg (2017). Private equity, layoffs, and job polarization. *Journal of Labor Economics 35*(3), 697–754.

Oxman, J. and Y. Yildirim (2011). The effects of lbo events on industry rivals. In *Midwest Finance Association 2012 Annual Meetings Paper*.

Proctor, C. H. and C. P. Loomis (1951). Analysis of sociometric data. *Research methods in social relations 2*, 561–585.

Sabidussi, G. (1966). The centrality index of a graph. *Psychometrika 31*(4), 581–603.

Slovin, M. B., M. E. Sushka, and Y. M. Bendeck (1991). The intra-industry effects of going-private transactions. *The Journal of Finance 46*(4), 1537–1550.

Tirole, J. (1988). *The theory of industrial organization*. MIT press.

Truong, H. S. (2022). Private equity investments and innovation: Evidence from europe.

Wright, M., N. Bacon, and K. Amess (2009). The impact of private equity and buyouts on employment, remuneration and other hrm practices. *Journal of Industrial Relations 51*(4), 501–515.

Zamborsky, P. and M. Larsen (2019). Cross-border m&a motives and home country institutions. In *European Academy of Management Annual Conference (EURAM)*.

Appendix

Figure 1: **Breakdown of the deal sample by year**

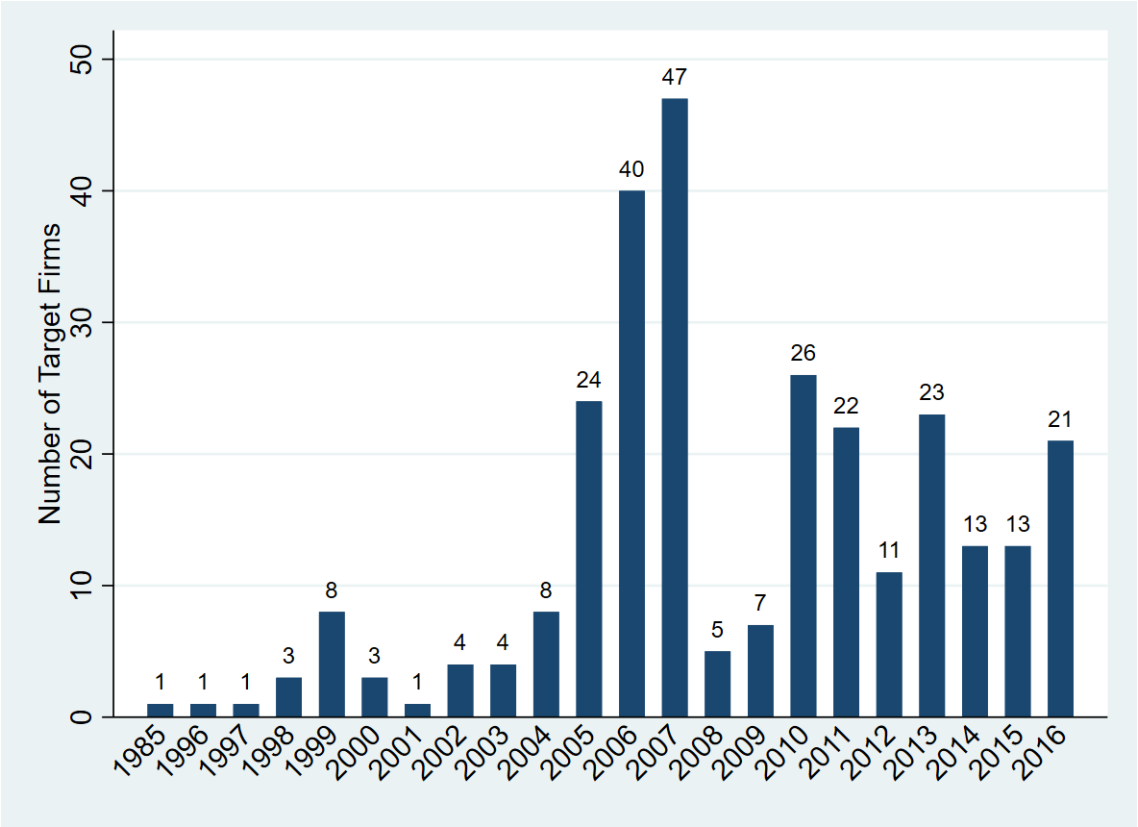
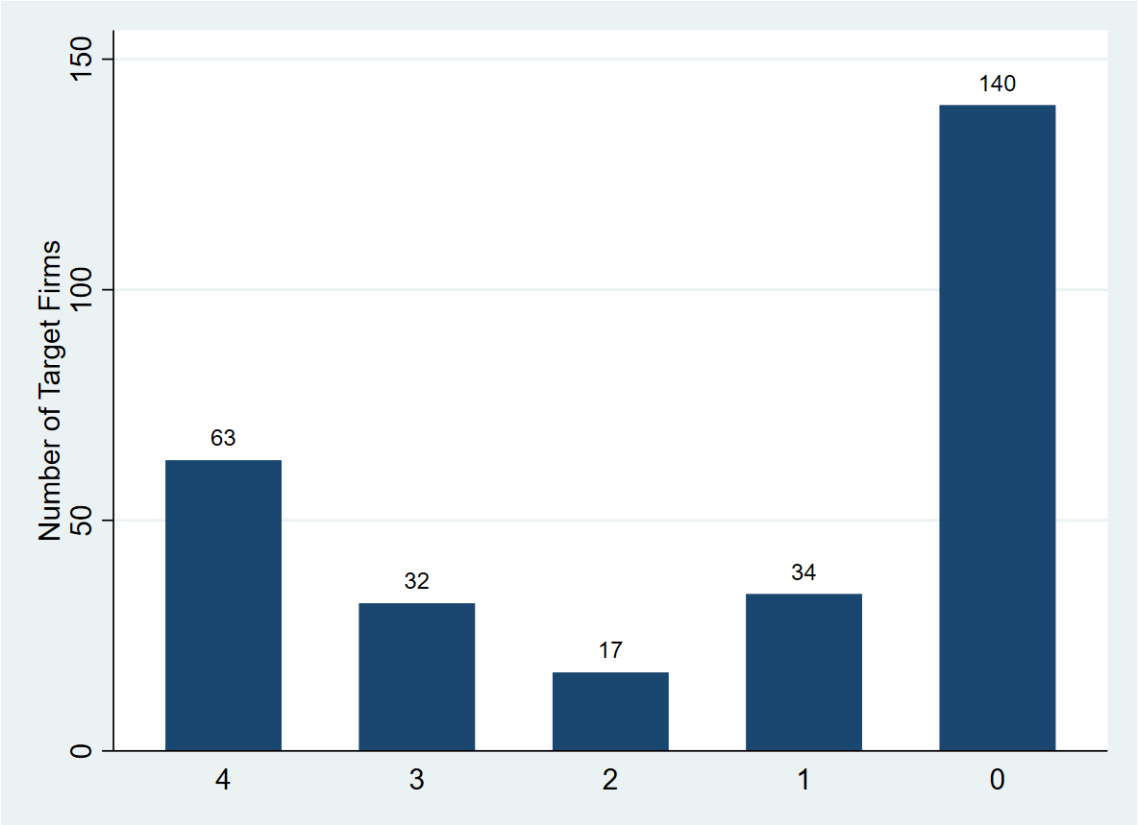
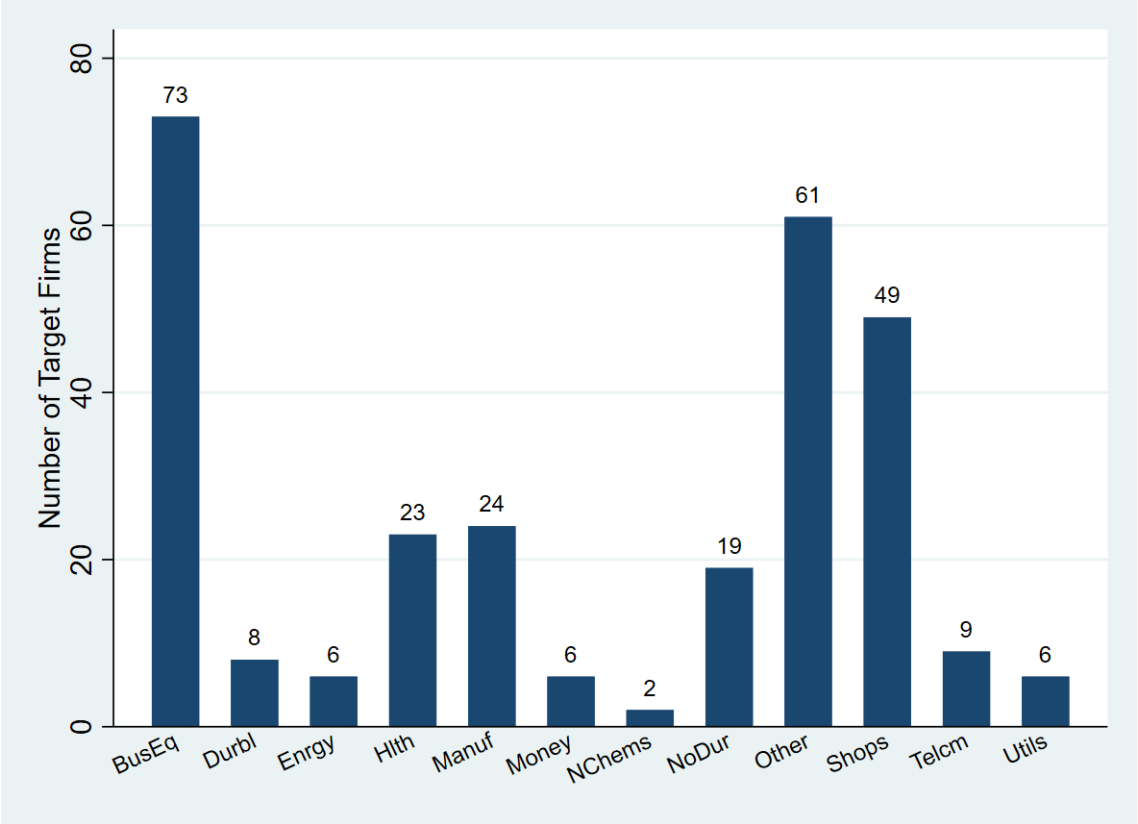


Figure 2: **Breakdown of the deal sample by four largest areas**



- Area 1: Minneapolis-St.Paul-St.Cloud (MN-WI), Phoenix-Mesa-Scottsdale (AZ), Dallas-Fort Worth (TX), Houston-Baytown-Huntsville (TX), Denver-Aurora-Boulde (CO)
- Area 2: Detroit-Warren-Flint (MI), Los Angeles-Long Beach-Riverside (CA), Seattle-Tacoma-Olympia (WA), Orlando-The Villages (FL), Atlanta-Sandy-Springs-GAinesville (GA-AL)
- Area 3: St.Louis-St.Charles-Farmington (MO-IL), Philadelphia-Camden-Vineland (PA-NJ-DE-MD), Chicago-Naperville-Michigan City (IL-IN-WI), Miami-Fort Lauderdale-Miami-Beach (FL), San Jose-San Francisco-Oakland (CA)
- Area 4: New York-Newark-Bridgeport (NY-NJ-CT-PA), Indianapolis-Anderson-Columbus (IN), Washington-Baltimore-Northern Virginia (DC-MD-VA-WV), Boston-Worcester-Manchester (MA-NH), Cleveland-Akron-Elyria
- Area 0: remaining states

Figure 3: **Breakdown of the deal sample by industry (12 Industry Portoflio clasification)**



Industry description:

1. NoDur: Consumer NonDurables – Food, Tobacco, Textiles, Apparel, Leather, Toys
2. Durbl: Consumer Durables – Cars, TV's, Furniture, Household Appliances
3. Manuf: Manufacturing – Machinery, Trucks, Planes, Off Furn, Paper, Com Printing
4. Enrgy: Energy – Oil, Gas, and Coal Extraction and Products
5. NChems: Chemicals and Allied Products
6. BusEq: Business Equipment – Computers, Software, and Electronic Equipment
7. Telcm: Telephone and Television Transmission
8. Utils: Utilities
9. Shops: Wholesale, Retail, and Some Services (Laundries, Repair Shops)
10. Hlth: Healthcare, Medical Equipment, and Drugs
11. Money: Money & Finance
12. Other: Other industries– Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entertainment

Figure 4: **Evolution of main variables by fiscal years**

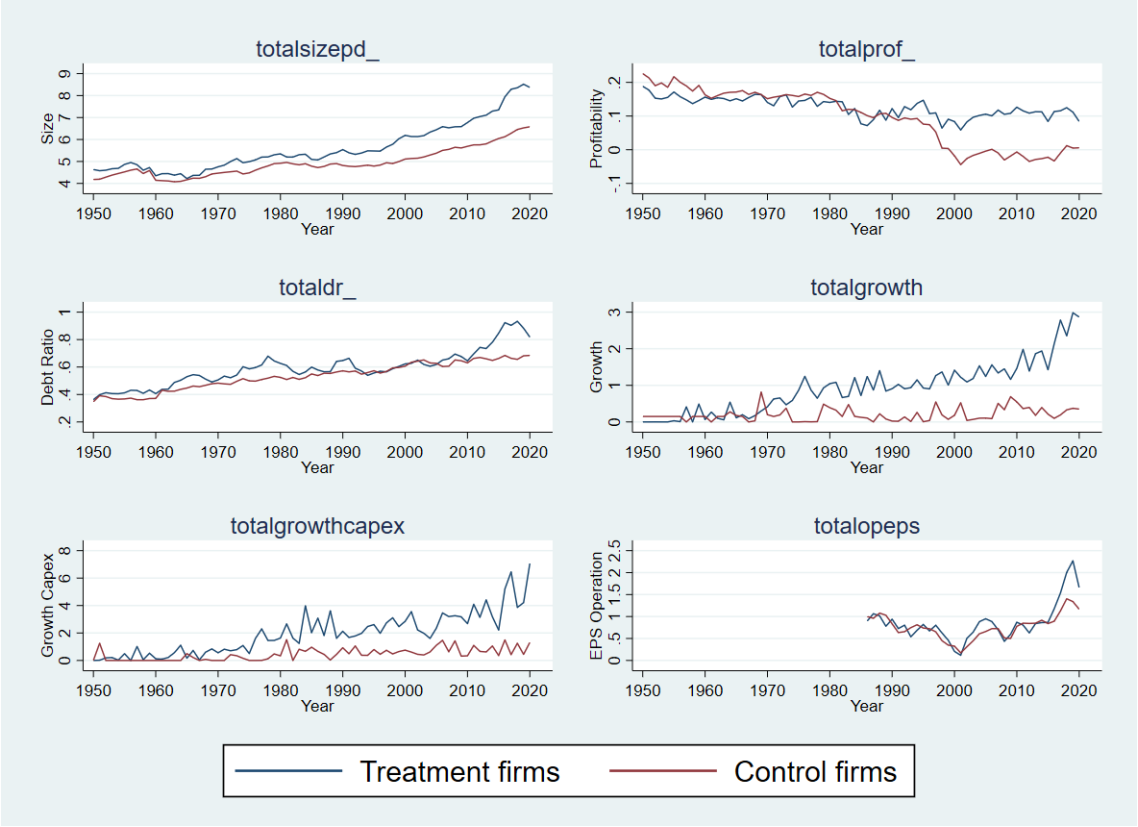


Figure 5: **Evolution of main variables by years relative to announcement year**

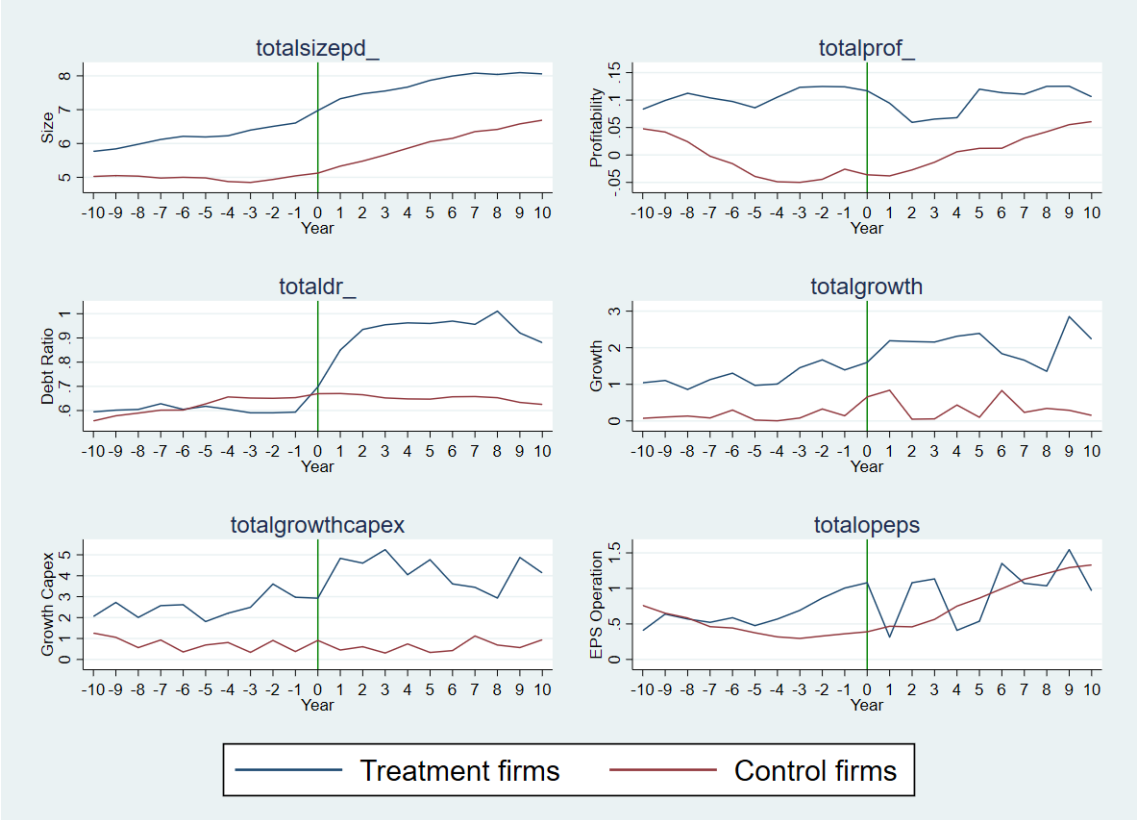


Figure 6: **Evolution of main variables by fiscal years (3 groups)**

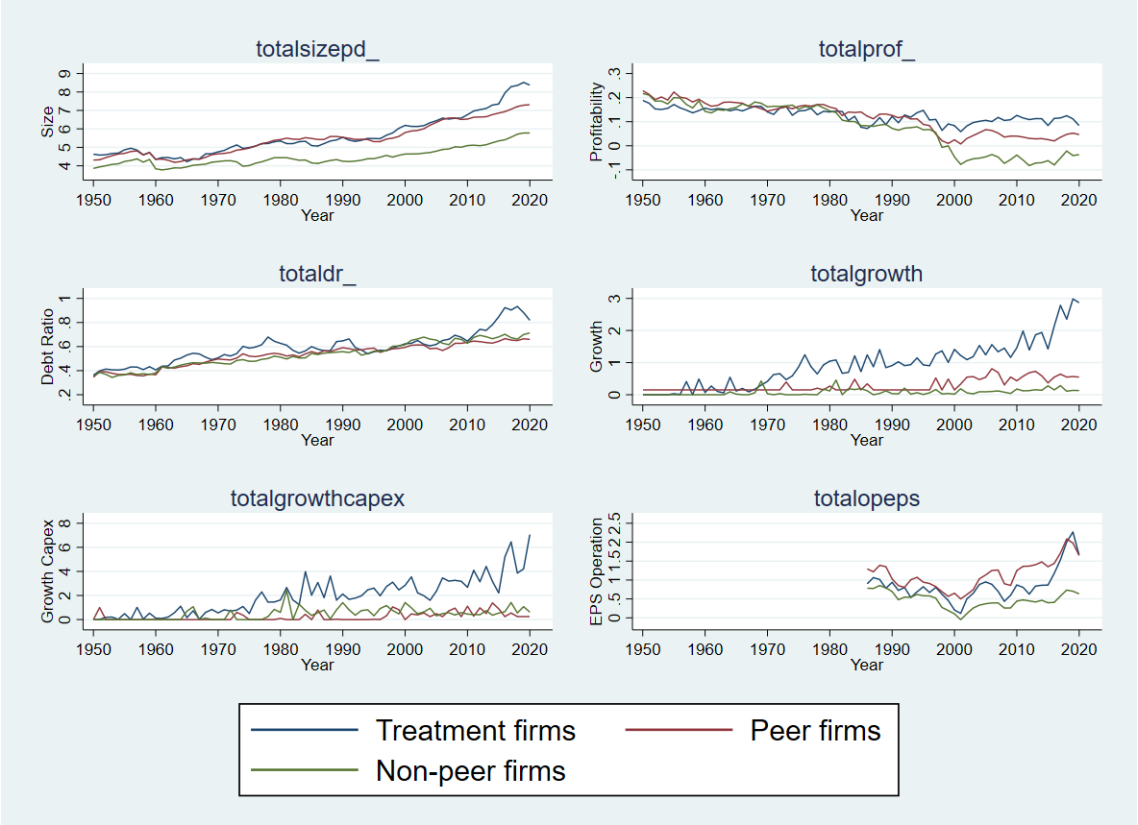


Figure 7: **Evolution of main variables by years relative to announcement year (3 groups)**

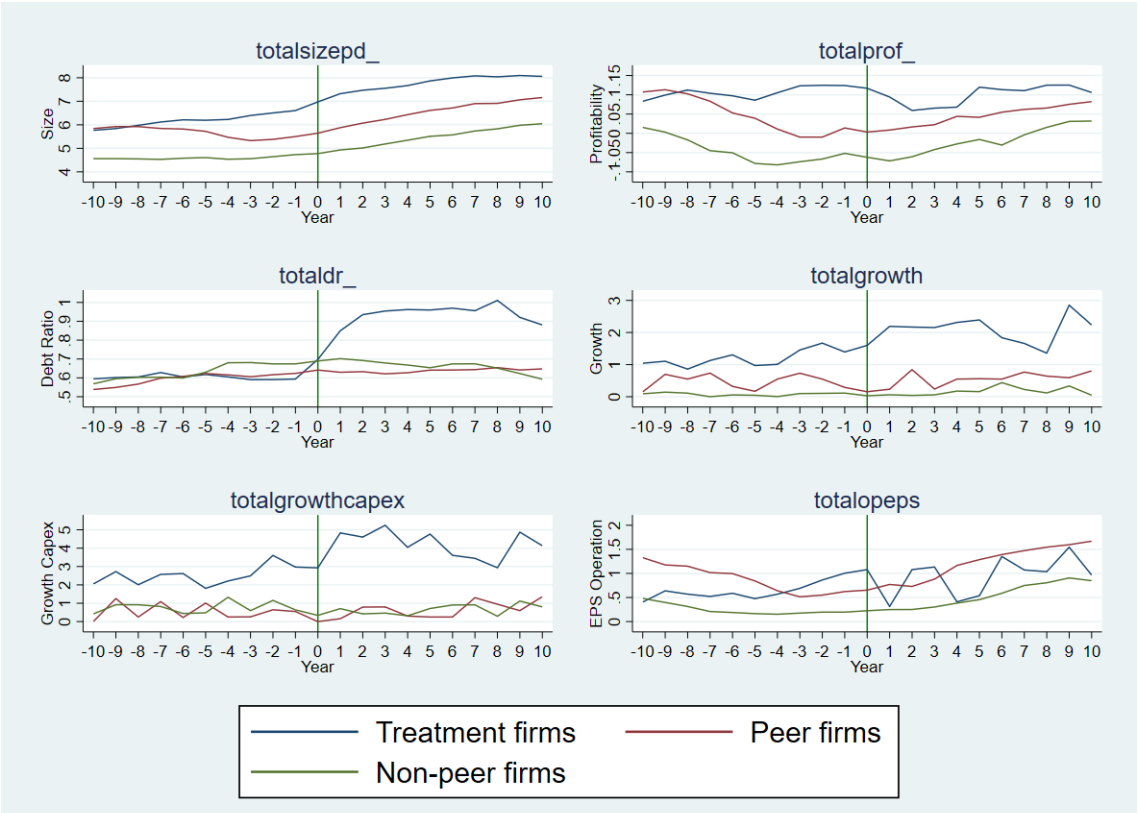


Figure 8: **Illustration of a sample network**

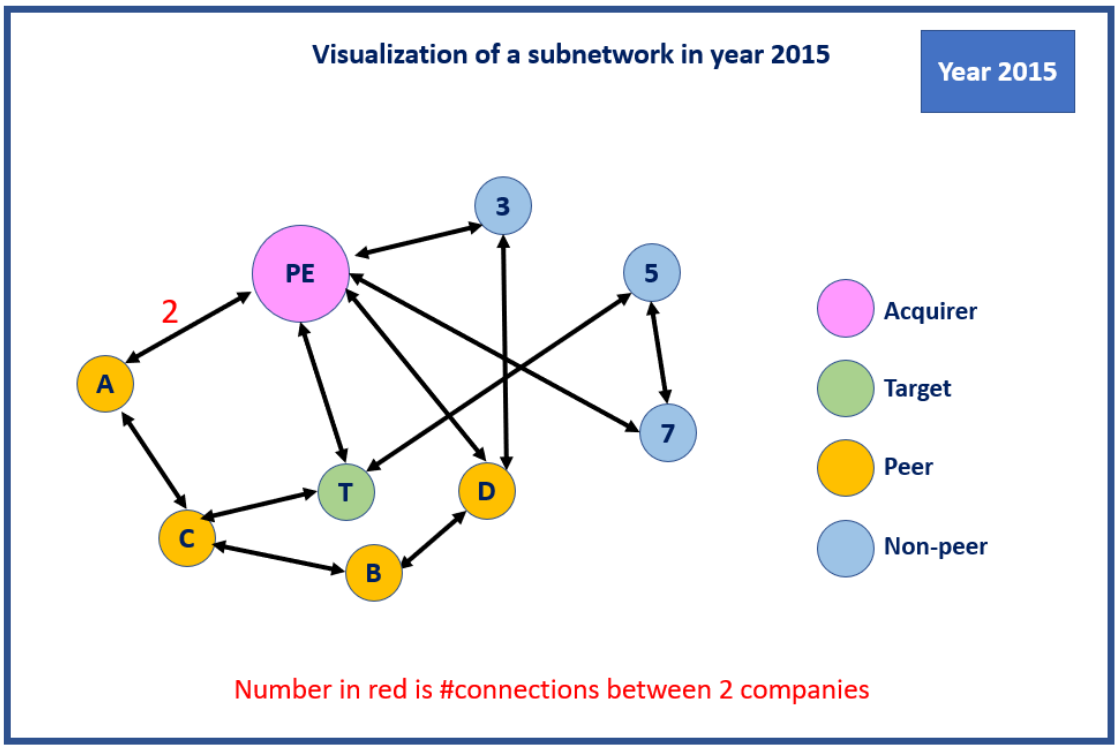


Figure 9: **Illustration of a connection formation**

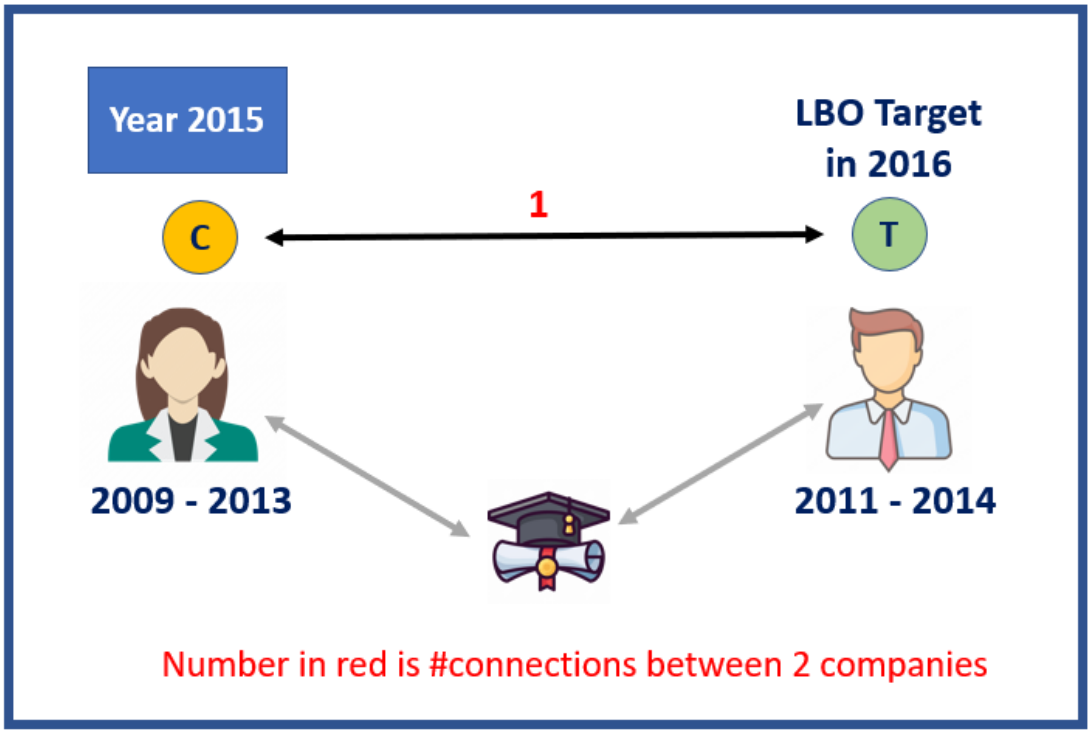


Table 1: Description of the variables.

This table provides variable names, definitions, and data sources.

Variable	Description	Source
Peer	$= 1$ if direct competitors in year $t-1$, 0 if public firms operating in the same industry of the LBO in year $t-1$	Marketline
Size	Logarithmic one plus yearly revenue	CRSP/Compustat Merged
Profitability	Total profit	CRSP/Compustat Merged
Debt ratio	Total liabilities divided/ Total assets * 100	CRSP/Compustat Merged
Growth	Logarithmic yearly sales growth rate	CRSP/Compustat Merged
CAPEX growth	Logarithmic yearly capital expenditures (CAPEX) growth rate	CRSP/Compustat Merged
OEPS	EPS From Continuing Operations	CRSP/Compustat Merged
ROA	Return on Assets = Net profit after tax/ Total assets	CRSP/Compustat Merged
Operating margin	Operating margin	CRSP/Compustat Merged
Employee	Number of employees	CRSP/Compustat Merged
Emp Productivity	Labour productivity, Sales per employee	CRSP/Compustat Merged
Degree	Degree centrality measure	BoardEx
Eigenvector	Eigenvector centrality measure	BoardEx

Table 2: Summary statistics

This table shows summary statistics for the sample. Firms are "peer" if they are identified as direct competitor of LBO firm by Marketline; "non-peer" if they are public firms operating in the same industry of the LBO. Further information for each variable is provided in Table 1. The sample ranges from 1980 to 2020.

Variable	Full Sample					Peer firms			Non-peer firms			
	Obs	Mean	SD	p(25)	p(75)	Obs	Mean	SD	Obs	Mean	SD	t-statistics
Peer	17695	0.43	0.5	0	1	7678			10017			
Size	17695	5.47	2.19	4.04	6.99	7678	6	2.25	10017	5.07	2.06	-0.93***
Profitability	17462	0.02	0.35	0.01	0.15	7484	0.05	0.3	9978	-0.01	0.37	-0.06***
Debt ratio	17652	0.59	0.45	0.33	0.72	7664	0.57	0.37	9988	0.6	0.5	0.03***
Growth	6212	0.03	0.43	0	0	2099	0.02	0.39	4113	0.03	0.44	0.01
CAPEX growth	1567	0.34	2.65	0	0	765	0.15	1.75	802	0.53	3.28	0.38**
OEPS	16914	0.5	1.75	-0.28	1.28	7083	0.83	1.89	9831	0.26	1.59	-0.57***
ROA	17654	-0.04	0.51	-0.03	0.11	7645	0	0.48	10009	-0.07	0.53	-0.07***
Operating margin	17469	-1.95	37.93	-0.03	0.13	7598	-1.31	39.45	9871	-2.45	36.72	-1.14**
Emp Productivity	17513	507.85	8602.48	123.83	386.21	7587	449.28	1471.54	9926	552.62	11353.99	103.34
Degree	17695	5.1	9.83	0	5	7678	9.1	12.82	10017	2.03	4.8	5.1***
Eigenvector	17695	19.96	29.44	0	29.67	7678	32.69	36.41	10017	10.2	17.18	-22.49***

Table 3: The impact of LBO on peers' performance - OLS regressions.

Columns (1) to (7) of this table present OLS panel regressions, with the dependent variables are column labels. See Table 1 for further information on the variables. All regressions include year fixed effects, industry fixed effects, industry-year fixed effects, and economic area fixed effects as indicated. Standard errors are clustered at firm level, and reported in parentheses. ***, ** and * denote 1%, 5% and 10% significance levels, respectively.

VARIABLES	Profitability	ROA	Sales growth	EPS Operations	Employee Productivity	Debt ratio	CAPEX growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Peer	0.062***	0.063***	0.008	0.520***	-213.683	-0.023	0.045
	(0.014)	(0.019)	(0.028)	(0.062)	(165.333)	(0.017)	(0.193)
Constant	0.198***	0.161***	-0.010	0.131	93.554	0.506***	0.436
	(0.029)	(0.032)	(0.181)	(0.194)	(220.927)	(0.113)	(2.340)
Observations	17,462	17,654	6,212	16,914	17,513	17,652	1,567
Number of gvkey	2,221	2,252	1,757	2,208	2,235	2,256	883
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EA FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: The effect of social network centralities on firm's probability of being the peer of and LBO

This table presents the effect of social network centralities on firm's probability of being the peer of an LBO from a probit regression. The dependent variable is *Peer* dummy. See Table 1 for further information on the variables. Column (1) has no control variables and fixed effects. From column (2) to (5), the fixed effects are added in this order: year FEs, industry FEs, economic area FEs, and industry-year FEs. Size and number of employees are added as control variables in column (6) and (7). Standard errors are reported in parentheses and clustered at the firm level. ***, ** and * denote 1%, 5% and 10% significance levels, respectively.

VARIABLES	peer	peer	peer	peer	peer	peer	peer
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
#degree	0.063***	0.066***	0.068***	0.069***	0.073***	0.065***	0.063***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Size						0.148***	0.125***
						(0.006)	(0.007)
Employees							0.007***
							(0.001)
Constant	-0.447***	0.901***	1.333***	1.669***	0.468	-0.443	-0.341
	(0.012)	(0.199)	(0.194)	(0.203)	(0.536)	(0.542)	(0.540)
Observations	17,695	17,695	17,695	17,695	16,731	16,731	16,731
Year FEs	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	No	No	Yes	Yes	Yes	Yes	Yes
EA FEs	No	No	No	Yes	Yes	Yes	Yes
Industry-Year FEs	No	No	No	No	Yes	Yes	Yes

Table 5: The impact of LBO on peers' performance - 2SLS regressions.

This table reports results from a 2SLS regression at the firm level. The dependent variable is given in the second row. See Table 1 for further information on the variables. Panel A reports the second-stage results where the endogenous variable is *Peer*. The employed instrument is based on a network-based model with director connections through university, club, and charitable organizations. Each connection between any two firms has equal weight. Panel B reports the first-stage results and *Peer_IV* is the predicted value of *Peer* based on fitted values from a probit model in Eqn 2. Panel C reports reduced form results where the independent variable is *Peer_IV*. All regressions include year fixed effects, industry fixed effects, industry-year fixed effects, and economic area fixed effects as indicated. Standard errors are clustered at firm level, and reported in parentheses. ***, ** and * denote 1%, 5% and 10% significance levels, respectively.

VARIABLES	Profitability	ROA	Sales growth	EPS Operations	Employee Productivity	Debt ratio	CAPEX growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: Second stage			
$\widehat{Peer}$	0.414***	0.461***	0.124**	2.802***	-240.074	-0.093***	1.101**
	(0.014)	(0.020)	(0.054)	(0.070)	(320.812)	(0.016)	(0.516)
				Panel B: First stage			
Peer_IV	0.891***	0.895***	0.890***	0.900***	0.896***	0.896***	1.065***
	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)	(0.061)
Observations	17,462	17,654	6,212	16,914	17,513	17,652	1,567
F-test	2814.74	2898.5	2340.25	2900.82	2887.15	2909.5	2909.5
				Panel C: Reduced form			
Peer_IV	0.369***	0.413***	0.11**	2.522***	-215.106	-0.083***	1.172*
	(0.014)	(0.021)	(0.064)	(0.066)	(342.965)	(0.017)	(0.602)
Observations	17,462	17,654	6,212	16,914	17,513	17,652	1,567
Firm controls in Table 5	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EA FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: The impact of LBO on peers' performance - robustness.

This table reports results from a 2SLS regression at the firm level. The dependent variable is given in the second row. See Table 1 for further information on the variables. Panel A reports the second-stage results where the endogenous variable is *Peer*. The employed instrument is based on a network-based model with director connections through university, club, and charitable organizations. Each connection between any two firms is the average of their node value. The points assigned to each node are Acquirer (4), Target (3), Peer (2), Non-peer (1). Panel B reports the first-stage results and *Peer_IV* is the predicted value of *Peer* based on fitted values from a probit model in Eqn 2. Panel C reports reduced form results where the independent variable is *Peer_IV*. All regressions include year fixed effects, industry fixed effects, industry-year fixed effects, and economic area fixed effects as indicated. Standard errors are clustered at firm level, and reported in parentheses. ***, ** and * denote 1%, 5% and 10% significance levels, respectively.

VARIABLES	Profitability	ROA	Sales growth	EPS Operations	Employee Productivity	Debt ratio	CAPEX growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: Second stage			
$\widehat{Peer}$	0.059***	0.066***	0.028	1.033***	-524.515	-0.084***	1.793*
	(0.013)	(0.016)	(0.045)	(0.088)	(473.769)	(0.021)	(0.979)
				Panel B: First stage			
Peer_IV	0.745***	0.744***	0.903***	0.769***	0.746***	0.739***	0.749***
	(0.016)	(0.016)	(0.033)	(0.016)	(0.016)	(0.016)	(0.053)
Observations	17,453	17,645	6,211	16,905	17,506	17,643	1,567
F-test	199.97	199.97	199.97	199.97	199.97	199.97	199.97
				Panel C: Reduced form			
Peer_IV	0.044***	0.049***	0.025	0.794***	-391.255	-0.062***	1.343*
	(0.009)	(0.012)	(0.042)	(0.067)	(358.367)	(0.016)	(0.814)
Observations	17,453	17,645	6,211	16,905	17,506	17,643	1,567
Firm controls in Table 5	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EA FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes