Exit Strategies and Holding Period for Private Equity Acquisitions under Time-varying Market Conditions

Charlotte Sun Clausen-Jørgensen[1]
University of Southern Denmark

Christian Riis Flor[2]
University of Southern Denmark

This version: January 15, 2024

[1]Department of Business and Management, University of Southern Denmark, Campusvej 55, DK–5230 Odense M, Denmark. E-mail: chcla@sam.sdu.dk, phone: +45 6550 8187. Charlotte Sun Clausen-Jørgensen is a research fellow of the Danish Finance Institute.

[2]Corresponding author. Department of Business and Management, University of Southern Denmark, Campusvej 55, DK–5230 Odense M, Denmark. E-mail: crf@sam.sdu.dk, phone: +45 6550 3384. Christian Riis Flor is a research fellow of the Danish Finance Institute.

Exit Strategies and Holding Period for Private Equity Acquisitions under Time-varying Market Conditions

This version: January 15, 2024

Abstract

Private equity funds develop a target and sell it within a limited time. The temporary ownership exposes the fund to time-varying exit market conditions. Using a dynamic continuous-time model we examine how these frictions impact a fund's exit strategy, holding period, and valuation of a target. Time-varying exit market conditions matter and cannot be approximated by a simple average. Our results show that if a target is acquired in a low state, the holding period is longer. Moreover, if completing a growth strategy is expected to take longer time, then the target likely attracts a strategic buyer. Yet, if a fund acquires such a target, a subsequent early exit to a strategic buyer occurs more often.

Keywords: Private Equity Strategies, Investment Policy, Limited Time, Real Options, Dynamic Model

JEL subject codes: G24, G32, G34

1 Introduction

Private equity (PE) funds play an active role in the market for corporate control and the funds have an immense amount of capital allocated to their activities. (e.g., Strömberg, 2008; Sørensen et al., 2014; Guo et al., 2011). For example, private equity fundraising volume was $340 billion in the U.S. and €118 billion for European funds in 2021.[1] The persistence of capital allocated to PE funds indicates that investors perceive such funds as valuable. This implies that a takeover by a PE fund must add value compared to a takeover done by a buyer operationally related to the target (a strategic buyer). Interestingly, a PE fund has some limitations compared to a strategic buyer. For example, a PE fund's ownership is in general limited to 10 years and a target is typically held for less than six years (e.g., Kaplan and Strömberg, 2009). Furthermore, timing an exit is at the PE fund's discretion and there is evidence demonstrating market timing abilities (Jenkinson et al., 2022; Gredil, 2022).

Our understanding of how these frictions impact a PE fund's actions is limited. Thus, our overarching research question examines how the time horizon of a PE fund impacts it's exit strategy, holding period, and valuation of a target. In particular, we pay attention to the fact that the PE fund's temporary ownership of a target exposes the fund to time-varying exit market conditions that do not only depend on macroeconomic or technological shocks. Our analysis leads to several interesting results. We find that the explicit incorporation of exit market conditions is important. Simply approximating this into an average exit market provides misleading conclusions because it neglects a hedging effect. In particular, the PE fund's valuation of the target will not be a simple average of the values in the full model that has a high and a low valuation state, and the expected holding

[1] Statistics from the American Investment Council 2022 Q2 Private Equity Trends Report and the Invest Europe Report 2022 H1, respectively. Available at http://www.investmentcouncil.org/ and http://investeurope.eu/. Accessed March 2023.

period of the target is generally shorter compared to the holding period when taking the two market states into account. Thus, the holding period depends on the exit market state and our results additionally show that if a target is acquired in a low state, the holding period is expected to be longer. In our base case, the difference is about a year. We also find that a shift in exit market conditions from a low state to a high state leads to an increase in exit activity. Moreover, we see that if the growth strategy of a target is more risky because it is expected to take longer to complete, this target is more likely to attract a strategic buyer. However, if such a target is acquired by a PE fund, the likelihood of a subsequent early exit to another strategic buyer is higher. That is, when we increase the expected completion time from 3.5 to 5 years, the likelihood increases from 5% to 40% if the target is initially acquired in the high state. Furthermore, we show that a strategic buyer can better exploit the value of waiting embedded in traditional real options. Thus, a higher volatility increases a strategic buyer's valuation of a target more than it does for a PE fund.

To obtain our results we take additional characteristics of PE funds into account. A PE fund has a value creation plan for a target often involving delisting, a restructuring of assets, and strategic investments in growth options (Lerner et al., 2011; Norbäck et al., 2013; Davis et al., 2014; Gompers et al., 2016; Biesinger et al., 2020). We take this as exogenous due to the arrangements among general and limited partners (e.g., Axelson et al., 2009; Metrick and Yasuda, 2010). In contrast, a strategic buyer more often seeks to exploit traditional synergies. Since these are difficult to obtain for a PE fund, a strategic buyer and a PE fund evaluate a target differently (e.g., Gorbenko and Malenko, 2014).

Our analysis uses a continuous-time real options analysis framework in which we incorporate the transformation of the target and the fund's exit. We explicitly include the institutional friction that the fund has limited time before selling the target, although this

implies that we have to resort to a numerical analysis only. The completion of the growth strategy requires a running cost by the PE fund and to simplify the analysis we let the success be determined by a Poisson event. The exit value of a target with a completed transformation depends on a profitability index which fluctuates due to shocks in financial markets. The value also depends on conditions that are specific to a sale to another PE fund. Several studies suggest that such market conditions are an important determinant for the exit decision of PE funds. Valuations of targets tend to be higher during favorable markets (Axelson et al., 2009; Gorbenko and Malenko, 2014) and since PE funds naturally want to achieve the highest possible exit price, they try to take advantage of "windows of opportunity" (Jenkinson and Sousa, 2015; Cao, 2011; Michala, 2019). We capture this effect by the high valuation state and the low valuation state and changing between the states is exogenous to the PE fund.

The target can also be acquired by a strategic buyer, and studies have found that strategic buyers are less active or successful in deploying the strategies used by PE funds, for example, buy-and-build strategies or taking portfolio companies into new markets (Bernstein et al., 2017; Hege et al., 2018; Hammer et al., 2017). Therefore, we normalize a strategic buyer to a simpler standard real options investment and use a setup without limited time to implement a growth strategy. Our modelling of the strategic buyer is simpler compared to that of a PE fund as this alternative buyer serves the role of being a benchmark.[2]

Since the PE fund's transformation of the target may take longer than expected, we also consider an alternative to completing the growth strategy. Specifically, the PE fund may find it optimal to make an early exit and thus the fund sells the target before the growth

[2]Although empirical evidence suggests large heterogeneity among the same type of buyer, we limit our set up to a strategic buyer and a PE fund for the initial acquisition of the target since these two types of buyers have more distinct characteristics.

strategy is complete. This decision depends on the level of the profitability index, the buyers in the exit market, and the conditions in that market. In practice, PE funds have various exit-routes available, for example, a trade sale or a secondary buyout. Intuitively, if the exit is done to another PE fund the exit value depends on several factors. For example, complementary skills between the selling and buying PE funds, as well as whether the selling fund is under a time pressure, influence secondary buyouts (e.g., Degeorge et al., 2016; Arcot et al., 2015). For tractability we abstract from details involving sequential acquisition strategies; that is, we only let the selling price depend on exit market conditions and the selling fund's remaining time horizon in a simple manner. In contrast, we model a sale to a strategic buyer as resembling the setup for a strategic buyer who initially acquires the target.

To have a tractable and focused analysis of exit strategies and differences in valuations of a target—based on the actions taken by a PE fund and a strategic buyer—we have neglected several important aspects. Our framework is general enough to suggest that our results will carry over when such aspects are included. One interesting path for future work is to include the financing elements and tax advantages related to the practices of acquiring through leveraged buyouts. This clearly influences the valuations between the two potential buyers, but understanding how it also affects exit strategies would be interesting. Another interesting issue is the ex-ante problem between the general partner and the limited partners as the friction faced by the PE fund must be the outcome of this agency problem (e.g., Ivashina and Kovner, 2011; Axelson et al., 2013; Flor and Sørensen, 2019; Clausen-Jørgensen et al., 2022).

The remainder of the paper is organized as follows. Section 2 sets up the model. Section 3 analyzes the outcome of the model and Section 4 discusses implications. We conclude in Section 5. Proofs are postponed to the appendix.

2 Model

To perform our analysis we set up a dynamic continuous-time model that involves the transformation of a target acquired by either a strategic buyer or a PE fund. We proceed as follows. First, we introduce the target and its intrinsic value. Second, we describe the strategic buyer, and finally we model the PE fund.

A target is characterized by an embedded growth option that serves as a value driver for the buyers. A target is also characterized by the underlying dynamics of earnings. Both of these dimensions affect the final value of the target. For tractability we assume earnings dynamics are linearly related to an observable market profitability index, x. Specifically, we assume that earnings dynamics follow the stochastic differential equation

$$dx_t = \mu x_t dt + \sigma x_t dW_t, \tag{1}$$

where μ is the instantaneous expected growth rate, σ is the volatility, and $W = (W_t)_{t=0}^{\infty}$ is a standard Brownian motion. All agents are risk neutral and the risk-free interest rate used for discounting is denoted r. To have well-defined values, we require that $\mu < r$. We let E denote the intrinsic value of the acquired target and assume that it has the form:

$$E(x) = s\frac{x}{r-\mu}, \tag{2}$$

where the scaling factor, s, depends on the strategy of the buyer. There is a fixed lump-sum cost for investing in the target's growth option, I_0.[3] This investment cost is the same regardless of the type of buyer but there can be other costs associated to a specific type.

[3]The analysis can be elaborated by disentangling the acquisition price as the sum of an acquisition price, A_0, and a initial transition cost, I_0. As is well-known in the takeover literature the information regarding A_0 and I_0 then enters into a bargaining game between the target and the buyer (Grossman and Hart, 1980; Shleifer and Vishny, 1986).

2.1 Acquisition by a strategic buyer

To analyze how the characteristics of a PE fund have a distinct effect on valuation and investment decisions, we set up the strategic buyer as an alternative buyer who serves the role of being a benchmark. The strategic buyer can gain from traditional synergies and is not subject to time frictions. Therefore, when the target is acquired by a strategic buyer, we assume that an investment in the target's growth option leads to a synergy scaling of s_B which is realized at the time of investment. To integrate the target, the strategic buyer must pay a readjustment or transaction cost denoted as R_{SB}. Hence, after paying the cost of investing in the growth option, the strategic buyer's value of the target is

$$E_{SB}(x;s) = s\frac{x}{r-\mu} - R_{SB}, \tag{3}$$

where $s = s_B$.

Without time constraints, the strategic buyer can fully exploit the value of waiting except for the fact that it has to acquire the target now ($t = 0$) due to competition from the PE fund. However, the strategic buyer has flexibility in deploying its strategy for the target once it is acquired. Therefore, the strategic buyer may optimally wait to invest in the target's growth option. With the cost for investing in the growth option and the readjustment cost, the total costs for the strategic buyer are $I_0 + R_{SB}$. We let x^*_{SB} denote the threshold of the profitability index at which the strategic buyer decides to invest in the target's growth option (we generally suppress time dependency as an argument). The corresponding time is denoted by T_B. We denote the strategic buyer's valuation of the target as $B(x)$ which satisfies

$$B\left(x_0\right) = \sup_{T_B} \mathbb{E}\left[e^{-rT_B}\left(E_{SB}\left(x^*_{SB}\right) - I_0\right)\right]. \tag{4}$$

The strategic buyer's problem is similar to a traditional real options investment. We briefly outline the steps below and postpone details to the appendix since the derivations are standard. We follow the usual steps in analyzing real option problems (e.g., Dixit and Pindyck, 1994; Hackbarth et al., 2007; Flor and Moritzen, 2020). As a result, the value for the strategic buyer satisfies the ordinary differential equation (ODE)

$$rB\left(x\right)=\frac{1}{2}\sigma^{2}x^{2}B''\left(x\right)+\mu xB'\left(x\right). \tag{5}$$

Since the strategic buyer optimally chooses when to undertake the investment in the target's growth option, the ODE is subject to the value-matching and smooth-pasting conditions at the investment threshold, x_{SB}^{*}, and a zero-value condition at $x=0$:

$$B\left(x_{SB}^{*}\right)=E_{SB}\left(x_{SB}^{*}\right)-I_{0}, \tag{6}$$

$$B'\left(x_{SB}^{*}\right)=E_{SB}'\left(x_{SB}^{*}\right). \tag{7}$$

For the strategic buyer, the resulting valuation of the target is

$$B\left(x\right)=\left(s_{B}\frac{x_{SB}^{*}}{r-\mu}-\left(I_{0}+R_{SB}\right)\right)\left(\frac{x}{x_{SB}^{*}}\right)^{\beta_{1}}, \tag{8}$$

where β_1 is stated in the Appendix A.1. The optimal investment threshold is given by

$$x_{SB}^{*}=\frac{\beta_{1}}{\beta_{1}-1}\frac{\left(r-\mu\right)\left(I_{0}+R_{SB}\right)}{s_{B}}. \tag{9}$$

2.2 The PE fund's acquisition decision

When a PE fund acquires a target and it immediately starts to implement a growth strategy that involves an investment in the target's growth option and restructuring of the target's

activities. Whether the acquisition is successful depends on a number of risk factors. First, the growth option adds value to the target, but it is not certain that the implementation of the growth option leads to exploiting the target's full potential. Second, the buyers in the exit market influence the PE fund's decision of whether to make an early exit. Third, time-varying exit market conditions impact the valuation of the target at exit. Finally, the life of a fund is limited. This implies that the fund has limited time to implement its growth strategy and to sell the target before expiration. All these factors influence the fund's acquisition decision. The timeline of the model is illustrated in Figure 1. We now turn to the details of the model of the PE fund.

2.2.1 The transformation of the target

The aim of the value creation plan is to enable a growth strategy that includes an investment in the target's growth option which in the end leads to a valuable exit. Hence, the investment cost, I_0, is paid to initiate the growth strategy but the strategy takes time to implement. To facilitate the value creating process, a restructuring of the target is set in place in which non-core activities are divested and funds are spend to improve the value of a growth option related to core activities (e.g., Kaplan and Strömberg, 2009). Since this complex process is not the focus of our analysis, we simplify matters by assuming that effort and capital spent with the aim of successfully transforming the target is captured by a cost rate, K, which the fund continuously pays until the growth strategy is complete.

A fully successful completion of the growth strategy results in the fund exploiting the full potential of the target. However, the outcome of the growth strategy can also be less valuable than hoped for. To model this we assume that the outcome of the growth strategy can either be good or moderate, so that the scaling is either s_G or s_M with $s_G > s_M > 0$. Furthermore, we let p denote the success-probability of the good outcome. Until the growth

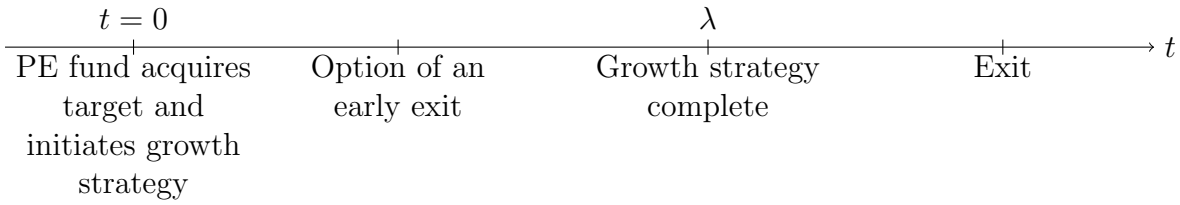


Figure 1: **Timeline of the model.**

strategy is complete, the expected scaling factor is $\bar{s} = ps_G + (1-p)\, s_M$. We assume that the completion of the growth strategy occurs with instantaneous probability λ, where λ is the intensity of a Poisson process, N. Thus, let $T_\lambda = \inf\{t > 0 | N_t = 1\}$ be the time at which the growth strategy is complete. Formally, T_λ is the time of the first jump of a Poisson process with intensity λ. We denote the expected time that completion occurs as $T_\lambda^e = 1/\lambda$.

The outcome of the PE fund's growth strategy is observable to the financial market, but the valuation of the target also depends on exit-market conditions. That is, we assume the final value of the target also depends on time-varying exit market conditions, y_t, where changes are exogenous to the PE fund. For tractability, we consider two different states: a high valuation state, H, and a low valuation state, L. We let $y_t \in \{y_H, y_L\}$ with $y_H > y_L > 0$. Let λ_i, for $i = H, L$, denote the instantaneous transition probability of y_t which we assume follows a Poisson law so that $(y_t)_{t \geq 0}$ is a two-state Markov chain. We denote the time to leave state i by T_i, and the expected time in state i (expected time to leave the state) is denoted by $T_i^e = 1/\lambda_i$. If the growth strategy is completed in the high state, the PE fund immediately sells the target since this gives the highest valuation. In contrast, the fund has an incentive to wait for better market conditions if completion occurs in the low state. That is, the fund awaits a shift to the high state which subsequently results in an immediate exit. However, the PE fund can only wait until maturity. Thus,

the exit value from completing the growth strategy is

$$E_{\lambda,H}(x) = \bar{s} y_H \frac{x}{r-\mu}, \tag{10}$$

in the high state. In the low state, with $T-t$ years left before the fund expires and assuming that a transition to the high state occurs at time $T_L \in (t,T)$, the value is

$$E_{\lambda,L}(x;t,T) = \mathbb{E}\left[\mathbb{1}_{\{T_L \leq T\}} e^{-(T_L-t)} \bar{s} y_H \frac{x_{T_L}}{r-\mu} + \left(1-\mathbb{1}_{\{T_L \leq T\}}\right) e^{-(T-t)} \bar{s} y_L \frac{x_T}{r-\mu}\right], \tag{11}$$

where the first term stems from a jump to the high state and the second term stems from waiting until the fund matures.

2.2.2 The early-exit decision

Instead of waiting for the growth strategy to be completed, the fund may also find it optimal to make an early exit. The value of the target at an early exit is influenced by the potential buyers in the exit-market. To focus our analysis we abstract from complex sequential acquisition strategies and restrict attention to a structure in which there is only a strategic buyer and another PE fund.

When sold to a strategic buyer, the value of the target is based on the scaling, s_M. We use this instead of s_B to highlight that the synergies the strategic buyer can obtain from integrating the target are less valuable at this stage because the PE fund has already initiated a non-completed growth strategy that differs from the strategic buyer's plan if the target had been acquired at time $t=0$. The strategic buyer still has to make readjustments to fit its operations which costs, R_{SB}, as described earlier when introducing a strategic buyer. Since the PE fund has already invested I_0, we assume that the strategic buyer does not need to do this, and hence the strategic buyer's early-exit value of the target has a form similar to (3). The fund's decision to sell to a strategic buyer depends on the profitability index. It also depends on the current market state since the fund gives up the

opportunity to exit in a different state and to a different buyer. We let $\underline{x}_{SB,i}$, $i = H, L$, denote the optimal threshold for an early exit to a strategic buyer. The first time this occurs is $T_{SB,i} = \inf\{t > 0 | x_t \leq \underline{x}_{SB,i}\}$.

Alternatively, the target can be sold to another PE fund that continues with a growth strategy that adds value to the target. This occurs at the profitability threshold $\overline{x}_{PE,i}$ for state i and the corresponding time is $T_{PE,i} = \inf\{t > 0 | x_t \geq \overline{x}_{PE,i}\}$. We assume a reduced-form valuation that depends on exit-market conditions and on the selling PE fund's remaining time:

$$E_{PE,i}(x) = \varphi_{1,i} x - \varphi_{0,i}(t, T), \qquad i = H, L. \tag{12}$$

We relate $\varphi_{1,i}$ to the buying PE fund's gross gain and $\varphi_{0,i}$ relates to costs:

$$\varphi_{1,i} = \frac{\lambda}{(r - \mu)(r - \mu + \lambda)} \left((1 - \rho_i) \bar{s} y_L + \rho_i \bar{s}' y_H \right), \tag{13}$$

$$\varphi_{0,i}(t, T) = \frac{K}{r + \lambda} + \rho_i \left(R_{PE} + \Delta(t, T) \right), \tag{14}$$

where $\bar{s}' = p' s_G + (1 - p') s_M$ with $p' > p$ and $\Delta(t, T) = \Delta_{\max} \cdot (1 - (T - t)/T)$. Specifically, for the buying PE fund we allow for another valuation by letting $\bar{s}'$ depend on a different success-probability, p', due to, for example, complementary skills. We also let the buying PE fund exploit that the selling PE fund has less bargaining power as time passes. This is modelled through $\Delta(t, T)$ which implies that the selling fund obtains a lower value as it gets closer to maturity. Furthermore, we adjust for exit-market conditions though the parameter ρ_i. Thus, the scaling $\varphi_{1,i}$ gives a reduced-form value that the buying PE fund obtains by continuing the development of the target. This requires a continued payment of the transformation cost K and a readjustment cost R_{PE} which enters into $\varphi_{0,i}$.

2.2.3 Exit at maturity

It can happen that the PE fund fails to complete the growth strategy or does not sell the target in an early exit before the fund matures. In this case the fund will sell to the buyer who offers the highest price at the current level of x, see (3) and (12). Thus, at the end of the fund's life the exit value is

$$\max\{0, E_{SB}(x_T, s_M), E_{PE,i}(x_T)\}, \qquad i = H, L. \tag{15}$$

2.3 PE fund's value of the target

The PE fund seeks to maximize the present value of its future decisions until the target is sold. During the transformation of the target via its growth strategy, the PE fund also considers the possibility of an early exit. In our analysis we use a parameterization yielding $\bar{x}_{PE,L} \leq \bar{x}_{PE,H}$ and $\underline{x}_{SB,L} \geq \underline{x}_{SB,H}$.

We let $P_i(x,t)$ denote the PE fund's value of the target for acquiring it in state $i = H, L$. To shorten notation we suppress the arguments x and t. Thus, we end up with a set of coupled time-dependent partial differential equations (PDEs) with jumps:

For $\bar{x}_{PE,L} \leq x \leq \bar{x}_{PE,H}$: (Change to low state implies exit to another PE fund)

$$rP_H = \frac{1}{2}\sigma^2 x^2 P_{H,xx} + \mu x P_{H,x} + P_{H,t} + \lambda(E_{\lambda,H} - P_H) + \lambda_H(E_{PE,L} - P_H). \tag{16}$$

For $x \in \left[\underline{x}_{SB,L}, \bar{x}_{PE,H}\right]$:

$$rP_H = \frac{1}{2}\sigma^2 x^2 P_{H,xx} + \mu x P_{H,x} + P_{H,t} + \lambda(E_{\lambda,H} - P_H) + \lambda_H(P_L - P_H), \tag{17}$$

$$rP_L = \frac{1}{2}\sigma^2 x^2 P_{L,xx} + \mu x P_{L,x} + P_{L,t} + \lambda(E_{\lambda,L} - P_L) + \lambda_L(P_H - P_L). \tag{18}$$

For $\underline{x}_{SB,H} \leq x \leq \underline{x}_{SB,L}$: (Change to low state implies exit to strategic buyer)

$$rP_H = \frac{1}{2}\sigma^2 x^2 P_{H,xx} + \mu x P_{H,x} + P_{H,t} + \lambda(E_{\lambda,H} - P_H) + \lambda_H(E_{SB} - P_H), \tag{19}$$

where $P_{i,xx}$ and $P_{x,i}$ denote the first- and second-order partial derivative with respect to x, and $P_{i,t}$ denotes the time derivative. The exit values, E_{SB}, $E_{\lambda,i}$, and $E_{PE,i}$, are given by (3), (10) (11), and (12), respectively. The system of PDEs is subject to boundary conditions for each state $i = H, L$:

$$P_i\left(\bar{x}_{PE,i}\right) = E_{PE,i}\left(\bar{x}_{PE,i}\right), \tag{20}$$

$$P_i\left(\underline{x}_{SB,i}\right) = E_{SB}\left(\underline{x}_{SB,i}, s_M\right), \tag{21}$$

with the addition of continuity at $\underline{x}_{SB,L}$ and $\bar{x}_{PE,L}$. The terminal condition at the fund's expiration, T, is given by

$$P_i\left(x, T\right) = \max\{0, E_{SB}\left(x_T, s_M\right), E_{PE,i}\left(x_T\right)\}. \tag{22}$$

Since the PE fund's problem is time-dependent, no closed-form solution can be obtained.[4] Thus, we will have to solve the problem numerically. We explain the procedure below.

3 Exit strategies, holding periods, and valuation

The structure of our model precludes an analytical investigation of the results. Since several of the parameters are difficult to observe in practice, we analyze the implications of our model by an extensive simulation analysis. To do so we consider a set of benchmark parameters. For the dynamics of the profitability index, we assume a growth rate of $\mu = 0.01$ and a volatility of $\sigma = 0.2$. The risk-free rate of interest is $r = 0.04$. An investment of $I_0 = 15$ is needed to exercise the growth option. The annual cost for transforming the target is $K = 6$. The PE fund is expected to have implemented its

[4]We have also considered the setup with an infinite time horizon. Although the regime-shifting feature of the model implies that it is not possible to get explicit closed-form solutions for the optimal thresholds, it is possible to derive expression for the solution and the value functions. As a robustness check, we have compared our numerical solutions to this version of our framework and by increasing the time horizon, T, we get similar results.

strategy within 4 years, $\lambda = 0.25$. A successfully implemented growth option yields with probability $p = 0.5$ a good scaling, $s_G = 2$, and with the remaining probability a moderate scaling, $s_M = 1$, which implies an average scaling equal to 1.5. The profit scaling for the strategic buyer is $s_B = 1.1$. To handle the PE fund's limited time to restructure the target and make it ready for a sale, we set $T = 8$ years. Finally, if the target is sold before the PE has fully implemented its growth strategy, there is a transaction cost equal to $R_{SB} = 10$ when selling to a strategic buyer. If the target is sold to another PE fund the transaction cost is $R_{PE} = 12.5$. As a consequence of reduced bargaining power, the buying private equity fund can charge a larger premium as the selling fund's maturity gets closer such that the selling fund at expiration loses at most $\Delta_{\max} = 7.5$, see (14). The exit conditions change over time. A high valuation state implies a profit scaling of $y_H = 1.2$, and a transition to a low valuation state occurs with instantaneous probability $\lambda_H = 0.25$. Similarly, in a low valuation state the scaling is $y_L = 1$ and it is left with probability $\lambda_L = 0.25$. Hence, the PE fund faces the risk that exit market conditions become worse compared to the time of the acquisition. On the other hand, if the PE fund acquires the target in a low valuation state it can bet that it can time the market better and exit during a high state market. Furthermore, the exit market conditions affect the value at which the PE fund can make an early exit to another PE fund. We let $\rho_H = 0.7$ be the scaling in the high-state market and $\rho_L = 0.5$ the scaling in the low-state market. The profitability index is initially normalized $x_0 = 1$.

As an input to the simulation analysis we first implement the model from Section 2 numerically by using the Crank-Nicolson approach. This gives us the thresholds for an early exit in the various exit strategies. For our base case the outcome is depicted in Figure 9 in Appendix B. Once we have these thresholds, we use them in a second step to perform an analysis of the distribution of exit strategies and the duration of the holding period.

Specifically, given the boundaries, we simulate a set of sample paths of the profitability index for time steps $dt = 1/365$ from 0 to T. For each path and for each time step we check for the occurrence of a jump for either completing the growth strategy or for a state-shift, or whether the thresholds are hit. We present the results below in which the simulations are based on 25,000 sample paths.[5]

3.1 Effect of the time-to-exit

We initiate our analysis by considering a prominent feature of a private equity acquisition, namely that the target has to be sold within a relatively short time horizon. Figure 2 and Figure 3(a) show the time-horizon effects as we vary the remaining lifetime of the fund from 4 years to 12 years.[6] In Figure 2(a) we consider the distribution of exit strategies assuming that the acquisition takes place when the exit market is in a high valuation state.[7] With only a 4-year time horizon, the probability that the strategy is successfully implemented is about 54%. Specifically, there is a 45% probability that the strategy becomes successful during a high valuation state and only a 4% probability that the strategy becomes successful when the exit market is in a low valuation state after which the PE fund awaits a shift to a high valuation state. The short time horizon also implies a high risk that the target is kept until maturity (20%). If the exit market shifts to the low state, the PE fund prefers to exit the target by selling it to a strategic buyer (12%) or another PE fund (14%). However, when the exit market is in a high state, an early exit without an implemented strategy rarely happens as an exit to a strategic buyer occurs with a 2%

[5]We have also performed our simulation analysis varying the number of paths from 10,000 to 50,000. We benefit substantially from increasing the number of sample paths from 10,000–25,000. With 25,000 sample paths our results appear robust in the sensitivity analyses, although some exit strategies still only occur infrequently. However, we do not gain much from increasing the number of sample paths further.

[6]We use this time frame since the life of a fund is typically 10 years but it can be extended with 1-2 years. The 4-year time horizon is motivated by the fact that the usual investment period makes up the first 5 years of the fund's life. Therefore, funds with a remaining life of less than 4 years should not be very active in undertaking acquisitions (Axelson et al., 2009).

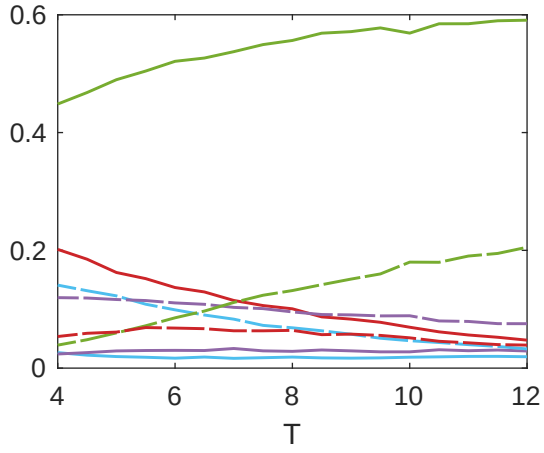
[7]We thank the reviewers for suggesting us to focus on these effects.

probability and an exit to another PE fund also has a 2% probability.

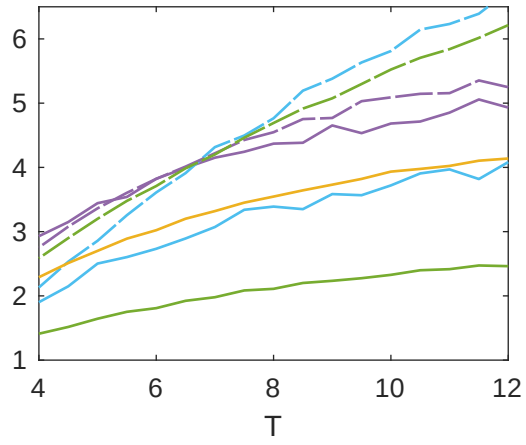
Increasing the time horizon to 12 years has a large effect on the exit distribution. Intuitively, the PE fund can better await a high valuation state when exiting which make more valuable outcomes more likely. Indeed, the probability that the strategy is successfully implemented increases from 54% to 84%. This increase stems both from more time to implement the strategy when in a high state (increasing from 45% to 60%) as well as from more time to wait for a high exit valuation, if the strategy is successfully implemented while the exit market is low (from 4% to 20%). The PE fund is also much more likely to make an exit before the fund matures. There is a significant drop from 20% to 5% in the probability that the fund keeps the target until maturity. In a similar vein, an exit in a low state before the strategy is implemented is much less likely. The probability of selling to a strategic buyer decreases from 14% to 3%; for selling to another PE fund the likelihood decreases from 12% to 3%.

We consider the expected time of the exit strategies in Figure 2(b). Overall, an exit is expected to occur after 2.3 years when the target can be held for 4 years. With a 12-year time horizon, the exit is expected to occur after 4.2 years. Thus, more time to implement the strategy and sell the target is used by the PE fund if it has this possibility. The distribution of the expected exit time for the different strategies clearly shows the PE fund's preferences for successfully implementing its strategy. Once the strategy is implemented, the target is sold as quickly as possible except if the exit market is in a low state. In this case, the fund awaits a shift to a high state. It is noteworthy that an exit to another PE fund in the low state is strongly postponed with an expected exit time increasing from 2.1 years to 6.7 years. This strong effect may point at why some funds are allowed to continue a year more after the initially decided maturity.

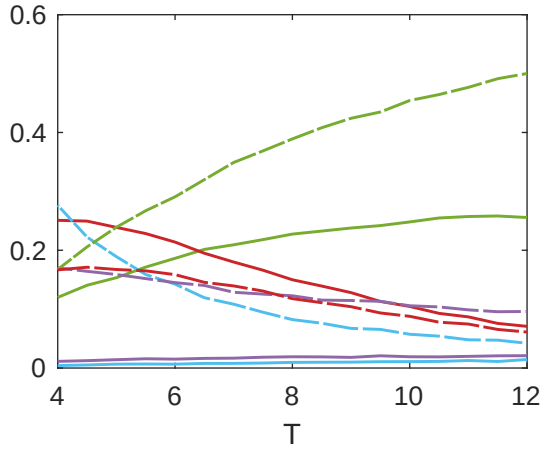
Alternatively, an acquisition can also take place when the exit market initially is in a



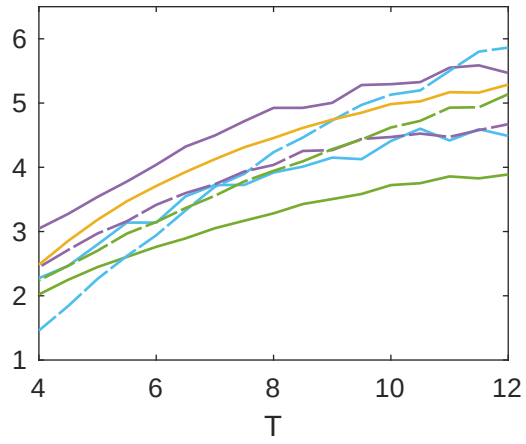
(a) Frequency of exit strategies for a takeover initiated when exit valuation is high (state H).



(b) Expected exit timing for various strategies for a takeover initiated when exit valuation is high (state H).



(c) Frequency of exit strategies for a takeover initiated when exit valuation is low (state L).



(d) Expected exit timing for various strategies for a takeover initiated when exit valuation is low (state L).

Figure 2: Time horizon and exit strategies: The figure shows direct effects of the time horizon, T. For the line specifications, a solid curve is used for the high state and a dashed curve for the low state, unless otherwise noted. The fund makes an early exit and sells to another PE fund at the blue curves, and sells to a strategic buyer at the purple curves. Completion of the growth strategy and subsequent exit happens at the green curves. Panels 2(a) and 2(c): The frequency of exits for a takeover initiated in state H and in state L, respectively. The solid red curve represents the fund's exit at maturity and the dashed red curve is for completion of the strategy but exit at maturity. Panels 2(b) and 2(d): The expected time for the exit strategies when a takeover is initiated in state H and in state L, respectively. The solid yellow curve shows the average holding period (average expected time for all exit strategies).

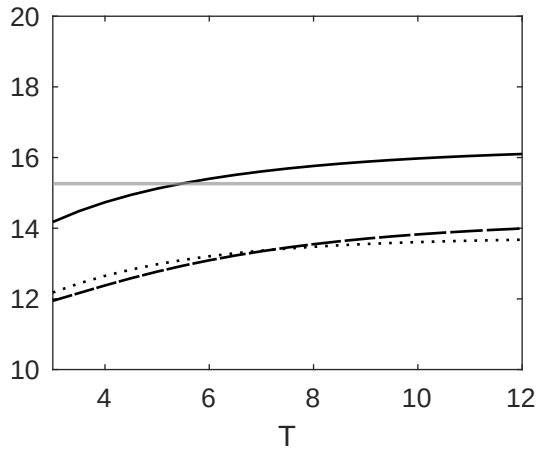
low state. We report results from this in Figure 2(c). Several effects carry over from the high state to the low state. However, a longer time horizon is relatively more valuable because it allows for a shift from the low state to the high state implying that an early exit is less attractive. Indeed, the probability that the strategy is implemented increases from 46% to 81%. Hence, if the PE fund has time enough to wait for a high exit valuation state, the probability of an implemented strategy is more or less the same. This also implies that the target is less likely to be sold at maturity; the probability decreases from 25% to 7%. The PE fund's use of a longer time horizon is also clearly seen in Figure 2(d). Specifically, the overall expected time before an exit increases from 2.5 years to 5.3 years. Compared to an acquisition in the high state, we observe an acquisition of the target in the low state implies that the average holding period is longer. Thus, if it is possible to hold the target for a longer time, this is exploited to a larger degree. With a 12-year time horizon at acquisition, the PE fund holds on to the target for about 5.3 years in the low state which is over a year more than with an acquisition in the high state.

We have established that the PE fund's time horizon has a substantial impact on the distribution and timing of the various exit strategies. This spills over to the PE fund's valuation of the target. Figure 3(a) shows that the valuation is highly sensitive in the time horizon. For example, an acquisition in the high state increases in value from 14.7 to about 16 (a 10% increase). In contrast, an acquisition in the low state has a lower value, but a longer time horizon increases the valuation from 12.3 to 14 (a 14% increase). Thus, the impact of the state of the exit market is substantial. The high-state exit market yields a valuation 15-20% above that of the low-state market. This implies that the ex-post risk of the state of the exit market affects which targets are interesting from a PE fund's perspective. In our setup we consider a strategic buyer as an ex-ante competitor to the PE fund for acquiring the target. The role of the strategic buyer is to highlight which elements

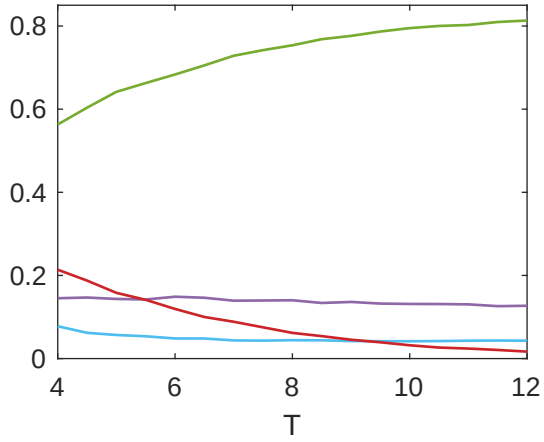
in the PE fund's valuation are central in its acquisition decision. The strategic buyer's valuation of the target in the base case is about 15.25. This is depicted as the horizontal line in Figure 3(a). The figure shows that the PE fund will not be able to outbid the strategic buyer when the exit market is in the low state. The PE fund can obtain a higher valuation of the target in the high state, but only if the fund has more than about 5.5 years left. This indicates that the time limit that PE funds face is certainly a constraining factor when considering acquisitions. In the following we are going to elaborate on other characteristics that either help or limit the PE fund to acquire the target.

3.1.1 No time-varying exit market conditions

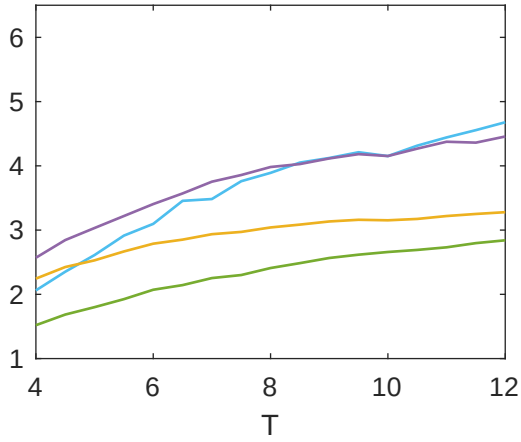
Our analysis of the time horizon effect shows that there is a substantial difference between the high state and the low state. The model becomes substantially simpler if we do not let the exit market valuation change between two states. To analyze the implications of such a simplification, we consider a model with an average exit market. Specifically, we let $y_H = y_L = 1.1$, $\rho_L = \rho_H = 0.6$ and then simulate the model as above. The PE fund's valuation of the target is illustrated in Figure 3(a) as the dotted black curve. Interestingly, the valuation of the target depends differently on the time horizon than when the average is disentangled in the two states. Specifically, the target has a higher value in the average exit market case than in the low exit market state. However, this intuitive relation vanishes as the time horizon increases. That is, using an average of the exit market implies that the target has a lower value than in the low exit market state when there is a long time horizon. This is due to the fact that with the average exit market model there is no possibility to reach the high-state market which is very beneficial. To put it differently, there is a "Jensen" effect in the sense of Jensen's inequality for convex functions: The average of the outcome of the model with a high and a low exit market state is higher than the model with an average exit market as an input. With an analogy to hedging,



(a) Target's value to the PE fund and the strategic buyer.



(b) Frequency of exit strategies in an average state.



(c) Expected exit timing for various strategies for a takeover in an average state.

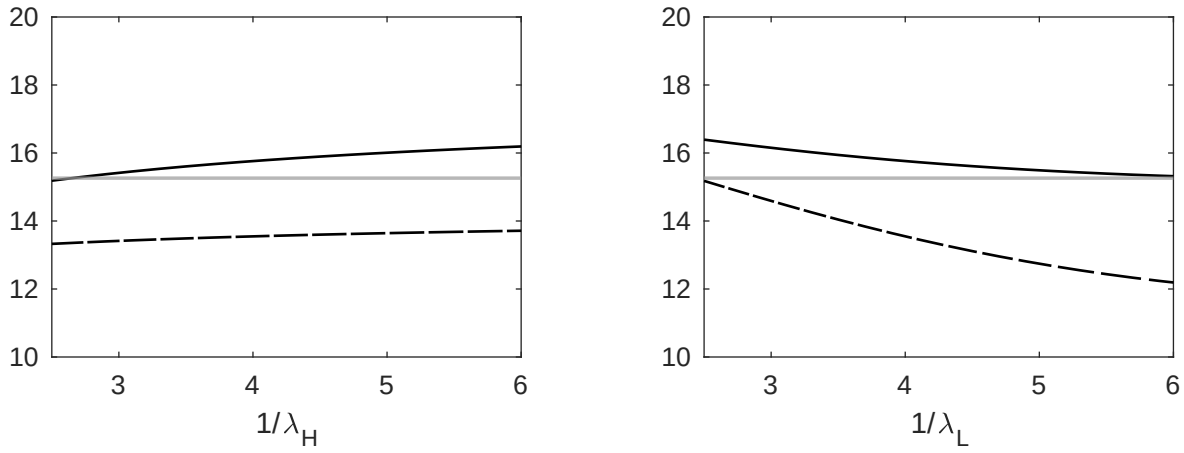
Figure 3: Time horizon, valuation and average state of the exit market: The figure shows the effects of the time horizon on valuation in our full model with two states and in a version with an average state (one-regime framework). Panel 3(a): The PE fund's initial valuation of the target for an acquisition in the high state (solid black curve), in the low state (dashed black curve), and in an average state (dotted black). The strategic buyer's initial valuation of the target is the solid grey curve. Panels 3(b) and 3(c) show the distribution and the expected time, respectively, of the PE fund's different exit strategies in the setup with an average state. The red curve represents the fund's exit at maturity. The yellow curve marks the average holding period for all exit strategies. For both panels, the fund makes an early exit by selling to another PE fund at the blue curve, sells early to a strategic buyer at the purple curve, and completes the growth strategy and subsequently exits at the green curve.

this effect implies that a PE fund is risk-seeking in terms of exit market fluctuations as long as the PE fund has time enough to wait for a shift to better exit market conditions. As we discuss below, this implies that there is a relatively large effect of the probability to enter the high state, λ_L. The hedging effect also illustrates an important friction for a PE fund when it gets closer to its maturity and it also implies that the exit time of the PE fund is different with an average exit market. Figure 3(c) shows that the overall expected exit time increases from 2.2 years to 3.2 years as the time horizon increases. Compared to the discussion related to Figure 2(b) and Figure 2(d), we see that the holding period is about the same when the time window is short, but the holding time is substantially shorter when the time horizon is long. Thus, time-varying conditions for the exit market are an important dimension for understanding a PE fund's valuation and policy.

3.2 Time-varying exit market conditions

Our discussion regarding the average exit market shows that taking an ex-post time-varying exit market into account is important. We now elaborate on the differences between the two exit markets. We first consider the effects of varying the (expected) time in the high-state market. Afterwards we do the same for the low-state market. In both cases we consider an acquisition initiated in the high state and in the low state, respectively.

When the exit market is in a high state, the probability of changing market conditions is a negative factor. Thus, a shorter expected time in the high-state market (i.e., λ_H increases) has a direct negative effect on the valuation of the target. This is seen by the solid black graph in Figure 4(a). Indeed, if the PE fund can only expect the high-state market to prevail in 2.5 years, the target's value is so low that the PE fund will be outbid by the strategic buyer. However, since we assume that the exit market does not affect whether the PE fund's strategy is successfully implemented or not, the probability of a successful implementation is not much affected by the risk of leaving the high-state market.



(a) Initial valuation of the target.

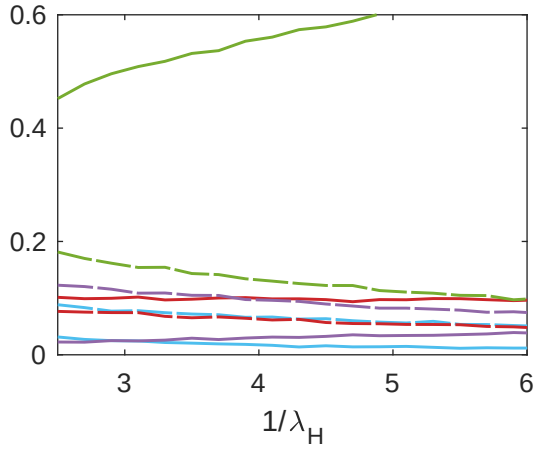
(b) Initial valuation of the target

Figure 4: Exit market changes and valuation: The figure shows the effects of exit-market changes on the initial valuation where Panel 4(a) is for the expected time in the high state, $T_H = 1/\lambda_H$, and Panel 4(b) is for the expected time in the low state, $T_L = 1/\lambda_L$. For both panels, the solid black curve is the fund's initial valuation in the high state, the dashed black curve is the fund's initial valuation in the low state, and the grey curve is for the strategic buyer's initial valuation.

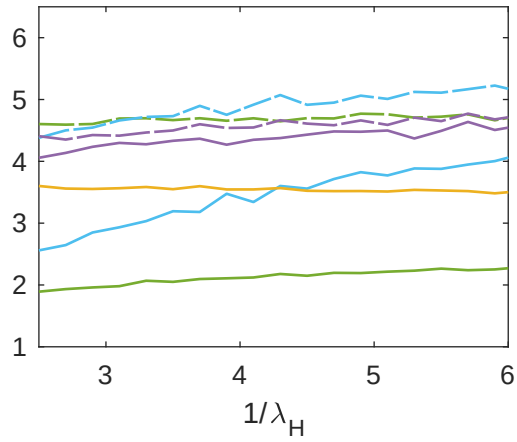
Rather, the negative effect is due to the fact that the target's value in the low state is much lower and for all variations considered it is lower than the strategic buyer's valuation.

The distribution of exit strategies in Figure 5(a) also shows a large effect of an increasing risk of leaving the high state. As the expected time in the high state decreases from 6 to 2.5 years, the probability of having the PE fund's strategy implemented in the high state decreases from 63% to 45%. In contrast, if the strategy is implemented in the low state, the probability increases from 10% to 18% as the expected time in the high state decreases. Therefore, if there is time to wait for a change in the exit-market conditions, the PE fund exploits this implying that an exit more often happens as the market moves from the low state to the high state. However, the exit-market conditions may not improve before the fund matures, implying that the probability of keeping the target until an exit must be done increases from 5% to 8%. Overall, while the risk of leaving the high state impacts the distribution of the exit strategies, the overall expected time for an exit is not much affected, as seen in Figure 5(b). If the PE fund acquires the target in the high state, the overall expected time to exit is about 3.5 years. This may seem surprising because, as we just argued, the PE fund tends to keep the completed target longer on average when the exit market is in the low state. Yet, it becomes optimal for the PE fund to make an exit earlier, i.e., before the strategy is implemented. Indeed, in the high state, the exit time for the PE fund to sell the target to another PE fund decreases from 4.1 years to 2.6 years, and the exit time for a sale to a strategic buyer decreases from 4.6 years to 4.1 years. The combined effect of a changed distribution of exit strategy and the associated exit time implies that the overall expected exit time is basically unaffected.

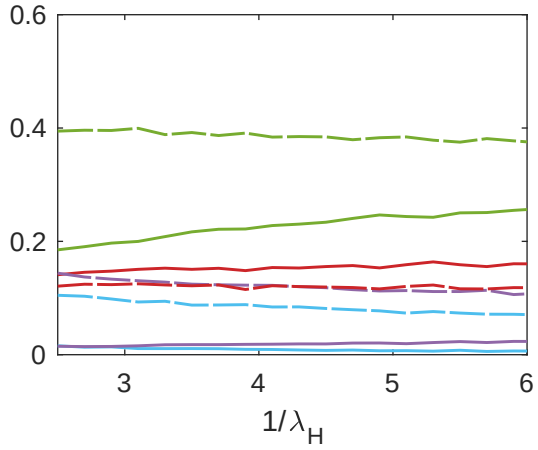
We also consider what happens if the PE fund acquires the target in a low state in Figure 4(a), Figure 5(c), and Figure 5(d). The implications of a shorter expected time in the high state are basically as if the target is acquired in the high state, but the effects



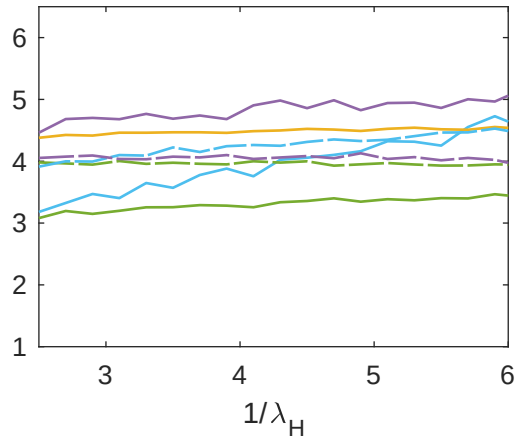
(a) Frequency of exit strategies for a takeover initiated when exit valuation is high (state H).



(b) Expected exit timing for various strategies for a takeover initiated when exit valuation is high (state H).

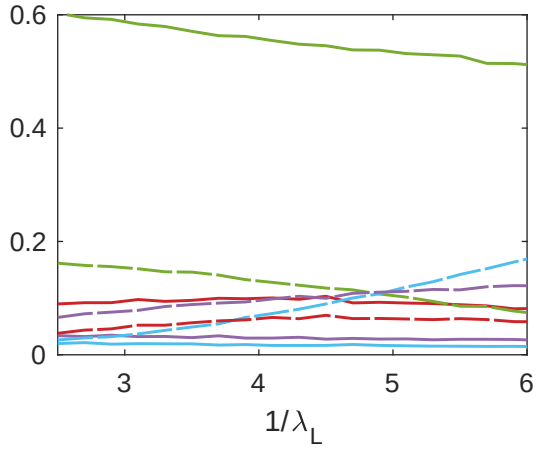


(c) Frequency of exit strategies for a takeover initiated when exit valuation is low (state L).

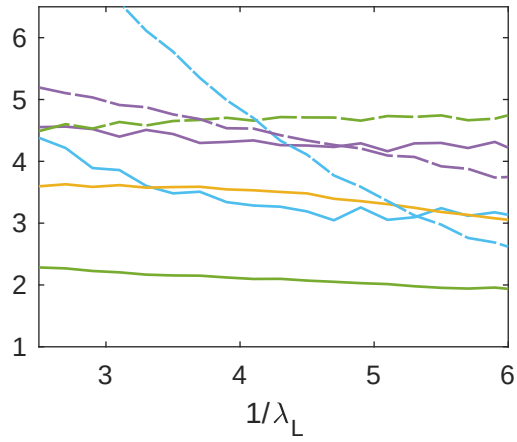


(d) Expected exit timing for various strategies for a takeover initiated when exit valuation is low (state L).

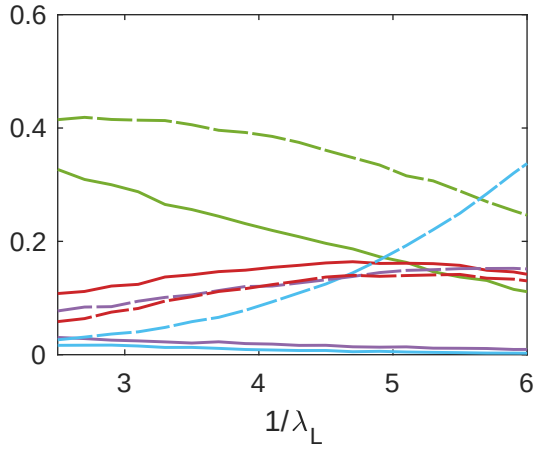
Figure 5: Changes of exit-market conditions from high to low and exit strategies: The figure shows effects of the expected time in the high state, $T_H = 1/\lambda_H$. For the line specifications, a solid curve is used for the high state and a dashed curve for the low state, unless otherwise stated. The fund makes an early exit and sells to another PE fund at the blue curves, and sells to a strategic buyer at the purple curves. Completing the growth strategy and subsequent exit happens at the green curves. Panels 5(a) and 5(c): The frequency of exits for a takeover initiated in state H and in state L, respectively. The solid red curve represents the fund's exit at maturity and the dashed red curve is for the completing the strategy but exiting at maturity. Panels 5(b) and 5(d): The expected time for the exit strategies when a takeover is initiated in state H, and in state L, respectively. The solid yellow curve shows the average holding period (average expected time for all exit strategies).



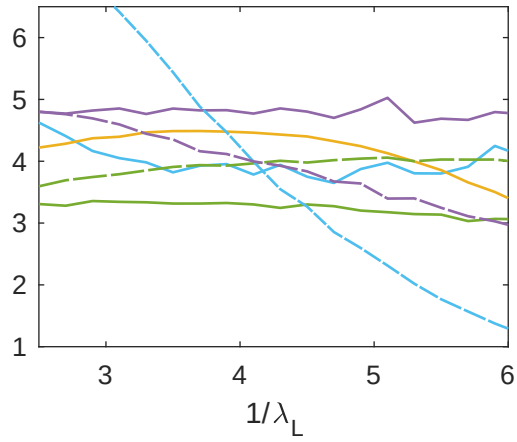
(a) Frequency of exit strategies for a takeover initiated when exit valuation is high (state H).



(b) Expected exit timing for various strategies for a takeover initiated when exit valuation is high (state H).



(c) Frequency of exit strategies for a takeover initiated when exit valuation is low (state L).



(d) Expected exit timing for various strategies for a takeover initiated when exit valuation is low (state L).

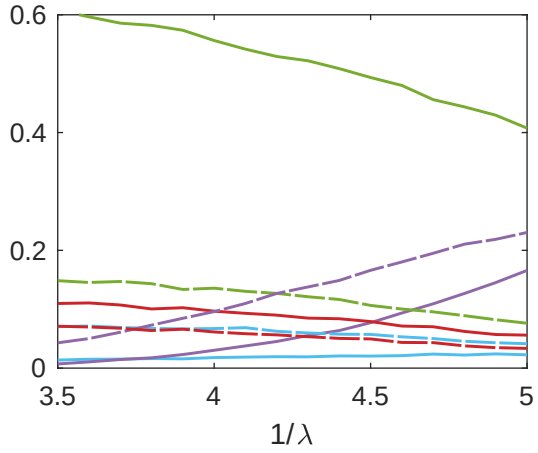
Figure 6: Changes of exit market conditions from the low to the high and exit strategies: The figure shows the effects of the expected time in the low state, $T_L = 1/\lambda_L$. For the line specifications, a solid curve is used for the high state and a dashed curve for the low state, unless otherwise noted. The fund makes an early exit and sells to another PE fund at the blue curves, and sells to a strategic buyer at the purple curves. Completion of the growth strategy and subsequent exit happens in the green curves. Panels 6(a) and 6(c): The frequency of exits for a takeover initiated in state H and in state L, respectively. The solid red curve represents the fund's exit at maturity and the dashed red curve is for the completion of the strategy but exit at maturity. Panels 6(b) and 6(d): The expected time for the exit strategies when a takeover is initiated in state H and in state L, respectively. The solid yellow curve shows the average holding period (average expected time for all exit strategies).

are generally dampened. This is because a higher risk of leaving the high state only comes indirectly into play when the acquisition happens in a low state.

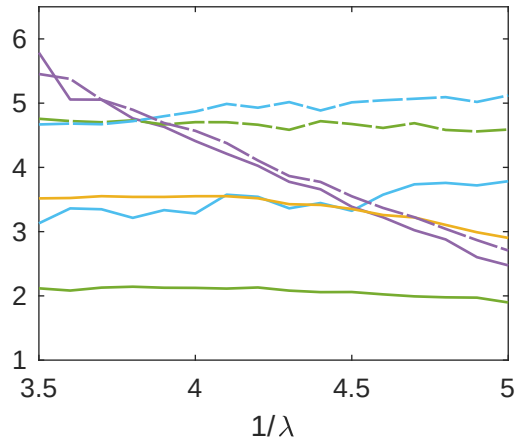
The effects of risking a shorter time in the low exit market are depicted in Figure 4(b) and Figure 6. Intuitively, leaving the low-state market is a positive event for the PE fund. Therefore, the general implications of decreasing the time in the low state are essentially as the implications of increasing the time in the high state. However, the sensitivities are not similar in the two cases. Interestingly, the risk of staying longer in the low-state market decreases the PE fund's valuation of the target from 15.2 to 12.2 if the acquisition is considered in the low state. This is a 20% decrease in value. The valuation decreases from 16.4 to 15.3, if the acquisition is considered in the high state (a 7% decrease). In contrast to Figure 4(a), a similar change in the expected time of staying in the high state increases the target's value by only 3% if the acquisition is initiated in the low state. The increase is about 7% if acquired in the high state. This shows that it is particularly harmful for the PE fund if the chance of getting into a high market valuation is low. As we highlighted in our discussion with an average exit market, the asymmetric effect of being in the low state versus in the high state implies that considering an average model for the exit market will hide key elements in understanding the role PE funds play in acquisitions.

3.3 Strategy implementation

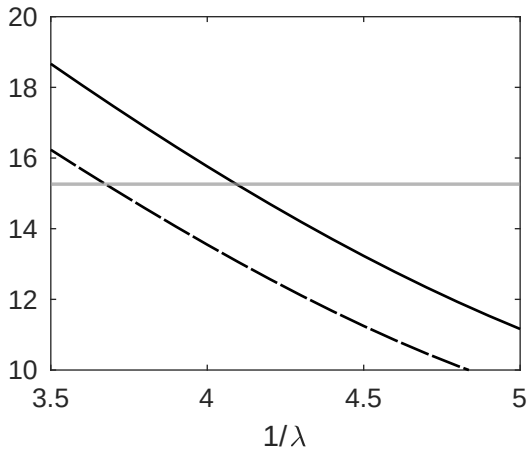
The likelihood of implementing the desired strategy is a central element in the PE fund's decision to acquire the target. We analyze this in Figure 7 and vary the expected time for implementing the strategy between 3.5 years and 5 years. Figure 7(c) shows that the valuation is highly sensitive in the expected implementation time. Intuitively, the longer time it is expected to take to obtain a successful strategy, the lower is the valuation of the target. If the acquisition is done in the high state, the value decreases from 18.7 to 11.2. In the low state the decrease is from 16.2 to 9.5. Since the strategic buyer evaluates the



(a) Frequency of exit strategies for a takeover initiated when exit valuation is high (state H).



(b) Expected exit timing for various strategies for a takeover initiated when exit valuation is high (state H).



(c) Initial valuation of the target.

Figure 7: Expected time for implementing the PE fund's growth strategy for exit strategies and valuation. The figure shows the effects of the PE fund's expected time to complete its growth strategy, $T_\lambda = 1/\lambda$. Panels 7(a) and 7(b) show the distribution and the expected time, respectively, of the fund's different exit strategies for an initial acquisition in the high state. For the line specifications, a solid curve is used for the high state and a dashed curve for the low state, unless otherwise noted. The fund makes an early exit and sells to another PE fund at the blue curves, and sells to a strategic buyer at the purple curves. Completion of the growth strategy and subsequent exit happens in the green curves. The solid red curve represents the fund's exit at maturity and the dashed red curve is for the completion of the strategy but exit at maturity. The solid yellow curve shows the average holding period (average expected time for all exit strategies). Panel 7(c): The PE fund's initial valuation of the target for an acquisition in the high state (solid black curve), in the low state (dashed black curve), and in an average state (dotted black). The strategic buyer's initial valuation of the target is the solid grey curve.

target at 15.25, the change in implementation time can make the difference for the PE fund. Specifically, in the high state the PE fund can outbid the strategic buyer as long as the expected implementation time is below 4.2 years. In the low state, the implementation time must be less than 3.7 years. These effects are a consequence of the limited time the PE fund faces. That is, with a longer time horizon, T, the PE fund's valuation increases and the sensitivity in implementation time decreases.

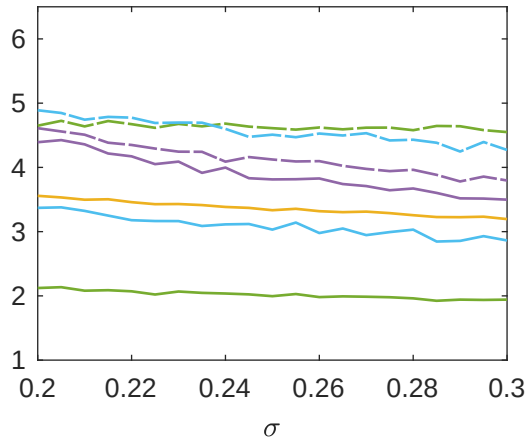
The distribution of exit strategies and the expected timing of these also depend on the implementation time of a successful strategy. We focus on an acquisition in the high state, as the effects intuitively carry over to the case in which the acquisition takes place in the low state. Figure 7(a) reveals the natural result that a longer waiting time decreases the probability of a strategy implementation in the high state. Moreover, the probability of an exit to a strategic buyer increases substantially. The overall expected exit time decreases from 3.5 years to 2.9 years, as seen in Figure 7(b). Apparently, this contradicts that the PE fund must wait longer before the planned strategy is implemented. However, we see that the PE fund decides to make an exit to a strategic buyer much earlier. This exit strategy is, on average, taking place after 5.6 years with a short implementation time, but increasing the implementation time decreases the exit time to about 2.6 years. Since the likelihood of an exit to a strategic buyer also increases considerably, the combined effect implies that the PE fund decides to sell the target at an earlier point in time. Specifically, up to 3 years earlier as the implementation time increases.

3.4 Intrinsic value of target

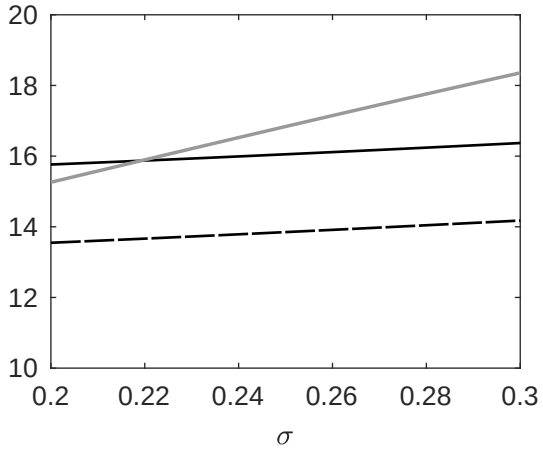
The intrinsic value of the target is affected by the volatility, σ, and the expected growth rate, μ. Traditionally, a higher volatility increases the value of waiting, but since the PE fund has limited time, waiting is not always possible. In contrast, a strategic buyer evaluates a higher volatility more. This effect impacts the PE fund's exit strategy. Figure 8(a)

shows that a higher volatility does not have a large impact on the expected time of the different exit strategies, but slightly more if we focus on those to a strategic buyer. In this case an exit to a strategic buyer occurs about a year earlier. This fits with the (unreported) outcome that the PE fund's probability of selling to a strategic buyer increases in the volatility. A higher volatility increases the valuation of the target, but since a successful implementation of the planned strategy does not depend on the volatility, and because the PE fund has limited time, the value increases only moderately in volatility. This is seen in Figure 8(b). The striking result is that the strategic buyer's valuation increases much more in volatility. This is due to the fact that the strategic buyer can better exploit the value of waiting. In this sense, an acquisition of the target is more like a traditional real options investment from the strategic buyer's point of view. In contrast, the PE fund benefits from acquiring the target if its growth strategy gets fully implemented. Hence, the strategic buyer evaluates the target higher than the PE fund for a high enough volatility.

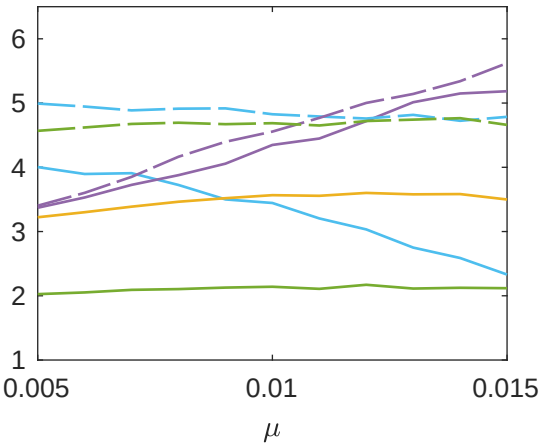
Moreover, a higher expected growth rate naturally increases the intrinsic value of the target, however it tends to decrease the value of waiting in a real options sense. Since the value of waiting is more beneficial for the strategic buyer than the PE fund, Figure 8(d) shows that the valuation of the target increases faster for the PE fund. As a result, the strategic buyer will only be able to acquire the target for relatively low expected growth rates. This holds even in the case of a current low exit market valuation. The effect that a strategic buyer's valuation increases at a lower rate spills over to the PE fund's exit strategies. Unreported results show that the likelihood of an exit to a strategic buyer decreases with the expected growth rate. This effect carries over to the exit time of the various strategies seen in Figure 8(c). For example, an exit to a strategic buyer increases from about 3.5 years to 5.5 years. In contrast, an exit to another PE fund occurs much sooner in the high state (decreases from 4 years to 2.3 years).



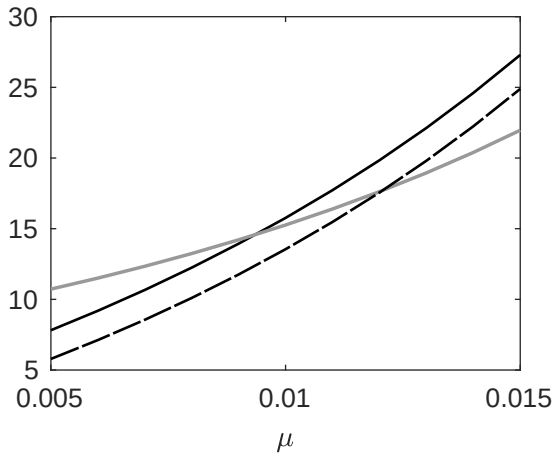
(a) Expected exit time for various strategies for a takeover initiated when exit valuation is high (state H).



(b) Initial valuation of target.



(c) Expected exit time for various strategies for a takeover initiated when exit valuation is high (state H).



(d) Initial valuation of a takeover.

Figure 8: Intrinsic value of the target, exit strategies and valuation: The figure shows the effects of the volatility, σ, and the expected growth rate, μ. Panels 8(a) and 8(c) show the expected time for the different exit strategies for an initial acquisition in the high state. For the line specifications, a solid curve is used for the high state and a dashed curve for the low state, unless otherwise noted. The fund makes an early exit and sells to another PE fund at the blue curves, and sells to a strategic buyer at the purple curves. Completion of the growth strategy and subsequent exit happens in the green curves. The solid yellow curve shows the average holding period (average expected time for all exit strategies). Panels 8(b) and 8(d) show the PE fund's initial valuation of the target for an acquisition in the high state (solid black curve) and in the low state (dashed black curve). The strategic buyer's valuation is the grey curve.

4 Implications and discussion

Our analysis so far focuses on how various characteristics impact the PE fund's exit strategies, holding time, and valuation of the target. Several of the parameters used in the model are difficult to observe in practice, and hence we now use the results of our analysis to formulate a set of predictions that more easily can be related to observable actions.

An effect that stands out in our discussion of the time horizon in Figure 2 is that the PE fund prefers to sell the target as soon as it has fully implemented its growth strategy. However, if the exit market is in a low state when the strategy is implemented, then it is preferable to wait for better market conditions. A change in exit market conditions thus impacts observed exits. This in turn implies that a PE fund closer to maturity is less willing to acquire a target if current exit market conditions are low. The effect of changing market conditions may also be part of the explanation why some PE funds are granted a (typically) one year extension close to maturity (Phalippou and Gottschalg, 2009). If the planned transition of the target is more or less complete, but current exit market conditions are bad, then investors may be ex-post willing to extend the PE fund's life. In particular when market conditions are expected to change soon.

Prediction 1:

a) Acquisitions by newly raised PE funds are less dependent on exit market conditions. PE funds closer to maturity undertake less acquisitions in low-market conditions.

b) A positive shift in exit market conditions leads to increased exit activity.

c) A short extension of the PE fund's life is more likely when the exit market is expected to improve in the near future.

PE funds also acquire targets that are subsequently sold before the planned strategy is fully implemented. The attractiveness of such strategies also depends on exit market conditions. The analysis related to the time-varying exit market conditions shows that if

the high state is expected to prevail for a shorter period, then it is better to sell while being in the high state. Importantly, we also find that there is an asymmetric effect of the risk of leaving a high state or a low state, respectively. While it is bad for the PE fund to have a shorter time in the high state, it is worse if the low state is expected to last longer. This has implications for the period the PE fund keeps the target. Our model shows that the holding period is longer if the acquisition is done in a low-state market.

Prediction 2:

a) An early exit is more likely when market conditions are expected to be good for a shorter period of time.

b) PE fund acquisitions and exit strategies are more affected by an expected longer time in a low-state market than an expected shorter time in a high-state market.

c) Acquisitions done in a low-state market are expected to be kept for longer time than if they are done in a high-state market.

We have also seen that the likelihood that the PE fund successfully implements its strategy for transforming the target plays a large role. As this dimension affects the PE fund, but not a strategic buyer, we expect to see relatively few PE acquisitions of firms or in industries in which the value creation of an acquisition is more uncertain or difficult to do successfully in a short time. Furthermore, acquisitions done in this case are more likely to be exited with a sale to a strategic buyer.

Prediction 3:

a) If a target's transformation strategy takes longer time to complete, the target is more likely to attract a strategic buyer.

b) If such a target is acquired by a PE fund, the likelihood of an exit to a strategic buyer is higher.

Degeorge et al. (2016) find that secondary buyouts create value unless it is done due to

pressure to spend committed capital. In this case the buying PE fund has a clear growth strategy, whereas late secondary buyouts do not create value, and thus a strategic buyer is more relevant in the latter case.

We also analyzed how the intrinsic value of the target affects the acquisition decision. Clearly, the underlying dynamics of the target's profitability impact the PE fund differently than the strategic buyer, because the strategic buyer can better exploit the value of waiting. Specifically, the strategic buyer can better exploit a real options investment in the target, and thus higher volatility is more valuable to the strategic buyer than the PE fund. On the contrary, our analysis shows that a target with a high expected growth rate is more interesting for a PE fund. In particular, an exit to another PE fund becomes more relevant when there is a potential for investing in a high-growth target. This indicates a characteristic for the buy-and-build strategy that is used by some PE funds and aligns with empirical evidence (e.g., Hammer et al., 2017).

Prediction 4:

a) A target firm with a higher volatility of earnings is more likely to attract a strategic buyer.

b) A high-growth target is likely to be exited to another PE fund before the transformation strategy is fully implemented.

Another way to think of the prediction is that firms with valuable real options available for competitors (strategic buyers) are not particularly attractive for PE funds. Since this seems to be the case in most circumstances, it implies that PE funds should not be willing to pay more than a strategic buyer. This fits with the empirical evidence that the average premium to the target is larger with a strategic buyer and that PE funds less often acquire a target (e.g., Fidrmuc et al., 2012; Gorbenko and Malenko, 2014).

When competition for acquiring a target is present, the PE fund needs to evaluate

the target higher than the strategic buyer. Intuitively, the exit market conditions play an important role in this respect. That is, if a PE fund can outbid a strategic buyer when the exit market is in a low state, then this requires that several other factors speak in the PE fund's favor.

Prediction 5:

An acquisition done in a low state market is more likely if the expected time in the low state is shorter, the strategy implementation is less risky, and the expected growth rate is high.

4.1 Discussion

We make a number of assumptions to analyze the main effects a restricted time period and time-varying exit market conditions have on a PE fund's exit strategies, holding period, and valuation. We consider our framework to be sufficiently general to allow for various extensions in which the main effects will carry over. We now discuss some avenues for examining these effects even further.

Our analysis is initiated at the point in time a PE fund wants to take over a given target. We include a strategic buyer in a reduced form to act as a competitor, thus giving a valuation threshold the PE fund must pass to acquire the target. In a more general corporate finance context, several papers have addressed the timing of acquisition activities (e.g., Lambrecht, 2004; Hackbarth and Morellec, 2008; Morellec and Zhdanov, 2008) and also effects of preemptive behavior (e.g, Pawlina and Kort, 2006; Flor and Moritzen, 2020). Our paper abstracts from such strategic considerations from a buyer's point of view. Extending the model to include preemptive behavior could provide interesting effects. That is, without the PE fund one can think of a strategic buyer who is considering to acquire a target. However, if (seen from the strategic buyer's point of view) there is a risk that a PE fund is established and thus may try to acquire the target, then the analysis in the

present paper must be part of the "ex-ante" analysis by the strategic buyer. The risk of a preemptive acquisition likely implies that the target is acquired at a lower level of the profitability index. Consequently, the PE fund and the strategic buyer will not deem this as equally costly. According to our analysis, the PE fund evaluates the target higher when the added value stems from implementing a transformation strategy. In contrast, embedded real options in the target benefit the strategic buyer more. Since a lower profitability index has no main effect on the former channel, but a direct negative effect on the latter channel, preemptive actions are more likely to be taken by a PE fund.

Another important extension of our model is to include that PE funds commonly use a substantial amount of debt to finance an acquisition (see e.g. Axelson et al., 2009). There are costs and benefits of this strategy. Clearly, if the tax regime allows for tax shields, debt financing (levered buyouts) in itself makes the acquisition cheaper for the PE fund. This should open up for paying a higher premium if neccessary (Axelson et al., 2013; Gorbenko and Malenko, 2014). Leverage also benefits the PE fund in at least two more dimensions. First, it allows for greater acquisition activities for a given amount of committed capital. Second, it helps to discipline management and keep a focus on value maximization. On the other hand, if the target performs less well than expected, the PE fund has to either support the target with more capital or to liquidate it. Since PE funds have a business model with repeated rounds of raising capital (including new debt in new acquisitions), they rely on reputation to keep the cost of debt low (Ivashina and Kovner, 2011; Malenko and Malenko, 2015; Huang et al., 2016). Thus, PE funds do not only have benefits from debt usage. Including the possibility of leveraged buyouts in the model will most likely provide positive value to the PE fund. Hence, there are more circumstances in which the fund is willing to pay more than the strategic buyer.

Extending our analysis with details regarding the operations of the PE fund can also be

insightful. For example, the match between a PE fund and a target clearly depends on the probability of a successful outcome, and when the match is good, it should be relatively cheaper for the PE fund to become successful. Referring to our model, we can consider a more elaborate implementation of the relation between the transformation cost, K, and the likelihood of a successful implementation of the strategy, λ. An extension in this direction can also involve more details about the actions taken by the PE fund. For example, the PE fund's strategy can rely on accumulating investments through acquisitions in which case a successful addition could follow the jump of a Poisson process that results in an increase in the scaling of $\bar{s}$. We expect that the main effects from our analysis hold with the above-described extensions, but a more detailed understanding of the distribution of exit strategies and the holding period would be valuable contributions. Finally, a more fundamental question is the ex ante game between the general partner and the limited partners when the PE fund is established. Our main friction, the limited life of the PE fund, should then be the outcome of an optimal contract. Understanding why the usual 10 year horizon is such an outcome is an interesting path for future research.

5 Conclusion

Private equity funds are active in shaping the corporate landscape. A PE fund restructures and develops a target with the purpose of selling it to a third party within a limited time horizon. In contrast, a strategic buyer is more likely to focus on integrating the target. Therefore, a PE fund has a different restructuring strategy and valuation of the target than a strategic buyer. Importantly, the value at exit is subject to time-varying conditions not controlled by the PE fund. In this paper we examine how the limited time a PE fund has to create value impacts it's exit strategy, holding period, and valuation of a target. We use a continuous-time real options analysis framework allowing for a transformation

of the target and including the PE fund's temporary ownership of a target that exposes the fund to time-varying exit market conditions.

Our analysis lead to several interesting results. We find that explicitly incorporating time-varying exit market conditions is important. We show that a simple approximation by using an average exit market neglects a hedging effect implying that the PE fund's valuation of the target will be too low. Importantly, the expected holding period of the target will be either too long or too short, depending on the remaining time the fund has available. We also find that a shift in exit market conditions from a low state to a high state leads to an increase in exit activity. Moreover, if a target is acquired in a low state, it is expected to be kept for a longer period of time. Furthermore, since a strategic buyer can better exploit the value of waiting embedded in traditional real options, a higher volatility tends to improve a valuation of a target more from a strategic buyer's point of view than from a PE fund's point of view. We have neglected several important aspects such as leverage, taxes, and agency issues. Future research on this will shed further light on exit strategies and valuation by PE funds, however our framework is general enough to suggest that our results will carry over when such aspects are included.

A Appendix

A.1 Strategic buyer

The problem in (4) is a first-passage time problem. Following the literature we transform this problem by applying Itô's Lemma (e.g., Dixit and Pindyck, 1994; Hackbarth et al., 2007; Flor and Moritzen, 2020). That is, we transform the problem to a solution of a differential equation in the continuation region (from the Hamilton-Jacobi-Bellman equation) and require value matching and smooth pasting at the decision thresholds. As a result, the value for the strategic buyer satisfy the ordinary differential equation

$$rB\left(x\right)=\frac{1}{2}\sigma^{2}x^{2}B''\left(x\right)+\mu xB'\left(x\right). \tag{23}$$

By inserting and manipulating terms, it can be verified that the general solution has the form:

$$B\left(x\right)=b_{1}X^{\beta_{1}}+b_{2}X^{\beta_{2}}, \tag{24}$$

where β_1 (β_2) is positive (negative) root in the quadratic equation

$$\frac{\sigma^{2}}{2}\beta\left(\beta-1\right)+\mu\beta-r=0, \tag{25}$$

and is given by

$$\beta_{1}=\frac{1}{2}-\frac{\mu}{\sigma^{2}}+\sqrt{\left(\frac{1}{2}-\frac{\mu}{\sigma^{2}}\right)^{2}+\frac{2r}{\sigma^{2}}}. \tag{26}$$

We solve the ODE which is subject to the value-matching and smooth-pasting conditions at the optimal investment threshold x^*_{SB} and a zero value condition at $x = 0$. The zero value condition implies that $B(x) \to 0$ when $x \to 0$, so it follows that $b_2 = 0$. From the

value-matching condition in (6) and rearranging terms we obtain

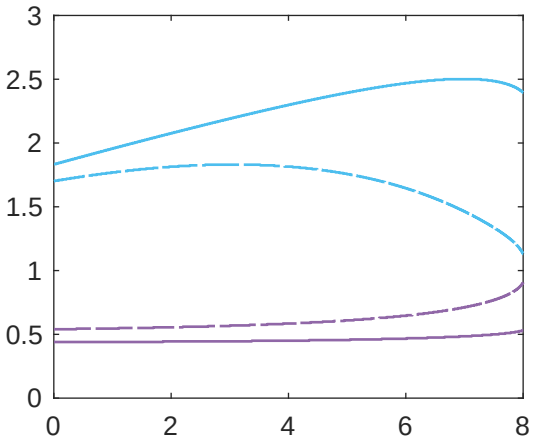
$$b_1 = \left(s_B \frac{x^*_{SB}}{r - \mu} - (R_{SB} + I_0) \right) (x_{SB})^{-\beta_1}, \tag{27}$$

and by inserting into (24), we arrive at the result for the strategic buyer's initial valuation of the target and the optimal investment threshold expressed in (8) and (9), respectively.

B Early exit thresholds in the base case

Using our numerical implementation of the model in Section 2, we obtain the four exit thresholds in Figure 9 when we vary the PE fund's time horizon, T.

In the figure, the solid blue curve corresponds to an early exit to another PE fund in the high state, $\bar{x}_{PE,H}$, whereas the dashed blue curve corresponds to an early exit to another PE fund in the low state, $\bar{x}_{PE,L}$ The solid purple curve corresponds to an early exit to a strategic buyer in the high state, $\underline{x}_{SB,H}$, whereas the dashed purple curve corresponds to an early exit to a strategic buyer in the low state, $\underline{x}_{SB,L}$



(a) Early exit thresholds in the base case.

Figure 9: Early exit thresholds: The figure shows the effects of the time horizon, T.

References

Arcot, S., Z. Fluck, J.-M. Gaspar, and U. Hege (2015). Corporate governance and value creation: evidence from private equity. *Journal of Financial Economics 115*(1), 102–1352.

Axelson, U., T. Jenkinson, P. Strömberg, and M. S. Weisbach (2013). Borrow cheap, buy high? the determinants of leverage and pricing in buyouts. *The Journal of Finance LXVII*(6), 2223–2267.

Axelson, U., P. Strömberg, and M. S. Weisbach (2009). Why are buyouts levered? the financial structure of private equity funds. *The Journal of Finance LXIV*(4), 1549–1582.

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

Biesinger, M., C. Bircan, and A. Ljungqvist (2020). Value creation in private equity. Swedish house of finance research paper no. 20-17, available at ssrn: https://ssrn.com/abstract=3607996 or http://dx.doi.org/10.2139/ssrn.3607996, EBRD WP No. 242.

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

Clausen-Jørgensen, C. S., C. R. Flor, and P. N. Sørensen (2022). Private equity funds and strategic buyers – effort, debt overhang, and cross-subsidization. Working paper, SSRN.

Davis, S. J., J. Haltiwanger, K. Handley, R. Jarmin, J. Lerner, and J. Miranda (2014). Private equity, jobs, and productivity. *The American Economic Review 104*(12), 3956–3990.

Degeorge, F., J. Martin, and L. Phalippou (2016). On secondary buyouts. *Journal of Financial Economics 120*, 124–145.

Dixit, A. K. and R. S. Pindyck (1994). *Investment under Uncertainty*. Princeton, New Jersey, USA: Princeton University Press.

Fidrmuc, J. P., P. Roosenboom, R. Paap, and T. Teunissen (2012). One size does not fit all: Selling firms to private equity versus strategic acquirers. *Journal of Corporate Finance 18*, 828–848.

Flor, C. R. and M. R. Moritzen (2020, juni). Entering a new market: Market profitability and first-mover advantages. *Journal of Corporate Finance 62*, 1–15.

Flor, C. R. and P. N. Sørensen (2019). Private equity acquisitions and strategic buyers: Information discounts versus synergies. Working paper, SSRN.

Gompers, P., S. N. Kaplan, and V. Mukharlyamov (2016). What do private equity firms say they do? *Journal of Financial Economics 121*, 449–476.

Gorbenko, A. S. and A. Malenko (2014). Strategic and financial bidders in takeover auctions. *The Journal of Finance LXIX*(6), 2513–2555.

Gredil, O. R. (2022). Do private equity managers have superior information on public markets? *Journal of Financial and Quantitative Analysis 57*(1), 321–358.

Grossman, S. and O. Hart (1980). Takeover bids, the free-rider problem, and the theory of the corporation. *The Bell Journal of Economics 11*, 42–64.

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

Hackbarth, D., C. A. Hennessy, and H. E. Leland (2007, September). Can the tradeoff theory explain debt structure? *The Review of Financial Studies 20*(5), 1389–1428.

Hackbarth, D. and E. Morellec (2008). Stock returns in mergers and acquisitions. *The Journal of Finance 63*(3), 1213–1252.

Hammer, B., A. Knauer, M. Plücke, and B. Schwetzler (2017). Inorganic growth strategies and the evolution of the private equity business model. *Journal of Corporate Finance 45*, 31–63.

Hege, U., S. Lovo, M. B. Slovin, and M. E. Sushka (2018). Divisional buyouts by private equity and the market for divested assets. *Journal of Corporate Finance 53*, 21–37.

Huang, R., R. J. R., and D. Zhang (2016). Private equity firms' reputational concerns and the costs of debt financing. *Journal of Financial and Quantitative Analysis 51*(1), 29–54.

Ivashina, V. and A. Kovner (2011). The private equity advantage: Leveraged buyout firms and relationship banking. *The Review of Financial Studies 24*(7), 2462–2498.

Jenkinson, T., S. Morkoetter, T. Schori, and T. Wetzer (2022). Buy low, sell high? do private equity fund managers have market timing abilities? *Journal of Banking & Finance 138*, 106424.

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

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

Lambrecht, B. M. (2004). The timing and terms of mergers motivated by economies of scale. *Journal of Financial Economics 72*, 41–62.

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

Malenko, A. and N. Malenko (2015). A theory of lbo activity based on repeated debt-equity conflicts. *Journal of Financial Economics 117*(3), 607–627.

Metrick, A. and A. Yasuda (2010). The economics of private equity funds. *The Review of Financial Studies 23*(6), 2303–2341.

Michala, D. (2019). Are private equity backed initial public offerings any different? timing, information asymmetry and post-ipo survival. *Journal of Corporate Finance 59*, 31–47.

Morellec, E. and A. Zhdanov (2008, March). Financing and takeovers. *Journal of Financial Economics 87*(3), 556–581.

Norbäck, P.-J., L. Persson, and J. Tåg (2013). Buying to sell: Private equity buyouts and industrial restructuring. Working paper, CESIFO WORKING PAPER NO. 4338.

Pawlina, G. and P. M. Kort (2006). Real options in an asymmetric duopoly: Who benefits from your competitive disadvantage? *Journal of Economics & Management Strategy 15*(1), 1–35.

Phalippou, L. and O. Gottschalg (2009). The performance of private equity funds. *The Review of Financial Studies 22*, 1747–1776.

Shleifer, A. and R. W. Vishny (1986). Large shareholders and corporate control. *Journal of Political Economy 94*(3), 461–488.

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

Strömberg (2008). The new demography of private equity. Geneva: World economic forum, The Globalization of Alternative Investments Working Papers Volume 1: The Global Economic Impact of Private Equity Report 2008.