Undervaluation Induced LBOs

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Abstract

This paper shows that market timing drives private equity activity. Using mutual fund fire sales as a source of target undervaluation, we show that both public-to-private and private-to-private deals are more common following a fire sale. Since fire sales are unrelated to firm fundamentals, we use this setting to provide causal evidence on the effects of private equity ownership on targets' characteristics.

Key Words: Private Equity, Leveraged Buyouts, Instrumental Variables, Mutual Fund Fire Sales

JEL Codes:

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1 Introduction

Private equity firms acquire companies in leveraged buyouts (LBOs) to improve their operating performance, take advantage of tax breaks, and/or exploit market timing (Kaplan, 1989; Boucly et al., 2011; Kaplan and Strömberg, 2009).[1] Whereas the first two motives are well documented in the literature, little is known about target undervaluation as a primary driver for LBOs. In this paper we show that market timing triggered by mutual fund's fire sales drives private equity activity.

One challenge in relating private equity activity to targets' undervaluation is to find shocks that reduce valuations while being unrelated to firms' fundamentals. We take advantage of the work by Coval and Stafford (2007) and Edmans et al. (2012) who argue that mutual fund fire sales, resulting from large investor outflows, are an exogenous source of firm undervaluation. Therefore, we collect mutual fund data (investor inflows/outflows, assets under management, and holdings) from Morningstar for eight European countries between 2004 and 2018. Fire sales are very common in our sample, with roughly 25% of firm-year observations being affected. We marry this data with private equity activity from Orbis M&A (previously known as Zephyr), a deal database from Bureau van Dijk, where we collect a sample of 217 public-to-private and 4,082 private-to-private deals.

We follow the mutual fund literature on how to measure fire sale's impact on stocks. Using Wardlaw (2020)'s "flow-to-stock" as a measure of misvaluation, we first note that fire sales create significant price pressure on affected firms, leading to a drop in returns that is followed by a reversal, in line with previous literature (Coval and Stafford, 2007; Edmans

[1] One of the first papers to empirical examine the operating performance is Kaplan (1989) and since then many papers have complemented this research. A (non-exhaustive) list of papers relate private equity ownership to several operating outcomes such as enabling growth by relaxing financial constraints in French LBOs (Boucly et al., 2011), growth through add-on acquisitions (Acharya et al., 2013), employee outcomes such as turnover and growth (Antoni et al., 2019; Davis et al., 2014; Davis et al., 2019), stimulating innovation (Lerner et al., 2011), and improving management practices (Bloom et al., 2015). Edgerton (2012) show that some public entities may have considerable agency problems. Acharya et al. (2013) show that these operating improvements explain a large part of the value generated in leveraged buyouts.

et al., 2012). Next, we regress LBO activity at the firm level on Wardlaw (2020)'s "flow-to-stock" while including firm level controls (return on assets and total revenue), as well as firm, country-year, and industry-year fixed effects. The results of these regressions show that the likelihood of a public-to-private buyout increases by 0.3% to 0.8%, a significant increase compared to the unconditional probability of 0.6%.

Given that we also want to study whether undervaluation increases the number of private-to-private deals, following Cespa et al. (2023), we construct a measure for price pressure at the country-industry level as the weighted average of the firm-level Wardlaw measure of listed companies. More than 20% of our country-industries experience undervaluation. When we aggregate private equity activity at the country-industry-year level and regress it on our value-weighted Wardlaw measure, we find that in sectors affected by fire sales private-to-private deals increase with 2.5%. The unconditional probability of a buyout in any industry is just over 12% in our sample, but it is nearly 5% higher in industries experiencing undervaluation. More substantially, we show that the total assets purchased in buyouts in industries that experience undervaluation are more than 50% higher, further highlighting the economic importance of market timing as a driver of private equity activity.

We expose this aggregate-level result to a battery of robustness tests and find that buyout activity continues to be higher when we differentiate between types of acquisitions (public-to-private, private-to-private, and follow-on acquisitions), market conditions such as hot - and cold deal markets, periods with high and low GDP growth, and regardless of credit market conditions. Our additional tests also suggest that buyout activity is primarily higher in industries that experience a stronger shock.[2]

A large body of literature shows that private equity ownership is related to increased

[2]We further exclude industries without listed assets and separately industries without private equity deal activity and the result continues to hold. And we replace the indicator variable for a continuous measure of industry-level undervaluation. Lastly, the results remain robust when we aggregate the activity and undervaluation at a European industry level.

profitability, improved management practices, higher quality innovation and growth for private targets. However, a host of econometric issues prevent previous studies from obtaining causal effects. Given that fire sales are exogenous to firm's fundamentals *and* drive private equity activity, we can use them as an instrument for understanding the causal effects of LBOs on targets' characteristics. In our first stage we regress private equity activity on Wardlaw 2020's "flow-to-stock" in a matched difference-in-difference setting. As in our previous results, the likelihood that a public firm is acquired in a buyout goes up when affected by fire sales. Importantly, in our preferred specification our first-stage F-statistic is well above 10, suggesting that the instrument is anything but weak. In our private firm sample, we also see that companies are more likely to be targets when their industry experiences undervaluation induced by mutual fund fires sales, in line with our first set of results at the country-industry level. We also see that our instrument has a first-stage F-statistic above 10.[3]

In our second stage regressions we show that private equity ownership has opposite effects on our private and public samples regards profitability and revenues (Sorensen and Yasuda, 2022). On the one hand, private equity leads to a significant growth in revenues and profitability of private targets in line with Boucly et al. (2011). On the other hand, public targets see their revenues and profitability decrease, in stark contrast to the prior literature that shows that private equity ownership leads to a growth of profitability for public targets (Kaplan, 1989; Lichtenberg and Siegel, 1990; Guo et al., 2011; Boucly et al., 2011).

We then examine the impact of private equity ownership on investment and acquisition activity. The existing literature shows that it leads to increased investments and acquisitions

[3]For public-to-private deals we use mutual fund fire sale induced selling pressure of the target firm concerned to instrument for private equity ownership. For private-to-private deals, as the target is not public, we instrument for private equity ownership using industry-level mutual fund fire sales induced selling pressure. This selling pressure is based on mutual fund fire sales of public firms within the same SIC-three digit industry as the target. We use this approach as both Dessaint et al. (2019) and Cespa et al. (2022) show that mutual fund flow induced price pressure on public firms in a given industry can have real economic consequences for all firms both public and private in that same industry.

(Boucly et al., 2011; Acharya et al., 2013; Cohn et al., 2022). We find that both decrease in public targets while the former increases in private-to-private deals. As regards the labor force, we find a significant reduction for the public sample whereas the opposite takes place in private-to-private deals in line with Davis et al. (2019). We find no significant changes in labour productivity, standing in contrast with prior work (Davis et al., 2014; Davis et al., 2019; Antoni et al., 2019).

Lerner et al. (2011) analyze the number of patent applications and patent quality, finding a strong increase in quality following private equity ownership. Using our instrumental variable approach we find that the total patent stock in public targets decreases, in line with the overall reduction in size, whereas for private targets we find an increase in the likelihood of a patent filing. We also explore whether there is a change in the type of patenting activity and find no change.

We conduct a number of robustness tests. We show that our results are robust to different versions of our instrument (continuous or a dummy-based indicator), different sample windows, using a reduced-form approach as opposed to two-stage regressions, and to using different control groups. We also study whether the changes we observe follow a U-shape where restructuring is followed by operational improvements, but our findings are not in line with this hypothesis.

Our paper contributes to various streams of literature. Our primary contribution adds to the discussion on the different motives of private equity investments (Boucly et al., 2011; Acharya et al., 2013; Cohn et al., 2022) by highlighting the role of undervaluation (Harford et al., 2019), and by showing that mutual fund fire sales are an important source of this undervaluation.

We also contribute to the discussion on the costs and benefits of the private equity ownership model (Jensen, 1986; Kaplan, 1989; Kaplan and Strömberg, 2009), by showing

that prior results do not necessarily stand when we use an instrument to measure private equity ownership. Noteworthy differences with prior work are that we show that private equity ownership does not lead to increases in profitability or growth for public targets, and that pre-buyout status matters for how these outcomes are affected.

Lastly our paper demonstrates an additional relation between public and private markets (Dessaint et al., 2021; Dong et al., 2021; Yan, 2023) and how noise in public prices can have real implications (Edmans et al., 2012). In our case, we show that noise in public prices has a real effect via the private equity channel.

2 Literature

2.1 Motives for buyouts

Private equity firms generate positive returns on their investments by improving the operating performance of companies, exploiting tax breaks, or by taking advantage of market timing and undervaluation (Kaplan and Strömberg, 2009). Guo et al. (2011) estimate that these three channels are equally important for explaining private equity returns. Similarly, Acharya et al. (2013) find that private equity deal-level performance is related to sales growth and improved operating margins, suggesting an important relation between operating gains and private equity returns. In this section, we review the literature on two of these channels[4]

2.1.1 Improving operating performance

In what follows we provide a brief description of five channels that impact target's performance, noting, however, that given the large size of the private equity market, it is unlikely

[4]To estimate operating gains, previous studies have mostly used accounting items (Morris and Phalippou, 2020) and benchmark the performance against industry-medians, quoted peers in the case of public-to-private buyouts, and using matched industry peers.

that a single channel predominates (Opler and Titman, 1993; Boucly et al., 2011; Davis et al., 2019).[5] More so, Sorensen and Yasuda (2022) review the literature and identify that the value creation from private equity ownership differs in public and private targets. We follow this distinction in our paper.

Profitability: Building on the work by Jensen (1989), most studies use a matched difference-in-differences framework and find a positive relation between private equity ownership and profitability (Kaplan, 1989; Boucly et al., 2011; Guo et al., 2011), and this finding seems to hold both for public-to-private and private-to-private buyouts.

Revenue growth. Boucly et al. (2011) argue that private targets have different financial constraints than public targets. In line with this argument, the authors analyze French LBOs and find that private targets grow more strongly under private equity ownership, whereas the same is not true for the public targets. Cohn et al. (2022) offer similar results in a sample of US buyouts and find stronger growth in the sample of targets with more financial constraints before the buyout. In a survey conducted by Gompers et al. (2016), private equity investors name growth as one of the more prevalent reasons to pursue an investment.

Investments: This growth can be decomposed into organic and acquisitive growth, where recent figures suggest that up to half of the private equity deal market is related to acquisitive growth strategies in both the US and Europe (Acharya et al., 2013; Bansraj et al., 2022). Buyouts that conduct follow-on acquisitions during the private phase show strong growth compared to industry peers (Acharya et al., 2013; Cohn et al., 2022), which is not too surprising given the high level of post-buyout M&A activity. Bansraj et al. (2022) further test whether the combined performance of portfolio companies and their follow-ons

[5]Early private equity investments in the '80s, were strongly characterized by optimizing financial structures or restructuring inefficient large conglomerates. With the maturing of the private equity market, the competition for targets increased. To sustain the high returns, private equity firms specialized and developed new investment strategies. One example concerns growth capital which focuses on mostly private targets that sit between venture capital investments and large leveraged buyouts. The aim of these strategies is to support the business in it's growth goals.

is higher, finding evidence of improved operating margins.

Employment: Davis et al. (2019) also differentiate between public and private buyout targets, finding opposite results: while private targets expand their workforce, public ones reduce it. Similarly, Antoni et al. (2019) find a reduction in employment in German buyouts. Further the reallocation of jobs among establishments during the private phase is related to improved productivity (Davis et al., 2014; Davis et al., 2019).

Innovation: To study the longer-term consequences of buyouts, Lerner et al. (2011) analyze the patenting activity of private equity-owned companies, showing that there is an increase in the quality of patents following a buyout as measured by the citation frequency of patents by buyout targets, but not necessarily a change in the number of applications.

2.1.2 Undervaluation as a motive for buyouts

Kaplan and Strömberg (2009), and more recently Jenkinson et al. (2022) and Gredil (2022), argue that private equity managers are able to time the market, buying firms when prices are low and selling them at higher valuations, elevating fund returns. Harford et al. (2019) suggests that management may take advantage of industry-wide undervaluation in management buyouts. In fact, it is not an unlikely assumption that private equity firms may have superior skills and information when identifying potential targets, given that most private equity funds specialize in a stage or industry, and spend considerable resources on deal sourcing.[6] In favour of this argument, both Jenkinson et al. (2022) and Gredil (2022) find evidence that private equity firms may have superior ability to time markets at exit, although they do not find any evidence at entry, suggesting that private equity firms may form better expectations about future industry performance.

In our setting, we analyze the response by private equity firms to noise on a firm- or

[6]Generally, deals may be sourced via established relations such as investment banks or former CEOs, via their own platform companies, or from market analysis.

industry-level, resulting from mutual fund fire sales, at entry. This undervaluation may then lead to private equity firms buying out companies that would otherwise not have been taken over. Subsequently, we ask how private equity ownership influences the performance of these UIBs.

While other investors, such as hedge funds, may also be targeting these undervaluation opportunities, we believe that private equity firms are well-suited to respond. At the moment of the outflow and resulting undervaluation, it may not be clear whether the opportunity indeed represents undervaluation. For private equity firms, however, the potential price reversal is less relevant when taking a firm private. Rather, more important is that the entry price drops as a result of the undervaluation, enabling the private equity firm to reap more value from the investment opportunity. In section 4.4, we show that deal multiples are lower at entry for undervalued company and in section 5.3, we discuss which type of company is more likely to be taken over by private equity firms in UIBs.

2.2 Mutual fund outflows as an instrument for undervaluation

If mutual funds experience redemptions that are greater than their cash cushions, their managers are forced to rapidly "fire-sell" funds' positions. As these fire sales are driven by the features of the funds themselves rather than their underlying stock positions, Coval and Stafford (2007) argue that these large mutual fund outflows can be used to instrument for downward stock price pressure that is exogenous to firm fundamentals. [7]

As mutual funds tend to be selective about which stocks they liquidate following large

[7] To calculate their price pressure measure for stock (i) in quarter t they take the intersection of those mutual funds that experience outflows of greater than 5 per cent in the quarter concerned and those mutual funds that hold stock (i) at the end of the previous quarter. Assuming that these mutual funds sell their holdings in proportion to these prior portfolio weights following outflows, this information can be combined to generate a measure of aggregate sales originating from fund (j) which can be aggregated across all stock (i) holding funds to give a measure of aggregate sales for stock (i) based on mutual fund outflows in quarter (t). To turn this value of aggregate sales into a measure of price pressure, the sales are then scaled by the value aggregate turnover for stock (i) in quarter (t).

redemptions (as demonstrated by Berger (2023)), Edmans et al. (2012) advocate instrumenting for non-fundamental price pressure by assuming that outflows will occur in proportion to prior holdings, thereby breaking the link between the fund response and prior firms' fundamentals. Yet Edmans et al. (2012) have been recently criticized, with Wardlaw (2020) arguing that their measure inadvertently depends on stock's returns prior to the fire sale, introducing a large bias. As a solution, Wardlaw (2020) constructs a "flow-to-stock" price pressure measure that purges the Edmans et al. (2012) measure of its bias.

Using Wardlaw (2020)'s "flow-to-stock" measure, Cespa et al. (2022) show that mutual fund fire sales generate an economically significant dip in prices, followed by reversals, when using data from sixteen European countries. That is, there is evidence suggesting that mutual fund outflow pressure captures non-systematic price pressure. Based on these findings, we therefore use Wardlaw (2020)'s "flow-to-stock" as an instrument for idiosyncratic price pressure, i.e., exogenous undervaluation.

3 Data

3.1 Sample construction

We collect deal data from Zephyr and company financial data from Orbis. Specifically, we collect public-to-private deals by private equity firms from eight European economies: Denmark, Finland, France, Germany, Norway, Spain, Sweden, and the United Kingdom. The availability of private company financials motivates our choice to analyze a European sample, since after the buyout, the reporting requirements for the previously public company change. In Europe, most private companies are required to report (abbreviated) accounts and this allows us to analyze the operating performance during the private equity holding period. We limit our full sample to deals a) completed between 2004 to 2018, b) in which

private equity purchased a majority stake, c) and deals with non-missing target company financials and industry classification.[8] We exclude secondary (and higher level) buyouts to understand how the change to private equity ownership affects corporate operating performance.

We take one final step and identify the private equity firms behind the transaction through a combination of sources. We use deal comments, acquirer identification by Zephyr, and historic ownership structures in Orbis to identify the private equity firm and its stake where available. We then cross-check this information with Preqin and Pitchbook and if necessary through private equity websites. Zephyr uses a broader definition of private equity deals which may for example include transactions through an acquisition vehicle set-up by wealthy individuals, but who do not further actively invest beyond this single deal. In this paper, our focus is on professionally managed funds. As a result, we drop a few deals which do not fit this definition, leaving us with a sample of 217 public-to-private deals and 4,082 buyouts of private targets. The distribution of the deals over time is presented in Figure 1. In the beginning of our sample, both the number of public-to-private and private-to-private deals show a similar increase in the run up to the financial crisis. Following the crisis the deal count drops significantly for both types, but while the number of public-to-private buyouts remains constant at this lower level in the following years, the private-to-private deal count immediately reverts back to almost pre-crisis levels, highlighting the growing importance of this buyout market.

[Figure 1 about here]

Table 1 reports the buyout count by country and SIC code. In terms of geographical

[8] We require that controls have at least one year before and four years of financials available after the year in which they are matched to the treated observation. This provides us with a consistent sample over time creating more reliability on whether the instrument predicts private equity ownership. For treated observations we relax this condition in the main analysis to ignore companies that may be sold or dissolved earlier, but require this condition in the robustness.

distribution, more than half of our public deals are from the United Kingdom (134), followed by Sweden (22), and Norway (17), and the other countries contributing the remainder. For the private targets, the three biggest contributors are again the United Kingdom (1,565), France (715) and Germany (454). The distribution of deals across the aggregated 1-digit SIC codes shows that a large proportion of public targets are active within services (SIC 7), whereas the private targets are scattered more broadly across industries.

[Table 1 about here]

3.2 Measuring company performance

We collect financial statements from Orbis to estimate the operating performance of private equity targets. However, when the status of a company changes from public to private, reporting requirements change, which may lead to the loss (or mismeasurement) of financial statements.[9] To overcome this challenge, we map the ownership structures of private equity targets using the Orbis ownership database, which provides the full history of shareholders. In each year, we identify the shareholder that holds a stake of 50% or more for each company in our eight countries, regardless of whether the company is private equity-owned or not. This information allows us to trace the subsidiaries of private equity targets before and after the deal. Additionally, we use the ownership information to identify acquisition vehicles that are incorporated for the purpose of completing the deal. In many instances when a public company is taken private, the consolidated financial statements will be published by these acquisition vehicles rather than the original legal entity which was identified as the target

[9] Another more technical complication that arises when analyzing the operating performance of public-to-private deals in Orbis is that the reporting entity may change. For example, a newly incorporated entity, sometimes referred to as acquisition vehicle, may start publishing financial statements. In other cases, it may be that the public company's stocks are kept in a shell company. After the buyout, the industrial company below this shell may then start reporting instead of the shell. We deal with these complications by taking advantage of ownership information before and after the deal.

in the deal. In Appendix OA1, we provide further details on how we collect and use the ownership data, and these adjustments change the estimates for the treated observations.

In short, we use the combination of financial statements and ownership relations to measure operating performance by summing the unconsolidated statements of the target, its subsidiaries, and of any acquisition vehicle. When a company only reports consolidated statements, we first deconsolidate it by subtracting the unconsolidated statements of its subsidiaries to avoid double counting. We prefer to use deconsolidated and unconsolidated statements, instead of consolidated only, to allow us to track individual companies over the event window. For the industry peers of targets that serve as a control group, we only use the consolidated statement when available or alternatively the unconsolidated statement. Since these entities do not go through a buyout, the mismeasurement from reporting changes is not relevant.

In addition to overcoming the inconsistency from changes in reporting requirements, the use of the ownership data also allows us to include the effects of follow-on acquisitions and divestitures. Private equity firms are increasingly active in buy-and-build strategies in which they grow their portfolio company through subsequent follow-on acquisitions (Hammer et al., 2017; Acharya et al., 2013; Bansraj et al., 2022) and this growth may not be fully captured when using financial statements of only the private equity target.

3.3 Data for stock price pressure from mutual fund flows

We measure undervaluation using stock price pressure driven by mutual fund outflows, constructing Wardlaw (2020)'s "flow-to-stock" measure. For this purpose we require data on mutual fund outflows, holdings, size (assets under management), and the amount of stock outstanding for each firm held by the funds. We gather this for all funds sold in Europe and domiciled in Europe from Morningstar Direct for the period 2003 to 2017. We include equity

only funds and mixed funds that include equity together with other asset classes (typically fixed income). Finally, we exclude mutual funds that invest most or all of their equity in a single sector or industry (sector funds), since investors may pull out money in anticipation of future performance in a particular sector. We gather data on shares outstanding in each firm from Compustat.

3.3.1 Public measure

We follow Edmans et al. (2012) and Wardlaw (2020) and define fire sales as occurring when funds experience outflows of greater than 5 per cent of total assets in a given quarter. To measure flow pressure for a given public target we take all funds experiencing fire sales in a given quarter that hold that listed stock. Using these funds, we then calculate the quarterly Flow To Stock (FTS) measure from Wardlaw (2020) and aggregate it to the annual level. We label this Flow To Stock measure for firm i at time t, $FTS_{i,t}$:[10]

$$FTS_{i,t} = \left(\sum_{j}^{m} \frac{|F_{j,t}|}{TA_{j,t-1}} \times \frac{SHARES_{i,j,t-1}}{SHROUT_{i,t-1}} \right) \tag{1}$$

We also calculate an annual flow dummy based on whether $FTS_{i,t}$ is positive or not and we label this $FTSDUMMY_{i,t}$:[11]

$$FTSDUMMY_{i,t} = \begin{cases} 1 & \text{if} \quad FTS_{i,t} > 0 \\ 0 & \text{if} \quad FTS_{i,t} = 0 \end{cases} \tag{2}$$

[10] Please see Wardlaw (2020) for the precise discussion to calculate the flow to stock measure. The Flow to Stock measure for stock i at time t is the sum across all m funds j that hold the stock of the absolute value of flow (F) into fund j at time t divided by the TA (total assets) of fund j at time *t-1* multiplied by the number of shares (*SHARES*) held by fund j in stock i at time *t-1* divided by the shares outstanding (*SHROUT*) of stock i at time *t-1*. As $|F(j,t)|$ is positive, *TA* is positive as are *SHARES* and *SHROUT*, this means that *FTS* is generally positive or zero.

[11] This method also remedies the problem of contemporaneous correlation of fire sales with the next quarter's return of the stock experiencing mutual funds' fire sales highlighted by Wardlaw (2020) of the (Edmans et al., 2012) method for calculating price pressure.

3.3.2 Private measure

For private, unlisted, targets we cannot use FTS as mutual funds typically do not invest in private unlisted securities.[12] Instead, we can use the measure of flow pressure at the country-industry level for private companies provided that there are public companies in the same industry. To construct this industry-level measure of undervaluation, we take all funds experiencing fire sales in a given quarter. Using these funds, we then calculate the value weighted FTS measure quarterly for all public stocks in a given country-industry (SIC-3) affected, provided that there are public companies in the same industry. As the dependent variables that we want to explain are annual, we aggregate up the value weighted quarterly FTS measure to the annual level and use this as our measures of country-industry level flow pressure. We label this variable FTSINDUSTRY(i,t), for private target i at date t and using this we also calculate FTSINDUSTRYDUMMY(i,t) which is one if FTSINDUSTRY(i,t) is greater than zero. We use FTSINDUSTRY and FTSINDUSTRYDUMMY to instrument for private equity ownership of private companies.

4 Undervaluation and private equity activity

In this section we establish the relation between a) mutual fund fires sales and firm and industry-level undervaluation, and b) between undervaluation and the likelihood of a private equity buyout, both for public and private companies.

[12] We can not measure FTS derived from mutual fund flows for private companies as mutual funds typically do not buy private company shares. Mutual fund shares are priced once a day to allow investors to buy or sell these fund shares. In order to price these mutual fund shares, the underlying assets need to be valued. As unlisted shares do not have a daily listed price, these private shares are not invested in by mutual funds as this prevents the daily mutual fund share price from being easily calculated.

4.1 Mutual fund fire sales and undervaluation

Figure 2 illustrates the extent of undervaluation following mutual fund fire sales, showing annual firm and country-industry-level abnormal returns around the year in which the firm (or industry) experience the largest outflow during our sample period. We regress the yearly abnormal returns at the firm (Panel A) or industry (Panel B) level for a set of dummies around the event, controlling for firm (country-industry) and country-year fixed effects. Standard errors are clustered at the country-year level. From the top figure, we can clearly see that in the year of the outflow event, the abnormal returns turn negative, reversing afterwards, in line with previous findings in the mutual fund literature. Thus, we show that the price pressure is significant and temporary, corroborating the notion that it is unrelated to firm fundamentals. At the industry level the dip in returns is more nuanced. In Figure 3 we show that at the country-industry level the effect of the shock can be thought of as an interaction between the strength of the fire sale and the proportion of the industry being affected. As such, strong shocks that involve a high proportion of the industry lead to significant undervaluation (top left figure), whereas this does not seem to happen with weaker shocks (bottom left and right figures).

[Figure 2 about here]

[Figure 3 about here]

4.2 Company-level undervaluation

We first ask whether company-level undervaluation driven by price pressure leads to a higher likelihood of being acquired by private equity. For this purpose we follow all publicly listed firms over our sample period, identifying whether a company a) experiences a fire sale driven

undervaluation shock in the past two years and b) whether it is the target in a buyout in the current year.

In Figure 4, we present the percentage of public firm observations that experience undervaluation in the past two years and in Panel A of Table A1.3 in the appendix, we provide sample statistics on the undervaluation measure and public-to-private deal activity. On average about 25% of listed firms experience undervaluation in the past year and more than 30% in the past two years, making these shocks quite common. These numbers are in line with Lou and Wang (2018), who find in their sample that the number of observations experiencing undervaluation ranges roughly between 10% and 45%.

[Figure 4 about here]

Next, we run OLS regressions in our sample of listed firms to understand whether the buyout likelihood increases with undervaluation. We set up an indicator variable *PE* that takes the value one for company-years in which a company is a private equity target and zero otherwise, and regress this on a measure for undervaluation from the past two years.[13] We exclude observations during the private equity holding period since there is no company-level measure for undervaluation when the company is private. For our measure of undervaluation, we use the indicator variable for whether a company experienced price pressure from mutual fund fire sales two years ago (FTSDUMMY t-2) and a continuous version (FTS 2y) that measures the average undervaluation over the past two years. We add control variables for size (revenue (log)) profitability, measured by return on assets. Further, we include company, industry-year, and country-year fixed effects.[14]

[13]Ex-ante it is not clear how long it takes before undervaluation materializes in a completed buyout, since it may take time to take a company private after undervaluation has taken place. Therefore, we run a horse race to understand how fast private equity firms may respond to undervaluation. In Table A1.4, we regress the buyout likelihood on three lags of company-level undervaluation and find consistent evidence that the buyout likelihood of public companies increases most with the second lag of our undervaluation measure FTSDUMMY.

[14]Summary statistics on the company-level observations are available in Table A1.2 by observations that

Table 2 presents the results. On a company level, undervaluation from mutual fund fire sales leads to a significant higher likelihood of being a target in a private equity buyout. Experiencing undervaluation increases the likelihood that a public company is a buyout target in the next period by 0.4% - 0.5%, even after controlling for firm characteristics and a host of fixed effects. Since the unconditional probability is 0.4%, this increase is economically relevant and corroborates previous findings showing how mutual fund fire sales increase M&A activity in listed firms (Edmans et al., 2012; Cespa et al., 2023).

[Table 2 about here]

4.3 Industry-level undervaluation

Next, we explore whether the measure for industry undervaluation increases aggregate buyout activity. If undervaluation is a driver of private equity activity, we should see that more deals being completed. However it is clearly an empirical question as to whether private equity firms also acquire unlisted firms following industry undervaluation, and we test whether this is the case.

First, we aim to understand how common undervaluation is in our sample. In Figure 5, we show the ratio of undervalued industry observations by 1-digit industry code (Panel A), by country (Panel B), and over time (Panel C). On average 22.6% of the industries in our sample experience undervaluation.[15] Particularly in SIC-3 and SIC-6, which respectively represent the Manufacturing and the Finance, Insurance, and Real Estate services industries, undervaluation is more common. The statistics in Panel B indicate that most undervalued

experience a shock (Panel A) and those that are private equity owned or not (Panel B). On average, large and more profitable companies experience undervaluation. The split by private equity ownership suggests that listed buyout targets in our sample are also on average larger and more profitable.

[15]In Panel B of Table A1.3, we provide summary statistics on the buyout activity and undervaluation measures on an industry level. On average, assets held by public firms represent 14.7% to 37.6% of the industry's total assets for respectively all industries and industries with listed firms only.

industries are from France and the United Kingdom, which is partially driven by large number of manufacturing and financial services industries in those countries. Lastly, the average size of the shock and ratio of shocked industries has strongly increased during the financial crises and dropped back slightly afterwards. But in recent years, the ratio of industries experiencing undervaluation is close to 40%, which is a sizable number. These numbers are considerable lower than in Lou and Wang (2018), who report that 67% of their industries are influenced by undervaluation on average. However, we note that our sample includes many industries without listed firms. Focusing solely on industries with listed firms raises our estimate to 44.9%.

[Figure 5 about here]

In Table 3, we regress the number of private equity deals and the value of targets at the country-industry level, on an indicator variable for undervaluation induced by mutual fund fire sales (FTSINDUSTRYDUMMY). We include one-period lagged controls for industry size (number of companies in log), importance of listed firms (sum of assets of listed firms in log), and past private equity activity. We further include country-year and industry-year fixed effects. Across all specifications, we find a strong and positive relation between private equity activity and measures of undervaluation. In industries affected by mutual fund fire sales, the number of deals is 2.6% higher (column 3), the likelihood of a deal is almost 5% higher (column 5), and the total assets purchased increases by more than 50% (column 6). The 4.7% higher private equity deal likelihood in column 5 implies an economically material increase of almost 40 percent when compared to the unconditional mean likelihood of 12.1%. Thus, while there is a moderate but significant increase in the deal count, the likelihood of a private equity deal increases more substantially. The reason why target total assets purchased increases strongly despite the more moderate effect on deal activity

and probability is because (as we show later in the paper) many of the deals induced by undervaluation are sizeable deals.

[Table 3 about here]

4.4 Are deal values affected?

Having shown that undervaluation leads to increased buyout activity, does it also translate into lower deal values? In Table 4, we provide suggestive evidence that it does. We regress two deal multiples on measures of pre-deal undervaluation for buyouts of private targets. In columns 1–3, we calculate enterprise multiples as deal value (corrected for when the acquired stake is less than 100%) plus total debt divided by total assets. In columns 4–6, we use revenue multiples, calculated as the deal value (again, corrected for partial acquisitions) divided by total revenue. As measures for undervaluation, we use FTSINDUSTRYDUMMY and FTSINDUSTRY in columns 1-2 and 4-5 respectively. In columns 3 and 6, we split FTSINDUSTRY into quartiles. Overall, the results suggest that targets in industries affected by undervaluation experience lower multiples. However, this effect is concentrated in periods with large undervaluations, as seen in columns 3 and 6.

[Table 4 about here]

4.5 Further tests

In Appendix OA2, we provide further evidence of the relation between undervaluation and aggregate buyout activity. We first show that, when differentiating by the type of deal (public-to-private, private-to-private, and follow-on acquisitions), industry level undervaluation increases the number and assets acquired across categories. We also show that our

results are robust when limiting our sample to industries with and without public firms in Table OA2.1 and Table OA2.2, and to excluding industries that do not see any private equity investment during our sample period, as shown in Table OA2.3. And they also take place in different market conditions, with Table OA2.4 showing that our results are present in hot and cold markets, periods with high and low yield, and high and low GDP growth.

Lastly, we test the robustness of our specification by using the continuous undervaluation measure (Table OA2.5), differentiating by the size (Table OA2.6), and timing of the shock (Table OA2.7), and we show that the results hold at an aggregate European-industry level (Table OA2.8). Overall, the results suggest that private equity firms respond to undervaluation by increasing buyout activity, and this effect is non-negligible.

5 Identification Strategy and Methodology

Now that we have established the relation between exogenous undervaluation and private equity investments, we ask how private equity ownership influences target's operating performance. That is, we use undervaluation as an instrument for private equity ownership to analyze its on operating performance.

5.1 Instrumenting private equity ownership

5.1.1 Public target instrument

For our undervaluation measures to be valid instruments for public targets, both exclusion and relevance conditions need to be met. First, for the exclusion restriction, the instrument needs to be exogenous to the outcomes we are testing for, affecting them only via private equity ownership. While it is difficult to completely rule out alternative channels, we first note that our undervaluation measures come from mutual fund outflows that are exogenous

to firm's fundamentals. Second, Wardlaw (2020) shows that his flow-to-stock measure is uncorrelated with next quarter's stock returns. As a whole, the evidence suggests that our price pressure measure for public targets satisfies the exclusion restriction.

Regards the relevance assumption, we have already shown in Table 2 that undervaluation from mutual fund fire sales is significantly related to an increase in the likelihood of private equity ownership. In the next section, we confirm this relation in a matched sample of treated and control firms.

5.1.2 Private target instrument

In the private sample, the exclusion restriction is more likely to hold since the shock is only indirectly related to target companies, namely through public entities in the same industry. It is therefore unlikely that our results will be driven by a direct relation between the price pressure and firm-level operating outcomes, but we are aware that we cannot test this explicitly.

It is likely that the instrument satisfies the relevance assumption based on our findings in Table 3. This point is further validated by Yan (2023), who shows that the valuation of public markets does affect the investments made by private firms. Again, for the purposes of our IV analysis, we confirm the relevance of the instrument at the company level in a sample of matched treated and control firms.

5.2 Implementation and validity

In this subsection we discuss the implementation of the instrumental variables proposed above. Let us first consider a standard difference-in-differences model:

$$Y_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 Post_{i,t} \times PE_i + \eta_i + \eta_t + \epsilon_{i,t}, \tag{3}$$

where PE_i is an indicator for whether a company is a private equity target or not. $Post_{i,t}$ is a time-varying indicator identifying the relative periods with respect to the year of the deal, taking the value of zero for the two years before the deal and one for the first four years after the deal.[16] For matched controls, the post indicator takes the same values as those of the private equity target. β_2 is our coefficient of interest and estimates the treatment effect. Finally η_i and η_t stand for company and year fixed effects.

The key adjustment required for our empirical approach is that we instrument $Post_{i,t} \times PE_i$ with mutual fund induced undervaluation. The first stage of the IV estimation is then:

$$Post_{i,t} \times PE_i = \alpha + \beta_1 Post_{i,t} + \beta_2 Post_{i,t} \times INSTRUMENT_i + \eta_i + \eta_t + \epsilon_{i,t}, \tag{4}$$

For $INSTRUMENT_i$ we use either FTS_i or $FTSDUMMY_{i,}$ for public targets or $FTSINDUSTRY_i$ or $FTSINDUSTRYDUMMY_i$ for private ones. Note that these instruments are time invariant, since we use the shock of the pre-buyout year to predict private equity ownership, and there is no firm-level undervaluation measure for public firms after they have been taken private.

The predicted values of this first-stage, $\widehat{Post_{i,t} \times PE_i}$, are used to estimate the influence of private equity ownership on outcomes in the second stage. As outcomes we include measures for profitability, revenue growth, investments, acquisition activities, labor, and innovation. Details on the definitions of these measures are provided in Table A1.1 in the

[16] We exclude the year of the buyout, since ownership information may not represent the right structure in that year, making it unclear how to properly account for consolidated and unconsolidated financial statements.

appendix. In both our first stage and second stage, we include firm, country-year, and industry-year fixed effects and cluster the standard errors at the firm and country-year levels.[17]

For this setting we draw our sample as follows. For the public targets, we keep all target firms and their public industry peers (3-digit SIC) as controls. We do so because large public entities in Europe are more likely to be bench marked against other large European competitors. And also because it further improves the power of the first stage since there are only a few public companies in the same country-industry. Importantly, one firm can act as a control observation multiple times for different buyouts.

For the private sample, the initial control group consists of all industry peers of the target company. However, since this sample contains several million company-year observations, we narrow the control group by matching on size and profitability. Specifically, we match each private target to the five closest industry peers from each of the eight countries. Thus one private target is matched to at most 40 controls (5 peers from its own country and 35 from the other seven countries). Since our industry-level instrument exploits variation in price pressure within the same industries but across countries, we retain this necessary variation by matching to controls from each of the eight countries.[18]

In Table 6, we provide pre-deal company characteristics for public and private targets, and their (matched) industry peers. On average, public targets are larger and more profitable, but not more efficient, than their industry peers. After matching, private targets appear more similar to their controls, although they still remain larger in terms of the

[17] There are 2,438 unique public companies and 141 country-year clusters in the public sample, and 65,866 unique private companies and 154 country-year clusters in the private sample.

[18] All private companies in a country-industry-year cluster experience the same shock. In the private deal sample, we therefore exploit the fact that the shock can vary between two 3-digit industries from two different countries. For example in the United Kingdom the *Hotels and similar accommodation* sector (NACE 551) may experience a shock, while in that same year there is no such shock or a weaker shock in the same industry in France. We argue that an UIB is then more likely in the hotel sector of the United Kingdom.

number of employees and have lower labour productivity, labour profitability, and asset efficiency.

[Table 6 about here]

The question that remains is whether our instruments are still relevant. If private equity firms respond to undervaluation induced by price pressure, then we should see that β_2 in Equation 4 is positive and significant. In Panel A of Table 7, we present first-stage regressions using different undervaluation measures: column 1 uses FTSDUMMY, a dummy for whether a company has experienced price pressure, column 2 uses FTS, the actual price pressure whereas column 3 uses FTS based on implied rather than actual fund flows. We include this measure because most US studies that calculate price pressure based on mutual fund flows use flows implied, as opposed to actual, from holdings data.[19]

Table 7 shows that for the public sample undervaluation is still positive and significantly related to private equity ownership, with the coefficient in column one indicating that buy-outs are 7.6% more likely following mutual fund induced undervaluation. The Table also shows that the F-statistic for FTSDUMMY is above 30, far above the common threshold of 10. The F-statistics for FTS and FTS implied are just around 10, still predicting private equity ownership. Given this, throughout the paper we will use FTSDUMMY as our preferred instrument.

[Table 7 about here]

We now turn to the private sample, reporting first-stage regressions in Panel B of Table 7. As in Panel A, undervaluation is still positive and significantly related to private equity activity, with the coefficient in Column 1 indicating that firms are 5.3% more likely to be

[19]The sample in all specifications in this table are based on the observations used when estimating the return on assets in the second stage.

targeted by private equity following mutual fund induced industry undervaluation. The instruments are very strong, with F-statistics well above the common threshold of 10: 116 in column 1, and 25-26 in columns 2 and 3. Overall, these results provide confidence that the instruments used are not weak. In the rest of the paper we will use FTSINDUSTRYDUMMY to instrument for private equity ownership of private firms.

5.3 Interpretation of LATE and complier characteristics

The instrumental variable approach estimates local average treatment effects. That is, we estimate the effect of being acquired by private equity for firms that suffer mutual fund induced undervaluation. In our setting, we can differentiate between three types of companies. First, companies that will always become private equity owned regardless of undervaluation ("always-takers"). Second, companies that will never be acquired by private equity even though they are affected by undervaluation ("never-takers"). These two groups represent non-compliers. Third, there are companies that are acquired by private equity as a result of undervaluation and those that are neither acquired nor affected by undervaluation ("compliers"). It is for this third group for which we can estimate the effect of private equity ownership on company performance.[20]

To shed some light on the characteristics of compliers in our sample, we estimate their characteristics in Table 8. Unfortunately, it is not possible to identify individual companies. Instead, we can estimate the likelihood that companies with certain characteristics belong to this group. First, from our first-stage regression, we know that the complier percentage is 7.6% and 5.3% for the public and private sample respectively. While these are relatively low numbers, they are not uncommon. Splitting this percentage for treated firms and control firms shows that the complier percentage is higher for the treated sample, 47.5% for public

[20] Assuming that there are no companies that would normally receive private equity ownership but because of the price pressure are now not taken over by private equity firms ("defiers") or vice versa.

targets and 61.4% for private targets, while for the controls the complier percentages are just above 3% and 2%.

Second, we estimate the likelihood that a company with above median profitability, size, or other characteristics is a complier. Then we calculate the relative complier likelihood for each characteristic.[21] A value above one suggests that companies with above median characteristics are more likely to be compliers. For example, the relative complier likelihood of public companies with above median return on assets is 0.52, suggesting that companies with high profitability are less likely to be compliers. Overall, we find that public compliers are unprofitable and unproductive companies, but not much smaller than non-compliers. Compliers in the private sample seem larger in both revenues and assets, less productive and with a balance sheet tilted towards fixed assets.

[Table 8 about here]

When calculating the relative complier likelihoods in the private sample, we find different results. Private compliers are more likely to be larger companies, but they still remain less profitable and less productive.

Regardless of the differences in characteristics between the compliers and non-compliers, the instrument is arguably unrelated to firm fundamentals (within compliers), and thus we can use it to estimate the effect of private equity ownership in an exogenous setting. However, when comparing the results to those from previous studies, we keep in mind this alternative private equity motive for the complier sample based on undervaluation. Our results may differ from previous private equity papers since our complier deals are more strongly motivated by undervaluation compared to the always-takers which are usually also

[21] This is calculated as follows. We run the first-stage regression using the subsample of companies that are above the median on the characteristics of interest. The first-stage coefficient from that regression is then divided by the first-stage coefficient when using the whole sample.

present in samples using matching methodologies.[22]

6 Results

6.1 Private equity ownership and operating performance

6.1.1 Profitability and revenue growth

We begin by estimating the effects of private equity ownership on profitability and sales. Table 9 reports our second-stage estimates where the dependent variables are the return on assets, return on sales, total revenue, and revenue by assets. Panel A presents the results for public-to-private while Panel B those for private-to-private buyouts.

[Table 9 about here]

The results in the table show that PE ownership decreases the profitability of public targets, and this happens whether we look at returns over assets in column one, returns over sales in column two, or revenue in column three. This stands in contrast to the prior literature that shows that PE ownership boosts profitability for public targets. The private sample shows opposing results, with an improvement in return on sales and revenue, in line with previous findings.

That the effect of private equity ownership on operating performance differs between public and private targets may stem from the difference in motivation for each type of deal. The motive for public-to-private deals is typically to undertake large-scale restructuring that would not be possible if the company remained listed. In contrast, an often cited motive for

[22]To shed some light on the development of operating performance by companies who are either private equity owned or not and are either experiencing undervaluation or not, we plot the development of total revenue and return on assets in Figure A1.1. From the figures is clear that most companies do not necessarily develop differently when receiving an undervaluation shock, rather performance changes when a company becomes private equity owned.

private-to-private deals is to provide additional finance for the target to grow. In light of these differences it is not surprising that we find that operating revenue shrinks for public targets while growing for private ones.

6.1.2 Investments

The results so far indicate that private equity ownership reduces the sales of public firms but increases those of private ones, which may happen because private equity typically seeks to restructure public firms but finances the growth of private firms (Boucly et al., 2011; Hotchkiss et al., 2021). Therefore, we take a look at investments after the acquisition, considering whether they are consistent with this explanation.

[Table 10 about here]

Investment can take the form of investment in fixed assets within the existing firm but can also involve investment through new acquisitions. In Table 10 we show the effect of private equity ownership on within firm investment. Panel A shows that for public-to-private deals there is a significant decrease in investment both measured by total and fixed assets, consistent with our previous finding on reduced revenue. Panel B shows that in the case of private-to-private deals, investment increases significantly, both when looking at total and fixed assets. This panel also shows that this goes hand-in-hand with an increase in the fixed asset ratio (the ratio of fixed assets to total assets).

We complement these results by studying acquisition and divestment activity, as recent studies suggest that PE backed companies engage in serial acquisitions.[23]

[Table 11 about here]

[23] See for example a recent report by the consultancy company Bain & Company (Bain and Company, 2018), or academic work on buy-and-build strategies (Hammer et al., 2017).

Table 11 analyzes whether private equity ownership influences acquisition activity in terms of deal probability, total acquisitions (measured by the sum of targets' assets), divestment probability, total divestments (the sum of divested firms' assets), and net acquisitions (the difference between acquisitions and divestments).

In Panel A, we find a strong decrease in acquisitions by public entities, both in the probability that they take place in column one, and the sum of their assets in column two. At the same time, we find no changes in divestment activities, resulting in a negative net acquisitions. Again, this finding shows that public entities taken over by private equity reduce their overall investments.

Panel B shows that while the acquisition likelihood does not increase, the assets acquired by private targets significantly increase. Similarly, we do not find any changes in divestment activities. Thus, in the case of private targets, we see a net positive change in terms of acquisitions.

6.1.3 Employment

Private equity firms have been viewed as corporate raiders, taking advantage of weaker stakeholders in order to increase shareholder returns. A stream of literature has therefore focused on how private equity ownership influences the labor forces of companies that are taken over. Davis et al. (2014) show that public-to-private deals reduce employment while private-to-private deals increase employment (table 7 of their paper). They also show that following PE ownership total factor productivity goes up and unit labour costs fall, which suggest that labor productivity may also rise.[24]

[24]There is also literature on the effect of private equity ownership on other stakeholders apart from labor. Hotchkiss et al. (2021) and Tykvová and Borell (2012) find that debt holders of PE companies are not disadvantaged by PE ownership as the risk of bankruptcy is not increased.Gupta et al. (2021) Also study the effect of private eqquity ownership on patient outcomes in nursing homes in the US and Bellon (2014) studies whether private equity firms reduce pollution in their portfolio companies.

[**Table 12 about here**]

In Table 12, we analyze the influence of private equity ownership on labor outcomes such as workforce size, labor profitability, and labor productivity. Like Davis et al. (2014) we find that employment shrinks, however in contrast to their study, we find that labour profitability and labour productivity remain unchanged following public-to-private deals. For private-to-private deals we find, in line with their paper, an increase in employment, but again no changes in productivity or profitability.

6.1.4 Innovation

Lerner et al. (2011) examine how private equity ownership influences innovation, measured as patenting activity and patenting quality for 472 LBOs in the United States. They show two main results. First, that there is no direct evidence of a change in the level of patenting activity. Second, that the patents applied for by the portfolio companies are more focused and more cited, suggesting that their quality improves. To complement their research, we analyze the effect of private equity ownership on patenting activity using our instrument.[25]

We collect patent data from Orbis that contains information on the company applying for the patent, the patent number, and the application date. We use this data to calculate a number of innovation related outcomes. Following Bloom et al. (2016) and Blundell et al. (1999), we calculate the stock of patents, which is the number of patents filed today plus the present value of the patent stock of the previous period.[26] In addition we calculate the fraction of exploitative and exploratory patents (Custódio et al., 2019). Lastly we calculate a patent dummy when a company files for a patent.[27]

[25] As argued in their paper, patenting activity may be a better measure for innovation than for example R&D expenditures because R&D expenditures may not convert into innovation.

[26] To calculate the present value of the patent stock, the patent stock of the previous period is depreciated with an assumed depreciation rate of 15% per period.

[27] In Appendix Table A1.5, we present statistics on the patent data in our sample for private equity targets and their peers

[Table 13 about here]

Table 13 examines the effect of private equity ownership on patenting activity. For public targets, we find a decrease in the patent stock, suggesting a decrease in patenting activity. Similarly, we find no change in the composition of the patent portfolio. For private targets, we find a higher probability of a patent filing, but no significant change in patent stock. We do find a minor decrease in the number of exploratory (or riskier) patents, in line with Lerner et al. (2011). Overall, the innovation results using our instrumental variable approach appear consistent with Lerner et al. (2011).

6.2 Additional results

Berger (2023) argues that the flow-to-stock variable may still be related the characteristics such as liquidity, age, and size of the portfolio companies in the mutual fund. This concern would be particularly relevant in a continuous measure in the public sample, but may still hold in the dummy variant that we apply. To address that concern, we take two steps. First, we identify all listed company-year observations that experience undervaluation and drop any company that does not experience undervaluation at all during our sample period, to exclude any companies that are not part of mutual fund holdings and may therefore represent a unique set of companies. Second, we then match the remaining observations to similar industry-peers without undervaluation in that year, resulting in a covariate balance for our main outcomes between companies with undervaluation and those without. Using this sample, we run our IV specification in difference-in-difference setting, where the relative years now refer to the moment of the undervaluation or matching year and private equity treatment may happen afterwards. Results are in line with our main findings, validating our interpretation from the first-stage (undervaluation leads to buyouts) and second-stage

(how private equity ownership influences performance in UIBs). Note that this concern is not relevant for our private sample, because by definition the flow does not affect private companies directly.

One concern with our empirical approach is that, for the public sample, we include all public companies from the same industry as the buyout target regardless of their country. We examine whether including only public peers from the same country-industry as controls affects the results. It mostly does not. Only net acquisitions becomes insignificant. Other results are quantitatively very similar.

We argue that the different results in the public and private sample may be explained by different restructuring motives, where larger companies require restructuring and smaller ones financial support. We try to shed some light on this interpretation by splitting the private sample into large and small companies. We find that most of the growth in size, profitability, and labour outcomes come from smaller targets. Larger targets continue to grow, although divestments increase for this group. These findings suggest that while all private targets benefit from newly financed growth, smaller targets seem also to benefit from operational improvements. We do not run this analysis for public firms since all these targets represent large companies.

We also estimate the treatment effect dynamically to understand how the private equity effect develops over the holding period. In untabulated results, we find that the negative effects on profitability, size, and acquisition activity already materialize in the first year after the buyout for public targets, and in the following years size continues to decrease. Only patenting and divestment activities take longer to become significant (period 2 and 3 respectively), where patenting likelihood is positive in the longer-run, mostly coming from a relative increase in exploratory patents. For the private sample, growth is positive and significant from the year after the buyout while asset productivity drops in the first year,

suggesting that improvements in profitability (ROS) take longer to develop. We also find that patent likelihood increases in the first three years, resulting in an increase in patent stock in years three and four.

The recent literature highlights potential issues when using instrumental variables, in particular when comparing the coefficients with those obtained through OLS (Jiang, 2017). For this purpose we compare our coefficients with those using OLS in a matched difference-in-difference analysis in the Appendix.

As noted by Jiang (2017), IV coefficients are typically larger in absolute value than OLS, although the sign and significance remain similar. In particular, IV coefficients under the public sample are more negative in terms of profitability, size, and labour productivity outcomes. The fact that OLS results are less negative, suggests one of two things. First, it may be that private equity selection skills in the public sample are positive and this effect is muted when using the instrument. Second, the motivation for private equity firms to buy listed companies that experience undervaluation is different from that based on restructuring, a difference we already see in Table 8 when looking at compliers. The comparison for the private sample does not follow the same pattern, with OLS and IV coefficients much more similar.

7 Discussion

Overall, some of our findings go against the conventional wisdom that private equity ownership improves operating outcomes, at least for public targets. What may explain these differences? We suggest one explanation.

Following the previous discussion on the differences between IV and OLS coefficients, the instrumental variable approach estimates local average treatment effects (LATE).[28] In

[28]LATE differs from an average treatment effect on the treated (ATT) because not all observations have

the context of our estimation, mutual fund flow shocks lead private equity firms to buy undervalued companies that would normally not be considered, as they were too expensive and offered low potential returns. If this is the case, private equity may consider these targets for motives more than restructuring, aiming to sell them for a higher price without significant improvements. As an implication, we should expect to see lower operational improvements in this sample, although to fully answer this question, pricing data and information on intermediate cash flows would be necessary.

8 Conclusion

In this paper we demonstrate that undervaluation can be a motivating factor for LBOs. Cespa et al. (2022) demonstrate that mutual fund fire sales exogenously cause industry level undervaluation of the target industry leading to an increase in the number of both public and private takeovers. We draw on this finding to show that undervaluation due to fire sales can boost LBO activity and cause LBO deals to go ahead that would not otherwise have proceeded.

Existing studies of the impact of private equity ownership struggle with the effects target selection. As the underpricing induced LBOs that we identify are due to exogenous fire sales, we use these sales as a cleaner instrument to understand the effects of private equity ownership.

In our first stage tests we demonstrate instrument validity and show that both public and private firms are more likely to be targets in a buyout when their industry experiences undervaluation caused by fire sales. In our second stage tests, we show that the effect of

to comply in line with the instrument. That is, some companies may never receive private equity ownership even with a very strong shock (never takers), other companies may always receive private equity ownership even without a shock (always takers), and the remaining entities may or may not receive ownership depending on the shock (compliers).

private equity ownership is different depending on whether the target is public or private. For private targets, private equity ownership leads to a significant growth in employment and revenues but for public targets we find a contrasting result where private equity ownership actually leads to a reduction in assets, employment and revenues of these firms. We also show that profitability follows a similar pattern and decreases in targets. for companies and increases in private targets. Some of these findings contrast with the prior studies, while other findings confirm the prior studies.

We also use this instrument to examine the effect of private equity ownership on within firm investment, acquisition activity, workforce changes and innovation. Existing work has shown that private equity ownership leads to more investment for private to private deals, more add-on acquisitions, higher quality innovation and changes in workforce composition. We find that the number of add-on acquisitions goes down significantly for public companies but not for private companies. On the labour side, we find that for public targets there is a significant reduction in the labour force and that this is accompanied by a decrease in labour profitability. In contrast for private targets we find an increase in the size of the labour force and an increase in labour profitability. As regards innovation, we find some evidence of an effect of private equity ownership on the volume and likelihood of patenting activity. Our research shows that care is needed when interpreting studies on private equity firms that do not rely on exogenous variation for identification.

Our paper makes several contributions. First, it contributes to the literature by providing undervaluation as a motivating factor for LBOs. Our second main contribution is that we use fire sales as an instrument for private equity ownership and which allows us to test in a much cleaner way than prior studies the effects of PE ownership. We show that not all findings from previous studies that use matching to control for target selection bias hold when using our cleaner methodology. In particular our study finds different results to

prior work regarding the effects of private equity ownership on firm performance (including profitability, growth in assets growth in revenue) but also its effects on key firm policy decisions (including investment, acquisition activity, workforce changes and innovation).

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9 Figures

Figure 1: Private equity deals by target status over time
This figure shows the public-to-private deals and private-to-private deals by private equity from eight European countries between 2004–2019.

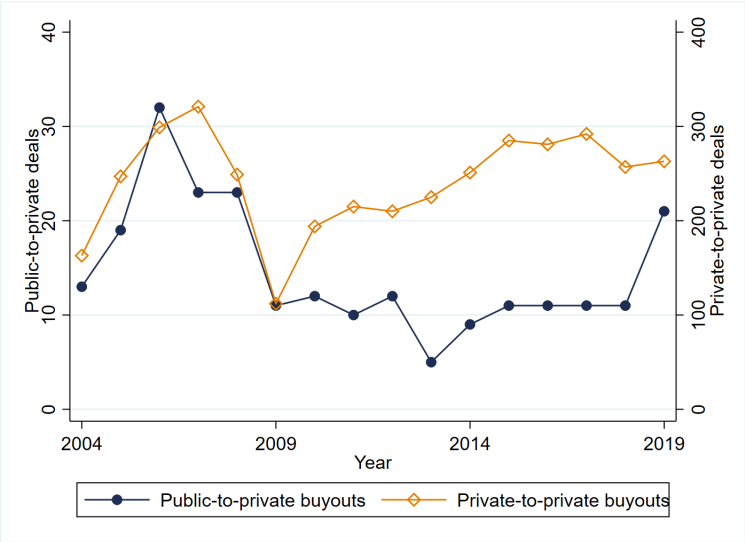
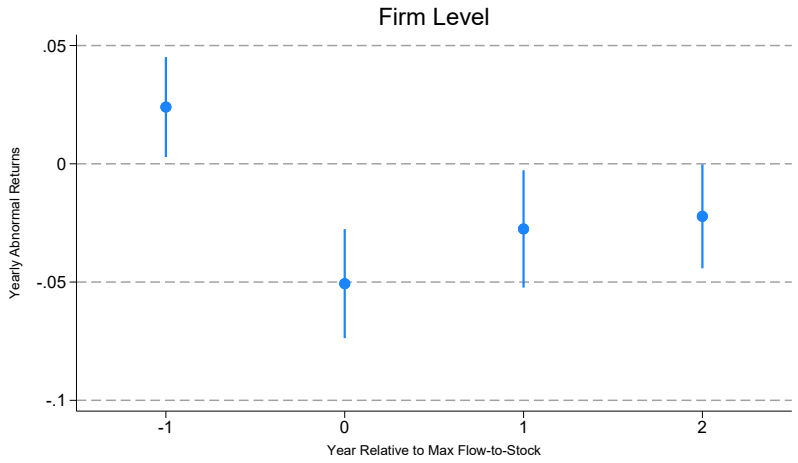
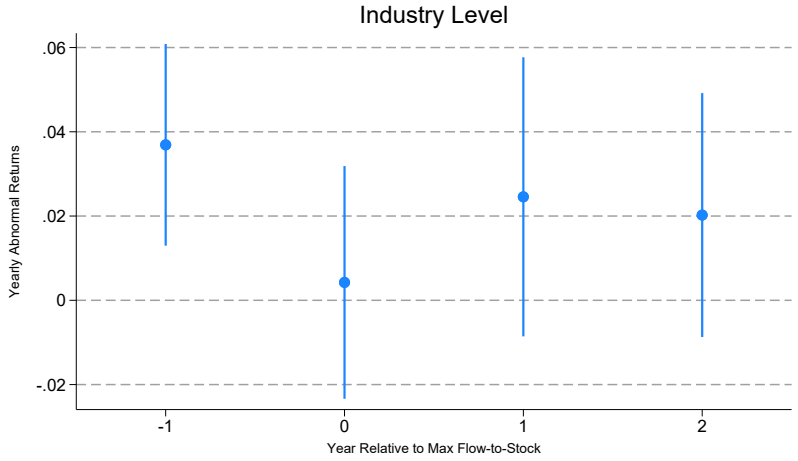


Figure 2: Illustration stock price pressure for firms and industries
This figure shows an event study around the max outflow event on a company-level. We regress the the yearly abnormal returns at the firm level (Panel A) and at the industry level (Panel B) for a set of dummies around the event, controlling for firm and country-year fixed effects on the firm level and for country-industry and country-year fixed effects. Standard errors are clustered at the country-year level. The max outflow event is the largest company-level undervaluation or yearly country-industry undervaluation in the sample. Undervaluation measures are based on Wardlaw (2020). Abnormal returns are presented on the y-axis and the event period around the fire sales are presented on the x-axis. The sample includes all listed firms in our eight European countries between 2003 and 2018.



Panel A: Firm level



Panel B: Industry level

Figure 3: Illustration stock price pressure by size and proportion
This figure shows the yearly price pressure for country-industries using the Wardlaw (2020) measure by the size of the shock and proportion of companies in an industry affected by the shock for the event periods around the fire sales. A strong shock identifies the largest shock in the industry over the sample window. We split the sample by high and low proportion of companies affected based on the industry median. The sample country-industry observations with listed firms in our eight European countries between 2003 and 2018.

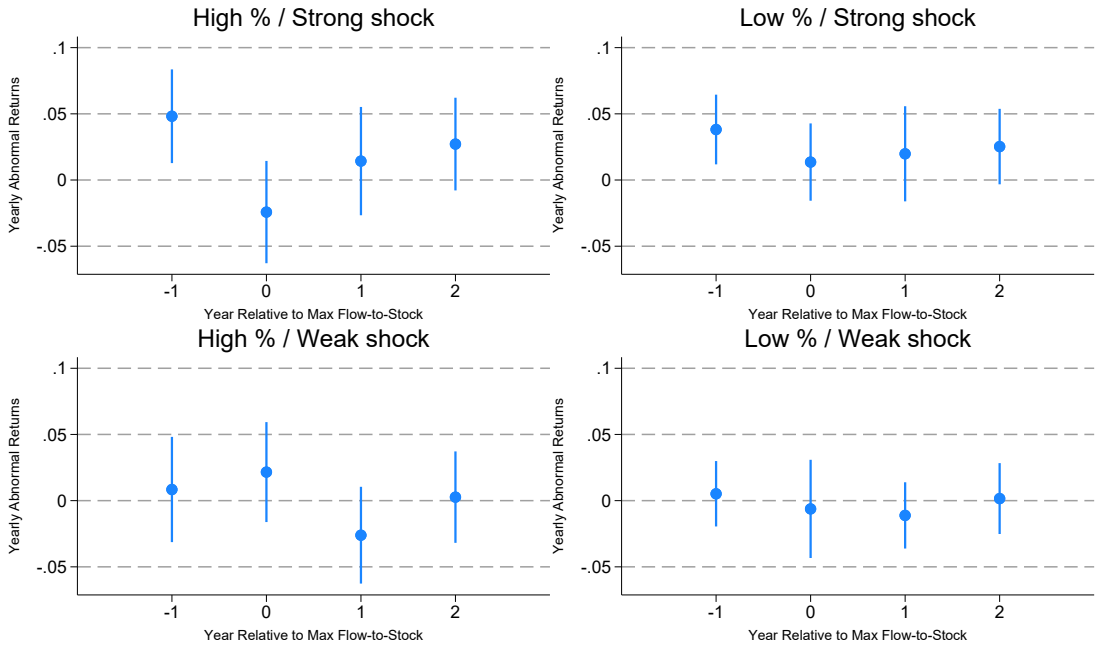


Figure 4: Proportion of companies affected by undervaluation
This figure shows the percentage of public companies that experienced undervaluation in the past year (FTS) or in the past two years (FTS 2) over time. The sample includes all listed firms in our eight European countries between 2005 and 2018. The yearly price pressure is based on the measure by Wardlaw (2020).

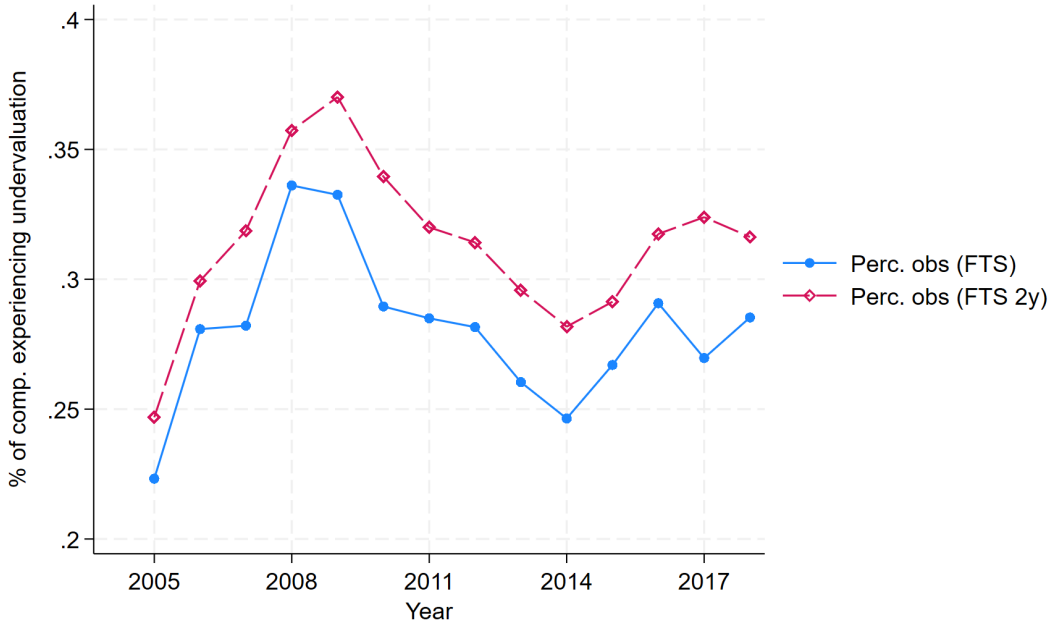
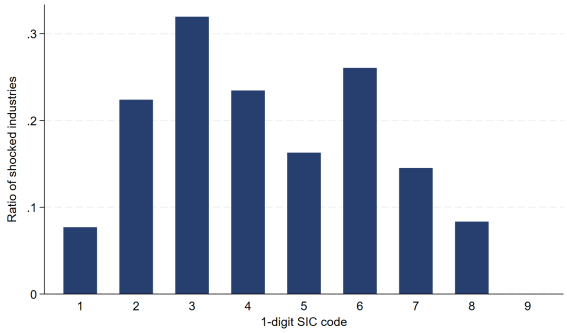
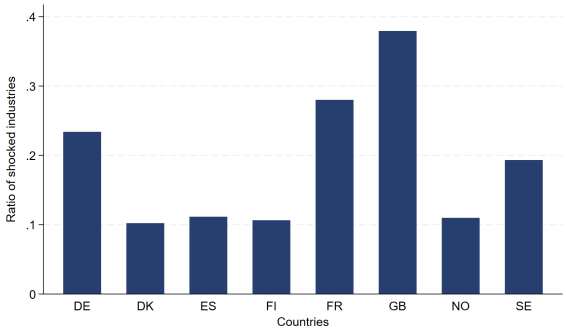


Figure 5: Proportion of industries affected by undervaluation

This figure shows the proportion of country-industries experiencing undervaluation within 1-digit SIC codes (Panel A), countries (Panel B), and over time (Panel C). In Panel C, the dashed line represents the proportion of industries affected by the shock and the solid line represents the mean size of the shock. The sample includes 3-digit SIC country-industry observations in our eight European countries between 2003 and 2017. The yearly price pressure is based on the measure by Wardlaw (2020).



Panel A: By industry



Panel B: By country

Panel C: By time

10 Tables

Table 1: Buyouts by countries and industries
The sample consists of buyouts completed between 2004 and 2018. We split the sample by the listed status of the target company. Panel A represents the deal count by country and Panel B represents the deal count by 1-digit SIC code.

	Panel A: Countries			
	Public buyouts		Private buyouts	
	N	%	N	%
Denmark	5	2.3	85	2.1
Finland	7	3.2	233	5.7
France	12	5.5	715	17.5
Germany	15	6.9	454	11.1
Norway	15	6.9	234	5.7
Spain	7	3.2	447	11.0
Sweden	22	10.1	349	8.5
United Kingdom	134	61.8	1,565	38.3
Total	217	100.0	4,082	100

	Panel B: 1-digit SIC codes			
	Public buyouts		Private buyouts	
	N	%	N	%
1	11	5.1	151	3.7
2	20	9.2	470	11.5
3	19	8.8	648	15.9
4	34	15.7	320	7.8
5	30	13.8	587	14.4
6	20	9.2	787	19.3
7	67	30.9	740	18.1
8	16	7.4	377	9.2
9	0	0.0	2	0.0
Total	217	100	4,082	100

Table 2: Undervaluation and private equity ownership

This table shows the relation between company-level undervaluation from mutual fund fire sales on the probability of being a target in a private equity buyout. The sample consists of company-year observations of public buyout targets between 2004 and 2018 and of their industry peers. The dependent variable is in indicator variable equal to 1 for company-years in which a company is a target and 0 otherwise. Observations after the year of the buyout are excluded for targets. FTSDUMMY (t-2) is an indicator variable equal to 1 if a company experiences outflows (FTS > 0) two periods before, and 0 otherwise. FTS is a continuous measure for price pressure from Wardlaw (2020). FTS 2y is the mean FTS over the past two years. Controls are lagged by one period and include the return on assets and total revenue of the company. Specifications include company, country-year, and industry-year fixed effects as indicated. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	PE	PE	PE	PE	PE	PE
FTSDUMMY (t-2)	0.008***	0.004***	0.005***			
	(6.21)	(2.83)	(3.00)			
FTS 2y				0.007***	0.003***	0.004***
				(6.58)	(2.75)	(2.71)
Return on assets			0.001			0.001
			(0.35)			(0.44)
Total revenue (ln)			-0.000			0.000
			(-0.49)			(0.06)
Observations	32,951	32,485	30,542	37,421	36,996	35,688
Mean Y	.005	.004	.004	.004	.004	.004
Public deals	149	128	125	156	145	145
N (shock)	9,655	9,597	9,325	9,518	9,512	9,512
F-test	38.58	8.00	3.4	43.29	7.56	2.84
Company FE		✓	✓		✓	✓
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table 3: Undervaluation and private equity activity

This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018. The dependent variable in columns 1–3 is the number of private equity deals in a country-industry-year, in column 4 the number of private equity deals in the next three years, in column 5 an indicator for a private equity deal, and in column 6 the sum of the target size measured by total assets in a country-industry-year. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if $FTSINDUSTRY > 0$ and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE deals (ln)	(2) PE deals (ln)	(3) PE deals (ln)	(4) PE deals 3y (ln)	(5) PE	(6) Total assets (ln)
FTSINDUSTRYDUMMY	0.055***	0.053***	0.026***	0.038***	0.047***	0.524***
	(7.60)	(6.97)	(4.32)	(6.88)	(6.79)	(5.58)
Nr. of companies (ln)		0.029***	0.016***	0.021***	0.021***	0.268***
		(11.55)	(9.01)	(12.15)	(10.94)	(9.95)
Listed assets (ln)		-0.030***	-0.019**	-0.023***	-0.020**	-0.121
		(-3.10)	(-2.33)	(-3.15)	(-2.40)	(-0.98)
Av. PE deals 3y (ln)			0.471***	0.455***		
			(16.20)	(16.41)		
PE					0.131***	
					(11.45)	
Av. PE assets 3y (ln)						0.229***
						(10.47)
Observations	35,209	32,670	32,670	28,461	32,670	32,670
Mean Y	.110	.110	.110	.128	.121	1.260
N (shock)	8,358	8,366	8,366	7,479	8,366	8,366
F-test	57.75	49.75	95.44	107.7	83.27	56.72
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table 4: Undervaluation and private deal values

This table shows the relation between industry-level undervaluation of the target and deal values in private buyouts. The sample consists of private buyouts between 2004 and 2018 with sufficient information on the deal value. In columns 1–3, we use as the dependent variable the deal value for 100 per cent of the equity plus total debt to total assets ratio (DTA multiple). In columns 4–6, we use the revenue multiple, calculated as the deal value for 100 per cent of the equity divided by the total revenue of the target, as the dependent variable. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. In column 6, we split FITSINDUSTRY into four quartiles (q=1 to q=4). As controls we include the return on assets, total revenue (ln), and leverage of the target company in the pre-deal year. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) DTA mutiple	(2) DTA mutiple	(3) DTA mutiple	(4) Rev. multiple	(5) Rev. multiple	(6) Rev. multiple
FTSINDUSTRYDUMMY	-0.220**			-0.353**		
	(-2.43)			(-2.00)		
FTSINDUSTRY		-4.142			-13.152**	
		(-1.65)			(-2.57)	
FTSINDUSTRY [q=2]			-0.198			-0.110
			(-1.64)			(-0.44)
FTSINDUSTRY [q=3]			-0.152			-0.331*
			(-1.56)			(-1.71)
FTSINDUSTRY [q=4]			-0.356***			-0.666**
			(-2.76)			(-2.51)
Return on assets	-1.217***	-1.206***	-1.197***	-0.621	-0.531	-0.559
	(-3.66)	(-3.62)	(-3.55)	(-1.18)	(-1.00)	(-1.07)
Revenue (ln)	-0.030	-0.036*	-0.030	-0.255***	-0.262***	-0.261***
	(-1.50)	(-1.83)	(-1.53)	(-4.07)	(-4.12)	(-4.11)
Leverage	0.024***	0.024***	0.024***	0.027***	0.027***	0.027***
	(6.75)	(6.71)	(6.76)	(4.82)	(5.15)	(4.76)
Observations	655	655	655	657	657	657
F-test	18.95	16.55	13.09	20.71	24.99	14.91
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table 5: Undervaluation and types of private equity deals

This table shows the relation between different types of private equity deals and undervaluation from mutual fund fire sales on an country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018. The dependent variable in columns 1–3 measure respectively the number of public-to-private buyouts, private-to-private buyouts, and the number of follow-on acquisitions. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if $FTSINDUSTRY > 0$ and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Buyouts			**Total assets**		
	(1) Public (ln)	(2) Private (ln)	(3) Follow-ons (ln)	(4) Public (ln)	(5) Private (ln)	(6) Follow-ons (ln)
FTSINDUSTRYDUMMY	0.003**	0.025***	0.009**	0.091***	0.462***	0.044
	(2.49)	(4.09)	(2.32)	(2.78)	(5.51)	(0.95)
Nr. of companies (ln)	0.001***	0.016***	0.006***	0.023***	0.242***	0.047***
	(2.76)	(8.72)	(5.14)	(2.73)	(9.29)	(3.51)
Listed assets (ln)	0.001	-0.021***	-0.011**	0.043	-0.176	-0.059
	(0.89)	(-2.68)	(-2.33)	(1.11)	(-1.59)	(-1.12)
Av. public deals 3y (ln)	0.211***					
	(5.14)					
Av. private deals 3y (ln)		0.471***				
		(16.36)				
Av. FO deals 3y (ln)			0.483***			
			(16.04)			
Av. public assets 3y (ln)				0.169***		
				(3.88)		
Av. private assets 3y (ln)					0.192***	
					(7.79)	
Av. FO assets 3y (ln)						0.149***
						(4.71)
Observations	32,670	32,670	32,670	32,670	32,670	32,670
Mean Y	.004	.110	.045	.091	.957	.306
N (shock)	8,366	8,366	8,366	8,366	8,366	8,366
F-test	10.27	97.23	74.10	8.871	30.10	8.57
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table 6: Pre-deal company characteristics

Pre-deal characteristics of treated and matched control observations in the year before the buyout. The sample consists of buyouts completed between 2004 and 2018 and the (matched) industry peers of the target company. Panel A presents the sample of public-to-private buyouts and listed industry peers. Panel B presents the sample of private-to-private buyouts and matched industry peers. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public sample

	Performance			Size			Labour	
	ROA	ROS	ATR	Oper. Rev. (ln)	Tot. Assets (ln)	Empl. (ln)	Lab. prof.	Lab. prod.
Buyouts								
Observations	211	211	211	211	211	210	210	210
Mean	0.045	0.051	0.959	19.326	19.033	6.693	0.056	0.370
Std. Dev.	0.143	0.371	0.642	1.627	1.546	1.725	0.263	0.640
Median	0.054	0.066	0.874	19.121	18.837	6.742	0.013	0.216
Controls								
Observations	2,265	2,227	2,265	2,265	2,227	2,079	2,079	2,079
Mean	-0.041	-0.202	1.078	17.714	17.352	5.150	0.038	0.373
Std. Dev.	0.328	1.033	0.958	2.345	2.453	2.235	0.270	0.635
Median	0.043	0.046	0.843	17.457	17.140	4.860	0.009	0.187
Buyouts-Control								
Mean diff	0.087***	0.253***	-0.119*	1.612***	1.681***	1.542***	-0.003	0.019
(T-stat)	(3.80)	(3.54)	(-1.77)	(9.77)	(9.77)	(9.71)	(-0.07)	(0.96)

Panel B: Private sample

	Performance			Size			Labour	
	ROA	ROS	ATR	Oper. Rev. (ln)	Tot. Assets (ln)	Empl. (ln)	Lab. prof.	Lab. prod.
Buyouts								
Observations	2,959	2,959	2,959	2,959	2,959	2,546	2,546	2,546
Mean	0.080	0.043	1.644	17.196	17.340	4.945	0.607	0.040
Std. Dev.	0.166	0.234	1.247	1.780	1.694	1.656	1.405	0.158
Median	0.069	0.053	1.416	17.149	17.423	4.977	0.252	0.013
Controls								
Observations	62,907	62,907	62,907	62,907	62,907	47,560	47,560	47,560
Mean	0.077	0.049	1.695	17.162	17.336	4.740	0.731	0.049
Std. Dev.	0.146	0.217	1.257	1.690	1.656	1.624	1.618	0.175
Median	0.060	0.045	1.463	17.160	17.445	4.804	0.297	0.013
Buyouts-Control								
Mean diff	0.003	-0.006	-0.051**	0.034	0.004	0.205***	-0.124***	-0.009**
(T-stat)	(0.95)	(-1.46)	(-2.15)	(1.08)	(0.14)	(6.21)	(-3.79)	(-2.41)

Table 7: Validity of instrument

This table shows the F-statistics of the first-stage estimates of our two-stage (2SLS) panel regressions. The sample consists of buyout targets and their (matched) industry peers for buyouts completed between 2004 and 2015. We include company observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. The dependent variable is *Post* × *PE* and is instrumented by *Post* × *Instrument*. Columns 1–3 represent the different measurements of the instrument. *FTSDUMMY* is an indicator variable equal to 1 if $FTS > 0$ and zero otherwise. *FTS* is a continuous measure for price pressure from Wardlaw (2020). FTS implied is similar to FTS, but is based on implied sales by mutual funds instead of actual sales in line with previous papers. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. *FTSINDUSTRY* implied is similar to *FTSINDUSTRY*, but is based on implied fire sales in mutual funds instead of actual fire sales. Instruments are pre-deal values. Specifications include firm, country-year, and industry-year fixed effects. Standard errors are clustered on a firm and country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Public sample		
	(1)	(2)	(3)
	PE	PE	PE
FTSDUMMY	0.076***		
	(5.69)		
FTS		2.735***	
		(3.10)	
FTS implied			1.962***
			(3.18)
post	0.026***	0.050***	0.050***
	(2.62)	(4.68)	(4.69)
Observations	14,420	14,420	14,420
F-test instrument	32.4	9.6	10.1

	Panel B: Private sample		
	(1)	(2)	(3)
	PE	PE	PE
FTSINDUSTRYDUMMY	0.053***		
	(10.83)		
FTSINDUSTRY		0.917***	
		(5.12)	
FTSINDUSTRY implied			0.594***
			(5.03)
post	0.033***	0.045***	0.046***
	(5.67)	(7.88)	(7.76)
Observations	385,352	385,352	385,352
First-stage F-test	116.6	26.2	25.3

Table 8: Complier characteristics

This table shows statistics on compliers in the public and private deal sample for buyouts completed between 2004 and 2015. The complier percentage coincides with the first-stage regression using the full sample. The fraction of compliers in the treated (controls) is calculated as the first-stage coefficient times the percentage of shocked observations, divided by the percentage of treated (control) observations. The relative complier likelihood indicates whether compliers are more or less likely to have above median characteristics. A value above one suggests above median characteristics. It is calculated as the first-stage coefficient using a sample consisting of companies with above median characteristics only divided by the first-stage coefficient of the full sample.

	Public	Private
Percentage treated observations	6.6%	4.3%
Percentage shocked observations	41.2%	38.7%
Complier percentage	7.6%	5.3%
Fraction of compliers in treated	47.5%	61.4%
Fraction of compliers in controls	3.3%	2.3%

	Public		Private	
	Median sample first-stage coefficient	Relative complier likelihood	Median sample first-stage coefficient	Relative complier likelihood
Return on assets	3.9%	0.52	4.4%	0.82
Return on sales	5.6%	0.74	5.9%	1.10
Total assets (ln)	7.0%	0.92	6.6%	1.25
Total revenue (ln)	7.4%	0.97	6.0%	1.13
Employees (ln)	7.0%	0.93	5.7%	1.07
Labour profitability	5.3%	0.70	4.5%	0.85
Labour productivity	5.6%	0.73	3.7%	0.70
Turnover by assets	4.1%	0.54	2.9%	0.54
Fixed assets (ln)	7.0%	0.93	7.1%	1.34
Fixed assets ratio	8.5%	1.12	6.8%	1.27

Table 9: Profitability and sales growth

Two-stage (2SLS) regressions. This table shows the operating performance of public buyout targets compared to public industry peers in Panel A and of private buyout targets compared to matched industry peers in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. In Panel A, *Post*×*PE* is the predicted variable from the first stage using the annualized measure for flow-to-stock price pressure, *FTSDUMMY*, as instrument for private equity ownership. In Panel B, the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, is used as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Public-to-private deals			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	-0.695***	-2.117***	-4.341***	-0.297
	(-3.83)	(-3.83)	(-5.16)	(-0.89)
Post	0.034*	0.104**	0.317***	0.004
	(1.75)	(2.37)	(5.02)	(0.13)
Observations	14,383	14,157	13,443	14,386
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

	Panel B: Private-to-private deals			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	0.028	0.082**	0.646***	-0.455***
	(1.10)	(2.56)	(3.83)	(-3.69)
Post	-0.007***	-0.001	-0.000	0.017**
	(-4.34)	(-0.46)	(-0.02)	(2.28)
Observations	384,352	384,370	296,964	384,551
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Table 10: Investments

Two-stage (2SLS) regressions. This table shows the investments in (fixed) assets of public-to-private deals by private equity compared to other public entities in Panel A and of private-to-private deals compared to matched industry peers in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. In Panel A, *Post*×*PE* is the predicted variable from the first stage using the annualized measure for flow-to-stock price pressure, *FTSDUMMY*, as instrument for private equity ownership. In Panel B, the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, is used as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	-3.006***	-2.763***	0.157
	(-4.48)	(-3.61)	(1.59)
Post	0.233***	0.218***	-0.005
	(3.92)	(3.52)	(-0.52)
Observations	14,165	14,269	14,386
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Panel B: Private-to-private deals

	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	0.746***	1.250***	0.118***
	(4.87)	(5.00)	(4.00)
Post	0.003	-0.000	-0.002
	(0.41)	(-0.03)	(-0.89)
Observations	385,352	378,177	384,098
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table 11: Acquisitions and divestments

Two-stage (2SLS) regressions. This table shows the acquisition and divestment activity of public-to-private deals by private equity compared to other public entities in Panel A and of private-to-private deals compared to matched industry peers in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. In Panel A, *Post*×*PE* is the predicted variable from the first stage using the annualized measure for flow-to-stock price pressure, *FTSDUMMY*, as instrument for private equity ownership. In Panel B, the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, is used as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE	-0.752***	-6.585***	-0.015	-2.330	-4.287**
	(-4.24)	(-3.00)	(-0.56)	(-1.43)	(-2.02)
Post	0.056***	0.357*	0.003*	0.093	0.273
	(3.86)	(1.96)	(1.79)	(0.80)	(1.36)
Observations	14,420	14,420	14,420	14,420	14,420
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Panel B: Private-to-private deals

	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE)	0.016	0.649***	0.008	0.005	0.573**
	(0.94)	(2.68)	(1.13)	(1.18)	(2.32)
Post	-0.000	-0.024	-0.001	-0.001	-0.032*
	(-0.24)	(-1.47)	(-1.25)	(-1.31)	(-1.86)
Observations	385,352	385,352	385,352	385,352	385,352
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Table 12: Labour outcomes

Two-stage (2SLS) regressions. This table shows the labour outcomes of public-to-private deals by private equity compared to other public entities in Panel A and of private-to-private deals compared to matched industry peers in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. In Panel A, $Post \times PE$ is the predicted variable from the first stage using the annualized measure for flow-to-stock price pressure, $FTSDUMMY$, as instrument for private equity ownership. In Panel B, the industry level price pressure from mutual fund flows, $FTSINDUSTRYDUMMY$, is used as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	Employees (ln)	Labour profitability	Labour productivity
Post × PE	-2.862***	-0.161	-0.416
	(-4.64)	(-1.30)	(-1.47)
Post	0.240***	0.005	0.009
	(5.29)	(0.59)	(0.44)
Observations	13,438	13,443	14,420
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Panel B: Private-to-private deals

	Employees (ln)	Labour profitability	Labour productivity
Post × PE	0.593***	-0.001	-0.048
	(5.60)	(-0.06)	(-0.32)
Post	-0.005	-0.000	-0.005
	(-0.61)	(-0.18)	(-0.44)
Observations	296,437	296,964	385,352
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table 13: Innovation

Two-stage (2SLS) regressions. This table shows the patenting activity of public-to-private deals by private equity compared to other public entities in Panel A and of private-to-private deals compared to matched industry peers in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. In Panel A, $Post \times PE$ is the predicted variable from the first stage using the annualized measure for flow-to-stock price pressure, $FTSDUMMY$, as instrument for private equity ownership. In Panel B, the industry level price pressure from mutual fund flows, $FTSINDUSTRYDUMMY$, is used as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	-2.549**	0.013	-0.041	-0.002
	(-2.34)	(0.29)	(-0.57)	(-0.02)
Post	0.132	0.002	-0.002	0.011**
	(1.58)	(0.38)	(-0.23)	(2.14)
Observations	14,420	14,420	14,420	14,420
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Panel B: Private-to-private deals

	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	-0.315	-0.006	-0.037**	0.068***
	(-0.82)	(-0.71)	(-2.07)	(3.77)
Post	0.023	0.001	0.001	-0.002*
	(1.02)	(1.19)	(1.16)	(-1.68)
Observations	385,352	385,352	385,352	385,352
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

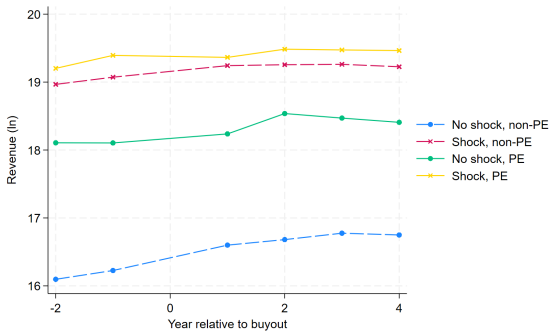
Table 14: Overview of IV and OLS estimates

This table shows the estimated coefficients when using two-stage least squares (2SLS) or ordinary least square (OLS) for public and private buyouts. The full specifications of the 2SLS estimates can be found in Tables 9 to 13 and of the ordinary least squares in Tables OA3.1 to OA3.5 in Appedix OA3. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

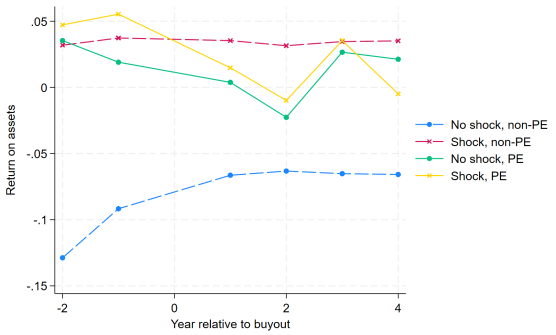
	Public-to-private deals		**Private-to-private deals**	
Outcomes	IV	OLS	IV	OLS
Return on assets	-0.695***	-0.052***	0.028	-0.020***
	(-3.83)	(-4.27)	(1.10)	(-5.51)
Return on sales	-2.117***	-0.141***	0.082**	-0.002
	(-3.83)	(-3.99)	(2.56)	(-0.45)
Operating turnover (ln)	-4.341***	-0.267***	0.646***	0.292***
	(-5.16)	(-3.20)	(3.83)	(11.81)
Turnover by assets	-0.297	-0.180***	-0.455***	-0.270***
	(-0.89)	(-3.81)	(-3.69)	(-11.92)
Total assets (ln)	-3.006***	0.156*	0.746***	0.540***
	(-4.48)	(1.85)	(4.87)	(17.07)
Fixed assets (ln)	-2.763***	0.053	1.250***	0.893***
	(-3.61)	(0.45)	(5.00)	(17.06)
Fixed assets ratio	0.157	-0.009	0.118***	0.100***
	(1.59)	(-0.42)	(4.00)	(16.34)
New deal	-0.752***	-0.091***	0.016	0.020***
	(-4.24)	(-3.22)	(0.94)	(5.23)
Target size	-6.585***	-0.485*	0.649***	0.499***
	(-3.00)	(-1.71)	(2.68)	(8.34)
Divestment dummy	-0.015	-0.021	0.008	0.002
	(-0.56)	(-1.43)	(1.13)	(1.38)
Divestment size	-2.330	0.035	0.005	0.092***
	(-1.43)	(0.21)	(1.18)	(4.42)
Net acquisitions	-4.287**	-0.496	0.573**	0.407***
	(-2.02)	(-1.52)	(2.32)	(7.07)
Employees (ln)	-2.862***	-0.306***	0.593***	0.249***
	(-4.64)	(-3.01)	(5.60)	(10.40)
Labour profitability	-0.161	-0.001	-0.001	0.003
	(-1.30)	(-0.05)	(-0.06)	(0.98)
Labour productivity	-0.416	0.127***	-0.048	0.025
	(-1.47)	(2.75)	(-0.32)	(0.84)
Stock of patents	-2.549**	-0.811**	-0.315	0.145
	(-2.34)	(-2.28)	(-0.82)	(1.57)
Exploitative ratio	0.013	-0.008	-0.006	-0.002
	(0.29)	(-1.05)	(-0.71)	(-1.04)
Explorative ratio	-0.041	-0.034**	-0.037**	-0.003
	(-0.57)	(-2.19)	(-2.07)	(-0.80)
Patent dummy	-0.002	0.023	0.068***	0.052***
	(-0.02)	(1.61)	(3.77)	(10.05)

Appendix

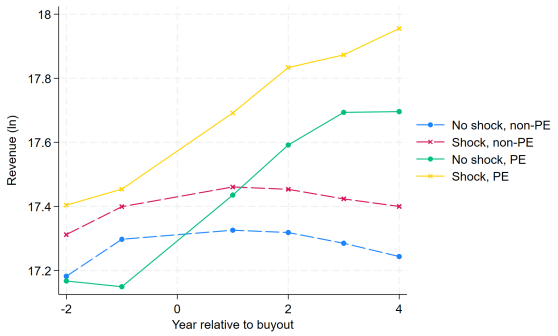
Figure A1.1: Development of performance by PE status and undervaluation
This figure shows development of total revenue and return on assets for public and private observations. We split the samples into four groups based on two dimensions, namely whether a company is private equity-owned or not and whether a company experiences undervaluation or not.



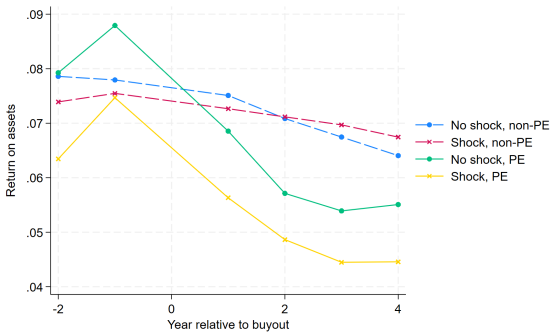
Panel A: Public revenue



Panel B: Public ROA



Panel A: Private revenue



Panel B: Private ROA

Table A1.1: Variable description

This table provides the descriptions of the operating outcome variables. All variables in the paper are winsorized at the 1% and 99% level. Variables are constructed using the financials of the target company, its subsidiaries over time, and newly incorporated acquisition vehicles for the treated observations. For controls, we do not explicitly follow the subsidiaries, but we use the consolidated statements where available and otherwise unconsolidated statements of the control company.

Variable	Description
Return on assets	Earnings before interest and taxes divided by the total assets.
Return on sales	Earnings before interest and taxes divided by the total operating revenue.
Operating revenue (ln)	Natural logarithm of the operating revenue.
Total assets (ln)	Natural logarithm of the total assets.
Fixed assets (ln)	Natural logarithm of the total fixed assets.
Fixed assets ratio	Total fixed assets divided by the total assets.
Target size (ln)	The sum of pre-deal target total assets in natural logarithm in the year of the follow-on deal. Note that target size here refers to the targets in deals in which the PE-owned entity (or one of its subsidiaries) or its industry peer is the acquiring company. Information on the deals is collected from Zephyr, target financials are collected from Orbis.
Cum. Target size (ln)	Cumulative sum of target size over the event window.
Deal dummy	Binary variable that is equal to 1 when a treated or control company completes an acquisition in a year, and is 0 otherwise.
Cumulative deals	Cumulative sum of the deal dummy over the event window.
Employment (ln)	Natural logarithm of the number of employees.
Labour profitability	Earnings before interest and taxes (in millions) divided by the number of employees.
Labour productivity	Operating revenue (in millions) divided by the number of employees.
Patents stock	Number of patents filed today plus the present value of the patent stock of the previous period, where the present value of the patent stock is the patent stock of the previous period times a 15% depreciation rate per period.
Exploitative patent ratio (%)	Number of patent filings identified as exploitative divided by the total number of patents filed.
Exploratory patent ratio (%)	Number of patent filings identified as exploratory divided by the total number of patents filed.
Patent dummy	Binary variable equal to one when a company files for a patent and equal to zero otherwise.

Table A1.2: Statistics of public companies by undervaluation and PE status
This table shows the summary statistics on company characteristics of public companies. In Panel A, we split the sample by company-year observations that experience undervaluation. Undervaluation is measured using *FTS*. In Panel B, we split the sample by company-year observations that were the target in a buyout (PE) or not (Non-PE). The sample includes listed companies between 2004 and 2018.

Panel A: By undervaluation

	Shocked			Non-Shocked				
	N	Mean	Std. dev.	N	Mean	Std. dev.	T-test	
Return on assets	12,446	0.028	0.186	34,758	-0.054	0.291	0.082***	(29.43)
Return on sales	12,287	-0.067	0.895	33,031	-0.367	1.443	0.300***	(21.52)
Revenue per asset	12,446	0.919	0.784	34,758	0.811	0.907	0.108***	(11.82)
Labour prof.	11,707	0.093	0.502	26,160	0.058	0.533	0.035***	(5.94)
Labour prod.	11,707	0.552	1.031	26,160	0.546	1.221	0.005	(0.40)
Total assets (ln)	12,446	19.666	2.019	34,758	17.355	2.449	2.311***	(94.41)
Total revenue (ln)	12,275	19.142	2.114	32,964	16.322	2.745	2.820***	(103.00)
Employees (ln)	11,707	6.582	2.169	26,160	4.242	2.297	2.340***	(93.18)

Panel B: By PE status

	PE			Non-PE				
	N	Mean	Std. dev.	N	Mean	Std. dev.	T-test	
Return on assets	210	0.049	0.119	45,801	-0.035	0.273	0.084***	(4.46)
Return on sales	210	0.037	0.383	43,915	-0.296	1.342	0.333***	(3.60)
Revenue per asset	210	0.962	0.700	45,801	0.834	0.881	0.128**	(2.11)
Labour prof.	203	0.027	0.286	36,508	0.070	0.530	-0.043	(-1.15)
Labour prod.	203	0.525	1.151	36,508	0.551	1.170	-0.026	(-0.32)
Total assets (ln)	210	19.342	1.774	45,801	17.931	2.565	1.410***	(7.96)
Total revenue (ln)	210	18.955	1.811	43,836	17.034	2.889	1.921***	(9.63)
Employees (ln)	203	6.575	1.914	36,508	4.913	2.510	1.662***	(9.42)

Table A1.3: Statistics on undervaluation measures

This table shows the summary statistics on our measures for undervaluation and private equity activity. In Panel A, the sample includes company-year observations between 2004 and 2018. In Panel B, the sample includes country-industry-year observations between 2004 and 2018. *Conditional* in Panel B indicates industry observations with at least one active public firm.

	Panel A: Public company deals and flows				
	Obs	Mean	Std. dev.	Min	Max
Public-to-private deals	47,204	0.004	0.061	0	1
FTSDUMMY	47,204	0.263	0.440	0	1
FTS	47,204	0.002	0.006	0	0.048
FTSDUMMY 2y	44,260	0.314	0.464	0	1
FTS 2y	44,260	0.002	0.005	0	0.048

	Panel B: Industry-level deals and flows				
	Obs	Mean	Std. dev.	Min	Max
Private equity deals	35,209	0.220	1.06	0	64
Public-to-private deals	35,209	0.006	0.084	0	4
Private-to-private deals	35,209	0.214	1.04	0	63
Follow-on deals	35,209	0.086	0.658	0	53
FTSINDUSTRYDUMMY	35,209	0.226	0.418	0	1
FTSINDUSTRY conditional	13,919	0.449	0.497	0	1
FTSINDUSTRY	35,209	0.001	0.003	0	0.015
Public assets (%)	35,209	0.147	0.303	0	1
Public assets (%) conditional	13,919	0.376	0.385	0	1

Table A1.4: Undervaluation and private equity ownership

This table shows the relation between company-level undervaluation from mutual fund fire sales on the probability of being a target in a private equity buyout. The sample consists of company-year observations of public buyout targets between 2004–2018 and of their industry peers. The dependent variable is in indicator variable equal to 1 for company-years in which a company is a target and 0 otherwise. Observations after the year of the buyout are excluded for targets. FTSDUMMY is an indicator variable equal to 1 if FTS > 0 and 0 otherwise. FTS is a continuous measure for price pressure from Wardlaw (2020). We include the one-year, two-year, and three-year lag. Controls are lagged by one period and include the return on assets and total revenue of the company. Specifications include company, country-year, and industry-year fixed effects as indicated. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	PE	PE	PE	PE	PE	PE
FTSDUMMY (t-1)	-0.001			-0.002	-0.005**	-0.005**
	(-0.71)			(-0.86)	(-2.11)	(-2.11)
FTSDUMMY (t-2)		0.004***		0.008***	0.005**	0.005**
		(2.83)		(2.93)	(2.36)	(2.32)
FTSDUMMY (t-3)			0.005***	0.003	0.003*	0.003*
			(2.77)	(1.41)	(1.78)	(1.79)
Return on assets						0.001
						(0.35)
Total revenue (ln)						-0.000
						(-0.21)
Observations	36,996	32,485	28,415	27,098	26,664	26,010
F-test	0.498	7.994	7.691	11.59	3.854	2.503
Company FE	✓	✓	✓		✓	✓
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table A1.5: Patent statistics

This table shows the summary statistics on patenting activity by public and private buyout targets and their (matched) industry peers). The sample includes buyouts completed between 2004 and 2015. For treated and controls, we include comany-year observations from two years before the buyout and up to four years after.

	Public sample			Private sample		
	PE-owned	Non-PE-owned	Total	PE-owned	Non-PE-owned	Total
Company-years	1,124	13,453	14,577	13,887	371,720	385,607
Filing company-years (N)	79	580	659	799	8445	9244
Filing company-years (%)	7.0%	4.3%	4.5%	5.8%	2.3%	2.4%
Patent filings (N)	1381	9,289	10,670	4,918	122,113	127,031
Mean filings (full sample)	1.23	0.69	0.73	0.35	0.33	0.33
Mean filings (filing years)	17.48	16.02	16.19	6.16	14.46	13.74
Exploitative patents (N)	392	1,646	2,038	1,002	26,629	27,631
Exploitative patents (%)	28.4%	17.7%	19.1%	20.4%	21.8%	21.8%

Undervaluation Induced LBOs

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Online Appendix. Not for Publication

OA1 Identification of ownership and ownership-level financials

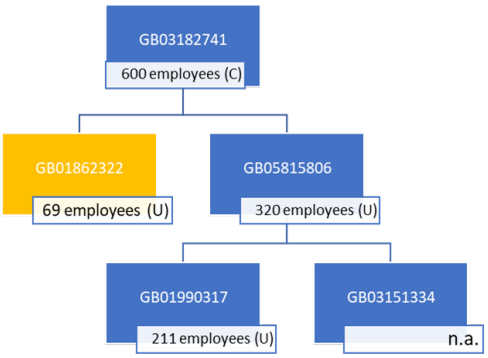
The analysis of a company's operating performance around a change in ownership may be problematic when the account that reports the financials changes. When using Orbis data, several changes that may be happening include: A) The change from consolidated to unconsolidated financials and B) the reporting after the deal is done by a different company than before the deal. This latter may be the case when the target company stops reporting because of a restructuring.

Consider the following example from our deal sample. In 2012 Parseq (formerly known as Intelligent Environments) was taken private by Nova Capital Management and Harbourvest Partners. A special acquisition vehicle, CNH Bidco Ltd, was set up in 2011 to complete the transaction. Up to 2012 the target reports consolidated statements, but from 2013 it stops reporting completely. Instead, the acquisition vehicle starts reporting consolidated statements. Thus, if we were to use company-financials only, we would not be able to estimate the changes brought by private equity.

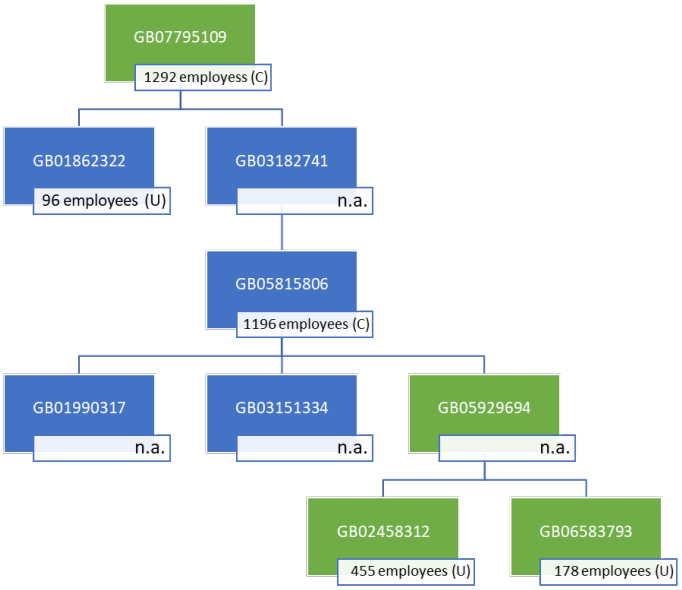
In this example, several restructuring activities occur. For example, in 2013 Parseq completes a follow-on acquisition. The financials of this target become part of the consolidated statements of the acquisition vehicle, as do the financials of other legal entities which were also added to the ownership structure as subsidiaries. A second restructuring example regards one of the original subsidiaries of Parseq. This entity becomes a direct subsidiary of the acquisition vehicle. Lastly, the original target goes in liquidation in 2014 and is dissolved in 2016, wheres CNH Bidco and other subsidiaries continue to report financials afterwards.

In Figure OA1.1, we provide a simplified view on the ownership structure in the pre-deal period (2011) and post-deal period (2013) using the BvDID codes since these are more consistent than company names. We take these two years given that there is often a one-year lag in the publication of ownership links and several restructuring activities took place when the target was taken private. For each legal entity, we provide the number of employees when reported and whether this was reported on an unconsolidated (U) or consolidated basis (C). From the figure, we can see a) the incorporation of the newco that starts reporting financials (GB07795109) and the target that stops reporting (GB03182741), b) restructuring of original subsidiary (GB01862322), and c) the addition of new subsidiaries (GB05929694). Overall, it exemplifies why company-level financials may be insufficient to capture the entire corporate activity after a takeover.

Figure OA1.1: Ownership structure of Parseq
This figure provides a simplified overview of the ownership structure of Parseq before the deal in 2011 (Panel A) and after the deal in 2013 (Panel B).



Panel A: Parseq in 2011



Panel B: Parseq in 2013

In this paper, we aim to collect consistent financials of the entire ownership structure around the deal. To do so, we take the following steps. First, using the ownership data in Orbis, for each company that publishes financials in one of our eight countries, we identify the shareholder that holds more than a 50% ownership stake in that company in a given year. If multiple shareholders are provided in one year, we keep the last reported subsidiary-shareholder relation. Using these relations, we can identify which companies belong to the same controlling owner that itself is not owned by a majority shareholder. These companies belong to the same ownership structure. Since in some cases the controlling owner may be a bank, fund, or other, we only keep "Corporate" companies according to the Orbis company type classification.

Second, we match all companies to the financial reports, whether consolidated or unconsolidated. If a company reports both accounts, we use the consolidated statements. Note that within the ownership structures, we know each shareholder-subsidiary relation. Therefore, we can use the statements to "deconsolidate" the consolidated statements by subtracting the financials of all direct and indirect subsidiaries of a particular company.[29]

[29]In our earlier example of Parseq, the deconsolidated number of employees of the target in the pre-

We are left with unconsolidated statements and deconsolidated statements which we can use to create ownership-level financials. Since these financials include all current subsidiaries, we control for changes in reporting accounts and for divestitures or add-ons. For the private equity target companies, we use the financials of the target company, any acquisition vehicle, and of the subsidiaries over time. We identify acquisition vehicles as shareholders which are incorporated around the date of the deal. Note that we exclude financials of older shareholders of the target, since this way we can control for carve-outs.

Finally, we need to be able to track the ownership structures over time, which is not straightforward when companies change ownership structures. For example, when two companies merge using a newly incorporated acquisition vehicle, a new ownership structure is formed in the data. But does that mean that before the merger there is no relevant account for this structure? Or that after the merger we cannot track the performance of the two companies anymore? We propose to identify ownership structures over time based on the original target company for treated structures.

To shed some light on the importance of this methodological adjustment, we provide a simple exercise and compare the financials of our method to using standard company-level financials for the public targets. When we look at the observations for which we have sufficient financials in Table OA1.1, we notice that using ownership-level financials captures are larger portion of the original targets. In the pre-deal year, we have financials of more than 200 targets when using ownership-level financials, whereas this number is well below 200 in the sample using company-level financials. Furthermore, while both samples show a drop in the availability of financials over time, the drop is much more severe in the case of company-level financials.[30]

Table OA1.1: Availability of financials over the event window
This table provides the count of public target company-year observations with sufficient financials over the event window using either only company-level financials or financials based on the ownership structure.

Year relative to deal	Company-level obs.	Ownership-level obs.
-2	165	200
-1	167	211
1	94	203
2	91	179
3	78	173
4	61	158
Total	656	1,124

Next, we compare the size of the two treated groups over time. In Figure OA1.2, we plot

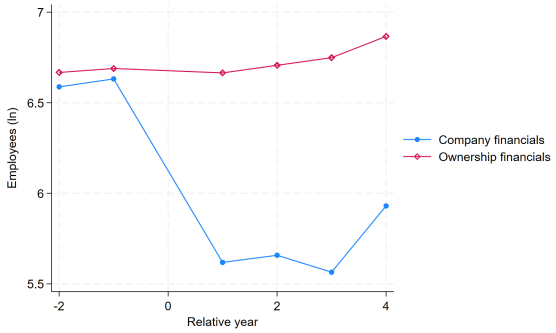
deal year would be $600 - 69 - 320 - 211 = 0$. In this case, all the unconsolidated statements add up to the number of the consolidated statement. In the post-deal year, the deconsolidated financials of the Newco are $1292 - 96 - 455 - 178 = 563$. Note that in the post-deal year there are two entities that report consolidated financials. We deconsolidated the statement of the highest legal entity and discard the lower-level consolidated statement since that is already included in the statement of the higher entity.

[30]The drop in observations over time may have several reasons, such as bankruptcies and exits, which represent valid operating reasons for why financials become unavailable. However, some observations may stop reporting for unclear reasons and these may represent problematic cases. The comparison between the company-level and ownership-level financials clearly indicates that the sample with company-level financials is more severely influenced by shifts in the legal entities that report the statements rather than a structural operating reason.

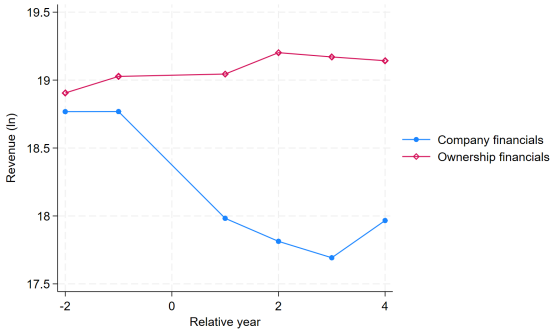
the average number of employees (Panel A), total revenue (Panel B), and total assets (Panel C) over time. The line with solid circles represents financials based on target company-level information only and the hollow diamonds is based on our method of ownership-level financials. In all three graphs there is a very clear difference in the development of size. In terms of employment and revenue, the company-level financials show a strong decrease while ownership-level financials show a moderate but stable increase. Turning to the assets, the company-level financials do show a more consistent development, however this seems to be an underestimate of the total investments when we compare it to the ownership-level financials which show a robust growth.

Figure OA1.2: Size development when using company-level and ownership-level financials

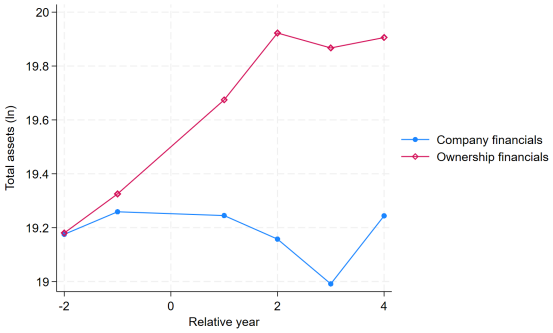
This figure plots the average levels of employment (Panel A), revenue (Panel B), and total assets (Panel C) for public targets. The lines with hollow diamonds present the averages when using financials from the ownership structure and the line with solid dots the financials when using target company information only.



Panel A: Employment



Panel B: Revenue



Panel C: Assets

We can also more formally test these differences in a regression model. We employ a simple difference-in-difference setting and present the results in Table OA1.2 for several outcomes. Note that all three size measures are much larger when using the ownership-level financials as indicated by *PostxOwnership*. Thus, using company-level financials underestimates the size or growth of private equity targets. However, for profitability and productivity measures, we do not find a significant difference. Excluding the financials of important subsidiaries and target companies therefore does not seem to be related to any particular bias, however we caution to interpret this as a motive for using company-level financials, since in each sample the mismeasurement may still lead to wrong conclusions.

Table OA1.2: Comparison ownership to company-level financials

Ordinary least squares (OLS) regressions. This table shows OLS estimates in a difference-in-difference framework of the influence of using ownership level financials on the development of several company outcomes. The sample includes public buyout targets between 2004 and 2015. We include companies observations from two years before the deal up to four years after. *PostxOwnerhip* identifies observations using ownership level financials. Specifications include company, country-year, and industry-year fixed effects as indicated. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) ROA	(2) ROS	(3) ATR	(4) Assets (ln)	(5) Revenue (ln)	(6) Empl. (ln)	(7) Lab. prof.	(8) Lab. prod.
PostxOwnership	0.000	0.093	0.012	0.471***	0.867***	0.901***	0.007	-0.209
	(0.02)	(1.26)	(0.17)	(4.47)	(3.82)	(3.04)	(0.14)	(-1.02)
Post	0.007	-0.086	-0.125	-0.134	- 0.861***	- 1.079***	0.055	0.145
	(0.33)	(-0.87)	(-1.17)	(-0.88)	(-2.95)	(-3.50)	(0.57)	(0.57)
Observations	1,098	1,098	1,100	1,100	1,108	990	986	990
Company FE	✓	✓	✓	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓	✓	✓

OA2 Robustness to private equity deal activity and undervaluation

Table OA2.1: Undervaluation and private equity deals: Excluding industries without listed firms

Ordinary least squares (OLS) and linear probability model (LPM). This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018 but excludes industries that do not have any listed firm during the sample period. The dependent variable in column 1 is the number of total private equity deals. In column 2, the dependent variable is an indicator variable for private equity activity and estimated using a linear probability model. In columns 3–5, the dependent variables are the total number of private equity deals with public targets, private targets, and follow-on deals respectively. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE deals (ln)	(2) PE indicator	(3) Public-to-private (ln)	(4) Private-to-private (ln)	(5) Follow-ons (ln)
FTSINDUSTRYDUMMY	0.019***	0.082***	0.006***	0.039***	0.022***
	(2.88)	(7.74)	(5.12)	(3.58)	(5.54)
Nr. of companies (ln)	0.032***	0.039***	0.002***	0.023***	0.009***
	(9.64)	(13.53)	(4.97)	(13.63)	(7.75)
Listed assets (ln)	-0.009	0.035***	0.006***	0.027***	0.013**
	(-0.97)	(2.84)	(3.61)	(3.00)	(2.16)
Av. PE deals 3y (ln)	0.443***				
	(15.29)				
PE Dummy 3y		0.207***			
		(11.93)			
Av. Public-to-private PE deals 3y (ln)			0.255***		
			(3.58)		
Av. private-to-private PE deals 3y (ln)				0.611***	
				(9.97)	
Av. Follow-on deals 3y (ln)					0.623***
					(7.67)
Observations	23,602	24,169	24,169	24,169	24,169
F-test	84.85	111.2	8.043	131.1	45.46
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Table OA2.2: Undervaluation and private equity deals: Excluding industries with listed firms

Ordinary least squares (OLS) and linear probability model (LPM). This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018 but excludes industries that have a listed firm at least once during the sample period. The dependent variable in column 1 is the number of total private equity deals. In column 2, the dependent variable is an indicator variable for private equity activity and estimated using a linear probability model. In columns 3–5, the dependent variables are the total number of private equity deals with public targets, private targets, and follow-on deals respectively. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE indicator	(2) Private-to-private deals (ln)	(3) Private-to-private assets (ln)	(4) Follow-ons deals (ln)	(5) Follow-ons assets (ln)
FTSINDUSTRYDUMMY	0.040***	0.018*	0.327**	0.006	0.050
	(2.86)	(1.80)	(2.32)	(0.94)	(0.61)
Nr. of companies (ln)	0.010***	0.006***	0.064***	0.003***	0.035***
	(6.97)	(6.01)	(6.64)	(4.21)	(3.93)
PE Dummy 3y	0.160***				
	(7.38)				
Av. private-to-private PE deals 3y (ln)		0.391***			
		(7.96)			
Av. private-to-private PE assets 3y (ln)			0.123***		
			(3.38)		
Av. Follow-on deals 3y (ln)				0.452***	
				(7.59)	
Av. Follow-on assets 3y (ln)					0.331***
					(3.42)
Observations	15,253	15,253	15,253	15,253	15,253
F-test	36.53	60.34	16.64	44.37	10.61
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Table OA2.3: Undervaluation and private equity deals: Excluding industries without private equity activity

Ordinary least squares (OLS) and linear probability model (LPM). This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018 but excludes industries that do not have any private equity deal activity during the sample period. The dependent variable in column 1 is the number of total private equity deals. In column 2, the dependent variable is an indicator variable for private equity activity and estimated using a linear probability model. In columns 3–5, the dependent variables are the total number of private equity deals with public targets, private targets, and follow-on deals respectively. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE deals (ln)	(2) PE indicator	(3) Public-to-private (ln)	(4) Private-to-private (ln)	(5) Follow-ons (ln)
FTSINDUSTRYDUMMY	0.019***	0.079***	0.006***	0.037***	0.024***
	(2.93)	(7.09)	(4.82)	(3.22)	(6.51)
Nr. of companies (ln)	0.035***	0.042***	0.002***	0.024***	0.010***
	(9.80)	(13.61)	(4.77)	(13.26)	(8.03)
Listed assets (ln)	0.003	0.044***	0.007***	0.032***	0.018***
	(0.32)	(3.45)	(3.35)	(3.41)	(2.77)
Av. PE deals 3y (ln)	0.457***				
	(14.34)				
PE Dummy 3y		0.222***			
		(11.76)			
Av. Public-to-private PE deals 3y (ln)			0.256***		
			(3.59)		
Av. private-to-private PE deals 3y (ln)				0.634***	
				(10.02)	
Av. Follow-on deals 3y (ln)					0.638***
					(6.91)
Observations	19,268	19,899	19,899	19,899	19,899
F-test	81.46	114.8	7.248	141.4	45.47
Country-year FE	✓	✓	✓		
Industry-year FE	✓	✓	✓		

Table OA2.4: Undervaluation and private equity deals under different market conditions

Ordinary least squares (OLS). This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on a country-industry-year level under different economic market conditions. The sample consists of country-industry-year observations between 2004 and 2018. Hot deal markets are defined as years with deal activity above the sample median and cold deal markets are defined as years with deal activity below the sample median. Columns 3–4 split the sample by the annual credit spread, calculated as the difference between the high-yield interest rate and risk-free rate. Columns 5–6 split the sample by the annual GDP growth of the country. The dependent variable is the number of total private equity deals (ln). *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if $FTSINDUSTRY > 0$ and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on a country-industry-year level. Controls include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. All independent variables are lagged by one period. Specifications include country-year and industry-year fixed effects. Standard errors are clustered on a country-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	PE deals (ln)					
	(1) Hot deal market	(2) Cold deal market	(3) High yield spread	(4) Low yield spread	(5) High GDP growth	(6) Low GDP growth
FTSINDUSTRYDUMMY	0.035***	0.018**	0.030***	0.026***	0.029**	0.024***
	(3.97)	(2.16)	(3.75)	(3.29)	(2.34)	(3.59)
Nr. of companies (ln)	0.019***	0.013***	0.012***	0.018***	0.019***	0.015***
	(6.77)	(6.64)	(4.46)	(8.26)	(6.78)	(6.64)
Listed assets (ln)	-0.020	-0.017	-0.011	-0.024**	-0.014	-0.021**
	(-1.60)	(-1.63)	(-0.93)	(-2.31)	(-0.99)	(-2.29)
Av. PE deals 3y (ln)	0.504***	0.415***	0.345***	0.525***	0.498***	0.468***
	(14.91)	(8.37)	(8.39)	(16.07)	(10.02)	(13.38)
Observations	17,060	15,610	9,042	23,628	9,340	22,766
F-test	87.81	27.63	23.36	100.2	44.44	64.52
Country-year FE	✓	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓	✓

Table OA2.5: Undervaluation and private equity deals using FTSINDUSTRY
Ordinary least squares (OLS) and linear probability model (LPM). This table shows the relation between private equity deals and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018. The dependent variable in column 1 is the number of total private equity deals. In column 2, the dependent variable is an indicator variable for private equity activity and estimated using a linear probability model. In columns 3–5, the dependent variables are the total number of private equity deals with public targets, private targets, and follow-on deals respectively. *FTSINDUSTRY* is a continuous measure for undervaluation from mutual fund fire sales on an country-industry-year level. Control variables are lagged by one period and include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. Specifications year fixed effects. Standard errors are clustered on an industry level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE deals (ln)	(2) PE indicator	(3) Public-to-private (ln)	(4) Private-to-private (ln)	(5) Follow-ons (ln)
FTSINDUNSTRY	2.975***	8.814***	0.789***	4.935***	2.974***
	(3.69)	(6.98)	(3.27)	(4.04)	(5.78)
Nr. of companies (ln)	0.017***	0.043***	0.001***	0.019***	0.008***
	(9.08)	(14.18)	(5.71)	(14.64)	(10.17)
Listed assets (ln)	-0.016**	0.055***	0.005***	0.028***	0.014***
	(-1.99)	(4.34)	(3.92)	(5.63)	(4.17)
Av. PE deals 3y (ln)	0.472***				
	(16.34)				
PE Dummy 3y		0.224***			
		(12.29)			
Av. Public-to-private PE deals 3y (ln)			0.257***		
			(3.67)		
Av. private-to-private PE deals 3y (ln)				0.632***	
				(11.06)	
Av. Follow-on deals 3y (ln)					0.634***
					(8.03)
Observations	32,670	19,899	32,993	32,993	32,993
F-test	95.24	102	9.517	112	42.13
Country-year FE	✓	✓	✓		
Industry-year FE	✓	✓	✓		

Table OA2.6: Undervaluation intensity and private equity deal activity
Ordinary least squares (OLS). This table shows the relation between private equity deals and the intensity of the undervaluation from mutual fund fire sales on an country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018. The dependent variable in columns 1–3 is the number of total private equity deals. *FTSINDUSTRYDUMMY high* is an indicator variable equal to 1 for observations with undervaluation above the sample median and otherwise 0. *FTSINDUSTRYDUMMY low* is an indicator variable equal to 1 for observations with undervaluation below the sample median and otherwise 0. *FTSINDUSTRY* is a continuous measure of undervaluation. Control variables are lagged by one period and include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. Specifications year fixed effects. Standard errors are clustered on an industry level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1)	(2)	(3)
	PE deals (ln)	PE deals (ln)	PE deals (ln)
FTSINDUSTRYDUMMY high	0.028***		
	(3.49)		
FTSINDUSTRYDUMMY low		0.008	
		(1.12)	
FTSINDUSTRY			2.975***
			(3.69)
Nr. of companies (ln)	0.017***	0.017***	0.017***
	(9.05)	(9.12)	(9.08)
Listed assets (ln)	-0.015*	-0.012	-0.016**
	(-1.94)	(-1.60)	(-1.99)
Av. PE deals 3y (ln)	0.472***	0.475***	0.472***
	(16.34)	(16.20)	(16.34)
Observations	32,670	32,670	32,670
F-test	94.86	96.73	95.24
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table OA2.7: Undervaluation and private equity deals using different lags
Ordinary least squares (OLS). This table shows the relation between private equity deals and undervaluation from mutual fund fire sales on a country-industry-year level. The sample consists of country-industry-year observations between 2004 and 2018. The dependent variable in columns 1–4 is the number of total private equity deals. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if *FTSINDUSTRY* > 0 and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on an country-industry-year level. We include three lags of FTSINDUSTRDUMMY. Control variables are lagged by one period and include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. Specifications year fixed effects. Standard errors are clustered on an industry level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1)	(2)	(3)	(4)
	PE deals (ln)	PE deals (ln)	PE deals (ln)	PE deals (ln)
FTSINDUSTRYDUMMY (t-1)	0.026***			-0.015
	(4.32)			(-1.32)
FTSINDUSTRYDUMMY (t-2)		0.031***		0.018
		(5.14)		(1.46)
FTSINDUSTRYDUMMY (t-3)			0.036***	0.033***
			(6.26)	(3.58)
Nr. of companies (ln)	0.016***	0.016***	0.016***	0.016***
	(9.01)	(8.93)	(8.79)	(8.80)
Listed assets (ln)	-0.019**	-0.019**	-0.023***	-0.023***
	(-2.33)	(-2.46)	(-2.80)	(-2.74)
Av. PE deals 3y (ln)	0.471***	0.470***	0.470***	0.470***
	(16.20)	(16.30)	(16.31)	(16.30)
Constant	-0.038***	-0.038***	-0.039***	-0.039***
	(-3.39)	(-3.42)	(-3.40)	(-3.39)
Observations	32,670	32,637	30,529	30,529
F-test	95.44	96.37	95.36	64.78
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Table OA2.8: Undervaluation and private equity deals on industry-year level
Ordinary least squares (OLS) and linear probability model (LPM). This table shows the relation between private equity deal activity and undervaluation from mutual fund fire sales on an industry-year level. The sample consists of industry-year observations between 2004 and 2018. The dependent variable in columns 1 and 2–4 is the number of private equity deals. In column 2, the dependent variable is an indicator variable for private equity activity and estimated using a linear probability model. *FTSINDUSTRYDUMMY* is an indicator variable equal to 1 if $FTSINDUSTRY > 0$ and zero otherwise, where *FTSINDUSTRY* is a measure for undervaluation from mutual fund fire sales on an industry-year level. Control variables are lagged by one period and include the number of companies, percentage of assets held by listed companies, and measures of past private equity activity. Specifications year fixed effects. Standard errors are clustered on an industry level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	(1) PE deals (ln)	(2) PE indicator	(3) Public-to-private (ln)	(4) Private-to-private (ln)	(5) Follow-ons (ln)
FTSINDUSTRYDUMMY	0.094***	0.114***	0.008***	0.093***	0.046***
	(5.50)	(7.96)	(3.20)	(5.46)	(4.52)
Nr. of companies (ln)	0.022***	0.033***	0.002***	0.022***	0.011***
	(13.64)	(17.73)	(6.59)	(13.53)	(10.10)
Listed assets (ln)	0.006	0.015**	0.005***	0.005	0.009*
	(1.00)	(2.50)	(2.66)	(0.87)	(1.94)
Av. PE deals 3y (ln)	0.686***				
	(25.15)				
PE Dummy 3y		0.328***			
		(17.09)			
Av. Publ-to-priv deals 3y (ln)			0.367***		
			(3.52)		
Av. priv-to-priv deals 3y (ln)				0.686***	
				(25.12)	
Av. FO deals 3y (ln)					0.678***
					(21.67)
Observations	7,862	7,862	7,862	7,862	7,862
F-test	495	505	21.47	488.3	211.8
Year FE	✓	✓	✓	✓	

OA4 Robustness and further tests

Table OA4.1: Second stage coefficients with continuous instrument
This table replicates the estimated private equity effect ($Post \times PE$) for the outcomes of Tables 9–13 when using the continuous *FTS* or *FTSINUDSTRY* as the instrument in the first stage to predict private equity ownership. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Public buyouts		Private buyouts	
	Coefficient	T-stat	Coefficient	T-stat
Return on assets	-0.857**	(-2.13)	0.076	(1.50)
Return on sales	-2.145***	(-2.63)	0.197**	(2.53)
Operating turnover (ln)	-4.015***	(-2.88)	1.720***	(5.65)
ATR	-0.348	(-0.66)	-0.305	(-1.60)
Total assets (ln)	-2.598*	(-1.94)	1.614***	(6.66)
Fixed assets (ln)	-2.879*	(-1.75)	1.972***	(5.19)
Fixed assets ratio	0.093	(0.47)	0.113**	(2.51)
New deal	-1.126***	(-2.62)	0.025	(0.83)
Target size	-14.782**	(-2.12)	0.136	(0.34)
Divestment dummy	-0.064	(-0.76)	0.015*	(1.75)
Divestment size	-5.397	(-1.15)	0.009	(1.60)
Net acquisitions	-9.626	(-1.34)	0.129	(0.32)
Employees (ln)	-3.510**	(-2.59)	1.006***	(4.82)
Labour profitability	-0.019	(-0.09)	0.062*	(1.73)
Labour productivity	-0.165	(-0.40)	0.263	(1.09)
Patent stock	-3.543	(-1.26)	-0.601	(-1.00)
Exploitative ratio	0.004	(0.05)	0.003	(0.29)
Explorative ratio	-0.419**	(-2.09)	-0.011	(-0.43)
Patent dummy	0.039	(0.22)	0.015	(0.64)

Table OA4.2: Performance of large and small private targets

Two-stage (2SLS) regressions. This table shows the estimated outcomes of private-to-private deals compared to matched industry peers by size of the target. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. $Post \times PE$ is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, $FTSINDUSTRYDUMMY$, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Large private buyouts		Small private buyouts	
	Coefficient	T-stat	Coefficient	T-stat
Return on assets	-0.061	(-1.46)	0.219**	(2.39)
Return on sales	0.182	(1.62)	0.203**	(2.14)
Operating turnover (ln)	0.834***	(2.76)	2.650***	(5.72)
ATR	-0.302	(-1.38)	-0.386	(-1.24)
Total assets (ln)	0.604**	(2.59)	2.706***	(6.43)
Fixed assets (ln)	0.868**	(2.02)	3.292***	(5.52)
Fixed assets ratio	0.091	(1.50)	0.142**	(2.31)
New deal	0.081	(1.46)	-0.016	(-0.68)
Target size	0.567	(0.85)	-0.364	(-1.03)
Divestment dummy	0.028*	(1.86)	0.003	(0.38)
Divestment size	0.017*	(1.76)	0.001	(0.30)
Net acquisitions	0.577	(0.86)	-0.385	(-0.99)
Employees (ln)	0.768***	(3.09)	1.213***	(4.08)
Labour profitability	0.030	(0.54)	0.105**	(2.33)
Labour productivity	-0.119	(-0.32)	0.690**	(2.21)
Patent stock	-0.153	(-0.15)	-0.738	(-1.52)
Exploitative ratio	0.014	(0.67)	-0.001	(-0.07)
Explorative ratio	0.043	(0.88)	-0.050*	(-1.82)
Patent dummy	0.044	(1.18)	-0.002	(-0.05)

Table OA4.3: Profitability and sales growth

Two-stage (2SLS) regressions. This table shows the operating performance of private-to-private deals compared to matched industry peers. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. *Post*×*PE* is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Large targets			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	-0.061	0.182	0.834***	-0.302
	(-1.46)	(1.62)	(2.76)	(-1.38)
Post	-0.001	-0.009	-0.026	0.022*
	(-0.35)	(-1.46)	(-1.36)	(1.75)
Observations	201,605	201,612	161,525	201,724
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

	Panel B: Small targets			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	0.219**	0.203**	2.650***	-0.386
	(2.39)	(2.14)	(5.72)	(-1.24)
Post	-0.018***	-0.004	-0.097***	-0.004
	(-3.52)	(-0.76)	(-3.57)	(-0.22)
Observations	182,029	182,040	134,979	182,109
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Table OA4.4: Investments

Two-stage (2SLS) regressions. This table shows the investments in (fixed) assets of private-to-private deals compared to matched industry peers. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. $Post \times PE$ is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, $FTSINDUSTRYDUMMY$, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Large targets		
	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	0.604**	0.868**	0.091
	(2.59)	(2.02)	(1.50)
Post	-0.006	0.003	-0.002
	(-0.47)	(0.11)	(-0.49)
Observations	202,169	199,926	201,562
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

	Panel B: Small targets		
	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	2.706***	3.292***	0.142**
	(6.43)	(5.52)	(2.31)
Post	-0.083***	-0.084**	-0.001
	(-3.50)	(-2.58)	(-0.16)
Observations	182,467	177,567	181,822
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table OA4.5: Acquisitions

Two-stage (2SLS) regressions. This table shows the acquisition and divestment activity of private-to-private deals compared to matched industry peers. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. *Post*×*PE* is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Large targets				
	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE)	0.081	0.567	0.028*	0.017*	0.577
	(1.46)	(0.85)	(1.86)	(1.76)	(0.86)
Post	-0.005	-0.028	-0.001	-0.001	-0.065*
	(-1.46)	(-0.72)	(-1.16)	(-1.10)	(-1.67)
Observations	202,169	202,169	202,169	202,169	202,169
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

	Panel B: Small targets				
	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE)	-0.016	-0.364	0.003	0.001	-0.385
	(-0.68)	(-1.03)	(0.38)	(0.30)	(-0.99)
Post	0.001	0.036	-0.001	-0.001	0.049*
	(0.66)	(1.47)	(-1.40)	(-1.44)	(1.84)
Observations	182,467	182,467	182,467	182,467	182,467
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Table OA4.6: Labour outcomes

Two-stage (2SLS) regressions. This table shows the labour outcomes of private-to-private deals compared to matched industry peers. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. *Post*×*PE* is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Large targets		
	Employees (ln)	Labour profitability	Labour productivity
Post × PE	0.768***	0.030	-0.119
	(3.09)	(0.54)	(-0.32)
Post	-0.024	-0.001	-0.001
	(-1.38)	(-0.27)	(-0.03)
Observations	161,205	161,525	202,169
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

	Panel B: Small targets		
	Employees (ln)	Labour profitability	Labour productivity
Post × PE	1.213***	0.105**	0.690**
	(4.08)	(2.33)	(2.21)
Post	-0.037*	-0.009***	-0.055***
	(-1.95)	(-3.41)	(-2.74)
Observations	134,769	134,979	182,467
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table OA4.7: Innovation

Two-stage (2SLS) regressions. This table shows the patenting activity of private-to-private deals compared to matched industry peers. Panel A includes target companies and their peers with pre-deal assets below the sample median (small targets) and Panel B includes includes target companies and their peers with assets above the sample median (large targets). The sample consists of buyout targets and matched industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. *Post*×*PE* is the predicted variable from the first stage using the industry level price pressure from mutual fund flows, *FTSINDUSTRYDUMMY*, as the instrument. Instruments are pre-deal values. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Large targets			
	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	-0.153	0.014	0.043	0.044
	(-0.15)	(0.67)	(0.88)	(1.18)
Post	0.023	-0.000	-0.003	0.000
	(0.38)	(-0.36)	(-1.14)	(0.03)
Observations	202,169	202,169	202,169	202,169
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

	Panel B: Small targets			
	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	-0.738	-0.001	-0.050*	-0.002
	(-1.52)	(-0.07)	(-1.82)	(-0.05)
Post	0.042	0.000	0.002	0.001
	(1.47)	(0.47)	(1.36)	(0.60)
Observations	182,467	182,467	182,467	182,467
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

OA3 OLS results

Table OA3.1: OLS estimates for profitability and sales growth
Ordinary least squares (OLS) regressions. This table replicates the results on operating performance from Table 9 using a matched difference-in-difference framework, estimated using OLS. Results on public buyout targets are in Panel A and for private buyout targets in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Public-to-private deals			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	-0.052***	-0.141***	-0.267***	-0.180***
	(-4.27)	(-3.99)	(-3.20)	(-3.81)
Post	-0.003	-0.011	0.079***	-0.003
	(-0.27)	(-0.42)	(2.72)	(-0.13)
Observations	14,383	14,156	14,158	14,386
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

	Panel B: Private-to-private deals			
	ROA	ROS	Oper. Rev. (ln)	ATR
Post × PE	-0.020***	-0.002	0.292***	-0.270***
	(-5.51)	(-0.45)	(11.81)	(-11.92)
Post	-0.004***	0.004**	0.019***	0.007
	(-4.79)	(2.06)	(3.33)	(1.52)
Observations	384,352	384,370	385,352	384,551
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Table OA3.2: OLS estimates for investments

Ordinary least squares (OLS) regressions. This table replicates the results on investments in (fixed) assets from Table 10 using a matched difference-in-difference framework, estimated using OLS. Results on public buyout targets are in Panel A and for private buyout targets in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

	Panel A: Public-to-private deals		
	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	0.156*	0.053	-0.009
	(1.85)	(0.45)	(-0.42)
Post	0.050*	0.055	0.005
	(1.73)	(1.42)	(0.82)
Observations	14,386	14,269	14,386
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

	Panel B: Private-to-private deals		
	Total assets (ln)	Fixed assets (ln)	Fixed assets ratio
Post × PE	0.540***	0.893***	0.100***
	(17.07)	(17.06)	(16.34)
Post	0.015***	0.019***	-0.001
	(3.91)	(2.82)	(-0.63)
Observations	384,551	378,177	384,098
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table OA3.3: OLS estimates for acquisitions and divestments
Ordinary least squares (OLS) regressions. This table replicates the results on acquisition and divestment activity from Table 11 using a matched difference-in-difference framework, estimated using OLS. Results on public buyout targets are in Panel A and for private buyout targets in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE	-0.091***	-0.485*	-0.021	0.035	-0.496
	(-3.22)	(-1.71)	(-1.43)	(0.21)	(-1.52)
Post	0.017*	0.005	0.004**	-0.041	0.054
	(1.84)	(0.04)	(2.01)	(-0.48)	(0.38)
Observations	14,386	14,386	14,386	14,386	14,386
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Panel B: Private-to-private deals

	New deal	Total acq. size (ln)	New divestment	Total div. size (ln)	Net acquisitions
Post × PE	0.020***	0.499***	0.002	0.092***	0.407***
	(5.23)	(8.34)	(1.38)	(4.42)	(7.07)
Post	-0.001	-0.016	-0.000	0.007	-0.023*
	(-0.64)	(-1.53)	(-0.97)	(1.07)	(-1.96)
Observations	385,352	385,352	385,352	374,599	385,352
Company FE	✓	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓	✓

Table OA3.4: OLS estimates for labour outcomes

Ordinary least squares (OLS) regressions. This table replicates the results on labour outcomes from Table 12 using a matched difference-in-difference framework, estimated using OLS. Results on public buyout targets are in Panel A and for private buyout targets in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	Employees (ln)	Labour profitability	Labour productivity
Post × PE	-0.306***	-0.001	0.127***
	(-3.01)	(-0.05)	(2.75)
Post	0.100***	-0.004	-0.020
	(4.31)	(-0.64)	(-1.52)
Observations	13,440	13,438	13,440
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Panel B: Private-to-private deals

	Employees (ln)	Labour profitability	Labour productivity
Post × PE	0.249***	0.003	0.025
	(10.40)	(0.98)	(0.84)
Post	0.017***	-0.001	-0.010
	(3.26)	(-0.51)	(-1.38)
Observations	296,964	296,437	296,964
Company FE	✓	✓	✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓

Table OA3.5: OLS estimates for innovation

Ordinary least squares (OLS) regressions. This table replicates the results on patenting activity from Table 13 using a matched difference-in-difference framework, estimated using OLS. Results on public buyout targets are in Panel A and for private buyout targets in Panel B. The sample consists of buyout targets and their (matched) industry peers for deals completed between 2004 and 2015. We include companies observations from two years before the deal up to four years after. For controls the deal year refers to the year in which we match the treated to controls. All regressions include company, country-year, and industry-year fixed effects. Standard errors are clustered on a company and industry-year level. ***, **, and * stand for a 1%, 5%, and 10% significance level respectively.

Panel A: Public-to-private deals

	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	-0.811**	-0.008	-0.034**	0.023
	(-2.28)	(-1.05)	(-2.19)	(1.61)
Post	0.037	0.003	-0.002	0.009***
	(0.68)	(0.89)	(-0.32)	(3.16)
Observations	14,386	14,386	14,386	14,386
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓

Panel B: Private-to-private deals

	Patents stock	Exploit (%)	Explore (%)	Patent dummy
Post × PE	0.145	-0.002	-0.003	0.052***
	(1.57)	(-1.04)	(-0.80)	(10.05)
Post	-0.002	0.000	-0.001	-0.001*
	(-0.23)	(1.35)	(-0.83)	(-1.75)
Observations	385,352	385,352	385,352	385,352
Company FE	✓	✓	✓	✓
Country-year FE	✓	✓	✓	✓
Industry-year FE	✓	✓	✓	✓