THE DISADVANTAGE OF INCOMPLETE PERFORMANCE FEEDBACK:

EVIDENCE FROM PRIVATE EQUITY–BACKED BUYOUTS

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ABSTRACT

We develop and test a theory of how organizations learn from performance feedback in the context of strategic decisions, where delayed outcomes result in performance feedback that is incomplete. In this context, firms facing a focal decision observe performance feedback for only a subset of their previous decisions. Using a sample of 7,223 private equity buyout investments, we find that incomplete performance feedback has a negative impact on the performance of a subsequent decision. Our results also suggest that incomplete performance feedback creates challenges when firms engage in problemistic search, reducing the well-established benefits of search for firm future performance. Moreover, this mitigating effect of incomplete feedback is stronger when performance falls below rather than exceeds aspirations.

INTRODUCTION

A fundamental question in strategy and organization theory research asks how managers learn from experience (Cyert and March, 1963; Levitt and March, 1988; March, 1981; Nelson and Winter, 1982). The behavioral theory of the firm tackles this question directly by examining the antecedents of learning and the resulting change (Cyert and March, 1963). This perspective posits that firms receive performance feedback by comparing their performance with aspirations (Cyert and March, 1963; Gavetti *et al.*, 2012; Greve, 1998). When feedback falls short of such aspirations, it activates "problemistic search," resulting in organizational change and risk taking (Kahneman and Tversky, 1979; Shinkle, 2012) to improve performance (Cyert and March, 1963: 169).

Yet feedback on past performance is often incomplete due to considerable temporal delays and interruptions. In such a case, firms are required to make a focal decision before they receive performance feedback on all previous decisions. The challenge of incomplete performance feedback is particularly acute in the context of strategic decisions (i.e., acquisitions, partnerships, and reorganizations) because performance feedback is often delayed or missing in these settings. In such cases, decision makers are prone to two forms of ambiguity: causal and outcome. Causal ambiguity concerns decision makers' inability to precisely determine the decisions explaining an outcome (Mosakowski, 1997), and outcome ambiguity concerns the decision makers' inability to know the outcome of a given decision (Ho *et al.*, 2002; Zollo, 2009). An example is the case of a pharmaceutical firm acquiring a young biotechnology company that has recently patented a promising molecule. Because 10 or 15 years may pass between the discovery of a molecule and its commercialization (Schilling, 2005), the acquiring firm will be unable to immediately determine the performance outcome of its acquisition. What lessons should the firm draw when faced with an opportunity to acquire a second biotechnology company? The answer is not obvious, because feedback on

the first acquisition is delayed and, due to ambiguity, difficult to predict.

Although the problems of causal and outcome ambiguity are likely to increase when feedback is incomplete, performance feedback theory has devoted little attention to the challenges of incomplete feedback. The limelight of extant research has been on the valence of performance feedback and, in particular, on how firms react to negative performance feedback, which is received when performance falls short of aspirations (Cyert and March, 1963; Greve, 2003a; March and Simon, 1958). However, many researchers have implicitly assumed that when decision makers receive performance feedback, the performance outcomes of all past decisions are well known.

In this study, we offer an important yet relatively overlooked dimension of performance feedback worth exploring: incompleteness. We formally define performance feedback incompleteness as *the percentage of past decisions for which an organization has not received objective performance feedback before a focal decision is made.* In introducing this notion to performance feedback theory, we build on studies of complex, dynamic systems, which emphasize the idea that feedback may be delayed, nonlinear, and interrupted (Denrell, Fang, and Levinthal, 2004; Fang and Levinthal, 2009; Rahmandad, Repenning, and Sterman, 2009; Rahmandad, 2008; Repenning and Sterman, 2002). Scholars have suggested that causal ambiguity increases when feedback indicates quality of only a subset of previous organizational decisions (Brehmer, 1995; Gibson, Fichman, and Plaut, 1997; Brehmer, 1995; Gibson *et al.*, 1997) because decision makers are unable to precisely determine the decisions explaining an outcome (Mosakowski, 1997). Finally, such delays have implications for organizational learning because problems of causal and outcome ambiguity are likely worse when feedback on past performance is interrupted or missing (Denrell *et al.*, 2004; Rahmandad *et al.*, 2009; Rahmandad, 2008).

We hence propose that performance feedback incompleteness may reduce the quality

of future decisions, undermining future performance of the firm. We expect that decision–performance linkages based on incomplete performance feedback will be prone to systematic error and less precise predictions because their correct specification requires an objective knowledge of the performance outcome (Zacharakis and Shepherd, 2001). Therefore, firms with higher performance feedback incompleteness will experience lower future performance, as imprecise estimates may undermine the understanding of causal linkages and lead to inaccurate decisions.

Given the detrimental consequences of incomplete performance feedback, we further propose that the well-established benefits of problemistic search for firm future performance will be contingent on feedback completeness. We expect the beneficial effect of problemistic search to diminish when information on past performance is missing due to incomplete feedback on past decisions. When decision makers draw on incomplete information, the resulting search will be biased and misdirected, leading to changes that are suboptimal for the focal firm. Finally, because search is most strongly activated for performance below aspirations, we expect that search relaying on incomplete performance will be more biased for firms performing below (rather than above) their aspiration levels.

The relative inattention to the problems of incomplete performance feedback in the context of strategic decisions may stem, in part, from considerable empirical challenges. Examining incomplete performance feedback requires finding a context in which it is possible to empirically disentangle two kinds of experience: that associated with objective feedback and that for which objective feedback has not yet been received. With an exception of formal models and simulations (e.g., Sterman, 1994), many empirical studies have typically confounded these two kinds of experience. To overcome this challenge, we focus on the private equity (PE) setting which is particularly well suited to our study because a series of independent investments is easy to observe, allowing us to separate individual investments

with and without performance feedback. Moreover, with available measures of investment performance, the PE industry enables us to empirically assess how incomplete feedback may affect the quality of future decisions and their performance. Using a proprietary dataset with 7,223 investments by 265 PE firms between 1973 and 2008 in 88 countries, we find support for all of our predictions.

Our study makes at least three main contributions. First, we introduce the dimension of incompleteness to performance feedback theory, which until now has mainly characterized performance feedback with respect to its valence and linked negative performance feedback to problemistic search. Second, we contribute to the line of research on experiential learning, for which the impact of experience on future performance has been extensively documented (see Sterman, 2000, for a comprehensive recent review; Lei, Hitt, and Bettis, 1996). Though learning from prior experience is crucial to enhancing the performance of key strategic activities, we add to the growing number of studies that specify the contingent nature of learning from experience, by suggesting that performance is hampered (enhanced) when a larger (smaller) share of experience is incomplete. Finally, we shed light on why and when managers benefit from performance feedback, by differentiating between its core attributes of valence and completeness.

Theory and hypotheses

Few ideas better illustrate how decision makers learn than the concept of performance feedback. *A Behavioral Theory of the Firm* asserts that due to bounded rationality, decision makers and their organizations use simplifying rules to determine whether they meet performance goals or not (Cyert and March, 1963). In this respect, feedback about past performance is a fundamental rule (e.g., Barreto, 2011; Harris and Bromiley, 2007; Iyer and Miller, 2008) because firms simply consider past performance outcomes, instead of collecting and analyzing the complete and detailed array of relevant information. When decision makers

receive feedback on a decision, they gather information to revise their "understanding of the world and the decisions [they] make" (Sterman, 2000: 14).

Importantly, performance feedback theory posits that feedback is not evaluated in terms of absolute outcomes but with reference to an aspiration level (Cyert and March, 1963; Lant, 1992; March and Simon, 1958), which is "the smallest outcome that would be deemed satisfactory by the decision maker" (Schneider, 1992: 1053). Under bounded rationality conditions, decision makers determine the boundary between success and failure by assessing the difference between achieved performance and the aspiration level (Lant, 1992). Specifically, performance feedback is considered negative when performance is below the firm's aspirations and positive when it is above. The valence of performance feedback is consequential for decision makers because negative performance feedback triggers "problemistic search": when performance falls short of aspirations, decision makers initiate search until an acceptable solution is found (Cyert and March, 1963; Greve, 2003a). According to behavioral theory, "in periods and domains of success, search is reduced[;] in periods and domains of failure, search is increased" (March, 1988: 4). Ultimately, these search processes aim to bring the organization back to a level of performance at or above its aspirations.

A large body of literature has linked negative feedback and the resulting search process with higher quality of subsequent decisions. For example, Kim, Kim, and Miner (2009) found that recovery experience—when a firm experienced extremely poor performance but later overcame it—generated survival-enhancing learning after a certain level of experience was reached. Kim and Miner (2007) showed that banks learned from near-failures and failures of other banks. Haunschild and Sullivan (2002) found that airline companies' experience with accidents and incidents decreased their subsequent accident/incident rates, implying that they learned from their own errors. Finally, Haunschild

and Rhee (2004) found that voluntary product recalls in the automotive industry subsequently resulted in a lower rate of involuntary recalls. In short, considerable theoretical and empirical research has focused on performance feedback, devoting close attention to feedback valence, the process of problemistic search and its positive impact on firm future performance (for a recent overview, see Gavetti *et al.*, 2012).

Incomplete performance feedback

While the valence of performance feedback is key to predicting search process and thus firm future performance, we propose that an alternative, and potentially equally important, way to characterize performance feedback is with respect to its completeness. Indeed, the notion that feedback is delayed in time or space permeates much research on dynamic and complex systems (e.g., Diehl and Sterman, 1995; Paich and Sterman, 1993; Sterman, 1989, 1994, 2000). Moreover, experimental studies in economics, psychology, and management have documented considerable learning challenges when feedback is indirect, delayed, and nonlinear (Gibson, 2000; Sengupta, Abdel-Hamid, and Bosley, 1999). Finally, the literature on organization learning has suggested that organizational decision makers are often faced with confusing experience, which results in learning myopia, or the tendency to overlook distant times, distant places, and failures (Levinthal and March, 1993).

Yet despite the abundant evidence on the relevance of feedback delays and interruptions, performance feedback theory has paid limited attention to the potential challenges of incomplete performance feedback and their influence on firm performance. Given this neglect, we propose that completeness is an important dimension of performance feedback because learning from incomplete feedback may hamper decision making in strategic contexts (Mintzberg, Raisinghani, and Theoret, 1976). When feedback is incomplete, firms have to make a focal strategic decision based on expectations of outcomes before such outcomes are observed. For example, corporate expansion strategies (e.g., acquisitions,

alliances, and joint ventures) and investments (e.g., R&D investments and corporate venture capital), where several years typically pass between a strategic decision and the reception of feedback, are particularly likely to yield performance feedback that is incomplete. In such cases, a firm is often required to make a focal decision before performance feedback for all past strategic decisions is observed, that is, before the feedback on past performance is complete.

In such cases, we expect feedback incompleteness to negatively influence the quality of subsequent strategic decisions. First, when feedback on past experience is not complete, estimating a causal linkage between an input (i.e., decision) and an outcome (i.e., performance) is difficult because decision makers lack an assessment of the outcome and because outcome ambiguity makes any prediction of the future outcome unreliable. The share of incomplete feedback may trigger an inaccurate assessment of the individuals' own skills and the validity of their judgment in future decisions. A number of scholars, for example, have documented adverse effects of feedback delays on individual learning (Gibson, 2000; Sengupta *et al.*, 1999), suggesting that individuals are prone to feedback misperceptions because they generally ignore temporal delays, fail to appreciate time delays between action and response, and remain insensitive to nonlinearities associated with different feedback loops (e.g., Diehl and Sterman, 1995; Repenning and Sterman, 2002; Sterman, 1989). Incomplete, unreliable information is problematic to the extent that it undermines the quality of decision making, generating common cognitive biases, which significantly reduce the accuracy of expectations (Griffin and Tversky, 1992; Kahneman and Tversky, 1982). When validity and clarity of feedback is less than certain, individuals rely on subjective heuristics; this results, in turn, in individuals overestimating the precision of their knowledge and exaggerating considerably the likelihood of future success (Fischhoff, Slovic, and Lichtenstein, 1977; Yates, 1990). In short, when performance estimates are imprecise and feedback is unclear and

noisy, inaccurate and erroneous judgments are likely to ensue (Paich and Sterman, 1993; Sterman, 1989).

A direct implication of this argument is that, in the context of strategic decision making, firms may act less carefully than they would have otherwise (Zacharakis and Shepherd, 2001) because sound decision making requires accuracy regarding what one knows and does not know. Incomplete performance feedback may adversely affect the performance of subsequent decisions because less care leads to excessive risk-taking (Fast *et al.*, 2012) and because taking excessive risks has been linked to performance losses (Barber and Odean, 2000; Odean, 1998). To illustrate the relevance of feedback incompleteness under such circumstances, consider Firm A and Firm B that have the same stock of experience but differ in level of performance feedback received on all past decisions. If the level of incomplete performance feedback is greater in Firm A than in Firm B, the former is likely subject to outcome ambiguity. Consequently, Firm A will be less likely to accurately specify the decision–performance linkages, and thus more likely to develop an inaccurate understanding of causal linkages between a performance outcome and the decision that led to it. In contrast, if performance feedback clearly and validly represents the quality of a previous decision—which occurs when firms receive objective feedback about past performance—decision makers will tend to assimilate its message and react more effectively. A complete performance feedback—by being clear and uninterrupted—will enhance the decision makers' ability to specify the performance linkages and thus avoid cognitive biases and erroneous estimates, more broadly.

Combining these, we expect that a given stock of experience may not necessarily lead to a certain quality of decision outcomes; rather, *ceteris paribus*, a greater share of incomplete feedback on past decisions may undermine the quality of future decisions, by increasing the influence of inaccurate beliefs and leading to systematic errors. Conversely, when a greater

share of performance feedback, that is, the stock of experience, is complete, decision makers may be more likely to receive accurate information that reduces the probability of systematic errors.

> *Hypothesis 1 (H1): As the share of incomplete performance feedback increases (decreases), the performance of a subsequent decision will decrease (increase).*

Incomplete and decreasing performance feedback

Central to our argument is the claim that, in addition to valence, performance feedback is also characterized by the level of its completeness: when feedback is incomplete, the quality of future decisions will be diminished because of cognitive bias and systematic errors in estimates. We further propose that, valence and completeness of performance feedback reinforce each other in enhancing the quality of future performance outcomes. That is, the well-established benefits of problemistic search for firm future performance (Greve, 2003a) are contingent on whether performance feedback is complete.

First, in bounded rationality search models, an organization is seen as responding to success or failure by varying the intensity of search (Cyert and March, 1963): decision makers increase their emphasis on distant, exploratory search when the discrepancy between their performance and aspirations is larger (Audia and Greve, 2006; Audia, Locke, and Smith, 2000; Greve, 1998, 2003c; Nohria and Gulati, 1996). Because a precise and accurate understanding of past performance predicts the direction and intensity of search, the latter risks being biased when performance feedback is incomplete, or when the information record on which decision makers base their search is an inaccurate representation of past decisions, and thus of future likelihoods. In particular, if decision makers reinterpret incomplete information as more favorable than it would be if feedback were complete, then the bias may be against distant search, with a firm searching locally, in the neighborhood of the identified problem (Baum and Dahlin, 2007; Baum *et al.*, 2005; Gavetti, 2012). Alternatively, if information is interpreted as less favorable than it would be if feedback were complete,

negative performance feedback may result in more distant search, further from the core competencies of the firm (Baum *et al.*, 2005; Cyert and March, 1963). In both cases, information deficiency due to incomplete feedback on past performance might increase a firm's tendency to misinterpret records on past performance and trigger search that is either more distant or more local, than it would be if decision makers received complete performance feedback.

Relatedly, when the causes of performance deficit are identified, concomitant organizational changes are a likely outcome of problemistic search (Cyert and March, 1963; Greve, 1998, 2003a, 2003c). Yet, a biased and subjective search process will result in suboptimal changes and possibly diminish firm performance. For example, when searching distantly is based on erroneous inferences, the process may lead to excessive risk-taking (i.e., reorientation of well-established strategies, or an introduction of new practices and processes), even when incremental solutions and refinements of existing practices would benefit the firm more. Alternatively, if problemistic search is focused locally, the resulting changes will likely occur near the apparent problem (Argote and Greve, 2007; Cyert and March, 1963), even though correcting performance discrepancies may require larger, riskier changes. Hence, when performance feedback is incomplete, the resulting adaptation will be ineffective and, in some cases, detrimental to firm performance.

In contrast, we expect that the benefits of problemistic search will be amplified when performance feedback is complete. When information on past performance is not missing, the resulting search process will be based on accurate evidence rather than erroneous estimates of future probabilities. Similarly, as decision makers engage in search processes, more complete information on past decisions will increase the accuracy of the current cause-and-effect beliefs. This will further enhance the efficacy and quality of the solutions applied in an effort to reduce the observed discrepancy between the outcome and the goals. Hence, the decisions

on how to effectively improve future performance should be of higher quality.

For all these reasons, we expect that performance feedback completeness will amplify the beneficial impact of problemistic search on firm performance. Because more complete information increases the accuracy of a firm's repertoire of decision–performance linkages, the benefits of search will be enhanced when feedback on past performance is complete. Conversely, such benefits will be reduced when performance feedback is incomplete, resulting in ineffective search process and suboptimal changes.

> *H2a: Performance feedback moderates the negative (positive) impact of performance feedback incompleteness (completeness), such that when performance decreases relative to aspirations, the negative (positive) impact of performance feedback incompleteness (completeness) on the performance of a subsequent decision will increase.*

However, the fact that problemistic search increases as performance feedback decreases relative to aspirations represents only one of the principles of performance feedback theory. The other, complementary principle is that the pace at which problemistic search increases is determined by whether performance falls below or exceeds aspirations (Greve, 1998, 2003a, 2003c; March and Shapira, 1992). In other words, the intensity of search increases the further the performance falls below aspirations, generating the so-called kinked-curve relation between performance and search, that is, a curve that changes slope at the aspiration level (Greve, 1998; 2003a). Overall, this second principle is a crucial condition for performance feedback theory, since it suggests that "the aspiration level changes the behavior by modifying the relation from performance to organizational change" (Greve, 2003a: 62).

Importantly, the tendency to search distantly and to undertake greater risk in result increases the further performance falls below aspirations (Baum *et a*l., 2005; Bromiley, 1991; March and Shapira, 1992). Empirical studies have found, for example, that the likelihood of radical change and risk-taking decreases for above-aspiration-level firms more than for below-aspiration-level ones (Greve, 1998, 2003a) and that the further performance exceeds

the performance benchmark, the less likely managers are to undertake changes resulting from problemistic search (Baum *et al.*, 2005; Combs and Ketchen Jr., 1999; Harris and Bromiley, 2007; Labianca *et al.*, 2009). A direct corollary of these theories is that the challenges of incomplete feedback should be more acute when performance falls below rather than exceeds aspirations. Since search is more intensive and more distant below aspirations, in such cases decision makers will be in greatest need of accurate and precise information regarding their past performance. Put differently, complete information about past performance will be most valuable when decision makers search distantly in response to performance shortfall below aspirations. In contrast, the completeness of information is less crucial when performance is above aspirations, because in such cases decision makers are less prone to engage in intense and distant search. Hence, we predict:

> *H2b: Performance feedback moderates the negative (positive) impact of performance feedback incompleteness (completeness), such that the moderating effect is stronger for firms performing below aspirations than for firms performing above aspirations.*

RESEARCH DESIGN

Research setting

Our hypotheses are tested using data from PE investments, which usually involve buyouts. Buyouts are standalone, controlling-stake acquisitions of a company (or a division) from its owners, usually with a limited time horizon and with strong involvement from specialized financial investment companies, referred to as general partners (Gilligan and Wright, 2012). Buyout investors try to build value by improving the firm's cost structure, tightening controls on corporate spending, initiating cost-reduction programs, increasing plant productivity, lowering labor costs, and reducing working-capital requirements. Post-acquisition activities often involve selling or shutting down less efficient units or projects, improving the quality of the management team and corporate governance.

PE is a suitable context for studying the effect of performance feedback on strategic

decisions, for two main reasons (Castellaneta and Zollo, 2015). First, buyouts remain in the portfolio of the PE firm for a limited time and are handled completely independently of one another. Companies acquired during buyouts remain fully separate legal and financial entities, operating as standalone firms with no cross-subsidies or forced interfirm sales (Landau and Bock, 2013). This separation makes it possible to measure the performance of each investment independently of those of other investments in the portfolio, in other words, without confounding factors. Additionally, the specificity of this industry allows us to directly and objectively measure performance feedback—in the form of returns—throughout a firm's history. Finally, PE investment decisions are similar to strategic decisions on several important dimensions (Zollo, 2009), the most significant being that both are complex. Buyouts, as strategic activities, tend to be complex and characterized by the difficulty of correctly specifying cause–effect linkages (Castellaneta and Zollo, 2015).

Sample

The data were collected from fundraising prospectuses, called private placement memoranda (PPMs), created by various investment firms operating in Europe, the United States, and emerging markets. PE firms produce new PPMs every three or four years for fundraising purposes. Moreover, once a PPM is produced, it is updated several times before the fundraising is closed, to incorporate changes in the PE firm portfolio (including divestments and new investments). We have access to all versions of the PPMs, and we have used the most recent PPM to compile our dataset. Given this timing and our access to all PPM versions and updates, the delay between the occurrence of an event (e.g., a new investment) and its recording in our dataset is limited.

The primary data source consists of hand-collected, audited records of PE firms reported in PPMs. Our collaborating investors are based in both Europe and the United States and gave us PPMs, irrespective of their final investment decisions (i.e., invest or not). From

the PPMs, we observe the list of investments made by each buyout firm, as well as the performance outcome of each investment. Our performance data have the advantage of being audited rather than self-reported. Moreover, buyout firms routinely disclose all investments in their PPMs, including underperformers.

After accounting for missing data, our sample includes 7,223 investments made by 265 PE firms between 1973 and 2008 in 88 countries. Our database is likely representative of the universe of PE investments because it contains around 91% of the 7,898 buyouts exited during this period (see Kaplan and Strömberg, 2009, for a study on the number of buyouts). Moreover, the data come from a number of limited partners (i.e., investors in PE firms) and include information about those PE firms in which they decided to invest as well as those in which they decided not to invest.

Measures

Dependent variables

In a typical buyout, a PE firm invests a certain amount of money to acquire a company and sells it after a period of time. The performance of each investment can be assessed by using the internal rate of return (IRR) (Kaplan and Schoar, 2005), which measures the gross return earned by investors from the acquisition of the company until it is sold. The IRR is calculated as an annualized, effective, compounded rate of return, using monthly cash flows and annual valuations for each company. Our data include significant outliers and thus we winsorize the dependent variable (IRR) at the 95th percentile (2.06, which corresponds to 206%). By doing so, we avoid the possibility that a few outliers will significantly change regression results by affecting the sign, significance, and magnitude of the slope (Hamilton, 2009). The winsorized IRR has a mean of 0.34 (34%) and a standard deviation (SD) of 0.66 (66%).

Independent variables

Performance feedback incompleteness. Our main independent variable measures the

percentage of prior investments that have not been completely divested. These are the investments in which the PE firm had not sold its entire stake prior to the starting date of the focal investment. Undivested investments are characterized by the presence of outcome ambiguity, given that the PE firm has not received objective performance feedback on those investments. This measure is computed as the ratio of the count of unrealized investments to the count of total investments (i.e., realized plus unrealized investments) made, prior to the focal investment.

Performance feedback. Past research has identified two factors influencing firms' aspirations: "the organization's past performance and the past performance of other 'comparable' organizations" (Cyert and March, 1963: 115). Consistent with the literature, we model performance feedback in two ways: (1) an assessment relative to the firm's own prior performance (historical aspiration point), and (2) an assessment relative to the performance of a meaningful referent group (social aspiration point) (Greve, 2003a). As noted by Iyer *et al.* (2008: 812), these two measures represent "two different proxies for aspirations." We describe each measure below.

Historical performance feedback. In PE, firms invest money on behalf of their investors, such as banks, insurance firms, pension funds, and university endowments. The main purpose of PE investment is to deliver positive returns to these investors. If returns are negative, PE firms risk obliterating their investors' wealth. Because firms aim to earn returns higher than zero (Jensen and Meckling, 1976), financial losses lend themselves to an assessment of historical aspirations (Schneider, 1992; Schurr, 1987); therefore, the natural aspiration point is zero. In this respect, "making or losing money stands out as an obvious important distinction" (Bromiley, 2009: 28) between positive and negative outcomes. Accordingly, we compute the weighted average of the winsorized performance (at the 95th percentile) based on investment size and duration. The core idea for the weighted average is

that bigger and longer investments contribute more to the overall performance of the PE firm (Phalippou and Gottschalg, 2009). In computing this measure, we include only the performance of the realized investments before the beginning of the focal investment. Given that the aspiration point is 0, we do not subtract any value from the average performance. We use a winsorized measure (at the 95th percentile) of historical performance feedback because standard errors do not appear to be normally distributed without winsorizing due to outliers (Cameron and Trivedi, 2009). However, our results are also robust to the use of a nonwinsorized measure (see "Supplemental Analyses").

Social performance feedback. To account for performance relative to other firms, we use the median, a standard measure of performance aspirations in PE. Past research has provided ample evidence that investors take the median of a comparable group as a reference point when comparing performance across different PE firms (or PE funds) (Phalippou and Gottschalg, 2009). Once high performers are identified, investors might compete to obtain a larger share of such industry leaders (Fraser-Sampson, 2011).

We take several steps to compute social performance feedback. First, we calculate the median winsorized performance (at the 95th percentile) of the buyouts bought in the same entry year and in the same-size tercile.[2] For each realized investment, we then compute the difference between the winsorized performance (at the 95th percentile) and the median winsorized performance. For each PE firm, we subsequently compute the weighted average of these differences based on investment size and duration. In computing this measure, we include only the performance of the realized investments. Similar to historical performance feedback, we use a winsorized measure of social performance feedback because standard errors do not appear to be normally distributed without winsorizing due to outliers (Cameron and Trivedi, 2009). However, our results are also robust to the use of a nonwinsorized

[2]We obtain similar results by using (1) size quartile, instead of size tercile; and (2) the mean, instead of median.

measure (see "Supplemental Analyses").

Spline variables. Prior literature has suggested that "problemistic search is increased when the organization performs below the aspiration level and decreased when the organization performs above the aspiration level" (Greve, 2003a: 58). Hence, if performance feedback incompleteness mitigates the positive effect of problemsitic search on the firm's subsequent performance, the interaction term should be more positive below than above a firm's aspirations.

To assess this mechanism, we split each measure into two variables: (1) *historical performance feedback* ≤ 0 and *historical performance feedback* > 0 and (2) *social performance feedback* ≤ 0 and *social performance feedback* > 0. The creation of spline variables is common in the performance feedback literature (Greve, 2003a) and allows for different slopes for values above and below aspiration levels. We then let each split variable interact with performance feedback incompleteness to assess the differential moderating effect of performance below and above aspirations.

Control variables

Based on a systematic review of prior empirical studies on buyouts (Kaplan *et al.*, 2005; Kaplan *et al.*, 2009; Phalippou *et al.*, 2009) and corporate acquisitions (Kim *et al.*, 2009a), we employ an extensive set of control variables to rule out potentially confounding factors.

The first set of controls accounts for various characteristics of the acquiring PE firm. First, we account for the *PE fund size* (expressed in 2006 USD millions), measured as the equity raised by the fund that acquired the focal company. We also include the *PE-firm fixed-effect (FE)* estimator to rule out the possibility that unobservable, time-invariant, PE-firm characteristics may drive our results (Castellaneta and Gottschalg, 2014).

The second set of controls accounts for a number of deal characteristics: the *investment duration* of the focal investment based on the month and year of entry and exit

from the buyout; the *investment size,* that is, the equity paid by the focal PE firm for the investment (expressed in 2006 USD millions); whether the exit from the company was realized through a public offer to the stock market (*initial public offering [IPO] dummy*); and whether the investment was done in the first part of the investment period (i.e., the first three years) or in the second part (i.e., after three years) (*investment period dummy*).

The third set of control variables accounts for market conditions that may influence the focal investment's performance. In particular, we control for change in stock market valuations between the entry date and the exit date (both measured based on the month and year) of the focal investment. Given that stock market returns are not available for several countries over the period considered, we aggregate countries in the six regions: Asia Pacific, Canada, Central Europe, East Europe & Middle East & Africa, Latin America, the US. For each of these regions, a stock market index is available over the period analyzed in this paper. In particular, Canada stock market returns are measured with the MSCI Canada index; Asia Pacific market returns are measured with the MSCI AC Asia Pacific index; Central Europe stock market returns are measured with the MSCI Europe index; East Europe & Middle East & Africa stock market returns are measured with the MSCI Emerging Emea index; the Latin America returns are measured with the MSCI Em Latin America index; and the US stock market returns are measured with the DJIA index. Second, we include a number of fixed effects that, based on previous works, (e.g., Castellaneta and Gottschalg, 2014; Fitza, Matusik, and Mosakowski, 2009) are likely to explain a significant portion of variance in buyouts' performance. We include year-FEs by using both *entry-time FEs* and *exit-time FEs* from the focal investment to account for potential, economy-wide shocks that may drive the observed performance. Third, we use (a) *country* and (b) the 48 Fama and French *industry FEs* (Fama and French, 1997) to account for unobserved heterogeneity at the country and industry levels, respectively.

ANALYSIS

All models are estimated with a PE-firm FE estimator with clustered standard errors (because our data include repeated observations of the focal PE firm). The omission of PE-firm effects would make the model poorly specified, biasing the estimated parameters (Cameron and Trivedi, 2009), because the PE-firm effect has been shown to explain a significant portion of the performance of PE investments (Castellaneta *et al.*, forthcoming). Finally, the Hausman test additionally confirms that an FE model is more appropriate in our setting than a random-effects model (Hausman, 1989). Table 1 presents the correlation matrix, as well as the means and standard deviations of the variables.

Table 2 reports the main results. We test our hypotheses by using both historical and social performance feedback to check whether results are robust to the use of these "two different proxies of aspirations" (Iyer and Miller, 2008: 812). Models 1 and 4 estimate the direct effect of performance feedback incompleteness; Model 1 controls for historical performance feedback, and Model 4 controls for social performance feedback. Model 2 estimates the interaction between performance feedback incompleteness and historical performance feedback. Model 4 estimates the interaction between performance feedback incompleteness and social performance feedback.

<Insert Tables 1 and 2>

Hypothesis 1 states that as performance feedback incompleteness increases, the performance of the subsequent decision will decrease. Models 1 (controlling for historical performance feedback) and 4 (controlling for social performance feedback) in Table 2 show that performance feedback incompleteness has a significant negative impact on subsequent performance, which supports H1. Moreover, the magnitude of this effect is economically relevant—a one SD increase in performance feedback incompleteness leads to a decrease in IRR of around 0.036 (3.6%) based both on Model 1 (controlling for historical performance

feedback) and Model 4 (controlling for social performance feedback).

Hypothesis 2a states that the negative impact of performance feedback incompleteness on the performance of subsequent decisions will increase (decrease) as performance decreases (increases) relative to a firm's aspirations. We expect a positive interaction term between performance feedback incompleteness and (historical or social) performance feedback, respectively. Models 2 and 5 show a significant and positive interaction term between performance feedback incompleteness and historical performance feedback (Model 2) and between performance feedback incompleteness and social performance feedback (Model 5). Therefore, H2a is supported. Moreover, the magnitude of this effect is economically relevant: when historical performance feedback decreases by one SD, a one SD increase in performance feedback incompleteness decreases IRR by around 0.018 (1.8%); when social performance feedback decreases by one SD, a one SD increase in performance feedback incompleteness decreases IRR by around 0.024 (2.4%).

Hypothesis 2b states that the moderating effect of historical performance will be more positive for firms performing below rather than above aspirations. Model 3 shows that the coefficient estimate for the interaction term of *historical performance feedback* $\leq 0 \times$ *performance feedback incompleteness* is more positive than the coefficient estimate for the interaction term of *historical performance feedback* $> 0 \times$ *performance feedback incompleteness.* Moreover, an F-test shows that the difference in coefficient estimates is significantly different from zero ($F(1, 6760) = 3.14$, $p = 0.08$). Model 6 shows that the coefficient estimate for the interaction term of *social performance feedback* $\leq 0 \times$ *performance feedback incompleteness* is more positive than that for the interaction term of *social performance feedback* $> 0 \times$ *performance feedback incompleteness.* An F-test also shows that the difference in coefficient estimates is significantly different from zero ($F(1, 6760) = 4.33$; $p = 0.04$). Overall, these results provide support for H2b, for both historical and

social performance feedback.

We conduct a number of supplemental analyses to probe deeper for the mechanisms behind our findings.

<Insert Tables 3 and 4>

First, our theory assumes that performance feedback incompleteness reduces the quality of subsequent decisions by triggering an inaccurate assessment of the individuals' own skills and the validity of their judgment, which may lead to overconfidence and excessive risk-taking. To investigate this mechanism, we examine whether performance feedback incompleteness is systematically correlated with two indicators of risk-taking: stock market level and the standard deviation of IRR. In particular, we consider whether decision makers with incomplete feedback are also more likely to make their focal investments, when the stock market is high. In this respect, Gervais and Odean (2001), Glaser, Langer, and Weber (2007), and Odean (1998) find that "the most robust effect of overconfidence" (Odean, 1998: 1888) is that the higher the degree of overconfidence of an investor, the higher her trading volumes. Overconfident investors will trade more aggressively, increasing their level of trading volumes, in both bull and bear markets. Similarly, overconfident PE firms should be more likely than their counterparts to invest when the stock market is at its peak, that is, when the opportunities for capturing value from a positive financial cycle are more limited. A high stock market tends to raise the buyout firm's value independently of the value addition initiatives undertaken. Consequently, firms with higher incompleteness will tend to invest, even though there are few opportunities for financial and multiple arbitrage (i.e., buy-low/sell-high strategy). As expected (Columns 1 and 2 of Table 3), we find a positive association between performance feedback incompleteness and the stock market level; that is, firms with incomplete performance feedback tend to make buyouts when the stock market is high and financial arbitrage opportunities are low. This finding lends some indirect support to

the hypothesized mechanism—PE firms with higher incompleteness tend to engage in greater risk-taking, possibility due to overconfidence, than PE firms with lower incompleteness.

We conducted an additional analysis to assess whether performance feedback incompleteness is positively related to the standard deviation of the IRRs from the investments initiated in the year of the focal investment. Similar to previous studies (Campbell *et al.*, 2001; Kacperczyk, Beckman, and Moliterno, 2015), the standard deviation of the IRRs measures the financial risk specific to the investments undertaken by the PE firm. Consistent with our theory, we find that PE firms with higher incompleteness make investments with a higher standard deviation of the IRRs (Columns 3 and 4 in Table 3). Again, this finding is consistent with the claim that PE firms with higher incompleteness tend to engage in greater risk-taking, possibility due to overconfidence, than PE firms with lower incompleteness.

Second, our theory on performance feedback incompleteness implies that realized investments will lead to an increase in firm future performance, and that unrealized investments will lead to a decrease. We assess this empirically by estimating a model in which we simultaneously included log transformed covariates of realized and unrealized investments—controlling for historical performance feedback in Column 5 of Table 3 and for social performance feedback in Column 6 of Table 3. As expected, our results confirm that realized investments are positively associated with future performance, whereas unrealized investments are negatively associated with future performance. Third, the weighted average of historical and social performance feedback used in Table 2 is computed based on size and duration. We check whether we obtain similar results by weighting historical and social performance only by size. As shown in Table 4, the results are maintained even when the weighting is based only on size.

Supplemental analyses

We also conducted a number of additional robustness checks (see the online Appendix for tables and further details). First, a possible concern is that the results are an artifact of using winsorized measures, when computing *historical and social performance feedback.* Hence, for robustness, we re-estimate the impact of performance relative to historical and social aspirations without winsorizing these measures. The results (Appendix Table 5) are maintained even when nonwinsorized measures are used. Second, we investigate the impact of buyouts that remain in a portfolio for a long period of time (Phalippou and Gottschalg, 2009). One possible concern is that such abandoned investments may affect our results, given that they may represent feedback for PE firms, even though they are not completely liquidated. This is because PE firms have the institutional mission of buying and selling companies over a commonly agreed investment timeframe (e.g., within four or five years). To account for these investments, we re-estimate our models now considering *abandoned investments*—defined as investments older than 10 years—as realized investments. Results (Appendix Table 6) are robust to a different operationalization of this variable. In additional analyses (available upon request), we consider different specifications of this variable, taking into account investments older than seven, eight, and nine years. The results remain unchanged across the different model specifications. Third, we use an FE ordinary least squares (OLS) model, which allows us to compute variance inflation factors (VIFs) and to assess potential multicollinearity problems in each model. However, whereas the FE OLS model produces the same coefficient estimates as those of the panel data model, standard errors may differ (Wooldridge, 2009). For this reason, we re-estimate our model with the panel data command. Results (Appendix Table 7) are robust to the use of a panel data model. Finally, we perform two different robustness checks to rule out the possibility that our results are simply driven by regression to the mean that might characterize historical and social

performance. Based on the results (reported in Appendix Tables 8), we are reasonably confident that the observed significant effects are not due to simple regression to the mean.

DISCUSSION AND CONCLUSIONS

Much prior literature has focused on performance feedback and considered its valence as an important dimension. Scholars have argued that whether performance feedback is negative or positive (i.e., falls below or exceeds aspirations) has important consequences for change and adaptation (Cyert and March, 1963; Greve, 2003a; March and Simon, 1958; for a recent review, see Shinkle, 2012). We complement this line of research by introducing completeness as an important and complementary dimension of performance feedback. We argue that performance feedback is not always complete, because feedback from some or all previous decisions may be observed only after a period of time has passed, and often only after one or more subsequent decisions have been made. Under these conditions, firms making a focal decision may have observed performance feedback for only a portion of their previous decisions. Though incomplete performance feedback is likely germane to a significant number of strategic decisions, its potential influence has received limited attention in performance feedback theory.

Building on prior research, we propose and find empirical support for the claim that when accumulated performance feedback available to a firm is less complete, performance of subsequent decisions diminishes. We attribute this negative effect to the notion that incomplete feedback increases outcome ambiguity, making it difficult for decision makers to accurately estimate the probabilities of future events. Our findings are also consistent with a host of experimental studies in economics, psychology, and management documenting that individuals tend to make inaccurate and erroneous judgments when validity and clarity of feedback is less than certain (Diehl and Sterman, 1995; Paich and Sterman, 1993; Sterman,

1989). In particular, we find empirical evidence that incomplete performance feedback is systematically correlated with risk-taking behavior, consistent with the notion that incomplete information likely results in overconfidence and thus greater risk (Griffin and Tversky, 1992; Tversky and Kahneman, 1977).

We further theorize and show that valence and completeness are interrelated in their influence on firm future performance. That is, we propose that feedback completeness matters in the context of strategic decisions because it influences the outcomes of the well-established problemistic-search process. The core of our argument is that problemistic search is likely biased and misdirected and might lead to suboptimal changes and adaptations if it is based on inaccurate understanding of performance–outcomes linkages. Empirically, we show that the benefits of problemistic search are, in part, contingent on feedback being complete. We also find that the complementary effect of completeness is stronger when performance falls below rather than exceeds aspirations. We motivate this prediction with the literature which suggests that problemistic search and the resulting changes are stronger below than above aspirations (Greve, 1998, 2003a, 2003b, 2003c; March and Shapira, 1992; Milliken and Lant, 1991). These results provide stronger evidence that our results predominantly reflect problem-driven, as opposed to slack-driven search. Overall, we document that the well-established effect of problemistic search is contingent on whether performance feedback is complete. Hence, completeness is an important dimension of performance feedback.

Our results advance the understanding of the organizational learning phenomenon in various ways. First, the negative association between incomplete performance feedback and future performance provides new and relevant empirical support for the intuition that organizations might use performance feedback from past decisions to improve their understanding of decision–performance feedback linkages (Levitt *et al.*, 1988). In this respect, our findings suggest that a firm's understanding of "what works" likely increases as its

performance feedback completeness level increases. In more general terms, firms are more likely to struggle to make effective decisions in the present when they have a less-complete understanding of the past.

Second, and relatedly, the observation of the importance of performance feedback completeness is consistent with the notion of the ambidextrous nature of strategic decision making. On one hand, it is a forward-looking exercise aimed at exploring new opportunities and/or locating solutions to problems (Barreto, 2011; Chen, 2008; Gavetti and Levinthal, 2000). On the other hand, it is backward-looking when aimed at developing an in-depth understanding of the past (Kim and Finkelstein, 2009). The result is that an effective, forward-looking, strategic decision-making process is built on an in-depth, backward-looking exercise.

Third, our finding that performance feedback incompleteness systematically moderates the relationship between negative performance feedback and firm future performance challenges previous work that considered past performance a proxy for organizational capabilities. This finding sheds new light on recent advances, showing that exceptional performance is only a weak signal of capabilities (due to chance events and noise) and that moderately high performers are expected to have the highest ability (Denrell, Fang., and Zhao, 2013). Our findings contribute to this theory on the origins of organizational capabilities by showing that firms develop capabilities due in part to the search processes triggered by unsatisfactory performance outcomes. Given the emphasis commonly placed on the concepts of sustainable competitive advantage and the perpetuation of organizational success (Porter, 1985; Powell, 2001), the causes behind this finding deserve further attention in the strategic management literature.

Finally, our findings suggest that a greater stock of experience does not necessarily lead to greater learning and better decision making. This is because experience tends to

increase learning only when the organization receives performance feedback on each decision made. On the contrary, experience lacking objective feedback might not only add little value, but also reduce organizational learning. This is because incomplete feedback might trigger an inaccurate assessment of the individuals' own skills and the validity of their judgment in future decisions.

Moreover, these findings shed new light on the mixed and puzzling findings about learning from experience in strategic contexts (see Barkema and Schijven, 2008b). For instance, in the mergers and acquisitions context, some studies found a positive relationship between experience and performance (Barkema et al. 1996; Bruton et al. 1994; Fowler and Schmidt 1989), while others found the relationship to be non-significant (Hayward, 2002; Wright *et al.*, 2002; Zollo and Singh, 2004) or U-shaped (Haleblian and Finkelstein, 1999; Porrini 2004). One potential explanation (among others) of these mixed results is that previous studies have confounded the two types of experience—with and without feedback—failing to take into account the contingencies under which experience is beneficial or harmful.

Managerial and policy implications

Our findings have implications for strategic managerial decisions in contexts where performance feedback from previous decisions is delayed and cannot be observed before a new decision is made. Managers searching for ways to improve decision making should focus not necessarily on collecting more feedback but on collecting feedback that is complete. Such complete feedback is particularly key for decision makers, as negative performance feedback activates problemistic search. Put differently, our results indicate that negative feedback might be more useful when it is complete and fine-grained, allowing managers to better identify actions to correct internal causes of low performance, as well as to learn from the actions of competitor firms.

For the PE industry specifically, our analysis suggests that PE firms should monitor

negative returns in a timely manner and actively adapt their practices to identify and invest in subsequent transactions that are more promising. This is of considerable practical relevance because investors in PE funds generally shy away from PE firms that lack a "spotless" track record. Our findings suggest that as PE firms appear to learn from negative performance feedback, the behavior of investors in PE funds should be reconsidered. The incompleteness of performance feedback is also especially important in this sector because PE firms almost always initiate new investments before complete feedback about past investments is available. Moreover, the economic magnitude of the estimated effects shows that they capture critical determinants of buyout performance.

Our findings also have policy implications. They suggest that recent regulatory requirements to regularly and systematically determine the market value of unrealized investments (cf. topic 820 of the Financial Accounting Standards Board) may be competence-enhancing for PE firms. This valuation process may help firms avoid overestimating the value of those investments, which may in turn skew the decision-making process with unwarranted cognitive biases resulting from potential overconfidence.

As with all studies, ours has several limitations that offer opportunities for further research. First, methodologically, the PE setting offers key advantages in examining performance feedback incompleteness. One is the possibility to quantify performance feedback incompleteness directly. Focusing on PE, researchers can observe the percentage of past decisions for which an organization has received objective performance feedback before a focal decision is made. As a result, our study is better able to measure when performance feedback is incomplete and thus assess its influence on the quality of future decisions as well as resulting performance. Although our focus is on PE, the theoretical arguments are likely to be generalized beyond the PE context to other industries. Specifically, we expect such incompleteness of performance feedback to be particularly salient and problematic for

decision makers in contexts where decisions are characterized by high complexity and outcome ambiguity, or the difficulty for decision makers to know the outcome of a given decision. Conversely, our findings may be less applicable to contexts in which decisions are less complex and associated with more predictable and speedy feedback. For example, our findings might be less likely to hold in the mutual funds industry, where returns on investment are precisely measured and publicly reported each month. In this and other similar industries, the potential influence of incomplete performance feedback is likely weaker. Future research may therefore investigate in greater detail the additional scope conditions associated with our theory.

Second, we offer indirect evidence that negative performance feedback triggers organizational change. Yet, we are unable to shed more light on the micro-level processes that trigger this change. Understanding such processes will be fundamental for explaining how organizations learn from negative performance feedback and the factors that may enhance or undermine such learning. One issue that merits further attention is the role of performance feedback quantity in fostering or constraining organizational learning. While our analyses account for performance feedback quantity, future studies may investigate whether the sheer quantity of feedback complements or substitutes for performance feedback completeness. Similarly, an attractive avenue for a future inquiry may be to investigate the relative strengths of the two effects so as to understand whether quantity or completeness is more central to shaping the quality of future decisions. Our results provide a first step in this direction by unpacking the mechanisms behind performance feedback completeness and differentiating these from performance feedback valence, a construct well established in past literature. Future studies should further examine the fine-grained mechanisms underlying the impact of performance feedback quantity on the quality of future decisions.

Third, although our data capture different regional contexts—Europe, the United

States, and emerging markets—we have not examined their respective impacts. Future research should examine the heterogeneity of learning in different regional contexts. Finally, we have been unable to control for whether deal financing involves syndicates of PE firms and whether a particular PE firm leads the syndicate. While all investors are likely to receive the same performance feedback from a successful or unsuccessful buyout, lead investors in a syndicate may have access to more complete information because they have closer involvement in a portfolio company (Wright and Lockett, 2003), probably affording greater learning. Further analysis could explore the learning differences between lead and non-lead investors.

Notwithstanding these limitations, our study advances the performance feedback theory and PE literatures by characterizing performance feedback with respect to its completeness and documenting its implications for firm performance. We hope to underscore the problems generated by delayed performance feedback and emphasize the need to consider completeness as an important concept in the strategic management literature.

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Table 1. Descriptive statistics and correlation matrix

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. IRR	0.34	0.66	1.00										
2. Performance feedback incompleteness (PFI)	0.65	0.21	−0.01	1.00									
3. Historical performance feedback (HPF)	0.56	0.41	0.05	0.17	1.00								
4. Social performance feedback (SPF)	0.28	0.42	0.03	0.19	0.89	1.00							
5. PE fund size	1373.82	1748.97	−0.05	−0.21	−0.10	−0.09	1.00						
6. Investment duration	3.65	2.49	−0.31	0.14	0.07	0.01	−0.02	1.00					
7. Investment Size	46.42	112.89	−0.03	−0.23	−0.04	−0.04	0.40	−0.02	1.00				
8. IPO dummy	0.13	0.34	0.07	−0.03	−0.00	−0.00	0.05	−0.06	0.06	1.00			
9. Investment period dummy	0.29	0.46	−0.00	−0.00	−0.10	−0.12	0.11	0.00	−0.09	−0.04	1.00		
10. Market returns	2.67	5.76	−0.00	0.02	0.04	−0.01	−0.05	0.15	0.02	0.04	−0.01	1.00	
11. HPF (weighting for size)	0.54	0.41	0.02	0.17	0.89	0.96	−0.09	0.07	−0.04	0.00	−0.10	0.03	1.00
12. SPF (weighting for size)	0.30	0.43	0.03	0.17	0.85	0.99	−0.08	0.01	−0.04	0.00	−0.12	−0.00	0.97
13. Experience Realized	24.51	35.87	−0.02	−0.48	−0.22	−0.15	0.33	−0.16	0.13	0.04	−0.04	−0.09	−0.16
14. Experience Unrealized	34.46	36.19	−0.05	−0.05	−0.17	−0.09	0.33	−0.05	−0.00	−0.00	0.02	−0.10	−0.10
15. Entry stock market	1389.39	2184.07	0.03	−0.07	−0.01	0.01	0.08	−0.10	0.06	0.04	−0.05	−0.15	−0.01
16. SD IRR	0.51	0.32	0.14	0.09	0.02	0.01	0.05	−0.01	−0.06	−0.01	−0.04	0.03	0.03

Variables	12	13	14	15	16
12. SPF (weighting for size)	1.00				
13. Experience realized	−0.12	1.00			
14. Experience unrealized	−0.06	0.73	1.00		
15. Entry stock market	0.01	0.03	0.00	1.00	
16. SD IRR	0.02	0.07	0.14	−0.01	1.00

Table 2. Results of fixed-effect estimation

Variables	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR
Performance feedback incompleteness (PFI)	−0.18*	−0.41***	−0.36***	−0.17*	−0.32***	−0.24**
	(0.07)	(0.10)	(0.10)	(0.07)	(0.08)	(0.09)
Historical performance feedback (HPF)	−0.07*	−0.41***				
	(0.03)	(0.11)				
PFI × HPF		0.41**				
		(0.13)				
HPF <= 0			−1.86*			
			(0.77)			
HPF > 0			−0.33**			
			(0.11)			
PFI × HPF <= 0			1.91*			
			(0.86)			
HPF × HPF > 0			0.34**			
			(0.13)			
Social performance feedback (SPF)				−0.06*	−0.45***	
				(0.03)	(0.11)	
PFI × SPF					0.48***	
					(0.13)	
SPF <= 0						−1.20**
						(0.40)
SPF > 0						−0.32**
						(0.12)
PFI × SPF <= 0						1.39**
						(0.46)
PFI × SPF > 0						0.31*
						(0.15)
PE fund size	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Investment size	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	0.13***	0.13***	0.13***	0.13***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Investment period dummy	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Market returns	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	−0.28	−0.15	−0.18	−0.29	−0.24	−0.30
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.28	0.29	0.29	0.28	0.29	0.29

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.

Table 3. Experience realized and unrealized, entry stock market, standard deviation (SD) IRR

Variables	(1) Entry stock market	(2) Entry stock market	(3) SD IRR	(4) SD IRR	(5) IRR	(6) IRR
Performance feedback incompleteness	709.74**	709.50**	0.07*	0.07*		
	(216.71)	(216.49)	(0.04)	(0.04)		
Experience realized					0.04*	0.04*
					(0.02)	(0.02)
Experience unrealized					−0.05*	−0.05*
					(0.02)	(0.02)
Historical performance feedback	−32.89		−0.02		−0.07*	
	(89.08)		(0.01)		(0.03)	
Social performance feedback		3.70		−0.01		−0.06*
		(84.54)		(0.01)		(0.03)
PE fund size	0.12***	0.12***	−0.00	−0.00	−0.00	−0.00
	(0.03)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−4.17	−4.30	−0.01**	−0.01**	−0.08***	−0.08***
	(10.67)	(10.68)	(0.00)	(0.00)	(0.01)	(0.01)
Investment Size	−0.57*	−0.57*	−0.00**	−0.00**	−0.00*	−0.00*
	(0.27)	(0.27)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	56.65	56.87	−0.02	−0.02	0.13***	0.13***
	(84.70)	(84.71)	(0.01)	(0.01)	(0.02)	(0.02)
Investment period dummy	18.08	20.19	−0.00	−0.00	−0.01	−0.01
	(58.73)	(58.85)	(0.01)	(0.01)	(0.02)	(0.02)
Market returns			0.00+	0.00+	0.00+	0.00+
			(0.00)	(0.00)	(0.00)	(0.00)
Constant	429.75	423.32	0.03	0.03	−0.26	−0.28
	(719.04)	(718.93)	(0.11)	(0.11)	(0.29)	(0.29)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.28	0.28	0.37	0.37	0.28	0.28

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.

Table 4. Results of fixed-effect estimation (weighting only for size)

Variables	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR
Performance feedback incompleteness (PFI)	−0.18**	−0.38***	−0.33**	−0.18**	−0.31***	−0.24**
	(0.07)	(0.10)	(0.10)	(0.07)	(0.08)	(0.09)
Historical performance feedback (HPF)	−0.07*	−0.35***				
	(0.03)	(0.10)				
PFI × HPF		0.35**				
		(0.12)				
HPF <= 0			−1.45*			
			(0.69)			
HPF > 0			−0.28**			
			(0.10)			
PFI × HPF <= 0			1.52+			
			(0.78)			
HPF × HPF > 0			0.28*			
			(0.12)			
Social performance feedback (SPF)				−0.05*	−0.38***	
				(0.03)	(0.10)	
PFI × SPF					0.41***	
					(0.12)	
SPF <= 0						−0.95*
						(0.37)
SPF > 0						−0.28*
						(0.12)
PFI × SPF <= 0						1.12*
						(0.44)
PFI × SPF > 0						0.27+
						(0.14)
PE fund size	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Investment size	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	0.13***	0.13***	0.13***	0.13***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Investment period dummy	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Market returns	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	−0.27	−0.16	−0.19	−0.29	−0.25	−0.30
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.28	0.29	0.29	0.28	0.29	0.29

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.

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Table 5. Results of fixed-effect estimation (without censoring)

Variables	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR
Performance feedback incompleteness (PFI)	−0.18**	−0.38***	−0.33***	−0.18*	−0.31***	−0.23**
	(0.07)	(0.10)	(0.10)	(0.07)	(0.08)	(0.08)
Historical performance feedback (HPF)	−0.05*	−0.32***				
	(0.03)	(0.09)				
PFI × HPF		0.32**				
		(0.11)				
HPF <= 0			−1.96*			
			(0.77)			
HPF > 0			−0.26**			
			(0.09)			
PFI × HPF <= 0			2.01*			
			(0.87)			
HPF × HPF > 0			0.27*			
			(0.11)			
Social performance feedback (SPF)				−0.05+	−0.37***	
				(0.03)	(0.10)	
PFI × SPF					0.40***	
					(0.12)	
SPF <= 0						−1.21**
						(0.40)
SPF > 0						−0.26*
						(0.11)
PFI × SPF <= 0						1.40**
						(0.47)
PFI × SPF > 0						0.26*
						(0.13)
PE fund size	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Investment size	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	0.13***	0.13***	0.13***	0.13***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Investment period dummy	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Market returns	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	−0.28	−0.17	−0.19	−0.29	−0.24	−0.30
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.28	0.29	0.29	0.28	0.29	0.29

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses

Table 6. Results of fixed-effect estimation (including abandoned investments)

Variables	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR
Performance feedback incompleteness (PFI)	−0.20**	−0.48***	−0.44***	−0.19**	−0.37***	−0.28***
	(0.06)	(0.09)	(0.10)	(0.06)	(0.07)	(0.08)
Historical performance feedback (HPF)	−0.08**	−0.48***				
	(0.03)	(0.10)				
PFI × HPF		0.51***				
		(0.12)				
HPF <= 0			−1.72**			
			(0.58)			
HPF > 0			−0.41***			
			(0.10)			
PFI × HPF <= 0			1.78**			
			(0.68)			
HPF × HPF > 0			0.44***			
			(0.12)			
Social performance feedback (SPF)				−0.06*	−0.52***	
				(0.03)	(0.10)	
PFI × SPF					0.57***	
					(0.12)	
SPF <= 0						−1.17***
						(0.34)
SPF > 0						−0.39***
						(0.12)
PFI × SPF <= 0						1.37***
						(0.40)
PFI × SPF > 0						0.40**
						(0.14)
PE fund size	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Investment size	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*	−0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	0.13***	0.13***	0.13***	0.13***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Investment period dummy	−0.01	−0.00	−0.00	−0.01	−0.00	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Market returns	0.00+	0.00+	0.00+	0.00+	0.00+	0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	−0.29	−0.16	−0.19	−0.31	−0.28	−0.34
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.29	0.29	0.29	0.28	0.29	0.29

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.

Table 7. Results of the fixed-effect estimation with panel data model

Variables	(1) IRR	(2) IRR	(3) IRR	(4) IRR	(5) IRR	(6) IRR
Performance feedback incompleteness (PFI)	−0.18*	−0.41**	−0.36**	−0.17*	−0.32**	−0.24*
	(0.09)	(0.13)	(0.14)	(0.09)	(0.10)	(0.11)
Historical performance feedback (HPF)	−0.07*	−0.41**				
	(0.03)	(0.15)				
PFI × HPF		0.41*				
		(0.17)				
HPF <= 0			−1.86***			
			(0.33)			
HPF > 0			−0.33*			
			(0.15)			
PFI × HPF <= 0			1.91***			
			(0.41)			
HPF × HPF > 0			0.34+			
			(0.17)			
Social performance feedback (SPF)				−0.06+	−0.45**	
				(0.03)	(0.16)	
PFI × SPF					0.48**	
					(0.18)	
SPF <= 0						−1.20***
						(0.36)
SPF > 0						−0.32+
						(0.18)
PFI × SPF <= 0						1.39***
						(0.41)
PFI × SPF > 0						0.31
						(0.20)
PE fund size	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Investment duration	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***	−0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Investment size	−0.00+	−0.00+	−0.00	−0.00+	−0.00+	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IPO dummy	0.13**	0.13**	0.13**	0.13**	0.13**	0.13**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Investment period dummy	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Market returns	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	2.81***	3.14***	1.70***	2.79***	1.77***	3.05***
	(0.33)	(0.36)	(0.44)	(0.34)	(0.45)	(0.36)
PE FEs	YES	YES	YES	YES	YES	YES
Entry FEs	YES	YES	YES	YES	YES	YES
Exit FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
Industry FEs	YES	YES	YES	YES	YES	YES
Observations	7,223	7,223	7,223	7,223	7,223	7,223
R-squared	0.20	0.20	0.20	0.20	0.20	0.20

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.

Robustness check: regression to the mean

An important concern is that our results might reflect short-term deviations and random processes, triggered by the law of small numbers mean reversion problems (Tversky and Kahneman 1971). Specifically, if a private equity (PE) firm had extremely good (bad) outcomes on past investments, it is then likely to have a worse (better) performance in the focal investment. Incidences of high future performance, in other words, may reflect extreme values of a random process. Regression to the mean might confound the observed impact of negative historical and social performance feedback because both are aggregate measures based on PE firms' past returns. However, mean reversion is unlikely to drive our results, because if mean reversion exists, the year dummies would control for its impact on subsequent performance decisions.

Nonetheless, we conduct additional analyses to investigate this possibility. First, we perform a counterfactual test based on a simulation where the IRRs are distributed randomly following a Gaussian normal distribution, with mean 0.34 and standard deviation 0.66 (i.e., with the same mean and SD of our data). Moreover, values above 2.06 are set at 2.06 and values below −1 are set at −1, because the IRR cannot be lower than −1 (i.e., −100%) and does not have values higher than 2.06 due to the censoring at the 95th percentile. By doing this, we generate a random dependent variable that follows a distribution similar to that of our real dependent variable. Given that there is no association between the random IRRs and the interaction terms between performance feedback incompleteness and historical/social performance, only a small fraction of parameters should come as statistically significant due to randomness. Regressions are then repeated 100 times. We find that the interaction term between performance feedback incompleteness and historical performance is insignificant 95% of the time. That is, only 5 times out of 100 are we able to observe a statistically significant result. Moreover, only two out these 5 times is the coefficient positive. Similarly, we find that the interaction between performance

feedback incompleteness and relative performance is insignificant 94% of the time. Hence, the fraction of statistically significant parameters is very low (5% in the first case and 6% in the second case), and this can happen even when the dependent variable is randomly generated. Therefore, we are reasonably confident that the observed significant effects are not due to simple regression to the mean.

Although the analysis above helps alleviate the concern that our results may simply reflect the regression to the mean, we took an additional step to investigate whether that was indeed the case. We re-estimate the baseline models, excluding from our sample observations with abnormally low or high values of performance feedback. We do so because the core idea of the regression to the mean problem is that abnormal performance is followed by average performance. Because regression to the mean will more likely affect those observations in our sample where historical and social performance are abnormally high or low, compared to the average PE firm performance, we exclude such observations from the analyses. Specifically, we re-estimate our models excluding those observations where historical and social performance is above or below the PE firm mean (measured over all periods) by four standard deviations. This greatly reduces the sample size. However, as can be seen in Table 8, the results are recovered even when we exclude observations most likely to reflect the regression to the mean. This again, mitigates our concern about regression to the mean.

Table 8. Regression to the mean: excluding outliers

Variables	(1) IRR	(2) IRR
Performance feedback incompleteness (PFI)	−0.31***	−0.25***
	(0.08)	(0.06)
Historical performance feedback (HPF)	−0.27**	
	(0.09)	
PFI × HPF	0.28*	
	(0.11)	
Social performance feedback (SPF)		−0.31**
		(0.10)
PFI × SPF		0.34**
		(0.11)
PE fund size	−0.00	−0.00+
	(0.00)	(0.00)
Investment duration	−0.05***	−0.04***
	(0.00)	(0.00)
Investment size	−0.00+	−0.00
	(0.00)	(0.00)
IPO dummy	0.09***	0.08***
	(0.02)	(0.02)
Investment period dummy	−0.00	−0.01
	(0.01)	(0.01)
Market returns	0.00+	0.00
	(0.00)	(0.00)
Constant	0.11	−0.39+
	(0.22)	(0.22)
PE FEs	YES	YES
Entry FEs	YES	YES
Exit FEs	YES	YES
Country FEs	YES	YES
Industry FEs	YES	YES
Observations	5,535	5,657
R-squared	0.36	0.30

*** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.1. Robust standard errors in parentheses.