Do Buy and Build Strategies Increase Illiquidity of Private Equity Investments?*

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Abstract

Increasing holding periods are a notable trend in private equity and a concern to limited partners because they tie up committed capital. I investigate whether the frequent use of Buy and Build (B&B) strategies can explain this trend. I find that B&B increases holding periods by up to 29%, which is robust to different identification strategies including the application of a survival-time treatment effect estimator. Further investigating channels through which B&B increases holding periods, I identify factors that can mitigate but not avoid prolongation. Thus, my findings point at increasing illiquidity risk as an unintended "dark side" of B&B strategies.

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1 Introduction

Increasing holding periods are a notable trend in the private equity (PE) industry. As I show in this paper, the average holding period of all 2012 exits (5.3 years) is up by 60% compared to all 2003 exits (3.3 years). This is a concern to both general partners (GPs) and limited partners (LPs) because longer holding periods make it more difficult to generate a sufficient internal rate of return (IRR) and increase illiquidity of committed capital. Existing literature provides evidence for such illiquidity concerns. For example, Cumming et al. (2005a) find that investment decisions strongly depend on liquidity conditions; Cumming et al. (2005b) document an adverse impact of illiquidity on future fundraising; and Sorensen et al. (2014) theoretically show that LPs require significant compensation for illiquidity.

A second important trend in the PE industry is the use of so-called Buy and Build (B&B) strategies in which a PE fund acquires a portfolio company as a platform for so-called add-on acquisitions: as the sample used in this paper documents, approximately 39% of all deals exited in 2012 made use of B&B strategies, compared to only 25% of all deals exited in 2003. Previous literature and recent industry reports[1] highlight the advantages of B&B. For example, Acharya et al. (2013) find abnormal margin and multiple improvements of deals with add-on acquisitions and Nikoskelainen and Wright (2007) find that the probability for a positive deal return is significantly higher in case of acquisition activity during the holding period. However, in light of the growing importance of B&B, it is also necessary to examine potential disadvantages. This paper is the first to address this research gap.

The aim of this paper is to investigate whether the use of B&B strategies can explain increasing holding periods in the PE industry and thus whether illiquidity is an unintended "dark-side" of B&B strategies. There are four major theoretical arguments for an increase of the holding period through B&B. The first argument relates to additional transaction costs. If portfolio firms acquire companies during the holding period, they need to engage in several

[1] See, for example, *"The Power of Buy and Build"* by The Boston Consulting Group or *"The Global Private Equity Report 2012"* by Bain & Company.

time-consuming processes such as (i) acquiring information about possible targets, (ii) conducting due-diligence, (iii) communicating with lawyers, advisors or institutional bodies, (iv) bargaining about acquisition prices and contractual terms, (v) arranging deal-financing, and (vi) integrating add-ons into the existing institutional structure. Some of these processes likely benefit from the sophistication of the PE owner (Cao et al., 2015; Cumming and MacIntosh, 2001) but even for specialized financial intermediaries like PE firms it is unlikely that add-on acquisitions come at zero transaction costs. Second, it is important to consider that the economic rationale of B&B strategies rests on economies of scale and efficiency improvements between the platform and add-on companies (Smit, 2001). Because it takes time for these B&B benefits to be reflected in the portfolio company valuation, it will also take time until the PE sponsor can realize the maximum compensation for the exit, which is an ultimate goal in a PE transaction (Kaplan and Strömberg, 2009). Third, add-on acquisitions cause opportunity costs. The limited attention hypothesis (Cumming and Dai, 2011; Humphery-Jenner, 2013) suggests that acquisition processes may distract attention from other value creation measures and, because the portfolio firm grows in size and complexity, there is a latent risk that PE and portfolio firm managers are overstretched in terms of implementing value creation measures and monitoring their progress. Thus, it may take longer for the portfolio company to grow in value and, again, PE owners will be tempted to hold the asset longer to realize the full value creation potential (Cumming and Johan, 2010). Finally, there is an information asymmetry problem between the buyer and the seller at exit because add-on acquisitions could be the result of opportunistic behavior rather than of an economic rationale.[2] Therefore, following the idea of Cumming and Johan (2010), Cumming and MacIntosh (2003) and Cumming and MacIntosh (2001), PE firms have incentives to remain invested in the portfolio company for some time after the add-on acquisition to signal economic value to potential buyers and reduce agency costs.

To investigate whether B&B strategies increase PE holding periods, I collect a comprehensive

[2] For example, anecdotal evidence suggests that PE firms have an incentive to utilize add-on acquisitions for "aging assets" to create a promising equity story to buyers. For further information, see the Silverfleet Capital *Buy and Build Monitor 2011.*

sample of 9,548 worldwide buyouts including 5,093 exits between 1998 and 2012 and 4,937 add-on acquisitions. I conduct my analyses in three steps.

First, I follow the literature on buyout duration (e.g. Espenlaub et al., 2015; Giot and Schwienbacher, 2007; Jelic, 2011) and employ a parametric accelerated failure time (AFT) model to obtain baseline results. I find an increase of the holding period through B&B of up to 22%, which coincides with a prolongation of the holding period from 3.7 to 4.5 years. This finding is robust to various control variables such as the buyout entry channel, participation of the portfolio firm management, deal syndication, institutional affiliation of the PE sponsor, fund maturity, fund size, acquisition experience of the PE and portfolio firm, profitability, size and interest coverage ratio of the portfolio firm as well as several fixed effects.

Second, I am interested in identifying the causal effect of B&B on holding periods. I address the identification problem in several ways. The start of my analyses is the, to the best of my knowledge, first application of a survival-time treatment effect estimator in the PE and VC literature. This estimator is a particularly powerful econometric tool because, next to censoring processes which can also be handled by traditional survival-analysis, it can model non-random assignment to treatment and/or duration. I back up this analysis by traditional propensity score matching and nearest neighbor estimators. All these statistical models confirm my baseline results in terms of statistical significance. The economic significance is, depending on the estimator and model, even larger and suggests and increase of the holding period of up to 29% (from 3.7 to 4.8 years) when controlling for self-selection on the basis of observable characteristics. Because self-selection could also occur on the basis of unobservable characteristics, I close the endogeneity discussion by estimating a two-stage endogenous treatment regression using the local market share of B&B deals as the exclusion restriction. I find that all B&B coefficients remain statistically and economically significant and that there is no evidence for a self-selection bias. These findings are also robust to using two-stage least squares instrumental variable (2SLS IV) regressions and to alternative instruments.

Finally, I investigate the channels through which B&B increases holding periods to detect factors that mitigate or avoid the B&B effect on holding periods. I consider three sets of channels. At first, I test whether the holding period is sensitive to the nature of the B&B strategy. I find that the number of add-on acquisitions has significant explanatory power for holding period prolongation. B&B strategies with multiple add-on acquisitions increase the holding period by up to 28%, whereas B&B strategies with a single add-on acquisition increase the holding period by only 18%. I also examine whether differences in holding periods exist for cross-border versus domestic B&B and for industry diversifying versus industry penetrating B&B but, as it turns out, the prolongation is roughly similar to the baseline results for any of these B&B strategies. Next, I test whether the B&B effect is sensitive to the exit channel using a competing risks regression framework. I find longer holding periods for deals with B&B for any exit channel but the magnitude of the effect is smaller for exits through secondary buyouts (SBOs) where the results indicate an increase of the holding period of only 12%. This finding is in line with existing theory suggesting that SBO exits are an effective instrument to keep investment periods relatively short (Jenkinson and Sousa, 2015). Finally, I test for sensitivity of the B&B holding period to various interaction effects. The increase of the holding period is reduced in case of management participation, if the PE firm is under exit pressure because the fund approaches the end of its lifetime and if the portfolio firm is a frequent acquirer. However, deals with B&B exhibit a still considerably longer holding period even after taking these factors into account. Despite addressing several economic channels, I cannot find a factor that offsets the increase of the holding period through B&B. This suggests additional illiquidity of committed capital as an unintended "dark side" of B&B strategies that cannot easily be eliminated.

This paper makes several contributions to existing literature. At first, this paper adds to the buyout duration literature. Previous studies discuss the differences in venture capital (VC) duration between Canada and the United States (Cumming and MacIntosh, 2001), the GP's tradeoff between expected marginal costs and benefits of maintaining an investment (Cumming and Johan, 2010), the impact of cross-border deals on duration (Espenlaub et al., 2015), the interplay between different exit routes and duration (Giot and Schwienbacher, 2007), the role of market conditions on duration (Cao, 2011; Jenkinson and Sousa, 2015) as well as the short term versus long term nature of buyout investments (Jelic, 2011; Kaplan, 1991). To the best of my knowledge, this is the first paper addressing acquisition activity under PE ownership as a determinant of buyout holding periods. Second, my findings contribute to the discussion about illiquidity of PE investments (Cumming et al., 2005a; Lerner and Schoar, 2004; Sorensen et al., 2014). This paper provides new evidence that B&B strategies increase illiquidity of buyout investments, which is important because existing findings on outperformance of B&B (Acharya et al., 2013; Nikoskelainen and Wright, 2007) appear upward biased without adjusting for an illiquidity premium (Sorensen et al., 2014). This paper also makes a methodological contribution. Cumming and MacIntosh (2001) and Gompers (1995) provide first applications of survival analysis to PE and VC investments; Giot and Schwienbacher (2007) introduce the competing risks framework. This paper takes the next step presenting the first use of a survival-time treatment effect estimator that allows for modeling non-random assignment to treatment next to censoring and duration processes.

The remainder of this paper is organized as follows. Section 2 describes the sample construction and summarizes the data. Section 3 presents several multivariate econometric models to explore the impact of B&B strategies on holding periods. Section 4 outlines robustness checks and additional analyses. Section 5 concludes.

2 Data

2.1 Sample Construction

I draw upon Bureau van Dijk's (BvD) Zephyr database to construct a sample of PE transactions and holding periods. Zephyr has been used by several other M&A and PE studies in recent years due to its good coverage of private firm acquisitions (Erel et al., 2015) and reporting of deal types (Brav, 2009). These two arguments also apply to this study. In addition, the use of Zephyr allows me to match the PE targets with accounting data from BvD Orbis.

From Zephyr, I extract all transactions between 1 January 1997 and 31 December 2010 where deal financing is labelled as "private equity" or "leveraged buyout". This includes "institutional buyouts", "management buyouts", "management buy-ins" as well as "buy-in management buyouts". However, I exclude pure management buyouts without financial sponsor and restrict the sample to transactions that involve a PE firm. This sampling methodology is in line with Arcot et al. (2015) and Tykvová and Borell (2012).

To construct the holding period, I check whether the portfolio firms in the transaction sample have been exited as of 31 December 2012. I consider any kind of exit event, i.e. also a default or liquidation, to not create a "successful exit bias". In the robustness section, I also discuss sensitivity of the results to an exclusion of defaults. If I cannot identify an exit in Zephyr, I use PE sponsor websites and press sources to validate whether the portfolio firm has been in PE portfolio as of 31 December 2012. This step is important to ensure that buyouts without reported exit are not mistakenly treated as censored. I drop all deals with unknown exit in case I cannot validate the portfolio company status. I end up with 9,548 worldwide PE transactions, of which 5,093 are exited, i.e. uncensored, and 4,455 unexited, i.e. censored.

Before I supplement the sample with additional variables, I check the transactions case-by-case and standardize names of portfolio companies and PE firms. This is important because Zephyr reports names inconsistently. I also collect information about different historical names of the same PE firm, which allows me to keep track of organizational changes over time. After standardization, the sample includes 7,466 portfolio companies and 1,642 distinct PE firms.

2.2 Variables and Summary Statistics

2.2.1 Dependent and Main Explanatory Variables

Throughout this paper, I focus on PE holding periods as the dependent variable. For uncensored deals, I define the holding period as (exit date - entry date)/365, whereas for censored deals, the holding period is (last observed date - entry date)/365 with last observed date being 31 December 2012. In case the estimator allows for censoring correction, I use a combined version of the holding period that includes both uncensored and censored observations. Otherwise, I restrict the sample to uncensored deals.

The main explanatory variable of interest is a *B&B* indicator. To construct this variable, I obtain the acquisition event history of every portfolio firm from Zephyr. In case the portfolio firm conducts majority acquisitions under PE ownership, I consider these to be "add-ons" within the context of B&B strategies. The major difficulty here is to account for "indirect" add-on acquisitions where two portfolio firms are merged. To make sure that these acquisition events are in the sample, I compare the event histories of all portfolio companies and additionally check the PE sponsor websites. I end up with 2,497 deals that use B&B strategies and 4,937 add-on acquisitions. The B&B indicator is equal to one if the portfolio company conducts at least one add-on acquisitions under PE ownership and zero otherwise.

Table 1 reports the mean uncensored holding period across different exit years and stratified by *B&B*. The mean holding period in the sample is 3.9 years, which is roughly similar to Acharya et al. (2013) and in-between the 3.3 years that Jelic (2011) reports and the 4.3 years as well 4.4 years of Jenkinson and Sousa (2015) and Degeorge et al. (2015), respectively. Similar to Jenkinson and Sousa (2015) and Degeorge et al. (2015), the mean holding period is just over four years if I exclude the first exit years from the analysis. These years suffer from left truncation because Zephyr coverage only dates back to 1997, i.e. exits in the years before 2000 must have a holding period less than three years. I further discuss this issue in the robustness section.

Insert Table 1 about here.

The time series depicted in Table 1 documents a strong tendency towards longer holding periods. With an average of 5.3 years, the holding period of 2012 exits is up by 60% compared to the 3.3 year average of all 2003 exits. These numbers are well in line with recent industry reports that raise concerns about committed capital being tied up for historically long time spans.[3]

Furthermore, Table 1 documents that B&B strategies are important for explaining cross-sectional variation of holding periods. Deals with B&B strategy exhibit a significantly longer

[3] See, for example, *"Clear Direction, Focused Vision: A Study of 2011-2012 North American Exits"* by Ernst & Young or *"The 2015 Global Private Equity Report"* by Bain & Company.

holding period in almost all exit years. On average, the holding period of a B&B deal is 0.8 years, i.e. 10 months, longer than that of a deal without B&B, which suggests a 20% longer holding period of deals with B&B.

Next to the general B&B indicator, I construct several alternative measures that indicate the nature of the B&B strategy. First, I construct two indicator variables *single* and *multiple* that differentiate between B&B deals with a single add-on and multiple add-ons (see Appendix A.1 for a detailed definition of all variables). Second, I construct two indicator variables *domestic* and *cross-border* that differentiate between B&B deals with entirely domestic and partly non-domestic add-ons. Finally, I construct two indicator variables *penetration* and *diversification* that differentiate between B&B deals with entirely industry penetrating and partly diversifying add-ons.

2.2.2 Control Variables

To explore the impact of B&B on holding periods in a multivariate framework, I supplement the sample with a number of control variables. I focus on three sets of variables: deal characteristics, PE firm characteristics and portfolio firm characteristics.

- *Deal characteristics.* Jelic (2011) discusses the vendor source, i.e. the entry channel, syndication and management participation as important factors for buyout longevity. Thus, I construct a number of indicator variables that are equal to one if the vendor at entry is a private corporation (*private-to-private*), a publicly listed entity (*public-to-private*), a larger corporation that spins-off a business unit (*divisional*), another PE firm (*financial*), a governmental institution (*privatization*) or a liquidator (*receivership*) and zero otherwise. I additionally control for two indicator variables *syndicate* and *management participation* that are equal to one if more than one PE sponsor backs the deal and if the management is indicated as an investor, respectively. I obtain all this information from Zephyr.
- *PE firm characteristics.* Similar to Arcot et al. (2015), I control for the institutional affiliation of the sponsoring PE firm. For every PE sponsor in the sample, I hand-collect information

about whether the PE firm is an independent partnership or affiliated to an institution (e.g. a bank, insurance company, pension fund, family office, governmental institution or any other financial or non-financial corporation) from Bloomberg's private company database and from Thomson One (previously called VentureXpert). The indicator variable *affiliated* is equal to one if the sponsoring PE firm is affiliated to one of the mentioned institutions and zero otherwise. This control variable is important because affiliated PE firms may have a different investment philosophy and time horizon for their investments. For example, they may seek strategic investments for their parent (Chemmanur et al., 2014) or foster regional growth (Lerner, 1999). In case they obtain capital from their parent or do not raise funds at all, they are not subject to illiquidity concerns of limited partners (Sorensen et al., 2014). All these considerations likely affect investment duration.

A second important determinant is the fund age at entry. Arcot et al. (2015), Jenkinson and Sousa (2015) and Espenlaub et al. (2015) suggest that funds investing at a late point of the fund lifetime have pressure to exit the investment. Thus, I collect information about the vintage years of all involved funds from Thomson One and construct an indicator variable *exit pressure* that is equal to one if the transaction occurs in year four or later, i.e. at the end of the investment period, of the sponsoring fund. This definition is analogous to Arcot et al. (2015).

From Thomson One, I also obtain information about the fund size. Analogous to previous studies (e.g. Cao, 2011; Cao and Lerner, 2009), I insert *LN (fund size)* as an additional control variable that captures the reputation and maturity of the PE sponsor. This is important because existing literature suggests that established and reputable PE firms are not subject to grandstanding issues (Gompers, 1996) and have less incentives to engage in risky investments (Giot et al., 2014), which may both coincide with longer investment horizons.

To control for the acquisition experience of the sponsoring PE firm, I construct an index which sets the PE firm's number of transactions at the time of the buyout in relation to the maximum number of transactions made by any PE sponsor at this point in time. I then use this acquisition index to construct an indicator variable *PE frequent acquirer* that is equal to one if the PE firm's index is above the 90th percentile of all index values and zero otherwise. This variable has the advantage that it takes the overall market development into account and thus it is a relative measure of acquisition experience at every point in time.

- *Portfolio firm characteristics.* Analogous to the PE firm level, I collect information about the entire acquisition history of all portfolio firms from BvD Zephyr and build an index similar to the above mentioned PE firm index. The indicator variable *PF frequent acquirer* is equal to one if the portfolio firm's index is above the 90th percentile of all index values and zero otherwise. On the portfolio firm level, controlling for acquisition experience is important to account for lower transaction costs (Servaes and Zenner, 1996) and learning advantages (Aktas et al., 2013) of repetitive acquirers that may affect speed of B&B execution and thus the holding period.

  Finally, I collect accounting data from BvD Orbis to address portfolio firm heterogeneity. I use *LN (Total Assets)* to control for portfolio firm size because larger buyouts may have more exit opportunities and thus a shorter holding period (Nikoskelainen and Wright, 2007; Wright et al., 1995). I use operating *RoA* (EBIT/Total Assets) to control for profitability in the year of the buyout because existing literature finds that buyout duration is positively associated with firm profitability (Cao, 2011). I also use the *interest coverage ratio* (EBIT/interest expenses) in the year of the buyout to control for portfolio firm leverage.[4]

Table 2 presents summary statistics for all variables. The combined holding period, including both uncensored and censored deals, is slightly higher than for uncensored deals alone. Table 2 furthermore shows that 26% of all deals execute B&B strategies. Single (15%) and multiple (12%) add-on deal strategies occur at approximately same rates, similar to penetration (14%) and diversification (13%) strategies. The majority of B&B deals is of domestic (17%) rather than of cross-border (9%) nature. The median fund size is 471 million USD and 43% of all funds approach the end of the investment period. In the year of the buyout, portfolio firms

[4] Similar to Jenkinson and Sousa (2015), I winsorize all accounting variables to improve the model fit. However, all results are robust to not winsorizing the variables.

have a median RoA of 8.6% and a median interest coverage ratio of four.

Insert Table 2 about here.

Table 2 also illustrates that the sample size varies with different sets of variables. While I have full information on all deal characteristics, the sample size reduces with PE firm and especially portfolio firm characteristics. This is a common problem in PE research (e.g. Guo et al., 2011; Valkama et al., 2013). In my multivariate analyses, I address this issue by running models with different data requirements to see how robust the effect of B&B is across different sample sizes. Note that I also investigate the correlation across all variables (unreported for brevity). I detect a relatively strong correlation between *LN (fund size)* and *LN (total assets)*. To avoid multicollinearity, I do not insert both variables into the same model.

3 Empirical Results

The major purpose of this paper is to investigate whether B&B strategies increase PE holding periods. Formally, I use three empirical models to address this relationship. I refer to these models as the reduced model (equation 3.1), extended model (equation 3.2), and full model (equation 3.3). The models are given by:

$$Y_i = \alpha + \beta \times B\&B_i + \omega \times \vec{v_i} + \epsilon_i \tag{3.1}$$

$$Y_i = \alpha + \beta \times B\&B_i + \omega \times \vec{v_i} + \theta \times \vec{w_i} + \epsilon_i \tag{3.2}$$

$$Y_i = \alpha + \beta \times B\&B_i + \omega \times \vec{v_i} + \theta \times \vec{w_i} + \phi \times \vec{x_i} + \epsilon_i \tag{3.3}$$

where $\vec{v}$ is a vector of control variables for deal characteristics including *public-to-private*, *divisional*, *financial*, *privatization*, *receivership*, *syndicate* and *management participation*; $\vec{w}$ is a vector of control variables for PE firm characteristics and portfolio firm acquisition experience including *affiliated*, *exit pressure*, *LN (fund size)*, *PE frequent acquirer* and *PF frequent acquirer*; and $\vec{x}$ is a vector of control variables for portfolio firm accounting performance including *LN* *(total assets)*, *RoA* and *interest coverage ratio.* In addition, all models control for industry, world region and time fixed effects. Y_i is the natural logarithm of both the uncensored and censored holding period in case the estimator can account for censoring. Otherwise, Y_i is the natural logarithm of the uncensored holding period.

3.1 Baseline Results

In my baseline regressions, I utilize a parametric accelerated failure time (AFT) model to account for right censoring in the data. Right censoring occurs when the PE exit is not observable within the observational period so that the actual buyout duration is unknown. OLS regressions are not feasible for this type of data because they cannot handle censoring processes. Thus, it would be necessary to restrict the sample to uncensored observations and completely omit the information contained in the time to censoring process. AFT models, in contrast, make use of Kaplan-Meier weights to control for the censoring process. They are therefore the preferred methodology in the duration literature (e.g. Espenlaub et al., 2015; Giot and Schwienbacher, 2007; Jelic, 2011).

In the generalized linear formulation, the AFT model can be expressed as:

$$LN(T_i) = \alpha + \beta \times \vec{u}_i + \epsilon_i \tag{3.4}$$

where T is the time to exit for the ith subject, α is the intercept term, $\vec{u}$ is a covariate vector as specified in the reduced, extended and full model, and ϵ is an i.i.d random variable with a common but unspecified distribution $f(\cdot)$. I choose among the available distributions for the error term according to the Akaike Information Criterion (AIC), the model log-likelihood and a graphical residual test.[5] As it turns out, a logistic parameterization fits best. For this

[5] The graphical residual test plots the estimates from the nonparametric cumulative hazard function against the parametric cumulative hazard function of the Nelson-Aalen estimator. A slope close to one indicates good model fit.

log-logistic regression model, the survival function is given by:

$$S(t) = [1 + (\lambda_i t_i)^{1/\gamma}]^{-1} \tag{3.5}$$

where γ is a scale parameter to be estimated from the data and λ is parameterized as $exp(-X_i\beta)$. A particular advantage of the AFT model is that coefficients can be interpreted as changing the time scale by the factor λ. Thus, a positive (negative) regression coefficient indicates acceleration (deceleration) of the time to exit.

Table 3 reports the coefficients for the reduced model (column one), extended model (column two) and full model (column three) with standard errors clustered by entry year.

Insert Table 3 about here.

I find positive and statistically significant coefficients for the B&B indicator across all models. The persistence of the B&B effect is striking: even for the full model with only 1,075 observations and the maximum set of control variables, the effect holds. The size of the regression coefficients furthermore suggests that the effect of B&B is economically strong: I find a minimum increase of the holding period of 14% in the reduced model and a maximum increase of 22% in the full model.[6] Considering the average non-B&B holding period of 3.7 years, a 22% prolongation coincides with a holding period of 4.5 years in case of B&B. This is also well in line with the descriptive statistics (see Table 1).

3.2 Identification

B&B strategies do not occur at random and give therefore rise to endogeneity concerns. In absence of a natural experiment, it is important to control for self-selection to treatment to obtain an unbiased estimate of the effect of B&B on holding periods. I utilize three approaches

[6] To quantify the effect of B&B, it is necessary to exponentiate the respective coefficients. This means that a coefficient of 0.131 (0.201) coincides with a time ratio of 1.14 (1.22) and thus with an increase of the holding period of approximately 14% (22%).

to control for the endogenous B&B choice: treatment effects, matching estimators and two-stage endogenous treatment-regressions.

3.2.1 Survival-Time Treatment Effects

In this section, I estimate treatment effects and potential outcome means for observational survival-time data. Survival-time treatment estimators have the advantage that they can cope with both non-random assignment to treatment and censoring.

The estimators draw upon standard causal inference theory and use potential outcome means to determine the average treatment effect on the treated (ATET):[7]

$$ATET = E(Y_1 - Y_0 \mid D = 1) \tag{3.6}$$

where D is a treatment indicator, Y_1 is the holding period in case of treatment and Y_0 is the potential holding period the buyout would have had without treatment. Obviously, we can only observe Y_1 and face a missing data problem for the counterfactual outcome Y_0. Yet we can observe the difference between the average outcome of subjects with and without treatment:

$$\triangle = E(Y_1 \mid D = 1) - E(Y_0 \mid D = 0). \tag{3.7}$$

Equation 3.7 will only be an unbiased estimate of equation 3.6 if conditional independence holds:

$$E(Y_0 \mid D = 1) = E(Y_0 \mid D = 0). \tag{3.8}$$

In other words, the estimator will only resolve self-selection in case the potential outcome mean

[7] For further details regarding causal inference theory, see Rubin (1974) and Holland (1986).

is independent of treatment assignment. To solve this problem, the survival-time treatment estimators make us of regression adjustment, weighting or a combination thereof.

Survival-time treatment estimators are a powerful econometric tool because, next to treatment assignment, they can model duration and/or time to censoring. The available estimators address treatment, duration and censoring in a variety of ways with each estimator having its own pros and cons. To make sure that my results are not driven by the choice of the estimator and its implicit assumptions, I present three survival-time treatment effect estimators: inverse probability weighting (IPW), inverse probability weighted regression adjustment (IPWRA) and weighted regression adjustment (WRA).

- The IPW estimator controls for non-random treatment assignment and censoring processes by weighting each observation with the inverse probability for treatment/censoring.[8] Thus, by assigning low (high) weights to individuals with high (low) probability for treatment/censoring, the estimator corrects for self-selection bias and balances the respective groups (treatment vs. non-treatment and censored vs. non-censored) on the basis of observable characteristics. The weights for treatment assignment are obtained from a probit model whereas the weights for the censoring process are obtained from a Gamma model.[9]
- The IPWRA estimator controls for non-random treatment assignment and censoring processes similar to the IPW estimator but, in addition, uses a weighting-adjusted regression model to predict the duration of treated and non-treated observations.[10] By running separate regressions for each treatment level, it is possible to model the potential outcome means for each group and thus solve the missing data problem. I specify the duration regression as a Gamma model similar to the censoring process.
- The WRA estimator predicts censoring weights for each observation and then runs separate

[8] For further details regarding weighting methods, see Hirano et al. (2003) and Robins and Rotnitzky (2006).

[9] Because the survival-time treatment estimators do not support a logistic parameterization, I use a Gamma distribution which turned out to have the second best model fit.

[10] This estimator is also called weighted-adjusted-censoring IPWRA estimator because it models the censoring process rather than correcting for it through a term in the likelihood function. In the latter case, this estimator is referred to as the likelihood-adjusted IPWRA estimator.

censoring-adjusted duration models for each treatment level to construct potential outcome means. Thus, the WRA estimator is similar to the IPW and IPWRA estimator in the sense that it uses weighting to correct for censoring; it is also similar to the IPWRA estimator in the sense that it relies on regression adjustment to correct for treatment assignment. However, it is different to the IPW and IPWRA estimators in the sense that it does not use a treatment assignment model. The censoring and duration models follow a Gamma distribution again.

For any estimator, the correct model specification is essential for achieving unconfoundedness. I address this issue in three ways. First, I present the reduced, extended and full model for each estimator to explore sensitivity of the results to different sets of covariates. Second, I use an overidentification test to check for covariate balance after running the IPW estimator. The null hypothesis of balanced covariates cannot be rejected for the reduced (p-value 0.77), extended (p-value 0.88), and full model (p-value 0.98). This indicates that the models are well specified with the full model being particularly powerful in balancing the covariates across groups. Third, I graphically examine probability density functions for obtaining each treatment level to check for fulfillment of the overlap assumption. The two density functions turn out to have a large area of common support for all three models.

Table 4 presents the results of the ATET estimation for the IPW (Panel A), IPWRA (Panel B) and WRA estimator (Panel C) across the reduced (specification 1), extended (specification 2) and full model (specification 3) with robust standard errors.[11] I focus on the ATET rather than on the average treatment effect (ATE) because this relaxes the conditional independence and overlap assumption.[12] An apparent feature of the survival-time treatment effect estimators is that they estimate potential outcome means (POM) and treatment coefficients in the units of the outcome variable. Thus, the estimates of the POM and treatment coefficient can be directly interpreted as the average counterfactual holding period and the average number of

[11] Note that the survival-time treatment effect estimators do not allow for S.E. clustering.

[12] In terms of conditional independence, estimating the ATET only requires $Y_0 \perp D \mid \vec{x}$, whereas estimating the ATE requires $(Y_0, Y_1) \perp D \mid \vec{x}$ with $\vec{x}$ being a vector of observable covariates. In terms of overlap, estimating the ATET only requires $P(D = 1 \mid \vec{x}) < 1$, whereas estimating the ATE requires $0 < P(D = 1 \mid \vec{x}) < 1$. For more details, see Imbens and Wooldridge (2009) or Rosenbaum and Rubin (1983).

years by which the treatment increases/decreases the holding period, respectively.

Insert Table 4 about here.

The results of the survival-time ATET are consistent with the baseline results. Depending on the estimator and model, I find that B&B increases the holding period by a minimum of 14% (full model WRA estimator) and a maximum of 20% (reduced model WRA estimator). Considering the estimated POM of 3.7 years, this coincides with a B&B holding period of 4.2 and 4.4 years, respectively. The size of the B&B coefficient is very robust across the different panels, which indicates that the choice of the survival-time treatment estimator does not drive the results. More importantly, the significance of the B&B coefficient turns out to be persistent across all estimators and models. This suggests that, no matter of the sample size or covariates I condition on, the statistically significant effect of B&B cannot be explained by self-selection to treatment and/or censoring on the basis of observable industry, time, world region, deal, PE firm or portfolio firm characteristics.

3.2.2 Matching Estimators

Next to the survival-time treatment effects, I present two matching estimators in this section. While matching estimators draw upon causal inference theory and the potential outcome model too, they use nearest neighbors in the non-treatment group to impute counterfactual outcomes and estimate the ATET. Because the matching estimators cannot handle censoring, I estimate the ATET for the sub-sample of uncensored observations. Thus, the estimators presented in this section test for both sensitivity of the results to an alternative estimation strategy and to an exclusion of censored observations.

- First, I use nonparametric nearest-neighbor matching (NNM) to identify counterfactual firms on the basis of the Mahalanobis distance. The estimator uses the inverse sample covariance matrix to find control firms with covariates patterns close to the treatment firms. Following Abadie and Imbens (2006) and Abadie and Imbens (2011), I use the bias-corrected version of the NNM estimator for the models that include more than one continuous covariate.

- Second, I use propensity score matching (PSM) to identify counterfactual firms on the basis of an estimated probability for treatment. The estimator bases on the propensity score theorem which states that if the potential outcome mean is conditionally independent of the treatment, then the propensity score must be conditionally independent of the treatment too (Rosenbaum and Rubin, 1983):

$$Y_0 \perp D \mid \vec{x} \;\; \Rightarrow \;\; Y_0 \perp D \mid p(\vec{x}) \tag{3.9}$$

  with $p(\vec{x}) = Pr(D = 1 \mid \vec{x}) = E(D \mid \vec{x})$. The propensity score is obtained from a probit model. To control for the fact that propensity scores are estimated and not known, I use the standard errors derived by Abadie and Imbens (2016).

Analogous to the previous estimations, I use the covariate sets of the reduced, extended and full model (less the B&B dummy) for calculating the Mahalanobis distance and for estimating the propensity score. Because there is a tradeoff between accuracy (few nearest neighbors) and efficiency (many nearest neighbors), I present results for the ATET using 1, 5, 10 and 50 nearest neighbors.

I test the conditional independence assumption by investigating covariate balance across the treated and non-treated firms before and after matching. In particular, I conduct univariate comparisons across the two groups and run probit estimations on the B&B indicator on the unmatched and matched sample (Appendix A.2 presents the results). While many covariates significantly discriminate across the two groups before matching, there are no statistically significant differences any more after the PSM. This indicates that the three models perform well in balancing the two groups.[13]

Table 5 presents the results of the ATET estimation for the NNM (Panel A) and PSM estimator (Panel B) across the reduced (specification 1), extended (specification 2) and full

[13] See chapter 3.2.1 for a check of the overlap assumption, which uses the same probit estimations in case a treatment model is specified.

model (specification 3) with robust standard errors. The dependent variable is the natural logarithm of the uncensored holding period.

Insert Table 5 about here.

The results of the matching estimators are consistent with the baseline results and survival-time treatment effects. Depending on the estimator and model, I find that B&B increases the holding period by a minimum of 17% (extended model PSM with NN=1) and a maximum of 29% (reduced model NNM with NN=50). Considering an average holding period of 3.7 years for deals without B&B, the coefficients suggest a B&B holding period of 4.3 and 4.8 years, respectively. The ATET estimation for the B&B indicator is again highly significant across the different estimators and models, despite the fact that the matching estimators exclude censored observations. I therefore conclude that my results are not driven by right censoring. In sum, the results of the survival-time treatment and matching estimators provide evidence for a causal increase of the holding period through B&B conditional on observable characteristics.

3.2.3 Two-Stage Endogenous Treatment-Regression

A particular limitation of both survival-time treatment and matching estimators is that they only provide causal inference if self-selection occurs on the basis of observable characteristics. Thus, the effect of B&B on holding period could still be endogenous if there are unobservable firm characteristics that are jointly correlated with B&B and holding period. To address this issue, I run a Heckman (1979) endogenous treatment-regression (also referred to as linear regression with endogenous treatment effect) which estimates the probability for treatment in the first stage and controls for the inverse Mills ratio in the second stage to capture self-selection on the basis of unobservable characteristics.

The two-stage estimation strategy requires an exclusion restriction for identification of the treatment effect. I follow the literature on endogeneity of PE and VC investments and construct a variable *local market B&B share* that captures the local availability of B&B treatment. The idea of this instrument is that portfolio firms can self-select to treatment once the treatment is available to them but they cannot affect the treatment availability itself. Thus, in contrast to the B&B indicator which may be the result of endogenous matching, the market share of B&B deals in a particular local market is exogenous to the portfolio firm. I construct this variable using 14 entry years x 17 Fama and French industry codes x 12 world regions, which leads to 2,856 local markets. For each of these local markets, I calculate the market share of B&B deals and use this variable as an additional explanatory variable in the first stage. Note that it is likely that the availability of B&B correlates with the choice for a B&B strategy, whereas there is no obvious reason why the local market share of B&B should have direct impact on the holding period of a particular deal. However, as with any instrument, it is possible to question the exclusion restriction. I therefore discuss sensitivity of the results to using other variables for identification in the robustness section.

Versions of this local markets approach are frequently available in the literature. For example, Siming (2014) uses the number of financial advisors in a local market to instrument for a PE firm manager's previous employment with a financial advisor; Brander et al. (2015) use local market averages of government-sponsored VC funding to instrument for government-sponsored VC backing; Bottazzi et al. (2008) use the local market business experience to instrument for a VC's business experience; and Hellmann et al. (2008) use geographic and temporal market shares of bank VC to instrument for bank VC backing.

Table 6 presents the results for the second stage regression on the natural logarithm of the uncensored holding period including the estimated inverse Mills ratio (Panel A) and the first stage regression including *local market B&B share* as an additional explanatory variable to predict *B&B* treatment (Panel B). I use the maximum likelihood estimator derived by Maddala (1983) with standard errors clustered by entry year.

Insert Table 6 about here.

The results of the first stage regression provide strong support for the relevance of the instrument: the coefficients of *local market B&B share* are comparatively large and significant at the 1% level across all specifications. When excluding the instrument from the first stage probit, pseudo R^2 drops from 15.7% to 4.5% (specification 1), 17.9% to 6.4% (specification 2) and 19.6% to 8.0% (specification 3), which indicates that the instrument largely enhances the predictive power of the model. Note that there is no formal weak instrument test for the two-stage endogenous treatment-regression because the first stage is a non-linear probit model. However, as an approximation, I also run a 2SLS IV regression instrumenting *B&B* with *local market B&B share* and ignoring the binary nature of the B&B indicator. Appendix A.3 presents the results. The test statistics indicate that there is no weak instrument problem: all three model specifications easily pass the critical F-statistic of ten suggested by Stock et al. (2002).

Furthermore, the second stage regressions confirm the results from previous estimations. The B&B indicator is positive across all specifications and remains highly significant even after controlling for unobservable characteristics. The size of the coefficient is somewhat larger than in the previous estimations and suggests an increase of the holding period by 23% to 40%. However, given the fact that the inverse Mills ratio is insignificant in all three models, there is no evidence that it is important to control for unobservable characteristics. The 2SLS IV regressions in Appendix A.3 yield similar results: both the Durbin and Wu-Hausman diagnostics indicate that the null hypothesis of exogeneity cannot be rejected for any model. The coefficients of the B&B indicator are furthermore highly significant and comparable in size to the baseline estimates. Thus, in sum, there is evidence for a causal prolongation of the holding period through B&B even after controlling for unobservable characteristics.

3.3 The Channels Through Which B&B Increases Holding Periods

The results of the previous section suggest that B&B increases holding periods and that this effect cannot be explained by self-selection on the basis of observable or unobservable characteristics. The effect is also economically strong: depending on the estimator and model, I find that B&B increases holding periods by up to 29%. These findings suggest that capital is tied up for considerably longer time spans when using B&B in PE buyouts.

In this section, I study channels through which B&B increases holding periods to investigate whether there are factors that can mitigate or even avoid prolongation. I focus on three channels: the nature of the B&B strategy, the type of exit channel and potential interaction effects with buyout, PE firm and portfolio firm characteristics.

3.3.1 Nature of the B&B Strategy

A major theoretical argument for the increase of holding periods through M&A activity is the existence of additional transaction costs. In the following, I investigate the nature of the B&B strategy in terms of number and complexity of add-on acquisitions as a potential determinant of the transaction cost amount.

First, regarding the number of add-on acquisitions, I expect that every additional add-on acquisition induces additional bargaining and enforcement costs that translate into longer holding periods. The marginal increase of the holding period with any additional add-on acquisition may be comparatively small for PE firms because of their scale economies in information acquisition and deal-making but it is unlikely that the marginal increase of the holding period is zero. Thus, the prolongation of the holding period should be a function of the number of add-on acquisitions throughout the holding period.

Second, regarding the complexity of add-on acquisitions, there is a wide body of literature suggesting that cross-border and industry diversifying acquisitions induce comparatively high transaction costs and thus they may also increase holding periods. In particular, cross-border B&B may increase holding periods because (i) information production is more difficult when add-on targets are not in geographic proximity to the platform (e.g. Buch and DeLong, 2004; Butler, 2008; Lau and Yu, 2010; Malloy, 2005), (ii) PE firms have to overcome different legal regimes or accounting standards when closing the deal (e.g. Erel et al., 2012; Rossi and Volpin, 2004), (iii) cultural differences create coordination costs that slow down post-merger integration (Ahern et al., 2015) and (iv) monitoring is more difficult for the PE sponsor when add-on and platform are not in proximity (Bernstein et al., 2015; Kang and Kim, 2008; Wang and Wang, 2012). Industry diversification may increase holding periods because unrelated acquisitions suffer from information asymmetries (Servaes and Zenner, 1996) and require more resource allocation and management attention (Humphery-Jenner, 2013).

To investigate the effect of the number and complexity of add-on acquisitions upon PE holding periods, I re-estimate the AFT regressions in Table 7 with *B&B* split up into indicators for *single* versus *multiple* B&B (Panel A), *domestic* versus *cross-border* B&B (Panel B) and *penetration* versus *diversification* B&B (Panel C).[14] Specifications one, two and three contain controls of the reduced model, extended model and full model, respectively. Standard errors are clustered by entry year.

Insert Table 7 about here.

Table 7 provides two important insights. First, I find that each B&B coefficient is positive and statistically significant at the 1% level, which suggests that B&B increases holding periods independent of the nature of the B&B strategy. Even *single add-on*, *domestic* and *industry penetrating* B&B strategies cannot avoid prolongation of the holding period. Second, I find that the holding period prolongation is sensitive to the number of add-on acquisitions but not (much) to add-on complexity. B&B strategies with a *single* add-on turn out to have a 11% to 18% longer holding period, whereas B&B strategies with *multiple* add-ons prolong the holding period by 18% to 28%. I cannot find similar effects for *domestic* versus *cross-border* B&B where the magnitude of the coefficients is somewhat similar and suggest an increase of the holding period by 12% to 24%. For *penetration* versus *diversification*, there is evidence for longer holding periods of industry diversifying add-on acquisitions but the difference to industry penetrating acquisitions is rather small. These findings lend support to the notion that PE firms can manage the complexity of add-on acquisitions but they cannot avoid that add-on acquisitions in general induce additional transaction costs that postpone exits.

3.3.2 Type of Exit Channel

Existing literature suggests that covariate effects depend on the exit channel (Espenlaub et al., 2015; Giot and Schwienbacher, 2007; Jelic, 2011). Therefore, I test for sensitivity of my results

[14] The omitted category for both approaches is *no B&B*.

to various alternative exit routes in an AFT competing risks framework. This framework is conceptually similar to the baseline AFT regressions presented in Section 3.1 but estimates covariate effects on holding periods for different competing exit routes.[15] To do so, the competing risks regression does not only treat non-exited buyouts as right censored but also exited buyouts with exit channels other than the one under consideration. For example, for exits through Initial Public Offering (IPO), it treats all non-exited and all non-IPO exited buyouts as being right censored. Similar to the baseline AFT regression, I utilize a logistic distribution to parameterize the error term.

Table 8 presents the results for different competing risks: in Panel A, the exit channel of interest is *Trade Sale*, whereas in Panels B and C it is *IPO* and *Secondary Buyout (SBO)*.[16] Specifications one, two and three make use of controls as in the reduced, extended and full model. The interpretation of the coefficients is similar to the baseline AFT regressions: positive (negative) coefficients indicate acceleration (deceleration) of the time to a particular exit channel. Standard errors are clustered by entry year.

Insert Table 8 about here.

The results indicate that B&B increases holding periods for any exit channel, whereas the strength of the effect differs in size and significance. First, for trade sales, I find highly significant coefficients across all models suggesting a prolongation of the holding period of 22%-25%. Because trade sales account for the majority of exits in the sample, the effect is comparable to the average holding period prolongation through B&B in the baseline AFT regressions. Second, for IPOs, the results are mixed: while the B&B coefficient is negative and insignificant

[15] See Giot and Schwienbacher (2007) for a more detailed introduction to the AFT competing risks framework. Versions of this approach are also applied in Espenlaub et al. (2015) and Jelic (2011).

[16] Note that exit through secondary buyout is termed SBO for convenience but also includes tertiary and quaternary buyouts. In addition, it is also possible to exit the buyout through default or liquidation. Because I am interested in the time to exit for successful buyouts, I do not separately model the covariate effects for liquidated buyout and treat the respective holding periods as right-censored for all competing risks. This has the advantage that I can still use the information contained in holding periods of liquidated buyouts for estimation. Note that all results are also robust to completely excluding defaults, as discussed in the robustness section.

in specification one, it is positive and slightly significant in specifications two and three; the size of the B&B coefficient is furthermore comparable to trade sales in specification two, whereas the coefficient in specification three suggests a prolongation of the holding period by 65%. In sum, the IPO estimates document considerable variation in terms of economic and statistical significance but there is no evidence for mitigation or avoidance of holding period prolongation. For SBOs, finally, the B&B coefficients are positive and mostly significant but suggest a holding period prolongation of merely 11%-12% (considering only the significant results). This finding is in line with existing literature suggesting that SBO exits are an effective instrument to keep investment periods relatively short (Jenkinson and Sousa, 2015).

3.3.3 Interaction Effects

Finally, I am interested in potential interaction effects between *B&B* and buyout, PE firm or portfolio firm characteristics. I therefore re-estimate the regressions from Table 3 with six interaction terms. First, I interact B&B with *financial* because I suspect that portfolio firms with prior PE-backing are familiar with PE and M&A practices, which may enable them to acquire add-ons more efficiently. Second, I interact B&B with *management participation* because insider information about possible targets likely correlates with reduced costs of information acquisition. Third, I interact B&B with *syndicate* because, all else equal, several PE investors should draw upon a greater pool of possible add-on targets and have more resources to close the deal and integrate acquisitions quickly. Following the idea of Arcot et al. (2015), I also interact B&B with *exit pressure* to test whether PE firms are tempted to exit B&B deals more quickly in case the fund is already at the end of the investment period. Lastly, I interact B&B with both *PE frequent acquirer* and *PF frequent acquirer* because firms with acquisition experience are likely to have learning advantages (Aktas et al., 2013) and scale economies (Servaes and Zenner, 1996) that enable them to acquire add-ons more efficiently.

Table 9 reports coefficients from AFT regressions for the reduced model (column one), extended model (column two) and full model (column three) with standard errors clustered by entry year.

Insert Table 9 about here.

The results provide evidence for a mitigation of the B&B effect in case of *management participation*, funds under *exit pressure* and if the portfolio firm is a *frequent acquirer*, which is evident from the statistically significant interaction terms in specifications two and three. However, the significance of all three coefficients varies across the specifications and even for those specifications where coefficients are statistically significant, economic significance is comparatively small and suggests that non of these three variables can offset the prolongation of the holding period. For specification three, for example, the stand-alone B&B coefficient suggests an increase of the holding period by 35%, whereas exit pressure and acquisition experience speed up exits by only 12% and 14%, respectively. Thus, the net effect is positive and indicates a still considerably longer holding period. From these findings I conclude that certain buyout, fund and portfolio firm characteristics can mitigate but not avoid holding period prolongation in case of B&B.

4 Robustness and Extensions

4.1 Alternative Model Specifications

AFT models allow for a variety of model specifications including so-called frailty models where an additional parameter enters the regression to account for unobserved heterogeneity or random effects. The unshared version of this model assumes that this parameter is individual-specific, while in the shared version the frailty is assumed to be group-specific. In both models the frailty is multiplicative to the hazard ratio and has unit mean and a finite variance that needs to estimated from the data. I first re-estimate the baseline AFT regressions using the unshared frailty model with a Gamma-distributed frailty. I then turn to the shared version running a number of regressions where I assume that the frailty is common to observations in the same country, having the same entry year, and being within the same Fama and French 30, 38 or 48 industry classification code. All results remain robust to these alternative specifications.

4.2 Alternative Measure of the B&B Variable

Throughout this paper, I assume that a B&B strategy is in place if the portfolio company conducts at least one add-on acquisition. However, this definition may suffer from measurement error if the size of the platform company remains similar or shrinks because the platform conducts divestitures too. To account for this rare case, I construct a variable *net B&B* that is equal to one if there are only add-on acquisitions during the holding period or more add-ons than divestitures and zero otherwise. I then re-estimating the regressions from Section 3 with *net B&B* as the main explanatory variable and obtain similar results. Thus, there is no indication that my main explanatory variable is biased because of measurement error.

4.3 Alternative Exclusion Restrictions for the Two-Stage Regression

The results of the endogenous treatment-regressions do not provide evidence for endogenous matching on the basis of unobservable characteristics. However, because the exclusion restriction is not testable, this result may be driven by the choice of the excluded variable. I therefore test for sensitivity to two other identification strategies.

First, I construct a variable *local market acquisition activity* that indicates the acquisitiveness of every local market and employ this variable in the first stage regression instead of *local market B&B share*. The variable is equal to the mean number of acquisitions that I observe for each of the 2,856 local markets including all acquisitions that portfolio firms have done before PE backing. I expect that high acquisition activity is a sign for market consolidation, which should be attractive for B&B strategies. However, I do not expect that the variable is correlated with PE holding periods because there is no obvious reason why aggregate market M&A activity should translate into shorter or longer holding periods of a particular deal. As it turns out, the coefficient of *local market acquisition activity* in the first stage is highly significant across all specifications, which confirms the hypothesis that B&B is more likely in local markets with prior M&A exposure. More importantly, the B&B indicator in the second stage remains positive and statistically significant at the 1% level.

Second, I replace *local market B&B share* by *aggregate local market inexperience* which, for every local market, captures the share of transactions where the sponsoring fund has not conducted any local market investment yet. A higher value of this variable indicates little aggregate market experience, which should be negatively correlated with B&B because I expect that, if the aggregate market experience is little, most PE firms lack the necessary deal-flow to conduct B&B. On the other hand, the average local market inexperience should not directly affect deal-level holding periods because it does not relate to firm-specific skill or exit opportunities. As expected, the coefficient for *aggregate local market inexperience* is negative and statistically significant at the 1% level across all specifications in the first stage, whereas the coefficient for the B&B indicator in the second stage remains positive and statistically significant at the 1% level.

In sum, both variables yield results similar to the previous two-stage regressions using *local market B&B share* as the exclusion restriction. I therefore conclude that my results are not driven by the choice of the exclusion restriction. All results and sensitivity tests indicate a causal relationship between increasing holding periods and B&B.

4.4 Sub-Sample Regressions

Finally, I test for robustness of my results to re-estimation on all post-2000 deals and to an exclusion of all liquidated buyouts. The sub-sample regression on all post-2000 deals is important to investigate whether my results are affected by left truncation. Left truncation occurs because BvD Zephyr coverage starts in 1997 and thus holding periods of the years 1997-2000 could be downward biased. I therefore drop these years from the estimations and find that all results remain unchanged. Furthermore, by excluding all liquidated buyouts, I examine whether "unsuccessful" exits affect my results. This could be the case because, in contrast to "successful" buyouts, the decision to exit through liquidation is involuntary. I find that all results remain robust.

5 Conclusion

This paper examines whether the frequent use of B&B strategies can explain increasing holding periods in the PE industry. Previous literature indicates that B&B strategies are a superior value creation strategy (Acharya et al., 2013; Nikoskelainen and Wright, 2007), although longer holding periods are a likely disadvantage of B&B. Such longer holding periods bother limited partners (Cumming et al., 2005b; Sorensen et al., 2014) because PE is an illiquid asset class and any increase of the holding period ties up committed capital even further.

For a sample of 9,548 worldwide buyouts and 4,937 add-on acquisitions, I find that B&B strategies increase the holding period by up to 29%. This finding is robust to several identification strategies including the first application of a survival-time treatment effect estimator to the PE and VC literature. I also find that the prolongation of the holding period is mitigated if the portfolio company conducts only one (rather than several) add-on acquisitions, if the PE firm exits through secondary buyout, and in case of management participation, fund maturity and acquisition experience of the portfolio firm. However, none of these factors can completely avoid that B&B strategies increase holding periods. Thus, there is evidence that additional illiquidity is an unintended "dark side" of popular B&B strategies.

In sum, the persistence and economic significance of the B&B effect suggest that acquisition activity during the holding period is an important determinant of buyout holding periods. This study also shows that, when evaluating the performance of B&B strategies, it is necessary to take into account an illiquidity adjustment to not be misguided by upward biased returns. Finally, this study makes a methodological contribution to existing literature using a survival-time treatment effect estimator to model non-random assignment to treatment next to censoring and/or duration, which is important in PE research because endogeneity and censoring are common problems and may occur jointly.

Table 1: Holding Period Stratified by Exit Year and B&B strategy

	All Deals		B&B		No B&B			
Exit Year	**Mean**	**N**	**Mean**	**N**	**Mean**	**N**	**Diff**	
1997-2000	1.75	136	1.98	28	1.69	108	0.28	
2001	2.49	104	3.16	12	2.40	92	0.75	**
2002	2.84	125	3.10	27	2.77	98	0.32	
2003	3.27	179	3.66	45	3.14	134	0.52	**
2004	3.50	322	3.93	77	3.37	245	0.56	***
2005	3.60	457	4.25	106	3.41	351	0.84	***
2006	3.63	572	4.13	139	3.46	433	0.67	***
2007	3.60	697	3.94	216	3.44	481	0.50	***
2008	3.64	501	4.07	129	3.49	372	0.58	***
2009	3.54	358	3.98	90	3.39	268	0.59	**
2010	4.36	521	4.85	159	4.14	362	0.71	***
2011	4.78	610	5.31	187	4.54	423	0.77	***
2012	5.33	511	5.57	198	5.17	313	0.40	**
Total	3.89	5,093	4.44	1,413	3.67	3,680	0.76	***

This table reports the uncensored mean holding period across different exits years for all deals in the sample, deals with buy-and-build (B&B) strategy and those without. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 2: Summary Statistics

Variable	N	Mean	S.D.	Q1	Median	Q3
Holding Period Measures						
Uncensored & Censored (Years)	9,548	4.54	2.20	2.81	4.43	5.82
Uncensored (Years)	5,093	3.89	2.03	2.36	3.58	5.10
B&B Measures						
B&B	9,548	0.26	0.44	0.00	0.00	1.00
Single	9,584	0.15	0.35	0.00	0.00	1.00
Multiple	9,548	0.12	0.32	0.00	0.00	1.00
Domestic	9,548	0.17	0.38	0.00	0.00	1.00
Cross-Border	9,548	0.09	0.29	0.00	0.00	1.00
Penetration	9,548	0.14	0.34	0.00	0.00	1.00
Diversification	9,548	0.13	0.33	0.00	0.00	1.00
Deal Characteristics						
Private-to-private	9,548	0.43	0.50	0.00	0.00	1.00
Public-to-private	9,548	0.07	0.26	0.00	0.00	1.00
Divisional	9,548	0.28	0.45	0.00	0.00	1.00
Financial	9,548	0.20	0.40	0.00	0.00	1.00
Receivership	9,548	0.02	0.14	0.00	0.00	1.00
Privatisation	9,548	0.00	0.05	0.00	0.00	1.00
Management Participation	9,548	0.16	0.37	0.00	0.00	1.00
Syndicate	9,526	0.17	0.38	0.00	0.00	1.00
PE Firm Characteristics						
Affiliated	8,603	0.22	0.41	0.00	0.00	1.00
Exit Pressure	4,304	0.43	0.49	0.00	0.00	1.00
Fund Size (USD million)	3,566	1262.50	2612.03	176.97	470.58	1124.68
PE Frequent Acquirer	9,526	0.10	0.30	0.00	0.00	1.00
Portfolio Firm Characteristics						
PF Frequent Acquirer	8,175	0.10	0.30	0.00	0.00	1.00
RoA (%)	2,577	8.60%	19.74%	0.06%	7.21%	16.76%
Total Assets (USD million)	2,827	399.41	2906.64	10.20	29.89	105.95
Interest Coverage Ratio	2,140	18.10	29.62	0.13	3.96	21.85

This table reports summary statistics for the entire sample and the variables used in the multivariate regressions. Variables are explained in detail in Appendix A.1.

Table 3: Baseline AFT Regressions for the Effect of B&B on Holding Period

	(1)	(2)	(3)
B&B	0.131***	0.178***	0.201***
	(0.03)	(0.02)	(0.06)
Public-to-private	-0.026	0.097	0.119
	(0.06)	(0.08)	(0.09)
Divsional	-0.123***	-0.051*	-0.089**
	(0.03)	(0.03)	(0.05)
Financial	-0.075***	-0.009	0.079*
	(0.02)	(0.03)	(0.05)
Receivership	-0.311***	-0.021	-0.056
	(0.10)	(0.11)	(0.14)
Privatisation	0.177**	0.359***	-0.065
	(0.07)	(0.10)	(0.39)
Management Participation	0.061*	0.053*	-0.004
	(0.03)	(0.03)	(0.04)
Syndicate	-0.041	-0.018	0.010
	(0.03)	(0.02)	(0.05)
Affiliated		-0.007	-0.091**
		(0.02)	(0.04)
Exit Pressure		-0.016	0.000
		(0.02)	(0.03)
LN (Fund Size)		0.023**	
		(0.01)	
PE Frequent Acquirer		-0.092**	0.010
		(0.05)	(0.05)
PF Frequent Acquirer		0.071***	-0.015
		(0.03)	(0.06)
RoA			0.217*
			(0.13)
LN (Total Assets)			-0.004
			(0.02)
Interest Coverage Ratio			-0.001
			(0.00)
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

This table presents regression coefficients for a log-logistic accelerated failure time (AFT) model. The dependent variable is the natural logarithm of the uncensored and censored holding period. Variables are explained in detail in Appendix A.1. The omitted variable for the entry channel is *private-to-private*. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses and clustered by entry year. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 4: Survival-Time Treatment Effect of B&B on Holding Period

Panel A: Inverse-probability weighted estimator (IPW)			
	(1)	(2)	(3)
ATET	0.667***	0.615***	0.689***
	(0.08)	(0.11)	(0.18)
Potential Outcome Mean	3.824***	3.804***	3.828***
	(0.04)	(0.06)	(0.11)
Treatment Model	Probit	Probit	Probit
Censoring Model	Gamma	Gamma	Gamma
Duration Model	-	-	-
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778
Panel B: Inverse-probability weighted regression adjustment estimator (IPWRA)			
	(1)	(2)	(3)
ATET	0.700***	0.565***	0.576***
	(0.07)	(0.10)	(0.16)
Potential Outcome Mean	3.672***	3.813***	3.742***
	(0.04)	(0.06)	(0.10)
Treatment Model	Probit	Probit	Probit
Censoring Model	Gamma	Gamma	Gamma
Duration Model	Gamma	Gamma	Gamma
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778
Panel C: Weighted regression adjustment estimator (WRA)			
	(1)	(2)	(3)
ATET	0.746***	0.599***	0.510***
	(0.07)	(0.10)	(0.15)
Potential Outcome Mean	3.686***	3.782***	3.680***
	(3.69)	(0.07)	(0.10)

Treatment Model	-	-	-
Censoring Model	Gamma	Gamma	Gamma
Duration Model	Gamma	Gamma	Gamma
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

This table presents the potential outcome means (POM) and average treatment effects on the treated (ATET) for IPW (Panel A), IPWRA (Panel B) and WRA estimators (Panel C). The dependent variable is the natural logarithm of the uncensored and censored holding period. In specification one, treatment/censoring/duration models make use of the reduced model, whereas in specification two and three they make use of the extended and full model, respectively. The reduced model controls for *public-to-private*, *divisional*, *financial*, *privatization*, *receivership*, *syndicate* and *management participation*; the extended model builds upon the reduced model and adds *affiliated*, *exit pressure*, *LN (fund size)*, *PE frequent acquirer* and *PF frequent acquirer*; the full model builds upon the extended model and adds *LN (total assets)*, *RoA* and *interest coverage ratio*. The censoring regressions additionally include a *B&B* indicator. Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Robust standard errors are shown in parentheses. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 5: Matching Estimators for the Effect of B&B on Holding Period

Panel A: Nearest-neighbor Matching (NNM)			
	(1)	(2)	(3)
ATET with NN=1	0.240***	0.168***	0.210***
	(0.02)	(0.03)	(0.06)
ATET with NN=5	0.245***	0.186***	0.229***
	(0.02)	(0.03)	(0.05)
ATET with NN=10	0.250***	0.191***	0.214***
	(0.02)	(0.02)	(0.04)
ATET with NN=50	0.256***	0.201***	0.215***
	(0.02)	(0.02)	(0.05)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
N	5,072	2,337	778

Panel B: Propensity Score Matching (PSM)			
	(1)	(2)	(3)
ATET with NN=1	0.232***	0.158***	0.248***
	(0.02)	(0.04)	(0.06)
ATET with NN=5	0.238***	0.200***	0.236***
	(0.02)	(0.03)	(0.04)
ATET with NN=10	0.248***	0.200***	0.215***
	(0.02)	(0.03)	(0.04)
ATET with NN=50	0.248***	0.209***	0.220***
	(0.02)	(0.02)	(0.04)
Treatment Model	Probit	Probit	Probit
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
N	5,072	2,337	778

This table presents the average treatment effects on the treated (ATET) for NNM (Panel A) and PSM estimators (Panel B). The dependent variable is the natural logarithm of the uncensored holding period. In specification one, Mahalanobis distance measures and treatment models make use of the reduced model, whereas in specification two and three they make use of the extended and full model, respectively. The reduced model controls for *public-to-private*, *divisional*, *financial*, *privatization*, *receivership*, *syndicate* and *management participation*; the extended model builds upon the reduced model and adds *affiliated*, *exit pressure*, *LN (fund size)*, *PE frequent acquirer* and *PF frequent acquirer*; the full model builds upon the extended model and adds *LN (total assets)*, *RoA* and *interest coverage ratio*. Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Robust standard errors are shown in parentheses. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 6: Maximum Likelihood Endogenous Treatment-Regression for the Effect of B&B on Holding Period

Panel A: Second Stage OLS Regression

	Dependent Variable: LN (Holding Period)		
	(1)	(2)	(3)
B&B	0.338***	0.211***	0.331**
	(0.06)	(0.08)	(0.13)
Public-to-private	-0.052**	-0.070	-0.004
	(0.03)	(0.06)	(0.08)
Divsional	-0.085***	-0.125***	-0.106**
	(0.02)	(0.02)	(0.04)
Financial	-0.072***	-0.115***	-0.099**
	(0.01)	(0.02)	(0.05)
Receivership	-0.147**	-0.138**	-0.025
	(0.07)	(0.06)	(0.16)
Privatisation	0.194**	0.286**	-0.483
	(0.08)	(0.14)	(0.35)
Management Participation	0.083***	0.072**	-0.013
	(0.03)	(0.03)	(0.04)
Syndicate	-0.034	-0.053**	-0.038
	(0.02)	(0.03)	(0.05)
Affiliated		-0.035	-0.029
		(0.03)	(0.04)
Exit Pressure		-0.027	0.007
		(0.03)	(0.03)
LN (Fund Size)		-0.008	
		(0.01)	
PE Frequent Acquirer		-0.030	-0.023
		(0.04)	(0.05)
PF Frequent Acquirer		0.017	-0.018
		(0.04)	(0.05)
RoA			0.146
			(0.09)
LN (Total Assets)			-0.023
			(0.02)
Interest Coverage Ratio			0.000
			0.001
Inverse Mills Ratio	-0.108	-0.022	-0.159
	(0.07)	(0.09)	(0.16)
Time FE	Yes	Yes	Yes

Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	5,072	2,337	778

Panel B: First Stage Probit Regression

	Dependent Variable: B&B Dummy		
	(1)	(2)	(3)
Local Market B&B Share	3.639***	3.679***	3.830***
	(0.07)	(0.12)	(0.55)
Public-to-private	0.266***	-0.137	-0.246
	(0.09)	(0.13)	(0.29)
Divsional	0.082	0.076	-0.192
	(0.06)	(0.07)	(0.17)
Financial	0.265***	0.247***	0.324**
	(0.05)	(0.05)	(0.13)
Receivership	-0.441***	-0.025	-0.180
	(0.16)	(0.39)	(0.65)
Privatisation	0.002	0.041	0.948
	(0.31)	(0.55)	(0.78)
Management Participation	-0.182***	-0.061	-0.052
	(0.07)	(0.09)	(0.07)
Syndicate	0.045	-0.059	-0.088
	(0.04)	(0.08)	(0.13)
Affiliated		-0.176**	-0.110
		(0.08)	(0.09)
Exit Pressure		-0.001	-0.072
		(0.07)	(0.11)
LN (Fund Size)		0.069***	
		(0.02)	
PE Frequent Acquirer		-0.105	0.136
		(0.13)	(0.13)
PF Frequent Acquirer		0.493***	0.530**
		(0.10)	(0.21)
RoA			-0.034
			(0.41)
LN (Total Assets)			0.072
			(0.05)
Interest Coverage Ratio			0.005**
			(0.00)
Time FE	Yes	Yes	Yes

Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	5,072	2,337	778

This table presents the results for an endogenous treatment-regression (also referred to as linear regression with endogenous treatment effect). The first stage is a probit regression using *local market B&B share* as an additional explanatory variable for the potentially endogenous B&B indicator. The second stage is a linear OLS regression on the natural logarithm of the uncensored holding period which controls for the inverse Mills ratio obtained from the first stage to control for unobservable characteristics that may affect self-selection. Variables are explained in detail in Appendix A.1. The omitted variable for the entry channel is *private-to-private*. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses and clustered by entry year. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 7: Nature of the B&B Strategy and Holding Period

Panel A: Single vs. Multiple Add-On B&B Strategy

	(1)	(2)	(3)
Single	0.100***	0.157***	0.164***
	(0.04)	(0.02)	(0.06)
Multiple	0.169***	0.203***	0.243***
	(0.04)	(0.04)	(0.07)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

Panel B: Domestic vs. Cross-Border B&B Strategy

	(1)	(2)	(3)
Domestic	0.115***	0.179***	0.210***
	(0.04)	(0.02)	(0.07)
Cross-Border	0.160***	0.176***	0.186***
	(0.03)	(0.03)	(0.07)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

Panel C: Industry Penetrating vs. Industry Diversifying B&B Strategy

	(1)	(2)	(3)
Penetration	0.120***	0.163***	0.196***
	(0.04)	(0.02)	(0.05)
Diversification	0.142***	0.193***	0.206***
	(0.03)	(0.03)	(0.08)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

This table presents regression coefficients for a log-logistic accelerated failure time (AFT) model. The dependent variable is the natural logarithm of the uncensored and censored holding period. In Panel A, *B&B* is split up into *single* versus *multiple* to investigate the impact of B&B strategies with different number of add-on acquisitions. In Panels B and C, *B&B* is split up into *domestic* versus *cross-border* and *penetration* versus *diversification* to investigate the impact of B&B strategies with different complexity. The omitted category for all panels is *no B&B*. The reduced model controls for *public-to-private*, *divisional*, *financial*, *privatization*, *receivership*, *syndicate* and *management participation*; the extended model builds upon the reduced model and adds *affiliated*, *exit pressure*, *LN (fund size)*, *PE frequent acquirer* and *PF frequent acquirer*; the full model builds upon the extended model and adds *LN (total assets)*, *RoA* and *interest coverage ratio*. Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses and clustered by entry year. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 8: Competing Risks Regression for the B&B Effect Across Different Exit Channels

Panel A: Trade Sales			
	(1)	(2)	(3)
B&B	0.202***	0.208***	0.224***
	(0.03)	(0.04)	(0.08)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Trade Sale Exits	2,375	1,046	338
Panel B: Initial Public Offerings (IPOs)			
	(1)	(2)	(3)
B&B	-0.110	0.236*	0.499*
	(0.16)	(0.13)	(0.29)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of IPO Exits	379	183	61
Panel C: Secondary Buyouts (SBOs)			
	(1)	(2)	(3)
B&B	0.034	0.105***	0.115**
	(0.03)	(0.03)	(0.06)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of SBO Exits	2,318	1,108	379

This table presents regression coefficients for a log-logistic AFT competing risks model. The dependent variable is the natural logarithm of the uncensored and censored holding period. In Panel A, regressions treat exits through trade sale as uncensored, whereas in Panels B and C they treat exits through IPO and SBO as uncensored, respectively. The reduced model controls for *public-to-private*, *divisional*, *financial*, *privatization*, *receivership*, *syndicate* and *management participation*; the extended model builds upon the reduced model and adds *affiliated*, *exit pressure*, *LN (fund size)*, *PE frequent acquirer* and *PF frequent acquirer*; the full model builds upon the extended model and adds *LN (total assets)*, *RoA* and *interest coverage ratio*. Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses and clustered by entry year. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

Table 9: Interaction Effects with B&B

	(1)	(2)	(3)
B&B	0.130***	0.203***	0.301***
	(0.04)	(0.05)	(0.07)
B&B * Financial	0.060	0.035	-0.092
	(0.05)	(0.08)	(0.10)
B&B * Management Participation	-0.102	-0.182**	-0.012
	(0.07)	(0.09)	(0.12)
B&B * Syndicate	0.013	-0.006	0.105
	(0.06)	(0.05)	(0.08)
B&B * Exit Pressure		-0.037	-0.129**
		(0.05)	(0.05)
B&B * PE Frequent Acquirer		0.036	-0.117
		(0.07)	(0.16)
B&B * PF Frequent Acquirer		0.030	-0.150**
		(0.06)	(0.06)
Financial	-0.096***	-0.023	0.115**
	(0.03)	(0.05)	(0.06)
Management Participation	0.083**	0.098***	0.006
	(0.04)	(0.04)	(0.06)
Syndicate	-0.045	-0.015	-0.022
	(0.04)	(0.03)	(0.06)
Exit Pressure		-0.003	0.044
		0.022	0.033
PE Frequent Acquirer		-0.103**	0.054
		(0.05)	(0.07)
PF Frequent Acquirer		0.055	0.058
		(0.03)	(0.06)
Controls	Reduced	Extended	Full
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	9,526	3,127	1,075
No. of Uncensored Obs	5,072	2,337	778

This table presents regression coefficients for a log-logistic accelerated failure time (AFT) model. The dependent variable is the natural logarithm of the uncensored and censored holding period. Specification one contains the remaining control variables of the reduced model including *public-to-private*, *divisional*, *privatization* and *receivership*. Specification two contains all controls from the reduced model and adds *affiliated* as well as *LN (fund size)*. Specification three contains all variables from the extended model and adds *LN (total assets)*, *RoA* and *interest coverage ratio*. Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008).

Standard errors are shown in parentheses and clustered by entry year. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

A Appendices

A.1 Variable Definitions and Sources

Dependent Variable	Definition
Holding Period	For uncensored deals: (exit date - entry date)/365. For censored deals: (last observed date - entry date)/365 with last observed date being 31 December 2012. Note: censored holding period is only calculated if portfolio firm has been in PE ownership as of 31 December 2012. All deals with unknown exit status have been excluded from the calculation. Source: BvD Zephyr

Independent Variables	Definition
B&B Measures	
B&B	Indicator variable that takes the value of one if the portfolio firm conducts at least one add-on acquisition under PE ownership, zero otherwise. Source: BvD Zephyr
Single	Indicator variable that takes the value of one if the portfolio firm conducts one add-on acquisition under PE ownership, zero otherwise. Source: BvD Zephyr
Multiple	Indicator variable that takes the value of one if the portfolio firm conducts more than one add-on acquisition under PE ownership, zero otherwise. Source: BvD Zephyr
Domestic	Indicator variable that takes the value of one if the portfolio firm conducts all add-on acquisitions in its country of origin, zero otherwise. Source: BvD Zephyr
Cross-Border	Indicator variable that takes the value of one if the portfolio firm conducts at least one add-on acquisitions outside its country of origin, zero otherwise. Source: BvD Zephyr
Penetration	Indicator variable that takes the value of one if all of the portfolio firm's add-on acquisitions have the same Fama-French 30 industry classification code as the portfolio firm, zero otherwise. Source: BvD Zephyr
Diversification	Indicator variable that takes the value of one if at least one of the add-on acquisitions has a Fama-French 30 industry classification code different to the portfolio firm's Fama-French 30 industry classification code, zero otherwise. Source: BvD Zephyr
Deal Characteristics	
Private-to-private	Indicator variable that takes the value of one if the portfolio firm's vendor at entry is an independent private firm, zero otherwise. Source: BvD Zephyr
Public-to-private	Indicator variable that takes the value of one if the portfolio firm's vendor at entry is a publicly listed entity, i.e. because of a going-private transaction, zero otherwise. Source: BvD Zephyr
Divisional	Indicator variable that takes the value of one if the portfolio firm has been a division or subsidiary of a corporation before the buyout event, zero otherwise. Source: BvD Zephyr
Privatization	Indicator variable that takes the value of one if the portfolio firm has been a government-owned firm before the buyout event, zero otherwise. Source: BvD Zephyr

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Independent Variables	Definition
Financial	Indicator variable that takes the value of one if the portfolio firm's vendor at entry is another PE-sponsor, zero otherwise. This includes Secondary Buyouts, Tertiary Buyouts and Quaternary Buyouts. Source: BvD Zephyr
Receivership	Indicator variable that takes the value of one if the portfolio firm was bought out of any kind of bankruptcy restructuring, zero otherwise. Source: BvD Zephyr
Management Participation	Indicator variable that takes the value of one if the buyout is labelled as "management buyout", "management buy-in" or "buy-in management buyout" in BvD Zephyr. Note: deals with management participation are only included if a PE investor is involved, i.e. pure management buyouts without any PE involvement are excluded. Source: BvD Zephyr
Syndicate	Indicator variable that takes the value of one if more than one PE-sponsor backs the portfolio firm, zero otherwise. Source: BvD Zephyr
PE Firm characteristics	
Affiliated	Indicator variable that takes the value of one if the PE sponsor is affiliated to a bank, insurance company, pension fund, family office, governmental institution or any other financial or non-financial corporation, zero otherwise. Source: Bloomberg, Reuters
Exit Pressure	Indicator variable that takes the value of one if, at the time of the buyout, more than three years elapsed since the inception of the sponsoring PE firm's fund, i.e. if the fund approaches the end of the investment period. Source: Thomson One
Fund Size	Fund volume (USD million) of the sponsoring PE firm. Variable is averaged in case of a syndicate. Source: Thomson One
PE Frequent Acquirer	Indicator variable that takes the value of one if the sponsoring PE firm's acquisition index exceeds the 90th percentile of all PE firm acquisition scores in the sample, zero otherwise. For each buyout, the acquisition index is calculated as follows: (no. of transactions made by the PE sponsor prior to the buyout)/(maximum no. of transactions made by any PE sponsor prior to the buyout). Source: BvD Zephyr
Portfolio Firm Characteristics	
PF Frequent Acquirer	Indicator variable that takes the value of one if the portfolio firm's acquisition index exceeds the 90th percentile of all portfolio firm acquisition scores in the sample, zero otherwise. For each buyout, the acquisition index is calculated as follows: (no. of acquisitions made by the portfolio firm prior to the buyout)/(maximum no. of acquisitions made by any portfolio firm prior to the buyout). Source: BvD Zephyr
RoA	(EBIT)/(total assets). Measured in the year of the buyout. Variable is winsorized. Source: BvD Orbis
Total Assets	Value (USD million) of the portfolio firm's total assets in the year of the buyout. Source: BvD Orbis
Interest Coverage Ratio	(EBIT)/(interest expenses). Measured in the year of the buyout. Variable is winsorized. Source: BvD Orbis

A.2 Balancing Diagnostics for Propensity Score Matching

Panel A: Univariate Sample Comparison

	Pre-match			Post-match		
	B&B	no B&B	Diff	B&B	no B&B	Diff
Public-to-private	0.081	0.061	0.020**	0.081	0.076	0.004
Divsional	0.325	0.334	-0.009	0.325	0.331	-0.006
Financial	0.223	0.165	0.058***	0.223	0.209	0.014
Receivership	0.011	0.026	-0.015***	0.011	0.011	0.000
Privatisation	0.003	0.004	-0.001	0.003	0.003	0.000
Management Participation	0.145	0.208	-0.063***	0.145	0.149	-0.004
Syndicate	0.189	0.172	0.017	0.189	0.177	0.012
Affiliated	0.163	0.206	-0.043**	0.163	0.164	-0.001
Exit Pressure	0.382	0.388	-0.006	0.382	0.385	-0.003
LN (Fund Size)	6.201	5.925	0.276***	6.201	6.212	-0.011
PE Frequent Acquirer	0.124	0.147	-0.023	0.124	0.124	0.000
PF Frequent Acquirer	0.211	0.103	0.108***	0.211	0.195	0.015
RoA	0.092	0.082	0.010	0.092	0.096	-0.004
LN (Total Assets)	11.127	10.673	0.454***	11.127	11.111	0.016
Interest Coverage Ratio	20.749	17.931	2.818	20.749	21.842	-1.093

Panel B: Probit Regressions

	Dependent Variable: B&B Dummy					
	Pre-match			Post-match		
	(1)	(2)	(3)	(1)	(2)	(3)
Public-to-private	0.236***	-0.133	-0.371*	0.047	-0.053	-0.049
	(0.08)	(0.13)	(0.21)	(0.08)	(0.13)	(0.23)
Divsional	0.070	0.081	-0.047	0.006	-0.015	-0.029
	(0.05)	(0.06)	(0.12)	(0.05)	(0.08)	(0.14)
Financial	0.270***	0.249***	0.290**	0.062	0.030	0.099
	(0.04)	(0.04)	(0.12)	(0.06)	(0.08)	(0.13)
Receivership	-0.314*	-0.067	-0.456	0.008	-0.121	-0.397
	(0.17)	(0.36)	(0.70)	(0.18)	(0.30)	(0.83)
Privatisation	0.037	0.267	0.728	0.077	0.163	0.832
	(0.36)	(0.56)	(0.96)	(0.37)	(0.48)	(0.85)
Management Participation	-0.193***	-0.055	-0.070	-0.008	-0.015	-0.010
	(0.07)	(0.10)	(0.09)	(0.06)	(0.09)	(0.11)
Syndicate	0.039	-0.098	-0.186	0.047	-0.011	-0.022
	(0.04)	(0.07)	(0.13)	(0.05)	(0.08)	(0.12)
Affiliated		-0.154*	-0.093		-0.008	0.006

		(0.08)	(0.09)		(0.08)	(0.10)
Exit Pressure		-0.019	-0.087		-0.007	0.054
		(0.07)	(0.10)		(0.06)	(0.10)
LN (Fund Size)		0.068***			-0.007	
		(0.02)			(0.02)	
PE Frequent Acquirer		-0.128	0.134		-0.007	-0.057
		(0.11)	(0.12)		(0.10)	(0.13)
PF Frequent Acquirer		0.477***	0.551***		0.073	0.212
		(0.09)	(0.19)		(0.09)	(0.14)
RoA			-0.049			-0.129
			(0.43)			(0.52)
LN (Total Assets)			0.081			-0.029
			(0.05)			(0.05)
Interest Coverage Ratio			0.004**			0.000
			(0.00)			(0.00)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	5,072	2,337	778	5,072	2,329	778

This table presents mean differences for deals with and without B&B before and after propensity score matching (Panel A) and probit regressions on a B&B indicator on the unmatched and matched sample (Panel B). Variables are explained in detail in Appendix A.1. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

A.3 2SLS IV Regression

Panel A: Second Stage			
	Dependent Variable: LN (Holding Period)		
	(1)	(2)	(3)
B&B	0.297***	0.219***	0.288**
	(0.05)	(0.07)	(0.13)
Public-to-private	-0.049	-0.070	-0.010
	(0.03)	(0.05)	(0.09)
Divsional	-0.084***	-0.125***	-0.108**
	(0.02)	(0.03)	(0.05)

Financial	-0.068***	-0.116***	-0.095
	(0.02)	(0.03)	(0.06)
Receivership	-0.151***	-0.137	-0.026
	(0.06)	(0.11)	(0.19)
Privatisation	0.194	0.285	-0.469
	(0.14)	(0.17)	(0.32)
Management Participation	0.081***	0.072**	-0.014
	(0.02)	(0.03)	(0.05)
Syndicate	-0.033	-0.053*	-0.041
	(0.02)	(0.03)	(0.05)
Affiliated		-0.034	-0.030
		(0.03)	(0.05)
Exit Pressure		-0.027	0.006
		(0.02)	(0.04)
LN (Fund Size)		-0.008	
		(0.01)	
PE Frequent Acquirer		-0.030	-0.022
		(0.04)	(0.06)
PF Frequent Acquirer		0.016	-0.010
		(0.04)	(0.07)
RoA			0.145
			(0.13)
LN (Total Assets)			-0.022
			(0.02)
Interest Coverage Ratio			0.000
			0.001
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	5,072	2,337	778

Panel B: First Stage

	Dependent Variable: B&B Dummy		
	(1)	(2)	(3)
Local Market B&B Share	0.973***	0.979***	0.987***
	(0.04)	(0.05)	(0.09)
Public-to-private	0.073***	-0.047	-0.081
	(0.02)	(0.04)	(0.07)
Divsional	0.020	0.021	-0.052
	(0.01)	(0.02)	(0.04)

Financial	0.081***	0.080***	0.103**
	(0.02)	(0.02)	(0.04)
Receivership	-0.099**	-0.011	-0.018
	(0.04)	(0.09)	(0.14)
Privatisation	0.008	0.015	0.307
	(0.10)	(0.14)	(0.24)
Management Participation	-0.049***	-0.012	-0.021
	(0.02)	(0.02)	(0.04)
Syndicate	0.015	-0.017	-0.031
	(0.02)	(0.02)	(0.04)
Affiliated		-0.047**	-0.032
		(0.02)	(0.04)
Exit Pressure		-0.001	-0.014
		(0.02)	(0.03)
LN (Fund Size)		0.020***	
		(0.01)	
PE Frequent Acquirer		-0.033	0.042
		(0.03)	(0.04)
PF Frequent Acquirer		0.163***	0.169***
		(0.03)	(0.05)
RoA			-0.056
			(0.10)
LN (Total Assets)			0.021*
			(0.01)
Interest Coverage Ratio			0.002**
			(0.00)
F-statistic Instrument	709.3***	331.5***	110.9***
p-Value Durbin	0.297	0.708	0.485
p-Value Wu-Hausman	0.299	0.710	0.499
Time FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Worldregion FE	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	5,072	2,337	778

This table presents the results for a 2SLS IV regression using *local market B&B share* as an instrument for *B&B*. The dependent variable in the second stage is the natural logarithm of the uncensored holding period. The dependent variable in the first stage is an indicator variable for *B&B*. Variables are explained in detail in Appendix A.1. The null hypothesis of the Durbin and Wu-Hausman diagnostics is that *B&B* is exogenous. The omitted variable for the entry channel is *private-to-private*. Industry fixed effects base on the Fama-French 17 industry classification. Time and world region fixed effects are analogous to Strömberg (2008). Standard errors are shown in parentheses. Statistical significance is represented at the 10% (*), 5% (**), and 1% (***) level.

References

Abadie, A. and Imbens, G. (2006). Large sample properties of matching estimators for average treatment effects. *Econometrica*, 74(1):235–267.

Abadie, A. and Imbens, G. (2011). Bias-corrected matching estimators for average treatment effects. *Journal of Business & Economic Statistics*, 29(1):1–11.

Abadie, A. and Imbens, G. (2016). Matching on the estimated propensity score. *Econometrica*, 84(2):781–807.

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

Ahern, K., Daminelli, D., and Fracassi, C. (2015). Lost in translation? The effect of cultural values on mergers around the world. *Journal of Financial Economics*, 117(1):165–189.

Aktas, N., Bodt, E. d., and Roll, R. (2013). Learning from repetitive acquisitions: Evidence from the time between deals. *Journal of Financial Economics*, 108(1):99–117.

Arcot, S., Fluck, Z., Gaspar, J.-M., and Hege, U. (2015). Fund managers under pressure: Rationale and determinants of secondary buyouts. *Journal of Financial Economics*, 115(1):102–135.

Bernstein, S., Giroud, X., and Townsend, R. R. (2015). The impact of venture capital monitoring. *The Journal of Finance forthcoming*.

Bottazzi, L., DaRin, M., and Hellmann, T. (2008). Who are the active investors? Evidence from venture capital. *Journal of Financial Economics*, 89(3):488–512.

Brander, J. A., Du, Q., and Hellmann, T. (2015). The effects of government-sponsored venture capital: International evidence. *Review of Finance*, 19(2):571–618.

Brav, O. (2009). Access to capital, capital structure, and the funding of the firm. *The Journal of Finace*, 64(1):263–308.

Buch, C. and DeLong, G. (2004). Cross-border bank mergers: What lures the rare animal? *Journal of Banking & Finance*, 28(9):2077–2102.

Butler, A. W. (2008). Distance still matters: Evidence from municipal bond underwriting. *Review of Financial Studies*, 21(2):763–784.

Cao, J. X. (2011). IPO timing, buyout sponsors' exit strategies, and firm performance of RLBOs. *Journal of Financial & Quantitative Analysis*, 46(4):1001–1024.

Cao, J. X., Cumming, D., Qian, M., and Wang, X. (2015). Cross-border LBOs. *Journal of Banking & Finance*, 50:69–80.

Cao, J. X. and Lerner, J. (2009). The performance of reverse leveraged buyouts. *Journal of*

Financial Economics, 91(2):139–157.

Chemmanur, T. J., Loutskina, E., and Tian, X. (2014). Corporate venture capital, value creation, and innovation. *Review of Financial Studies*, 27(8):2434–2473.

Cumming, D. and Dai, N. (2011). Fund size, limited attention and valuation of venture capital backed firms. *Journal of Empirical Finance*, 18(1):2–15.

Cumming, D., Fleming, G., and Schwienbacher, A. (2005a). Liquidity risk and venture capital finance. *Financial Management*, 34(4):77–105.

Cumming, D., Fleming, G., and Suchard, J.-A. (2005b). Venture capitalist value-added activities, fundraising and drawdowns. *Journal of Banking & Finance*, 29(2):295–331.

Cumming, D. and Johan, S. (2010). Venture capital investment duration. *Journal of Small Business Management*, 48(2):228–257.

Cumming, D. and MacIntosh, J. G. (2003). A cross-country comparison of full and partial venture capital exits. *Journal of Banking & Finance*, 27(3):511–548.

Cumming, D. J. and MacIntosh, J. G. (2001). Venture capital investment duration in canada and the united states. *Journal of Multinational Financial Management*, 11(4–5):445–463.

Degeorge, F., Martin, J., and Phalippou, L. (2015). On secondary buyouts. *Journal of Financial Economics Forthcoming*.

Erel, I., Jang, Y., and Weisbach, M. S. (2015). Do acquisitions relieve target firms' financial cconstraint? *The Journal of Finace*, 70(1):289–328.

Erel, I., Liao, R. C., and Weisbach, M. S. (2012). Determinants of cross-border mergers and acquisitions. *The Journal of Finace*, 67(3):1045–1082.

Espenlaub, S., Khurshed, A., and Mohamed, A. (2015). Venture capital exits in domestic and cross-border investments. *Journal of Banking & Finance*, 53:215–232.

Giot, P., Hege, U., and Schwienbacher, A. (2014). Are novice private equity funds risk-takers? Evidence from a comparison with established funds. *Journal of Corporate Finance*, 27:55–71.

Giot, P. and Schwienbacher, A. (2007). IPOs, trade sales and liquidations: Modelling venture capital exits using survival analysis. *Journal of Banking & Finance*, 31(3):679–702.

Gompers, P. A. (1995). Optimal investment, monitoring, and the staging of venture capital. *The Journal of Finance*, 50(5):1461–1489.

Gompers, P. A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics*, 42(1):133–156.

Guo, S., Hotchkiss, E. S., and Song, W. (2011). Do buyouts (still) create value? *The Journal of Finance*, 66(2):479–517.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1):153–161.

Hellmann, T., Lindsey, L., and Puri, M. (2008). Building relationships early: Banks in venture capital. *Review of Financial Studies*, 21(2):513–541.

Hirano, K., Imbens, G., and Ridder, G. (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*, 71(4):1161–1189.

Holland, P. W. (1986). Statistics and causal inference. *Journal of the American Statistical Association*, 81(396):945–960.

Humphery-Jenner, M. (2013). Diversification in private equity funds: On knowledge sharing, risk aversion, and limited attention. *Journal of Financial and Quantitative Analysis*, 48(05):1545–1572.

Imbens, G. and Wooldridge, J. (2009). Recent developments in the econometrics of program evaluation. *Journal of Economic Literature*, 47(1):5–86.

Jelic, R. (2011). Staying power of UK buy-outs. *Journal of Business Finance & Accounting*, 38(7-8):945–986.

Jenkinson, T. and Sousa, M. (2015). What determines the exit decision for leveraged buyouts? *Journal of Banking and Finance*, 59:399–408.

Kang, J.-K. and Kim, J.-M. (2008). The geography of block acquisitions. *The Journal of Finance*, 63(6):2817–2858.

Kaplan, S. N. (1991). The staying power of leveraged buyouts. *Journal of Financial Economics*, 29(2):287–313.

Kaplan, S. N. and Strömberg, P. J. (2009). Leveraged buyouts and private equity. *Journal of Economic Perspectives*, 23(1):121–146.

Lau, S. T. and Yu, J. (2010). Does proximity matter in international bond underwriting? *Journal of Banking & Finance*, 34(9):2027–2041.

Lerner, J. (1999). The government as venture capitalist: The long-run impact of the SBIR program. *The Journal of Business*, 72(3):285–318.

Lerner, J. and Schoar, A. (2004). The illiquidity puzzle: theory and evidence from private equity. *Journal of Financial Economics*, 72(1):3–40.

Maddala, G. (1983). *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge University Press.

Malloy, C. (2005). The geography of equity analysis. *Journal of Finance*, 60(2):719–755.

Nikoskelainen, E. V. and Wright, M. (2007). The impact of corporate governance mechanisms on value increase in leveraged buyouts. *Journal of Corporate Finance*, 13(4):511–537.

Robins, J. and Rotnitzky, A. (2006). Inverse probability weighting in survival analysis. In Keiding, N. and Andersen, P. K., editors, *Survival and Event History Analysis*, pages 266–271. Wiley.

Rosenbaum, P. R. and Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1):41–55.

Rossi, S. and Volpin, P. F. (2004). Cross-country determinants of mergers and acquisitions. *Journal of Financial Economics*, 74(2):277–304.

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of Educational Psychology*, 66(5):688–701.

Servaes, H. and Zenner, M. (1996). The role of investment banks in acquisitions. *Review of Financial Studies*, 9(3):787–815.

Siming, L. (2014). Your former employees matter: Private equity firms and their financial advisors. *Review of Finance*, 18(1):109–146.

Smit, H. T. J. (2001). Acquisition strategies as option games. *Journal of Applied Corporate Finance*, 14(2):79–89.

Sorensen, M., Wang, N., and Yang, J. (2014). Valuing private equity. *Review of Financial Studies*, 27(7):1977–2021.

Stock, J., Yogo, M., and Wright, J. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business and Economic Statistics*, 20:518 – 529.

Strömberg, P. J. (2008). The new demography of private equity. In Gurung, A. and Lerner, J., editors, *The Globalization of Alternative Investments Working Papers Volume 1: The Global Economic Impact of Private Equity Report 2008*, pages 3–26. World Economic Forum.

Tykvová, T. and Borell, M. (2012). Do private equity owners increase risk of financial distress and bankruptcy? *Journal of Corporate Finance*, 18(1):138–150.

Valkama, P., Maula, M., Nikoskelainen, E., and Wright, M. (2013). Drivers of holding period firm-level returns in private equity-backed buyouts. *Journal of Banking & Finance*, 37(7):2378–2391.

Wang, L. and Wang, S. (2012). Economic freedom and cross-border venture capital performance. *Journal of Empirical Finance*, 19(1):26–50.

Wright, M., Thompson, S., and Robbie, K. (1995). Management buy-outs in the short and long term. *Journal of Business Finance & Accounting*, 22(4):461–483.