

PRIVATE EQUITY BUYOUTS OF HIGH-TECH TARGETS

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Abstract

We document and investigate an emergent, fast-growing, and increasingly prominent phenomenon of high-tech firm buyouts by private equity (PE) acquirers. These buyouts present a puzzle for strategy and technology management scholars, because both prior research and earlier evidence suggest that high-tech firms should be unpalatable targets for PE acquirers. Yet by 2020 PE firms account for over 35% of all majority-share high-tech buyouts, and some of the most successful PE firms choose to specialize only in high-tech acquisitions. Have PE firms discovered a new business model, or are they applying their existing capabilities in a novel context? We conceptualize a type of a high-tech firm that may make an attractive target for a PE buyout. We describe and test its various dimensions and find empirical support for its attractiveness to PE acquirers in a sample of 2,367 high-tech acquisitions, finding that PE buyers target high-tech firms that are older, less dependent on intellectual property, and that are more likely to serve B2B or B2G customers, engage in their acquisitions, and be owned by other PE firms. In a supplementary analysis, we consider the differences between PE and different types of corporate buyers, as well as heterogeneity across PE acquirers themselves.

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INTRODUCTION

“While strategic M&A deals involving large technology companies like Microsoft often grab headlines, there is a far more powerful and pervasive trend that accelerated in 2018 and looks set to continue in 2019. Quietly, tech has become a private equity-backed industry.. A wholesale shift of tech into PE hands has profound implications for industry’s future.. Perhaps most pertinent for a tech industry focused on revenue growth rather than profits, PE investors will be aiming for startups to reach profitability sooner.. In short, PE is causing tech to behave like all other industries, more mainstream, more valuable, healthier and more profitable, but perhaps just that little bit less ‘special’ and ‘transformational”

Victor Basta, Managing Director of investment bank, Magister Advisors (Basta, 2019)

Over the last few decades, buyout private equity (PE) has emerged as a prominent phenomenon, attracting attention from strategy practitioners and scholars alike. In the market for corporate assets, PE firms appear to be a distinct set of actors, targeting distinct types of businesses, and leveraging a unique set of capabilities that may be unavailable to corporate acquirers (Kaul, Nary, & Singh, 2018; Nary & Kaul, 2021). PE firms tend to favor undervalued, mismanaged, mature targets that are likely to have a stable cash flow, tangible assets, and the potential for operational improvement (Fidrmuc et al., 2012; Kaul et al., 2018; Nary & Kaul, 2021; Singh, 1990). PE firms often deploy financial leverage in their buyouts, thus in these transactions they prefer targets with tangible assets that could be used as collateral, and dependable cash flow which could be channeled to support debt repayment (Axelson et al., 2009; Cotter and Peck, 2001). PE firms typically retain control of the assets for about five years with a plan to exit their investments expecting a positive net return (Montgomery and Baker, 1994; Wright et al., 1994). Thus, the modal PE target can generally be expected to be a potentially undervalued, capital-intensive business with potential for change in corporate or business scope through partial selloffs or improved efficiencies, but with cash flows that are stable and substantial enough both to support debt repayment and to make for an attractively valued target at exit.

Therefore, it may come as a surprise to both practitioners and scholars that PE firms now account for more than one-third of all full buyouts of high-tech firms, making them some of the

most active acquirers in high-tech M&A (Basta, 2019; Braithwaite, 2017; Jain, 2017; Levy, 2019; McElhaney, 2017). This is also a relatively new phenomenon, with most of the increase in the number of high-tech PE buyouts occurring over the last decade. The increased prominence of PE firms in high-tech settings is surprising from a theoretical perspective, as high-tech firms do not easily fit the profile of a typical PE target. In fact, prior research implies that high-tech firms, especially firms “in industries where technology is rapidly changing are excluded” from the list of targets that should be attractive to PE acquirers (Easterwood, Seth, & Singer, 1989; Fox & Marcus, 1992, p. 67). Yet PE firms continue to grow the number of their high-tech buyouts, with some PE firms such as Vista Equity and Thoma Bravo focusing entirely on high-tech acquisitions, and at least so far, these transactions may be among some of the most lucrative PE investments in recent years (Basta, 2019; Braithwaite, 2017; Jain, 2017; Levy, 2019; McElhaney, 2017).

What can explain this rapid rise of high-tech PE buyouts? On the one hand, counter to prior theorizing, it is possible that the PE business model may have some features that translate even to idiosyncratic high-tech settings. In their M&A activities, PE firms tend to deploy PE-specific capabilities and they rely on a unique set of advantages, such as those related to valuation, ownership, timing, and bargaining, relative to other actors in the market for corporate assets (Nary & Kaul, 2021). For example, PE firms may be able to improve operations, align incentives, and encourage managers to be more entrepreneurial using mechanisms that are typically unavailable to most corporate acquirers (Guo et al., 2011; Hege et al., 2018; Kaul et al., 2018; Klein et al., 2013; Nary and Kaul, 2021; Wright et al, 2000). In fact, these and other advantages may have contributed to the impressive rise of private equity as one of the dominant actors in the broader market for corporate assets in general, as PE firms now control thousands of firms, leveraging trillions of dollars in capital, while the number of public firms continues to decline.

On the other hand, the usual characteristics and dynamics of high-tech M&A do not seem to align with the PE business model, at least not in line with what prior research suggests. First, prior work indicates that acquirers, generally high-tech firms themselves, typically engage in tech M&A to gain access to specific knowledge, technologies, nuanced complementarities, and synergies, which

are unlikely to be the motives for PE firms (Ahuja & Katila, 2001; Graebner, Eisenhardt, & Roundy, 2010; Makri, Hitt, & Lane, 2010). Second, high-tech targets themselves are more likely to have intangible rather than tangible assets, for example human capital, and tacit knowledge, lacking the type of “harder” assets that PE acquirers seem to prefer (Ahuja and Katila, 2001; Laamanen et al., 2014; Makri et al., 2010; McEvily et al., 2004; Ozmel et al., 2017; Puranam, Singh, & Zollo, 2006). Third, the market for high-tech businesses is opaque, especially for outsider firms, and valuations of high-tech targets tend to be ambiguous and idiosyncratic (Humphery-Jenner, 2014; Laamanen, 2007; Laamanen et al., 2014; Makri et al., 2010). Fourth and final, high-tech M&A is notoriously challenging throughout the whole process relative to M&A in other settings, and it is thought to require deep knowledge, industry experience, complementary assets, and the ability to carefully integrate the acquired resources and capabilities with the acquirer’s own (Makri et al., 2010; Puranam, Singh, & Zollo, 2006; Puranam & Srikanth, 2007). Thus, it is logical that prior work suggests that high-tech targets should be unpalatable for PE acquirers (Easterwood et al., 1989; Fox and Marcus, 1992; Klein et al., 2013).

Yet the dramatic and well-documented increase in PE’s buyout activity in high-tech settings is undeniable, and even seemingly profitable for PE acquirers, who sometimes even outbid corporate acquires (Basta, 2019; Braithwaite, 2017; Gorbenko & Malenko, 2014; Jain, 2017; Levy, 2019; McElhaney, 2017). PE firms have announced over \$400B in high-tech deals in 2021 in the US alone (Wachtell, Lipton, Rosen, Katz, 2022), and of the top twenty-five largest PE firms, at least five now specialize exclusively in technology acquisitions, while the rest of the largest PE firms tend to at least dabble in high-tech M&A. Three of these five largest technology-focused PE firms are also in the top twenty of 502 PE firms ranked by financial performance in the period spanning 2005-2014, with Thoma Bravo, a high-tech buyout specialist with just 85 employees and \$21 billion in assets at the time of the survey, taking the first spot as the single most profitable PE firm (Cooper & Lim, 2018; HEC Paris, 2019). High-tech PE buyouts even seem to have outperformed other types of PE buyouts over the last decade (McArthur et al., 2020). Clearly, it seems that PE acquirers have found a way to create and capture value in the market for high-tech businesses.

In this study, we explore the mechanisms that may have contributed to PE's ability to capture a significant foothold in high-tech M&A and to successfully compete with both corporate acquirers and other forms of private capital such as venture capital or hedge funds. We especially aim to analyze whether the increase in PE's activity in high-tech settings is due to PE's newfound ability to transplant their existing capabilities there, or due to the development of wholly new capabilities more suited to creating and capturing value in technologically-intensive settings.

We propose that PE acquirers were able to aggressively expand into high-tech M&A by focusing on a subset of high-tech targets that fit their existing capabilities. These targets are more likely to be mature technology businesses that, through the virtue of their business model, make for less uncertain investments from the PE perspective. Such companies are older, more likely to provide services and products that are infrastructure-like, typically targeting businesses and enterprise clients, with the resulting cash flows more likely to be stable, and their characteristics making them more similar to firms with tangible capital assets targeted by PE firms in other settings. Moreover, we offer that PE firms provide competent ownership that these firms may need, as they may improve these targets operationally and help them scale and become more attractive businesses for other potential owners, including strategic buyers, after they've been owned by PE (Foss et al., 2020; Nary & Kaul, 2021). Moreover, we discuss how PE firms are less attracted by IP and technologies that may attract strategic corporate buyers, and how PE firms may mitigate uncertainties of high-tech settings by engaging in secondary buyouts with other PE firms. In our discussion and conclusion, we also ask whether the ability to apply PE's traditional capabilities may actually be more valuable for high-tech targets at some point in their lifecycle than even potential synergies resulting from acquisitions by strategic corporate buyers.

Using a sample of 2,362 acquisitions of software firms over the ten years spanning 2010-2019, and bolstering the quantitative analysis with qualitative insights from interviews with high-tech PE insiders, we conduct an empirical inquiry into the behavior of PE acquirers in high-tech settings. We find support for our broad theorizing. Compared to software firms targeted by corporate acquirers, high-tech firms targeted by PE buyers are more likely to be mature, established, high-

tech firms that tend to target B2B and B2G clients. PE firms are also more likely to target high-tech firms that provide opportunities for operational and efficiency improvements, and less likely to target software firms that are dependent on intellectual property. Finally, we find evidence that PE firms may be mitigating some of the technological and temporal uncertainty inherent in high-tech settings by using secondary buyouts, that is M&A transactions between PE firms themselves. In our supplementary analysis, we highlight the differences between high-tech firms targeted by strategic corporate buyers, non-strategic corporate buyers, and PE acquirers, as well as minor differences in high-tech firms targeted by generalist and high-tech specialist PE firms.

This work is oriented towards two broad contributions. First, we contribute to the literature on the role, behavior, and ever-growing importance of PE firms in the market for corporate assets by uncovering and exploring a new and previously thought to be an unlikely context in which PE firms have gained prominence, elaborating and documenting this phenomenon (Benner & Zenger, 2016; Castellaneta & Gottschalg, 2016; Cumming, Siegel, & Wright, 2007; Jensen, 1989; 1993; Kaul et al., 2018; Nary & Kaul, 2021). Second, we contribute to the high-tech M&A literature, as well as work investigating the dynamics of ownership and governance in high-tech settings, by documenting and describing a new, distinct, and prominent type of high-tech M&A acquirers and their transactions that are novel, distinct, and important to strategy scholars and to practitioners (Ahuja & Katila, 2001; Graebner et al., 2010; Makri et al., 2010; Puranam et al., 2006; Puranam & Srikanth, 2007). Here we also show that not all high-tech firms and high-tech M&A transactions are alike, highlighting a novel aspect of heterogeneity with respect to high-tech M&A acquirers and their targets, as well as their distinct goals, strategies, and resulting behavior (Andersson & Xiao, 2016; Graebner et al., 2010; Ozmel, Reuer, & Wu, 2016).

THEORY & HYPOTHESES

Value creation and capture in high-tech M&A

A considerable portion of strategy literature is dedicated to studying acquisitions of high-tech firms. These acquisitions are important because they may provide corporate buyers with important

strategic resources, as well as inputs for innovation (Ahuja & Katila, 2001; Ahuja, Lampert, & Tandon, 2008; Makri et al., 2010; Sears & Hoetker, 2013), because they provide a way for firms to explore both adjacent and distant knowledge contexts (Stettner & Lavie, 2014), and because they may allow the acquirer to secure important intellectual property which could be used to create and capture value by increasing appropriability in tumultuous, competitive, and often uncertain high-tech settings (Grimpe & Hussinger, 2014; Teece, 1986). Firms may engage in high-tech acquisitions to enter new markets, and to both expand and deploy their own existing resources and capabilities in new settings, as well as to acquire technological assets complementary to those they already own (Kaul, 2012; Kaul & Wu, 2015). Firms may also use high-tech acquisitions to increase market power, whether through expansion, or even through elimination or co-optation of rivals (Graebner et al., 2010; Grimpe & Hussinger, 2007; Santos & Eisenhardt, 2009; Cunningham, Ederer, & Ma, 2020). Strategic buyers often compete against one another for acquisitions of the most promising high-tech targets, especially in periods when uncertainty about new technologies or markets where these targets operate decreases and when the incumbents may be pressured by these developments. This competition among bidders may lead to higher acquisition premiums often paid by corporate buyers for high-tech assets (Laamanen, 2008; Ozmel et al., 2017).

While high-tech acquisitions may be important and useful for strategic buyers, it is notoriously challenging to create and capture value from high-tech acquisitions in practice. Multiple potential barriers exist that may make realizing returns from high-tech M&A difficult for even the savviest of corporate buyers (Graebner et al., 2010). High-tech acquisitions are challenging to execute, manage, and integrate, and they are more often subject to information asymmetries and “extreme” uncertainty than most other types of acquisitions (Graebner et al., 2010, p. 78; Puranam & Srikanth, 2007; Puranam, Singh, & Chaudhuri, 2009). Moreover, technology M&A literature stresses not only the importance of possessing the right knowledge, experience, and technological, strategic, and operational foresight, but it also highlights the critical role of complementary resources and capabilities, including relevant IP, all to be able to benefit from high-tech acquisitions (Ahern, 2012; Chondrakis, 2016; Graebner et al., 2010; Grimpe & Hussinger, 2014). Targets of high-tech

M&A are also often younger, less mature firms that may not yet be commercially viable on their own, or at least without large injections of external capital and resources, which creates additional uncertainty and volatility for the acquirers (Graebner, 2004; Graebner et al., 2010; Makri et al., 2010; Ozmel et al., 2017; Renko et al., 2022).

Private equity and high-tech M&A

The unexplained rise of high-tech acquisitions by PE firms underscores the need for research on the drivers of value in such transactions, because despite all of the idiosyncrasies and the challenges associated with high-tech M&A, over the last two decades, private equity firms have become some of the most prominent acquirers of high-tech firms, with some PE firms even choosing to specialize in high-tech buyouts. Corporate acquirers engaging in high-tech acquisitions are generally in pursuit of potentially valuable synergies and resources, and look to the use of complementary resources and knowledge that can help them create and capture value in these transactions (Ahuja and Katilla, 2001; Graebner et al., 2010; Laamanen et al., 2014; Makri et al., 2010; McEvily et al., 2004; Ozmel et al., 2017; Puranam, Singh, & Zollo, 2006; Sears and Hoetker, 2014; Teece 1986). PE acquirers are not known to possess the same kind of complementary resources, technologies, or knowledge and experience as do strategic corporate acquirers engaging in high-tech M&A. Thus, the new prominence of PE in high-tech settings is counterintuitive to existing high-tech M&A research. Moreover, it is especially puzzling because at least so far, PE firms seem to generate consistent positive returns from high-tech M&A, and these returns do not seem to stem from ownership of complementary strategic resources or sophisticated technological knowledge and experience that acquirers engaging in high-tech M&A should have according to the existing literature, but which PE firms likely do not possess. This leads to the question: what are the sources of value creation and capture mechanisms deployed by PE firms in high-tech M&A, and how do they differ from those relied upon by corporate buyers?

There are a few features and characteristics of the PE business model that appear nearly universal to most PE buyouts. First, PE acquirers may tend to target businesses that are distinct

from those targeted by corporate acquirers (Fidrmuc et al., 2012; Kaul et al., 2018). Second, recent theoretical work suggests that in order to create and capture value in the market for corporate assets, PE typically relies on one or more of the three broad sources of advantage: valuation, ownership, or timing (Nary & Kaul, 2021). Thus, PE firms may have an advantage over other potential acquirers when it comes to determining the intrinsic value of a target, an advantage when it comes to being able to drive operational improvement, to encourage entrepreneurial behavior by managers, or to improve governance at their portfolio companies; or an advantage when it comes to timing their transactions given the market and industry cycles (Nary & Kaul, 2021). Moreover, all three advantages could be further boosted by the strong bargaining and transactional capabilities that PE firms are likely to have as professional buyers and sellers of businesses (Nary & Kaul, 2021).

So, what are the potential mechanisms explaining why PE firms are acquiring high-tech targets, and how they are generating returns in the market for high-tech corporate assets? We suggest that there are four possibilities to consider. First, we have to acknowledge the possibility that these transactions are mostly opportunistic, random, or experimental forays into high-tech spaces by PE firms. Second and related, it is also important to consider whether the crowding of PE into high-tech space may be an example of misguided imitative behavior and unproductive crowding on part of PE firms, and that the majority of these deals will be unlikely to generate extraordinary returns (Dunne, Roberts, & Samuelson, 1988; Gupta et al., 2020; Ozmel et al., 2017; Persons & Warther, 1997). Yet based on the existing data and our own interviews with insiders, and given the high volume, growth, overall profitability, prominence, and regularity of these deals, both of these two explanations seem generally unlikely.

Third, it is also possible that this is a whole new type of PE activity, and that some PE firms may have developed whole new capabilities and sources of advantage that allow them to compete in the market for high-tech assets specifically. Conversely, the fourth, and perhaps the simplest explanation is that PE firms may have found a profitable niche in the market for high-tech firms by focusing on a subset of high-tech firms that best match PE's existing capabilities and sources of advantage, perhaps with some tweaks. In fact, our interviews and qualitative evidence also suggest

that some of the drivers of value creation in high-tech buyouts by PE firms may be similar to those in other types of PE buyouts. For example, based on our interviews, operational improvement and business model refinement are important drivers of value creation in PE buyouts of high-tech firms. Yet since these last two explanations for PE's new prominence in high-tech industries may turn out to be mutually exclusive, if we set aside the case where both may be happening, it is then possible to test the differences empirically. Thus, what kind of a high-tech firm makes for a palatable PE target?

Characteristics of high-tech targets that may be attractive to PE

“Silicon Valley thinks the same way they have since inception – singularly focused on top-line revenue growth”¹

Orlando Bravo, Managing Partner and Co-founder of Thoma Bravo, one of the largest and most successful high-tech PE specialist firms (Braithwaite, 2017)

“PE firms manage tech companies differently to venture investors, balancing growth with profitability, meaning investment is done at a slower pace – both in people and technology – with a reduced risk appetite for major new innovations.. PE buyers seek to support thoughtful but incremental investment rather than groundbreaking initiatives.. This means a focus on key performance metrics, financial discipline, and expense control. It will also steer fast growing companies away from blue-sky investments.” (Basta, 2019)

“Robert [Smith], over time, convinced an entire market to see this cash-flow stream of software revenue as a reliable annuity that could be financed with debt”

Gregg Lemkau, co-head of Goldman Sachs' investment banking division (Gottfried & Cooper, 2018)

“Software companies taste like chicken. They're selling different products, but 80% of what they do is pretty much the same”

Robert Smith, CEO of Vista Equity Partners, one of the other largest private equity firms specializing in technology acquisitions (Gottfried & Cooper, 2018)

PE firms are not generally known to have complementary resources similar to those that a corporate buyer in a high-tech setting might use to create synergies, and which may increase a buyer's bargaining power and the ability to capture value, as well as help justify high acquisition

¹ Braithwaite, 2017

premiums often observed in high-tech M&A transactions by strategic buyers, for example, where an acquirer is targeting firms with strong R&D and valuable intellectual property (Adegbesan, 2009; Grimpe & Hussinger, 2014; Laamanen, 2007; Laamanen et al., 2014; Schijven & Hitt, 2012). Instead, PE firms are more likely to target businesses distinct from those targeted by corporate acquirers, likely focusing their attention on a specific subset of high-tech targets that provide the best opportunity to apply one or more of PE's unique advantages when it comes to valuation, ownership, and timing, and PE's targets are likely to share some characteristics that may make them a suitable fit for the PE business model (Castelanetta & Gottschalg, 2016; Kaul et al., 2018; Nary & Kaul, 2021).

First, at the core of the private equity business model is the idea of using the target's own cash flows, which have to be at least somewhat stable and repeatable, to support debt service in a leveraged buyout (LBO) model typically employed by the vast majority of PE acquirers (Axelson, Stromberg, and Weisbach, 2009; Berg & Gottschalg, 2005; Cotter & Peck, 2001; Cumming et al., 2007). What type of high-tech targets may generate cash flows reliable enough to support an LBO?

Our baseline argument is that since PE acquirers will be looking for stability and reliability of cash flows (as well as their existence), they will be more likely to acquire firms that are on average more mature, and thus older than those targeted by corporate acquirers. Corporate acquirers may engage in acquisitions of high-tech targets for the purposes of "acqui-hire", that is securing strategic human capital through acquiring, or for the purposes of securing specific intellectual property such as patents (Graebner & Eisenhardt, 2004; Graebner, Eisenhardt, & Roundy, 2010; Ranft & Lord, 2000). Then the targets of these acquisitions do not need to be sufficiently mature, producing significant cash flows, or even revenues to make for attractive acquisition candidates for corporate acquirers. On the other hand, the fact that PE acquirers require targets to have an established business model generating reliable cash flows is more likely to make high-tech targets that are attractive to PE older. Moreover, older firms will also provide opportunities for restructuring and improvement, the subject of the hypotheses to follow (Thornhill & Amit, 2003).

Hypothesis 1A: Private equity acquirers are more likely than corporate acquirers to target high-tech firms that are five years old or older.

Prior work also suggests that among high-tech firms, those serving business customers, especially larger enterprises and governments or municipalities are more likely to have repeat sales and long-term relationships with their customers that may span years (Mayer and Argyres, 2004; Mayer and Nickerson, 2005; Argyres, Bercovitz, and Mayer 2007). In fact, business and government clients are considered so lucrative, that high-tech firms may extend incentives and bid low to secure what they see as valuable repeat business with these clients (Whang, 1995). Moreover, many of these relationships with business and government clients become stronger over time as the counterparties may become more closely integrated, and as these high-tech firms may develop client-specific capabilities over time (Ethiraj et al., 2005). Our own interviews with multiple high-tech industry and PE insiders strongly confirm the relative attractiveness of B2B and B2G businesses and their business models and resulting cash flows for PE owners. Thus,

Hypothesis 1B: Private equity acquirers are more likely than corporate acquirers to target high-tech firms serving organizations, including businesses and governments.

Second, given that a target is suitable for a leveraged buyout, PE owners may seek to increase returns by engaging in operational and efficiency improvement at the target, and will be more likely to target businesses that offer opportunities for such improvements (Ayash, Bartlett, & Poulsen, 2017; Berg & Gottschalg, 2005; Guo et al., 2011; Nary & Kaul, 2021). What type of a high-tech target may provide opportunities for value creation through improvement? Acquisitions are known to often create inefficiencies due to redundancies, challenges with recombining different resources, processes, and cultures, as well as integration failures, which are one of the main sources of challenges in high-tech M&A (Hayward & Shimizu, 2009; Hitt et al., 1998; Kaul et al., 2018; Shaver, 2009; Zollo, 2009). Thus, high-tech targets that have themselves engaged in M&A may present an opportunity for operational and efficiency improvement, one of the core value creation mechanisms PE firms deploy in their buyouts.

Hypothesis 2A: Private equity acquirers are more likely than corporate acquirers to target high-tech firms that have engaged in acquisitions.

However, not all high-tech targets may present a value creation opportunity that fits PE owners' core capabilities. Compared to high-tech corporate acquirers motivated by strategic synergies, PE acquirers may be less likely to possess sophisticated technological knowledge, own IP, or high-tech experience necessary to create value from technologies and R&D, and they may be less likely to have complementary assets that are necessary to create and capture value from intellectual property (Bei, 2019; Ceccagnoli et al., 2010; Rothaermel, 2001; Teece, 1986; 2017). Thus, PE acquirers will be less likely than strategic corporate buyers to target firms only for their valuable knowledge and intellectual property.

Hypothesis 2B: Private equity acquirers are less likely than corporate acquirers to target high-tech firms that have patents.

Third, environmental turbulence and technological uncertainty are key features of high-tech industries, which may lead to investment timing and resulting optimal holding periods that may be longer than the typical three to six years a target may spend in the portfolio of a typical PE owner (Abernathy & Clark, 1985; Anderson & Tushman, 2001; Fleming, 2001). This is one of the major challenges a financial buyer like a PE firm may face in a high-tech context (Easterwood, Seth, & Singer, 1989; Fox & Marcus, 1992). Moreover, growth and scaling of technology ventures may require different types of resources and capabilities at different stages, and a PE firm that was able to create and capture value at one stage in the portfolio firm's lifecycle may not be an optimal owner at another stage. So how might PE firms mitigate environmental, technological, and temporal uncertainty associated with buyouts in high-tech settings? Our review of prior work suggests that a secondary buyout (SBO), that is a sale to another PE firm, may be a potential mechanism to moderate these challenges and to extend the overall PE holding period (Achleitner & Figge, 2014; Degeorge, Martin, & Phalippou, 2016; Wang, 2012). While some of the "lower-hanging fruit" when it comes to operational and efficiency improvement may be harvested during the first few years of PE ownership, SBOs may generate value where growth and scaling, rather than efficiency improvement, may create more value (Achleitner & Figge, 2014; Ayash et al., 2017; Degeorge et al.,

2016), where the ability to generate value under PE ownership may persist through more than one cycle or require a holding period longer than a typical PE ownership cycle (Achleitner & Figge, 2014), or where additional PE ownership may bring complementary skills and capabilities to create additional value at the target company (Arcot et al., 2015; Degeorge et al., 2016). Thus,

Hypothesis 3: Private equity acquirers are more likely than corporate acquirers to target high-tech firms owned by other private equity firms.

*** Insert Table 1 about here ***

DATA AND METHODS

Sample and data

We constructed our sample by identifying all public and private US-based firms in SDC Platinum and Crunchbase databases that have at any time been involved in the software industry. We linked that list to all acquisitions of software firms spanning 2010-2019 where these acquisitions were listed in both SDC Platinum and Crunchbase data. We augmented this data by carefully identifying PE firms and their characteristics and transactions using the data from Pitchbook and Preqin, the two databases that together contain more accurate and complete private equity data than either SDC Platinum or Crunchbase. We also use raw data from the US Patent Office to identify patents belonging to software firms in our data. Our final sample has 39,194 US-based firms that are or have been involved in the software industry, with 7,414 of these firms being acquired at some point in time, and 2,362 of these acquisitions that occur in the ten years spanning 2010-2019 cross-listed in both Crunchbase and SDC Platinum with sufficient data available for our analysis.

Our sample consists of acquisitions of software firms for three reasons. First, software acquisitions comprise the majority of technology acquisitions in the 21st century, representing more than two-thirds of all high-tech transactions, and more than 70% of technology acquisitions by PE acquirers specifically. Second, software acquisitions strike the right balance between representing transactions that are homogeneous and comparable enough across the sample, yet with enough

underlying variance in their characteristics to test our theory more precisely than in a more heterogeneous sample. Third and related, the software industry has long been used as an empirical setting for management research, including M&A, providing an opportunity to compare our results with other work (Dushnitsky & Lavie, 2010; Laamanen et al., 2014; Stettner & Lavie, 2014).

Dependent variables

Our main dependent variable is *PE Buyer*, that is whether an acquirer is a buyout PE firm or not. We code this binary variable by carefully cross-referencing ultimate parent acquirers listed in SDC Platinum and Crunchbase data to PE firms listed in Pitchbook and Preqin. For additional analysis, we created a *Strategic Buyer* variable that includes all corporate acquirers with core business in software, and a *High-Tech PE Buyer* variable that designates PE firms that engage primarily in buyouts of high-tech firms. The remaining corporate acquirers are coded as *Non-Strategic Corporate Buyers*. For additional supplementary multinomial logit analysis, we created an *MBuyer* variable, which takes on a value of 0 for a non-strategic buyer, 1 for a PE buyer, and 2 for a strategic buyer.

Independent variables

We test our theory using a battery of independent variables from available data that allow us to probe multiple relevant characteristics of technology firms that may present an attractive target to a PE acquirer. For our first set of hypotheses (1A and 1B), we measure whether the *Focal Firm is Five Years or Older at Acquisition*, as well as whether the *Focal Firm Targets Business and/or Government Clients*, to proxy for the maturity, financial viability, and size of the target firm. For our second set of hypotheses (2A and 2B respectively), we measure whether the *Focal Firm is an Active Acquirer* as a proxy for capacity for operational and efficiency improvement by PE owner, and we measure whether the *Focal Firm has Patents* as a proxy for whether the target firm may be valuable due to its intellectual property, or its business model, processes, and customer base. Finally, for our third hypothesis, we consider whether the *Seller of Focal Firm is a PE Firm*.

Control variables

We include additional variables noted as relevant in prior work to control for the presence of other confounding factors. To assess the overall potential quality of the business and its characteristics we measure whether the focal firm received investment from any venture capitalists, corporations, non-profits or foundations, other PE firms, banks, or asset managers, as well as any elite VCs (Bertoni et al., 2011; Rosenbusch, Brinckmann, & Müller, 2013). We also control for the number of outside investors and total number of funding rounds, as well as the total amount of outside funding, and whether the firm had raised any outside funding at all. We control for whether the target is a public firm, and for whether it is based in California, since most of the highly-valued high-tech firms and “unicorns” tend to be based in software clusters in Silicon Valley and in Southern California (Brown & Wiles, 2015). We also include a measure of the target firm size and prominence as its estimated revenues and whether these are unknown, or under \$10 million, between \$10 and \$50 million, between \$50 and \$100 million, between \$100 and \$500 million, or over \$500 million. We also include year effects in all of our models, and cluster robust standard errors at the acquirer level.

Model specification

The focus of our analysis is on the selection of technology targets by private equity acquirers. However, since not all firms choose to be acquired, we need to account for endogenous selection into selling (Shaver, 1998; Smart and Waldfogel, 1994). We employ a two-stage Heckman selection model to account for this (Heckman, 1977). In the first stage, we consider what factors may drive high-tech targets to sell, and then in the second stage model, we estimate which targets are acquired by PE firms conditional on those targets being acquired.

We employ nonlinear probability logistic regression models (probit) in both stages of the analysis. The first stage model is a probit regression that estimates the likelihood of any of the software firms in our larger sample being acquired in any specific year. An exclusion restriction unique to the first stage is necessary that is correlated with the likelihood of an acquisition, but not

correlated with the likelihood of the acquirer being a PE firm. We measure whether the firm has *Multiple Founders* as a proxy for the overall viability of the business that may at some point in time make it an attractive acquisition target, but that should not have any bearing on whether a future acquirer is a PE firm. We then use the results of the first stage probit regression to calculate the inverse Mills ratio, which we include as a selection adjustment in the second stage probit regression.

Endogeneity is an inescapable multidimensional feature of this setting, thus we do not claim that our results are causal even though, as described above, we do our best to control for some of the aspects of endogeneity likely to be present in our setting. Yet considering that our models are selection- and not outcome-based, we believe that our analysis is reasonably rigorous given our available data, yet ask our readers to interpret it as correlational but representative.

*** Insert Figures 1 and 2, Tables 1, 2, 3, and 4 about here ***

RESULTS

Descriptive data

As Figures 1 and 2, as well as Table 1 show, there has been significant and steady growth in the number of acquisitions of software companies by private equity buyers within our sample spanning 2010-2019. By 2019, 35.2% of all software acquisitions in our sample were made by PE firms, while at the beginning of the decade, the proportion of all high-tech buyouts by PE firms was hovering around ten percent. In the early 2000s, only 1-2% of software acquisitions were attributable to PE buyers. Table 2 contains the names of the most frequent corporate and PE acquirers in our data. As previously discussed, the most active PE acquirers are more active than strategic buyers, and they engage in more acquisitions of software firms than even the largest corporate acquirers such as Alphabet or Microsoft, both of which are also primarily software-based businesses. Four of the top five most active PE acquirers in our sample are also PE firms that chose to specialize in technology buyouts, with software buyout specialists Vista Equity Partners and Thoma Bravo taking the top two spots. In our sample of 2,362 acquisitions, 1,257 deals are done by strategic corporate buyers (other software firms), 647 deals are done by non-strategic corporate

buyers, that is non-software buyers, and 458 acquisitions were done by PE buyers. Table 3 contains detailed descriptive statistics for our sample of acquired companies, while Table 4 contains the correlations between the variables in our analysis.

*** Insert Table 5 about here ***

Regression Analysis

Table 5 contains the results of the main analysis. Model I is the first stage of the two-stage Heckman selection probit model. The data structure in this model is that of an unbalanced panel at the firm-year level, where the dependent variable is the likelihood of a software firm being acquired in any given year. Although it is not a part of our main analysis, this model provides insight into the types of software firms that may get acquired. Our exclusion restriction, whether a firm is known to have multiple founders, is a strong positive predictor of a likelihood of being acquired ($\beta = 0.242, p = 0.000$). Software firms are also likely to get acquired if they go through a high number of funding rounds, if they have patents, if they target b2b or b2g clients, if they are an active acquirer or a middle market firm, and if they have received an investment from any VC or an elite VC, a PE firm, or a venture accelerator. Notably, firms that were not funded externally are also likely to get acquired. On the other hand, software firms were less likely to get acquired if they received funding from a bank or an asset management firm, if they were publicly owned, based in California, or were known to produce revenues. Detailed regression data can be found in Table 5.

The main results of our analysis are in Model II in Table 5. Model II is a second-stage probit regression that predicts the likelihood that, conditional on being acquired, the acquirer is a PE firm. Overall, our analysis is consistent with our hypotheses and our overall logic that PE buyers target mature high-tech firms generating stable and reliable cash flows and targeting b2b and b2g customers, and these are older, high-tech targets with functional business models, and opportunities for operational and efficiency improvement and deployment of PE-specific capabilities.

First, we find support for both Hypotheses 1A and 1B and the role of stable and reliable cash flows, as PE firms are more likely to target software firms that are five years or older at the time of the acquisition ($\beta = 0.724, p = 0.000$), as well as software firms with b2b or b2g customers (β

= 0.172, $p = 0.017$). Second, we also find support for our second set of hypotheses (2A and 2B), as our analyses suggest that PE acquirers are more likely to target software firms that have actively engaged in their own acquisitions ($\beta = 0.394, p = 0.000$), and less likely to target software firms that have patents ($\beta = -0.196, p = 0.008$). These results suggest that opportunities for operational and efficiency improvement, instead of aiming to profit from innovation, may be a core motive for PE acquisitions of high-tech targets. Finally, PE buyers are also more likely to acquire from other PE firms ($\beta = 0.274, p = 0.055$), in support of our third hypothesis that PE firms may be mitigating uncertainties of high-tech settings by extending the PE ownership period of high-tech firms.

There are noteworthy highlights with respect to our control variables. First, PE buyers are less likely to target software firms that have gone through many funding rounds ($\beta = -0.057, p = 0.029$). PE buyers are also less likely to target firms in California ($\beta = -0.267, p = 0.001$). This is broadly in line with our overall logic that PE firms are less likely to target high-tech firms that have high capital requirements, and those in Southern California and Bay Area high-tech clusters, because these may be indicative of those targets' focus on high growth and pursuit of novel technologies rather than generating dependable cash flows. Second, PE firms may be more likely to target software firms that are middle-market firms ($\beta = 0.651, p = 0.000$), and firms that have been successful in raising funds from elite investors, which may indicate an endorsement of target's intrinsic quality ($\beta = 0.217, p = 0.068$). Finally, the inverse Mills ratio itself is of low significance ($p = 0.372$), suggesting that selection into being acquired is not a significant factor for whether the target gets acquired by a private equity firm.

Overall, we interpret these results as being broadly in support of our theorizing that PE buyers target mature high-tech firms targeting b2b and b2g customers, generating stable and reliable cash flows, presenting opportunities for operational and efficiency improvements instead of relying on intellectual property, as well as PE-owned businesses that may require longer holding periods.

*** Insert Table 6 about here ***

Supplementary Analysis

Having found evidence in support of our theorizing, we further probe two additional sources of heterogeneity in this setting. First, taking into consideration the heterogeneity of non-PE buyers, we explore the differences between software firms targeted by PE buyers, strategic corporate buyers, and non-strategic corporate buyers. The results of our analysis can be found in Models III and IV in Table 6. We use multinomial logit model specification here because the three different buyer types represent a set of competing choices, and only one type of a buyer can ultimately acquire the target. While econometrically there are major differences between our original two-stage probit models and a single stage multinomial logit model, the results across both specifications, as well as our main analysis repeated in a single-stage logit model (not shown due to space limitations, available upon request), are broadly consistent. In Model III, we consider the differences in characteristics of software firms targeted by either non-strategic corporate buyers, that is firms not engaged in software as their primary business, or PE buyers, when both are compared to strategic corporate buyers. Several differences stand out. Non-strategic corporate buyers are more likely than strategic corporate buyers to acquire firms from PE owners ($\beta = 0.544, p = 0.063$), more likely to acquire targets that have undergone a higher number of funding rounds ($\beta = 0.080, p = 0.037$), and more likely to acquire firms that have received a corporate venture capital (CVC) investment ($\beta = 0.405, p = 0.013$), and they are less likely to acquire firms that target b2b or b2g clients ($\beta = -0.314, p = 0.008$), firms that have received an investment from an elite VC ($\beta = -0.327, p = 0.041$) or an asset manager ($\beta = -0.658, p = 0.084$), or firms that are based in California ($\beta = -0.262, p = 0.031$). On the other hand, compared to strategic corporate buyers, PE firms are more likely to acquire firms that are older firms ($\beta = 1.353, p = 0.000$), targets that are themselves active acquirers ($\beta = 0.737, p = 0.000$), or that were already owned by another PE firm ($\beta = 0.695, p = 0.012$), as well as middle market firms ($\beta = 1.051, p = 0.000$). PE firms are less likely than strategic corporate buyers to acquire firms with patents ($\beta = -0.338, p = 0.016$), and California firms ($\beta = -0.553, p = 0.000$).

In Model IV we consider the differences in software firms targeted by strategic corporate and PE buyers compared to non-strategic corporate buyers. Compared to non-strategic corporate

buyers, strategic corporate buyers are more likely to target firms focusing on enterprise clients ($\beta = 0.314, p = 0.008$), as well as firms that have received financing from asset managers ($\beta = 0.658, p = 0.084$) or elite VCs ($\beta = 0.327, p = 0.041$), and California-based targets ($\beta = 0.262, p = 0.031$). Strategic corporate buyers are less likely than non-strategic corporate buyers to target firms already owned by PE ($\beta = -0.544, p = 0.063$), firms that have undergone a high number of financing rounds ($\beta = -0.080, p = 0.037$), and firms that have received a CVC investment ($\beta = -0.405, p = 0.013$). On the other hand, compared to non-strategic corporate buyers, PE firms are more likely to target businesses that are older ($\beta = 1.293, p = 0.000$), those that focus on b2b and b2g clients ($\beta = 0.496, p = 0.001$), active acquirers ($\beta = 0.541, p = 0.003$), middle market firms ($\beta = 1.110, p = 0.000$), and firms that have received investment from asset managers ($\beta = 0.819, p = 0.048$) or elite VCs ($\beta = 0.595, p = 0.009$), and they are less likely than non-strategic corporate buyers to target firms that have patents ($\beta = -0.358, p = 0.020$), that have undergone a high number of funding rounds ($\beta = -0.148, p = 0.004$), and that are based in California ($\beta = 0.291, p = 0.089$).

This analysis highlights intriguing differences between buyer types and their preferred targets in the market for high-tech businesses, and further supports the assertion that PE acquirers target a distinct subset of businesses even in idiosyncratic high-tech settings that differ from those targeted either by strategic or non-strategic corporate buyers, echoing earlier findings in the manufacturing sector by Kaul and coauthors (2018). Notably, while both PE firms and non-strategic corporate buyers may target software businesses with a few similar characteristics, PE firms seem to select targets somewhat more similar in some, but not all ways to those targeted by strategic corporate buyers when compared to non-strategic corporate buyers. This may indicate that they are pursuing at least somewhat similar paths to create and capture value in this context. Yet again, on the whole, it is clear that PE buyers do target software businesses that differ significantly from those targeted by either strategic or non-strategic corporate acquirers.

Second, we also consider whether there is more heterogeneity among PE firms in their acquisitive behavior in high-tech industries. Here we consider the emergence of technology specialist PE firms, and consider whether their acquisitions differ from those by generalist PE firms. Model V

is identical to Model II in its specification, except that the dependent variable is whether the acquirer is a high-tech PE specialist. We find that overall, PE firms specializing in high-tech PE tend to behave like other PE firms in general, with just a few notable exceptions. First, there is no evidence that PE firms specializing in tech may be more likely to acquire from other PE firms ($\beta = -0.211, p = 0.124$). Second, PE firms specializing in high-tech are more likely to acquire targets that have raised more external financing ($\beta = 0.002, p = 0.022$). Third, there is no evidence that PE firms specializing in high-tech seem to be less likely to acquire California-based targets ($\beta = -0.157, p = 0.180$). We interpret these results as potentially indicating that PE firms specializing in high-tech buyouts may be beginning to deviate from generic PE strategies, potentially taking on more risk and relying on their own high-tech expertise.

Robustness Checks

Logistic regression model specifications are based on certain econometric assumptions, and have some characteristic features (such as the fact that the mean and the variance of the dependent variable are not separately identified) that may present challenges for reliability and interpretation of our main findings (Breen, Karlson, and Holm, 2018). It is often recommended to confirm results of nonlinear probability models such as logit by using a linear probability model (LPM), which has fewer relevant assumptions, and may be easier to interpret within the bounds of the analysis. We do so, and our results remain the same (Results not shown, available upon request). We also repeat our analysis while excluding acquisitions of larger firms, that is those valued at \$500 million or more, to ensure that our results can be compared to prior research into technology acquisitions that focused on smaller transactions (Makri et al., 2010; Puranam & Srikanth, 2007), and find no significant differences (Results not shown, available upon request). Similarly, our results are generally consistent even if we restrict our analysis only to 484 transactions where the exact value of the transaction is known. Since intellectual property plays an important role in this context, we also consider the 2014 US Supreme Court *Alice Corp vs. CLS Bank* decision which is considered to have largely invalidated the enforceability and value of software patents, and our results remain the same when controlling

for this event. Here we also observe that, in fact, PE activity in the software industry increases in the years following that important court decision, providing further potential support for our theorizing that PE firms may target processes and business models, not intellectual property and patents. Additionally, we repeat our first stage at the firm level without incorporating year effects, and the results incorporating the reconstructed inverse Mills ratio remain the same.

DISCUSSION AND CONCLUSION

This study offers important new insights into the phenomenon of private equity buyouts of high-tech firms. Over the last two decades, PE firms have established themselves as prominent actors in high-tech M&A by focusing on a subset of targets to which the private equity buyout model and PE “playbook” can be most fruitfully applied. Our findings show that PE buyers target high-tech firms generating stable cash flows commensurate with their value, and mature, established, high-tech firms that serve b2b and b2g customers, and that are more likely to create value from functional business models and processes rather than intellectual property. This is noteworthy considering that growth-at-all-costs focused, highly-valued high-tech “unicorns” tend to capture much of the markets’ and investors’, and perhaps even academics’ attention. We also show that PE firms may be using secondary buyouts to mitigate some of the inherent uncertainty in dynamic high-tech settings.

We highlight factors that align with some of those theorized in prior research into how PE firms create and capture value more broadly in the market for corporate assets (Nary & Kaul, 2021). First, PE firms may target firms that are out-of-spotlight, and potentially ignored, if not outright undervalued by other investors. PE firms are less likely to acquire firms that have required many successive rounds of financing, or those located in the usual high-tech hotspots of Silicon Valley and Southern California. Second, PE firms are also more likely to target more mature high-tech firms, and those more likely to be established, stable businesses. Thus, we observe that PE firms are less likely to target firms that rely on intellectual property or young firms, instead focusing their attention on firms that are larger, more likely to be active acquirers themselves, and firms that serve primarily

business, enterprise, and government clients. These findings suggest that PE owners are more likely to focus on firms where the value can be created and captured in the business process, and its potential improvement, rather than by focusing on intellectual property or technology development, and they highlight the importance of target maturity and dependability of the underlying business model and recurring cash flows and revenues.

In offering these insights, we contribute to the literature on the role, behavior, and ever-growing importance of PE firms in the market for corporate assets (Benner & Zenger, 2016; Castellaneta & Gottschalg, 2016; Cumming, Siegel, & Wright, 2007; Jensen, 1989; 1993; Kaul et al., 2018; Nary & Kaul, 2021). We document and describe the emergent and yet already prominent and important phenomenon of private equity buyouts of high-tech firms, and highlight some of the specific factors that may be behind its explosive recent growth. Our findings build on and contribute to recent work, especially that focusing on PE target selection (Kaul et al., 2018), and that more broadly theorizing PE's potential advantages in the market for corporate assets (Nary & Kaul, 2021).

Moreover, we contribute to technology M&A literature by documenting and describing a new, distinct, and prominent type of technology M&A actors and their transactions that are both novel and important to strategy scholars and to practitioners (Ahuja & Katila, 2001; Graebner et al., 2010; Makri et al., 2010; Puranam et al., 2006; Puranam & Srikanth, 2007). Much of the prior academic work has considered acquisitions of technology firms primarily from the perspective of strategic buyers, whether those seeking innovative inputs, or those looking to consolidate market power and to reduce rivalry (Graebner et al., 2010; Grimpe & Hussinger, 2007; Santos & Eisenhardt, 2009; Cunningham et al., 2020). Yet PE buyers have entered the markets for high-tech targets in full force, and they seem to target a specific subset of high-tech firms that are distinct from high-tech firms targeted by other buyers, whether strategic or non-strategic corporate acquirers, in markets for high-tech businesses (Andersson & Xiao, 2016). This contribution is noteworthy as PE buyers differ from corporate buyers in that they are not expected to possess complementary resources, deep technological knowledge, or intellectual property, the importance of all of which in this context is highlighted in prior research, and yet these PE buyers have been able to carve a large and profitable

niche for themselves in this space (Ahuja & Katila, 2001; Graebner, 2004; Grimpe & Hussinger, 2014; Makri et al., 2010; McEvily et al., 2004; Puranam et al., 2006; Puranam & Srikanth, 2007).

Our work highlights a few potential directions for future work in this area. First, more research is needed to better understand how and why PE firms are selecting their high-tech targets, as well as to investigate the matching process between PE owners and high-tech firms. Second, we currently only have anecdotal evidence with respect to how PE firms may create and capture value in high-tech buyouts, and more work is necessary to precisely articulate those mechanisms of value creation and capture and explore how they may differ from those used by PE elsewhere. For example, it would be interesting to understand the degree to which PE firms may depend on operational improvement, as both media sources and our interviews speak to the introduction of “playbooks” and the professionalization of high-tech businesses by private equity owners. A natural question here is whether PE ownership may in some circumstances be beneficial to a specific business due to its focus on improving the standalone value of that business compared to an acquisition by a strategic buyer, which may instead be focused only on some specific valuable resources or technologies that the target owns, or even worse, is out for a “killer acquisition” (Cunningham, Ederer, & Ma, 2021). Moreover, here the ability to apply PE’s traditional capabilities may, in fact, be more valuable for these targets at some point in their lifecycle than even potential synergies resulting from acquisitions by strategic buyers. Third, our interviews also suggest that PE acquirers have come to play an even more important role in high-tech settings than may appear initially, with PE engaging in high-level manipulation of resources by combining businesses and engaging with industry incumbents in ways that may significantly change the landscape of high-tech industries. Moreover, the fact that PE acquirers tend to focus on high-tech targets that are infrastructure-like and that serve primarily businesses, large enterprises, and governments is especially intriguing in the context of technologies and digitization affecting almost every part of the private and public sectors. Naturally, this raises the question of what PE activity means for high-tech industries and their customers, for markets for technologies, and for strategic buyers.

This study has several limitations. Although we do our best to conduct a rigorous empirical analysis given the limitations of our data, including adjusting for some of the underlying selection processes, our results should be considered primarily correlational and not causal. Our sample of targets is limited to software firms, and although these transactions constitute the majority of all high-tech acquisitions, some of our results may not fully generalize to all high-tech settings, especially those that are highly idiosyncratic, such as the biotechnology industry. This is also a dynamic, fast-changing setting, where new trends seem to emerge and change rapidly, and so what we capture may end up being largely period-specific. We also do not directly observe matching and negotiating process between high-tech acquirers and targets, and thus are unable to fully understand both parties' motives and deal dynamics. We do not observe what PE acquirers do with the high-tech targets once acquired, although this should be considered in future work. Finally, we lack full and consistent transparency across all of the transactions in our data, and in some cases, we lack information with respect to deal value or structure, and some deals may be missing from our sample.

These limitations notwithstanding, we are confident that our study is an important first step towards a better understanding of PE buyouts of high-tech firms, and the consequent still-growing prominence of private equity firms as important actors in high-tech industries. We explore and elaborate the mechanisms that have contributed to PE's ability to capture a significant foothold in high-tech M&A. We show that PE firms may have found a subset of high-tech targets well suited to the PE buyout model, and that PE buyers target high-tech firms generating stable cash flows commensurate with their value, and mature, established, high-tech firms that serve b2b and b2g customers, and that are more likely to create value from functional business models and processes rather than intellectual property. We also show that PE firms may be using secondary buyouts to mitigate some of the inherent uncertainty in dynamic high-tech settings. We also hope that one of the main contributions of this work will be the reinvigoration of scholarly interest in private equity and its role and behavior in markets for corporate assets, whether in high-tech, or other settings that PE has managed to penetrate over the last few decades without attracting much, or at least not enough, in these authors' opinion, academic attention from strategy scholars.

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Figure 1: Number of Software Acquisitions by Acquirer Type

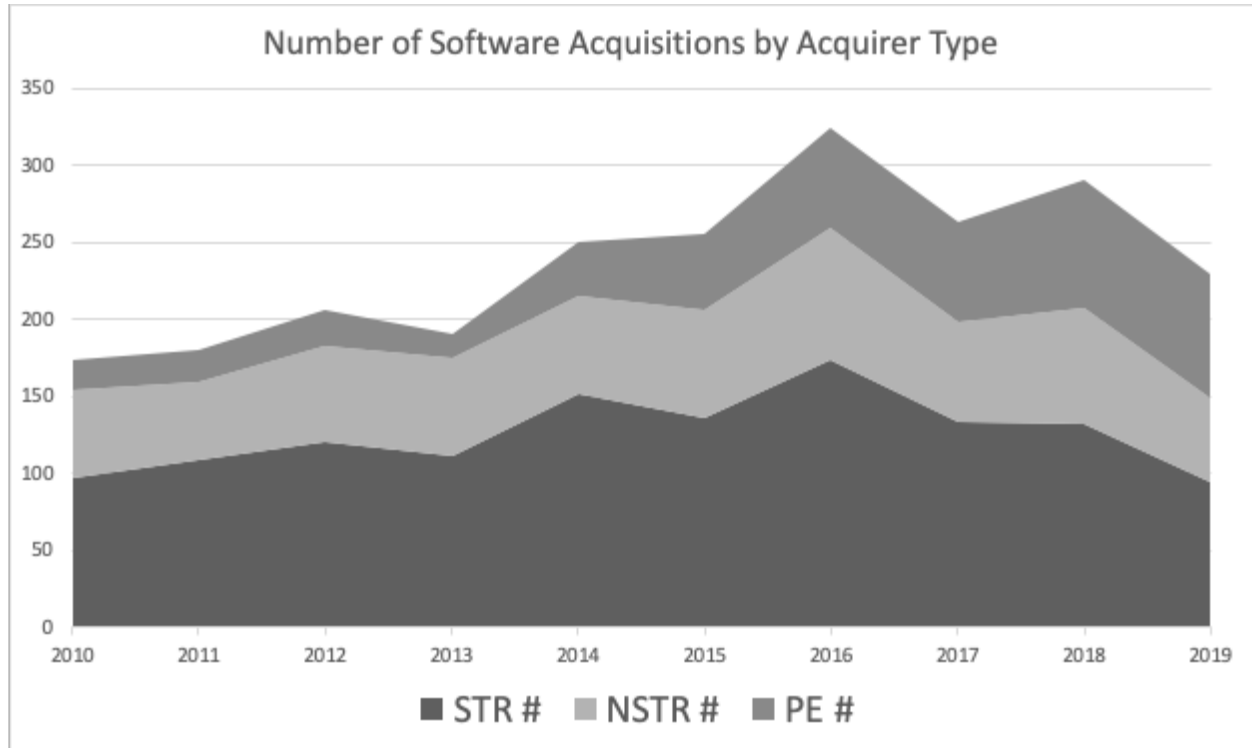


Figure 2: Relative Proportion of Acquirers of Software Targets

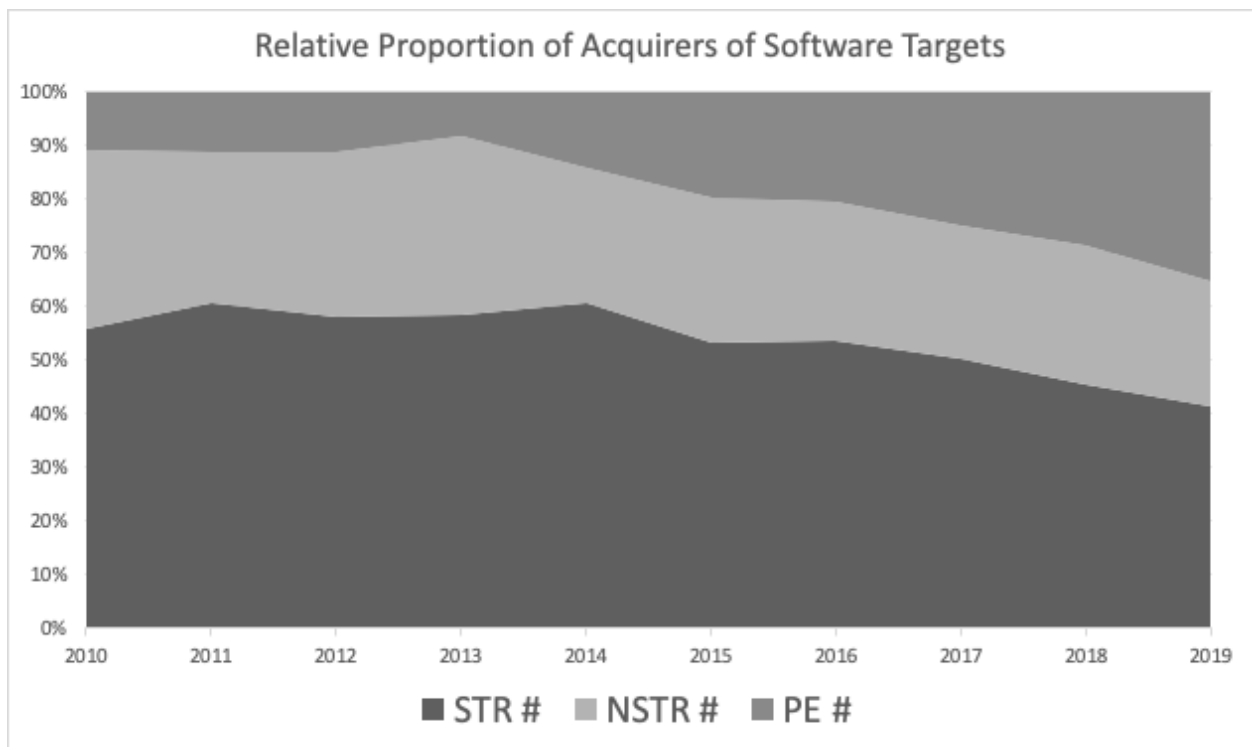


Table 1: Acquirer Types in Software Acquisitions

Year	STR #	STR %	NSTR #	NSTR %	PE #	PE %	Total
2010	97	55.7%	58	33.3%	19	10.9%	174
2011	109	60.6%	51	28.3%	20	11.1%	180
2012	120	58.3%	63	30.6%	23	11.2%	206
2013	112	58.6%	63	33.0%	16	8.4%	191
2014	152	60.8%	63	25.2%	35	14.0%	250
2015	136	53.1%	70	27.3%	50	19.5%	256
2016	174	53.5%	85	26.2%	66	20.3%	325
2017	133	50.4%	65	24.6%	66	25.0%	264
2018	132	45.4%	76	26.1%	83	28.5%	291
2019	95	41.3%	54	23.5%	81	35.2%	230

Table 2: Top Acquirers of Software Firms in the Sample

Top Corporate Acquirers		Top Private Equity Acquirers	
Alphabet Inc	24	Vista Equity Partners LLC*	55
Microsoft Corporation	23	Thoma Bravo LLC*	30
Cisco Systems Inc	21	Marlin Equity Partners LLC	28
Oracle Corporation	21	Insight Venture Partners LLC*	18
IBM Corporation	18	Genstar Capital LLC*	11
EMC Corporation	16	Francisco Partners LP*	9
Dell Inc	14	GI Partners LLP	9
Salesforce.com Inc	14	KKR	9
Facebook Inc	12	Reservoir Capital Group LP	9
Twitter Inc	12	Silver Lake Management LLC*	9
Synopsys Inc	10	TA Associates Management LP*	9
		TPG Capital LP	9

* These PE firms are either high-tech specialist PE firms, or have a significant part of their portfolio focused in high-tech industries

Table 3: Descriptive Statistics

	<u>Across All Software Acquisitions</u>				
	Mean	Median	Min	Max	Std. Dev
PE Buyer	0.194	0	0	1	0.395
FF five years old or older at acquisition	0.680	1	0	1	0.466
Focal firm targets business and/or government clients	0.471	0	0	1	0.499
Focal firm is an active acquirer	0.201	0	0	1	0.401
Focal firm has patents	0.314	0	0	1	0.464
Owner of focal firm is a PE firm	0.048	0	0	1	0.214
Number of total funding rounds	1.831	1	0	16	2.232
Focal firm is a middle market firm	0.089	0	0	1	0.285
Focal firm received investment from VC	0.470	0	0	1	0.499
Focal firm received investment from a corporation	0.151	0	0	1	0.358
Focal firm went through a venture accelerator	0.059	0	0	1	0.235
Focal firm received investment from a non-profit	0.022	0	0	1	0.145
Focal firm received investment from a PE firm	0.099	0	0	1	0.299
Focal firm received investment from a bank	0.054	0	0	1	0.226
Focal firm received investment from an asset manager	0.026	0	0	1	0.159
Focal firm received investment from an elite investor	0.368	0	0	1	0.482
Total number of outside investors in focal firm	2.679	1	0	37	4.036
Total amount of outside funding	16.464	0.514	0	950	49.750
Focal firm not funded	0.405	0	0	1	0.491
Focal firm is a public firm	0.036	0	0	1	0.187
Focal firm based in Cali	0.353	0	0	1	0.478
FF revenues under \$10M	0.131	0	0	1	0.338
FF revenues under \$50M	0.088	0	0	1	0.283
FF revenues under \$100M	0.017	0	0	1	0.131
FF revenues under \$500M	0.025	0	0	1	0.156
FF revenues over \$500M	0.009	0	0	1	0.094

Table 4: Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1 PE Buyer	1.00																									
2 FF five years old or older at acquisition	0.23	1.00																								
3 Focal firm targets business and/or government clients	0.08	0.09	1.00																							
4 Focal firm is an active acquirer	0.24	0.25	0.19	1.00																						
5 Focal firm has patents	0.02	0.23	0.14	0.25	1.00																					
6 Owner of focal firm is a PE firm	0.17	0.12	0.08	0.30	0.08	1.00																				
7 Number of total funding rounds	0.01	0.10	0.24	0.22	0.31	-0.04	1.00																			
8 Focal firm is a middle market firm	0.23	0.16	0.13	0.39	0.18	0.24	0.09	1.00																		
9 Focal firm received investment from VC	-0.03	-0.07	0.20	0.11	0.24	-0.04	0.67	0.04	1.00																	
10 Focal firm received investment from a corporation	0.01	0.01	0.10	0.10	0.20	-0.02	0.43	0.07	0.35	1.00																
11 Focal firm went through a venture accelerator	-0.05	-0.23	0.01	-0.07	-0.06	-0.06	0.14	-0.07	0.18	0.01	1.00															
12 Focal firm received investment from a non-profit	-0.01	0.02	0.01	0.01	0.10	0.03	0.20	0.01	0.11	0.08	0.07	1.00														
13 Focal firm received investment from a PE firm	0.11	0.17	0.13	0.24	0.15	0.14	0.26	0.11	0.17	0.07	-0.07	0.04	1.00													
14 Focal firm received investment from a bank	0.02	0.12	0.09	0.14	0.16	-0.02	0.30	0.05	0.20	0.15	-0.05	0.02	0.13	1.00												
15 Focal firm received investment from an asset manager	0.03	-0.02	0.06	0.09	0.03	0.04	0.14	0.07	0.12	0.04	0.13	0.01	0.08	0.00	1.00											
16 Focal firm received investment from an elite investor	0.01	-0.05	0.18	0.16	0.24	-0.02	0.60	0.07	0.71	0.40	0.30	0.10	0.20	0.20	0.11	1.00										
17 Total number of outside investors in focal firm	-0.02	-0.06	0.14	0.14	0.21	-0.05	0.67	0.05	0.64	0.43	0.34	0.12	0.18	0.23	0.13	0.63	1.00									
18 Total amount of outside funding	0.08	0.15	0.16	0.31	0.23	0.01	0.44	0.20	0.25	0.25	-0.04	0.06	0.20	0.19	0.10	0.30	0.35	1.00								
19 Focal firm not funded	0.01	0.09	-0.24	-0.15	-0.24	0.01	-0.68	-0.05	-0.77	-0.35	-0.20	-0.12	-0.27	-0.20	-0.13	-0.62	-0.55	-0.27	1.00							
20 Focal firm is a public firm	0.08	0.12	0.09	0.31	0.21	-0.04	0.06	0.34	0.05	0.03	-0.04	-0.01	0.06	0.04	0.03	0.07	0.04	0.19	-0.06	1.00						
21 Focal firm based in Cali	-0.12	-0.19	0.05	-0.02	0.09	-0.07	0.13	-0.04	0.22	0.12	0.08	-0.01	-0.04	0.00	0.00	0.25	0.23	0.07	-0.18	0.00	1.00					
22 FF revenues under \$10M	0.01	-0.05	0.02	-0.07	0.00	-0.07	0.13	-0.10	0.16	0.12	0.10	0.02	-0.01	-0.01	-0.02	0.14	0.18	-0.02	-0.18	-0.08	0.06	1.00				
23 FF revenues under \$50M	0.04	0.08	0.06	0.12	0.12	-0.02	0.28	-0.02	0.20	0.12	0.03	0.07	0.10	0.13	0.00	0.18	0.22	0.12	-0.20	-0.03	0.05	-0.12	1.00			
24 FF revenues under \$100M	0.07	0.07	0.02	0.12	0.06	0.05	0.16	0.07	0.08	0.09	-0.01	0.00	0.03	0.05	0.04	0.09	0.12	0.15	-0.10	0.10	0.03	-0.05	-0.04	1.00		
25 FF revenues under \$500M	0.09	0.09	0.04	0.27	0.14	0.07	0.20	0.29	0.10	0.13	-0.03	0.03	0.16	0.05	0.08	0.15	0.17	0.36	-0.12	0.20	0.02	-0.06	-0.05	-0.02	1.00	
26 FF revenues over \$500M	0.02	0.02	0.06	0.12	0.11	0.00	0.06	0.14	0.03	-0.01	-0.02	0.02	0.03	0.04	0.01	0.06	0.05	0.31	-0.04	0.17	0.02	-0.04	-0.03	-0.01	-0.02	1.00

Table 5: Main Results

	Model I			Model II		
	Stage 1: Likelihood of being acquired			Stage 2: Likelihood of PE acquirer		
	Coefficient	Std. error	p-value	Coefficient	Std. error	p-value
Multiple Founders	0.242	0.014	0.000			
FF five years old or older at acquisition (H1A)	0.010	0.014	0.484	0.724	0.086	0.000
Focal firm targets business and/or government clients (H1B)	0.042	0.012	0.000	0.172	0.072	0.017
Focal firm is an active acquirer (H2A)	0.153	0.026	0.000	0.387	0.092	0.000
Focal firm has patents (H2B)	0.054	0.015	0.000	-0.196	0.074	0.008
Owner of focal firm is a PE firm (H3)	-0.674	0.103	0.000	0.274	0.143	0.055
Number of total funding rounds	0.018	0.004	0.000	-0.057	0.026	0.029
Focal firm is a middle market firm	0.118	0.027	0.000	0.651	0.128	0.000
Focal firm received investment from VC	0.187	0.019	0.000	-0.019	0.113	0.864
Focal firm received investment from a corporation	-0.011	0.022	0.621	0.085	0.123	0.490
Focal firm went through a venture accelerator	0.040	0.028	0.155	-0.047	0.172	0.783
Focal firm received investment from a non-profit	0.009	0.042	0.834	0.104	0.254	0.682
Focal firm received investment from a PE firm	0.040	0.024	0.096	0.146	0.120	0.226
Focal firm received investment from a bank	-0.097	0.032	0.003	-0.047	0.129	0.718
Focal firm received investment from an asset manager	-0.090	0.039	0.019	0.180	0.193	0.350
Focal firm received investment from an elite investor	0.156	0.021	0.000	0.217	0.119	0.068
Total number of outside investors in focal firm	-0.003	0.002	0.126	-0.008	0.017	0.646
Total amount of outside funding	0.000	0.000	0.788	0.000	0.001	0.522
Focal firm not funded	0.686	0.027	0.000	0.042	0.111	0.704
Focal firm is a public firm	-0.399	0.059	0.000	0.057	0.174	0.745
Focal firm based in Cali	-0.020	0.013	0.119	-0.267	0.079	0.001
FF revenues under \$10M	-0.791	0.015	0.000	-0.030	0.140	0.830
FF revenues under \$50M	-0.401	0.023	0.000	0.033	0.129	0.798
FF revenues under \$100M	-0.391	0.050	0.000	0.334	0.220	0.129
FF revenues under \$500M	-0.322	0.046	0.000	-0.195	0.209	0.350
FF revenues over \$500M	-0.279	0.073	0.000	-0.378	0.380	0.319
Inverse Mills Ratio				0.118	0.132	0.372
N		297,686			2,362	
Log Likelihood		-24,596.52			-964.133	
Pseudo R2		0.1078			0.1701	
Model Significance Level		p>0.000			p>0.000	
Model type		Unbalanced firm-year panel probit			Transaction level pooled probit	
Year Effects		Yes			Yes	
Robust standard errors clustered at FF level		Yes			Yes	

Table 6: Supplementary Analysis

	Model III						Model IV						Model V		
	Acquirer is a non-strategic buyer			Acquirer is a PE firm			Acquirer is a strategic buyer			Acquirer is a PE firm			Stage 2: Likelihood of HT PE acquirer		
	Coefficient	Std. error	p-value	Coefficient	Std. error	p-value	Coefficient	Std. error	p-value	Coefficient	Std. error	p-value	Coefficient	Std. error	p-value
FF five years old or older at acquisition	0.060	0.125	0.631	1.353	0.181	0.000	-0.060	0.125	0.631	1.293	0.191	0.000	0.375	0.076	0.000
Focal firm targets business and/or government clients	-0.314	0.119	0.008	0.183	0.136	0.181	0.314	0.119	0.008	0.496	0.154	0.001	0.261	0.083	0.002
Focal firm is an active acquirer	0.196	0.164	0.234	0.737	0.172	0.000	-0.196	0.164	0.234	0.541	0.183	0.003	0.165	0.098	0.090
Focal firm has patents	0.019	0.129	0.881	-0.338	0.141	0.016	-0.019	0.129	0.881	-0.358	0.154	0.020	-0.173	0.075	0.021
Owner of focal firm is a PE firm	0.544	0.293	0.063	0.695	0.275	0.012	-0.544	0.293	0.063	0.151	0.303	0.618	-0.211	0.137	0.124
Number of total funding rounds	0.080	0.038	0.037	-0.068	0.050	0.172	-0.080	0.038	0.037	-0.148	0.051	0.004	-0.029	0.024	0.227
Focal firm is a middle market firm	-0.058	0.233	0.802	1.051	0.233	0.000	0.058	0.233	0.802	1.110	0.263	0.000	0.612	0.179	0.001
Focal firm received investment from VC	-0.058	0.197	0.769	-0.126	0.207	0.545	0.058	0.197	0.769	-0.068	0.235	0.774	-0.146	0.111	0.187
Focal firm received investment from a corporation	0.405	0.164	0.013	0.294	0.229	0.199	-0.405	0.164	0.013	-0.111	0.248	0.653	0.102	0.180	0.569
Focal firm went through a venture accelerator	0.276	0.234	0.239	0.001	0.330	0.998	-0.276	0.234	0.239	-0.275	0.353	0.436	-0.203	0.182	0.266
Focal firm received investment from a non-profit	0.275	0.326	0.397	0.145	0.465	0.755	-0.275	0.326	0.397	-0.130	0.478	0.785	0.208	0.321	0.518
Focal firm received investment from a PE firm	0.210	0.197	0.287	0.313	0.222	0.157	-0.210	0.197	0.287	0.104	0.237	0.662	0.036	0.164	0.824
Focal firm received investment from a bank	-0.204	0.251	0.416	-0.120	0.245	0.625	0.204	0.251	0.416	0.084	0.270	0.756	0.032	0.164	0.844
Focal firm received investment from an asset manager	-0.658	0.382	0.084	0.161	0.351	0.648	0.658	0.382	0.084	0.819	0.414	0.048	0.429	0.250	0.086
Focal firm received investment from an elite investor	-0.327	0.161	0.041	0.268	0.215	0.212	0.327	0.161	0.041	0.595	0.228	0.009	0.122	0.173	0.480
Total number of outside investors in focal firm	-0.008	0.018	0.682	-0.016	0.034	0.632	0.008	0.018	0.682	-0.009	0.035	0.810	0.006	0.025	0.809
Total amount of outside funding	0.002	0.001	0.107	0.002	0.001	0.196	-0.002	0.001	0.107	0.000	0.001	0.726	0.002	0.001	0.022
Focal firm not funded	0.235	0.183	0.198	0.098	0.200	0.622	-0.235	0.183	0.198	-0.137	0.220	0.533	0.007	0.135	0.959
Focal firm is a public firm	-0.514	0.385	0.182	-0.068	0.319	0.832	0.514	0.385	0.182	0.447	0.381	0.242	0.203	0.126	0.108
Focal firm based in Cali	-0.262	0.121	0.031	-0.553	0.151	0.000	0.262	0.121	0.031	-0.291	0.171	0.089	-0.157	0.117	0.180
FF revenues under \$10M	0.062	0.174	0.721	0.092	0.201	0.648	-0.062	0.174	0.721	0.030	0.223	0.894	-0.014	0.251	0.957
FF revenues under \$50M	0.135	0.194	0.486	0.151	0.224	0.499	-0.135	0.194	0.486	0.016	0.238	0.946	0.104	0.164	0.527
FF revenues under \$100M	-0.150	0.441	0.733	0.511	0.398	0.198	0.150	0.441	0.733	0.662	0.494	0.181	-0.120	0.207	0.562
FF revenues under \$500M	0.024	0.388	0.950	-0.324	0.396	0.414	-0.024	0.388	0.950	-0.348	0.424	0.413	0.099	0.209	0.635
FF revenues over \$500M	-0.456	0.601	0.448	-0.718	0.637	0.260	0.456	0.601	0.448	-0.261	0.816	0.749			
Inverse Mills Ratio													0.149	0.161	0.355
N	2,367						2,367						2,346		
Log Likelihood	-2158.79						-2158.79						-454.925		
Pseudo R2	0.0955						0.0955						0.1332		
Model Significance Level	p>0.000						p>0.000						p>0.000		
Model type	Transaction level mlogit (base = strategic buyer)						Transaction level mlogit (base = non-strategic buyer)						Transaction level pooled probit		
Year Effects	Yes						Yes						Yes		
Robust standard errors clustered at FF level	Yes						Yes						Yes		