Management and Organization Review (2024), **20**, 296–315
doi:10.1017/mor.2024.3

ARTICLE

Influence of Underperformance Duration on Firms' Responses to Performance Feedback: Evidence from the Chinese Manufacturing Industry

Xuefeng Liu[1], Lanlan Song[1], Guowei Lai[1], and Yuying Xie[2]

[1]School of Management, Xiamen University, Xiamen, China and [2]Department of Economics and Finance, Shepherd University, Shepherdstown, West Virginia, USA.
Corresponding author: Guowei Lai (gwlai@xmu.edu.cn)

(Received 28 October 2021; accepted 21 July 2023)

Abstract

The management literature has extensively explored how firms respond to underperformance through innovation, with prior studies based on the behavioral theory of the firm and the threat-rigidity thesis producing inconsistent results. The shifting focus of attention model provides crucial insights to reconcile this contradiction. We extend this model by highlighting the temporal dimension of performance shortfall. Specifically, we argue that underperformance duration flattens the inverted U-shaped relationship by attenuating both the problemistic search and threat rigidity mechanisms. The empirical results from a sample of Chinese listed manufacturing firms between 2010 and 2019 support our predicted inverted U-relationship between underperformance intensity and research and development (R&D) investment, and the moderating effect of underperformance duration. Interestingly, the inverted U-shape flips to a U-shape if underperformance extends into the long term. We contribute to the literature on performance feedback by considering both underperformance intensity and duration, which conceptualizes their interaction and reconciles extant contradictory findings from a new perspective. We also add new insights into innovation research by theorizing and examining the overlooked boundary condition for the curvilinear relationship between performance shortfalls and R&D investments, which calls for future research to explore the dynamics of the relationship and account for temporal effects.

摘要

管理文献广泛地探讨了企业如何通过创新应对绩效落差，但是现有研究基于企业行为理论或威胁刚性理论得出了不一致的结论。注意力转换模型为调和现有矛盾提供了重要见解。本文通过强调绩效落差的时间维度扩展了该模型。具体而言，我们认为绩效落差持续度通过削弱问题搜索和威胁刚性机制减弱了绩效落差与研发投入之间的倒u型关系。基于 2010–2019 年中国制造业上市公司的实证分析，研究结论验证了绩效落差强度与研发投入的倒u型关系，以及绩效落差持续度的调节作用。有趣的是，如果落差长时间持续存在，落差强度与研发投入之间的倒U型关系会翻转为U型。本文通过结合绩效落差的强度和持续度，概念化了二者的交互作用，并从新视角调和了现有矛盾。此外，本文检验了绩效落差与研发投入研究中被忽视的边界条件，结合时间效应考察了二者关系的动态变化，为创新研究提供了新见解。

Keywords: behavioral theory of the firm; R&D investment; threat-rigidity thesis; underperformance duration; underperformance intensity

关键词: 企业行为理论; 威胁刚性理论; 绩效落差强度; 绩效落差持续度; 研发投入

Introduction

The effect of business performance feedback on innovation has prompted numerous studies (e.g., Chen, 2008; Chen & Miller, 2007; Greve, 2003; He, Huang, & Yang, 2021; Jirásek, 2019; Yu, Minniti, & Nason, 2019). The behavioral theory of the firm offers a solid foundation for the literature on performance feedback, which proposes that when performance falls below aspirations, firms conduct problemistic search and prefer risk-taking (Cyert & March, 1963). Therefore, these firms may increase R&D investment (Chen, 2008; He et al., 2021). The threat-rigidity thesis posits that organizations react to underperformance by conserving resources (Staw, Scandelands, & Dutton, 1981). Firms may tighten available budgets and reduce expenses, such as by decreasing R&D investment. These contradictory arguments are reconciled by the shifting focus of attention model, which suggests that firms focus on the different reference points between aspirations and survival depending on how far firms are performing below their aspirations (March & Shapira, 1992). This model is one of the dominant frameworks for understanding firms' responses to performance shortfalls (e.g., March & Shapira, 1992; Miller & Chen, 2004; Iyer & Miller, 2008).

Most previous studies have focused only on the intensity of performance shortfalls (i.e., the distance between performance and aspirations) but have overlooked the impact of duration (i.e., the time length of performance shortfall) and the interaction between intensity and duration (e.g., Chen, 2008; Chen & Miller, 2007; Greve, 2003; He et al., 2021; Jirásek, 2019). Psychological studies have already revealed the impact of performance persistence on decision-making (Neef, Shades, & Miller, 1994; Yu et al., 2019). An extended period of underperformance may change an organization's perception of and response to the same intensity of performance shortfall (Lehman & Hahn, 2013). In addition, Haleblian and Rajagopalan (2005) proposed that the failure to consider duration and intensity together is a plausible reason for the mixed and inconsistent findings of previous studies on performance feedback. The consideration of only underperformance intensity cannot completely reflect the performance feedback and accurately describe firms' behavioral responses. Therefore, it is necessary to conceptualize performance feedback more completely by highlighting the time dimension of performance shortfall and considering underperformance intensity and duration together. We extend the research stream of performance feedback by integrating the shifting focus of attention model and temporal effect to explore how the intensity and duration of underperformance jointly affect firms' R&D investment.

Using a sample of Chinese A-share listed manufacturing firms from 2010 to 2019, we find an inverted U-shaped relationship between underperformance intensity and firms' R&D investment. When performance falls just below aspirations, firms focus on aspirations and conduct the problemistic search to improve performance (Cyert & March, 1963). Thus, firms may increase their R&D investment. As performance falls well below aspirations, firms shift their attention toward survival and enact risk-averse threat rigidity responses (Staw et al., 1981). Therefore, these firms may decrease R&D investment. Then, we explore the effect of the interaction between underperformance intensity and duration on the performance–innovation relationship. Our findings reveal that underperformance duration weakens the inverted U-shaped relationship when it lasts for a short period. Interestingly, the inverted U-shape flips to a U-shape when the performance shortfall persists for a long time.

By introducing the time dimension to explore the moderating effect of underperformance duration between underperformance intensity and R&D investment, we make several contributions. First, we contribute to the literature on performance feedback by considering both underperformance intensity and duration. This study conceptualizes the interaction of intensity and duration, which also reconciles the conflicting findings in extant studies from a new perspective. Second, we add new insights into innovation research by theorizing and empirically examining an overlooked boundary condition for the curvilinear relationship between performance feedback and innovation. We reveal that this curvilinear relationship depends on the duration of performance shortfall; that is, an inverted U-shaped relationship exists when the performance shortfall lasts for a short period, and a U-shaped relationship emerges when such underperformance persists for a long time. This finding calls for future research to explore the dynamics of the relationship and account for temporal effects.

Hypotheses Development

Underperformance Intensity and R&D Investment

Most of the current literature on performance feedback is rooted in the behavioral theory of the firm, which models organizations as goal-directed systems and explores the processes of organizational performance evaluation, search, and decision-making (Cyert & March, 1963). In general, organizations evaluate their current performance relative to aspirations, which are based on historical performance and comparable peer performance (Cyert & March, 1963). When performance falls below aspirations, firms initiate problemistic search to find a solution and engage in risk-taking (Cyert & March, 1963; Gavetti, Greve, Levinthal, & Ocasio, 2012). Innovation is an important strategy that enables firms to enhance their core competence and competitiveness to improve performance (He et al., 2021). The search for solutions through R&D is an important form of organizational search, which is the organizational process most directly related to innovation (Greve, 2003). Thus, underperforming firms may increase R&D investment with high risk and high returns to mend their performance shortfall (Chen, 2008; He et al., 2021).

The threat-rigidity thesis offers another perspective to understand organizations' responses to underperformance, especially when performance falls well below aspirations. This thesis suggests that organizations show rigidity or inability to act and do something new because of information restriction, control constriction, and resource conservation in the face of threats (Staw et al., 1981). When performance losses loom large enough to be perceived as existential threats, organizations may reduce their system-response capabilities or narrow their behavioral repertoires (Kotiloglu, Chen, & Lechler, 2021; Shimizu, 2007; Staw et al., 1981). Organizations may tighten their available budgets and reduce costs (Liu, Chen, & Kittilaksanawong, 2013; Staw et al., 1981). In addition, Sitkin and Pablo (1992) suggested that negative situations encourage risk aversion through threat-rigidity responses. Several studies have used firms' proximity to bankruptcy to examine the threat-rigidity effect and have shown that firms performing far below aspirations may develop conservative, risk-averse tendencies (Chen & Miller, 2007; Liu et al., 2013). Therefore, firms may decrease their R&D investment when they are greatly underperforming.

These contradictory arguments about the relationship between underperformance intensity and R&D may be partially reconciled by the shifting focus of attention model. This model suggests that decision-makers shift their attention between aspirations and survival according to the perceived threat from performance shortfalls, which influences risk-taking and risk aversion in response to underperformance (March & Shapira, 1992; Posen, Keil, Kim, & Meissner, 2018). An extended stream of literature predicts a complex relationship between performance feedback and risk preference based on the shifting focus of attention model (e.g., Hu, Blettner, & Bettis, 2011; March & Shapira, 1992; Miller & Chen, 2004). Firms focus more on the reference point closest to their current position (March & Shapira, 1992; Ref & Shapira, 2017). Underperforming firms focus on aspirations when their performance is in the neighborhood of aspirations; furthermore, they initiate problemistic search and prefer to take risks, such as increasing R&D investment, to improve their performance (Chen, 2008; Chen & Miller, 2007). When their performance falls well below aspirations, firms tend to focus more on survival, avoid risk and choose conservative strategies, in which the threat-rigidity thesis plays a leading role (Iyer & Miller, 2008; March & Shapira, 1992). Therefore, these firms would prefer to decrease R&D investment (Chen & Miller, 2007).

To summarize, we propose that if performance falls just below aspirations, firms may increase R&D investment. As performance falls far below aspirations, firms may decrease R&D investment. Thus, our first hypothesis is as follows:

Hypothesis 1 (H1): Firms' R&D investment first increases and then decreases with underperformance intensity, showing an inverted U-shaped relationship.

The Moderating Effect of Underperformance Duration

Previous studies have focused mainly on the intensity of underperformance (e.g., Chen, 2008; Chen & Miller, 2007; Greve, 2003; He et al., 2021; Iyer & Miller, 2008; Jirásek, 2019). More recently, the temporal effect of performance feedback has been identified as potentially important (Haleblian & Rajagopalan, 2005). A few studies have revealed that the duration of underperformance affects an organization's decision-making (Yu et al., 2019; Zhong, Ren, & Song, 2023). However, these studies have not fully explored the joint effect of underperformance duration and intensity. Haleblian and

Rajagopalan (2005) proposed that assessing the duration and intensity of performance together is necessary to predict strategic change. Even if firms have the same intensity of underperformance, their search activities and the degree of risk-taking may differ because they have different perceptions of performance shortfalls when they experience different durations of underperformance (Iyer, Baù, Chirico, Patel, & Brush, 2019). Considering underperformance intensity and duration together provides a more comprehensive representation of performance feedback, which may help develop a more precise understanding of the behavioral response of firms. Therefore, we incorporate the temporal effect into the shifting focus of attention model by examining how underperformance duration may moderate the relationship between underperformance intensity and R&D investment. We expect that underperformance duration flattens the inverted U-shaped relationship by attenuating the problemistic search and threat-rigidity mechanisms.

When performance falls just below aspirations, firms focus on aspirations and initiate problemistic search as mentioned in hypothesis 1 (Chen, 2008; Desai, 2008). These firms are optimistic about their future performance and believe that they can repair their performance shortfalls through proactive problemistic search, such as by increasing R&D investment. However, a sustaining poor performance trajectory over time reduces the optimism about future performance. When an organization experiences a performance shortfall for a long duration, its expectations for the future appear bleak (Lehman & Hahn, 2013). In such a case, members of such an organization believe that the firm's future performance is expected to decline even further; thus, managers are likely to think and act in a distressed and negative manner (Lehman & Hahn, 2013). Hence, they have less motivation to proactively repair performance shortfalls than do those with low underperformance intensity and short duration. Such firms have been increasing and repurposing R&D investment for a long time but have failed to improve performance to meet aspirations. They may attenuate previous problemistic search, expand the search boundary and try alternative strategies to address the persistent performance shortfalls. Therefore, a long underperformance duration weakens the problemistic search mechanism.

As performance falls well below aspirations, firms focus on survival and enact the threat rigidity responses as mentioned in hypothesis 1. These firms may tighten available budgets and reduce costs (Staw et al., 1981), such as by decreasing R&D investment. However, when these high-intensity underperforming firms have a long underperformance duration, it implies that the threat of survival is intensified. It is most likely caused by radical changes in the market (Staw et al., 1981) while the underperforming firms are not able to catch up. Alternatively, with the market environment having undergone a series of incremental changes, firms are not able to respond in time and are thus progressively left behind due to their weak environmental awareness. Firms that have experienced failure in the past have difficulty scanning the environment and capturing changes, whether radical or incremental (Lant, Milliken, & Batra, 1992). Thus, it is difficult for them to find solutions in the changed environment, resulting in a much more unknown and unclear coping mechanism to address performance problems. Staw et al. (1981) propose that organizational general threat-rigidity reactions are functional only when the environment is stable and the coping mechanisms are clear. So, the threat-rigidity effect may be dysfunctional when underperformance duration is long. Overall, underperformance duration weakens the threat rigidity mechanism.

All in all, we propose that underperformance duration moderates the effect of performance shortfall on R&D investment by weakening the problemistic search and threat-rigidity mechanisms. Thus, we make the following prediction:

Hypothesis 2 (H2): Underperformance duration weakens the inverted U-shaped relationship between underperformance intensity and R&D investment; that is, a longer underperformance duration results in a less sharp inverted U-shaped relationship between underperformance intensity and R&D investment.

Methods

Data and Sample

The manufacturing industry is a suitable context in which to test our predictions because it devotes a large portion of its budget to R&D expenses and is particularly suited to an investigation into how a

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

firm's innovative behavior may change in response to underperformance (Yu et al., 2019). To avoid the impact of the financial crisis from 2007 to 2009, we selected the data period from 2010 to 2019 for Chinese A-share listed manufacturing companies. We lagged all explanatory variables by one year. We obtained the initial sample of firms from the Wind Economic Database and the China Stock Market & Accounting Research (CSMAR) database, which are authoritative databases offering information on all listed companies in China.

We cleaned the initial sample in several ways. First, we excluded the specially treated companies labeled ST, SST, and *ST, which are at risk of delisting due to the financial or other abnormal conditions, to ensure that the firms in our sample are in normal operation. Second, since the calculation of underperformance duration requires continuity in a firm's data, we kept only the data for firms that have uninterrupted data over the covered period. That is, if a firm's data have a gap due to the missing values, then we retain the data only for the longer time span. For instance, for a firm that has data from two time periods, e.g., 2010–2012 and 2014–2019, but not for 2013, we kept the data for only the six years from 2014 to 2019 instead of for the three years from 2010 to 2012[1]. We dropped 163 firm-year observations as a result. Third, we excluded industries with fewer than five firms in a year to avoid possible biases in the estimates of social aspirations (SA) and industry R&D intensity (Chen & Miller, 2007; Ye, Yu, & Nason, 2021). We therefore further dropped an additional 133 firm-year observations. The final sample with complete information includes 1,296 firms and 7,002 unbalanced panel data.

Measures

Dependent variable

R&D investment at time t + 1 ($RD_{i,t+1}$). R&D investment is measured as R&D intensity, which is calculated as expenditures divided by sales (Chen & Miller, 2007; Greve, 2003).

Independent variables

Performance at time t ($P_{i,t}$). Following prior studies (e.g., Bromiley & Washburn, 2011; Chen & Miller, 2007; He et al., 2021), we use the generally representative return on assets (ROA) as the performance measure.

Aspirations at time t ($A_{i,t}$). According to the behavioral theory of the firm (Cyert & March, 1963; Greve, 2003), aspiration is formed by historical aspiration (HA) and social aspiration (SA), which assumes that organizations have a single aspiration for a performance dimension. This concept is very much in line with corporate practice: companies typically retain only a set of stated goals for a given set of activities at a given time (Bromiley & Harris, 2014). In addition, previous studies have shown that both HA and SA impact organizational R&D investment (Chen & Miller, 2007; Yu et al., 2019). Therefore, we use a composite aspiration by combining HA and SA. We estimate weights by searching all parameter values in increments of 0.1 from 0.1 to 0.9 and choosing the highest 'log-likelihood' model (Greve, 2003). This process produces a value of 0.2 for α. The specific formula is as follows:

$$A_{i,t} = \alpha HA_{i,t} + (1-\alpha)SA_{i,t}.$$

Historical aspirations at time t ($HA_{i,t}$). $HA_{i,t}$ is the HA level of firm i at time t, which is a mixture of actual performance and the HA level of firm i at time $t-1$ (Bromiley & Harris, 2014; Greve, 2003). Firm i's HA level at time 0 ($HA_{i,0}$) is represented by the actual performance at time 0. We also estimate the weight of β by choosing the highest 'log-likelihood' model, producing a value of 0.7:

$$HA_{i,t} = \beta HA_{i,t-1} + (1-\beta)P_{i,t-1}.$$

Social aspirations at time t ($SA_{i,t}$). The SA level of firm i at time t ($SA_{i,t}$) is the mean of performance at time t of other firms except the focal firm in the same industry. We calculate SA values according to 26 segments of the manufacturing industry from the Guidelines on Industry Classification of Listed Companies, revised by the China Securities Regulatory Commission in 2012:

$$SA_{i,t} = \left(\sum\nolimits_{j \neq i} P_{j,t}\right)/N - 1.$$

Underperformance intensity at time t ($Gap\_int_{i,t}$). Drawing on previous studies, we use $I_{i,t} \times (P_{i,t} - A_{i,t})$ to measure underperformance intensity; $I_{i,t}$ is a dummy variable that equals 1 when performance falls below aspiration and 0 otherwise.

Moderator

Underperformance duration at time t ($Gap\_dur_{i,t}$). According to Yu et al. (2019), underperformance duration is the number of periods in which underperformance persists. We code this variable as 0 if the performance is above or equal to aspirations and as the length of the underperforming period for firms. For example, we code this variable as 1 if a firm has been underperforming for 1 year, 2 if it has been underperforming for 2 consecutive years, and so on. At time 0, if the firm is underperforming, the underperformance duration is 1 and 0 otherwise.

Control variables

We control for industry- and firm- level variables.

Industry-level variables. *Industry R&D intensity at time t*: We control for the R&D investment of each sector of the manufacturing industry that affects firms' R&D decisions (Chen & Miller, 2007; Yu et al., 2019). We measure this variable by excluding the focal firm, summing R&D expenditures in the same sector, and dividing that number by total industry sales. *Industry sales growth at time t*: Because industry prospects influence firms' investments (Chen & Miller, 2007), we control for the growth in industry sales from $t-1$ to *t*. *Environmental dynamism at time t*: Firms will adopt different strategies when faced with environmental dynamism (Ghosh & Olsen, 2009). We control the abnormal fluctuations of firms' sales caused by environmental dynamism, that is, the coefficient of variation in abnormal sales for the past five years adjusted by industry (Ghosh & Olsen, 2009; Shen, Yu, & Wu, 2012). First, we use the past five years of sales for each firm to estimate abnormal sales separately using the ordinary least squares (OLS) method with the following model:

$$Sale = \varphi_0 + \varphi_1 Year + \varepsilon.$$

That is, sales in year $t/t-1/t-2/t-3/t-4$ are used as the dependent variable, and the corresponding values for the variable *Year* are 5, 4, 3, 2, 1 respectively. The residuals (ε) are abnormal sales. Second, we calculate the unadjusted environmental dynamism, i.e., the coefficient of variation in the firm's abnormal sales over the past five years. Then, we divide it by the industry environmental dynamism, which is the median unadjusted environmental dynamism of all firms in the same industry and year. A greater value indicates higher environmental dynamism.

Firm-level variables. *Size at time t*: Because a firm's size can influence its innovation (Audia & Greve, 2006), we use the natural logarithm of the final total assets to measure it (Kuusela, Keil, & Maula, 2017). *Age at time t*: Aging processes also affect firms' R&D investments and responses to underperformance (Desai, 2008). We control for a firm's age using the natural logarithm of years of establishment plus 1. *State-owned enterprise (SOE) at time t*: We assign a value of 1 to SOEs and 0 to otherwise (He et al., 2021), which affects firms' risk preference and risky strategies, such as R&D investment. *Board independence at time t*: The independence of boards affects organizational strategic decisions through supervision; thus, we control for board independence using the ratio of independent directors to the total number of directors (He et al., 2021). *Institutional shareholdings at time t*: Because institutional investors can participate effectively in the governance and supervision of firms, they play critical roles in strategic decisions. We use the total number of shares of institutional investors divided by the total share capital to measure it. *Slack at time t*: According to the behavioral theory of the firm, slack search also affects firms' strategic decisions (Greve, 2003). Following previous research (Bourgeois, 1981; Bourgeois & Singh, 1983; Chen, 2008), we use the average value of available slack (current assets/current liabilities), recoverable slack (sales and administrative expenses/sales), and potential slack (owners' equity/total liabilities) to measure slack. *Outperformance intensity at time t*: In line with the extant literature (Kuusela et al., 2017; Yu et al., 2019), we also control for outperformance when performance is higher than aspirations, which is measured by $(1 - I_{i,t}) \times (P_{i,t} - A_{i,t})$, where $I_{i,t}$ is a dummy measuring whether the firm is underperforming. *Outperformance duration at time t*: In contrast to underperformance duration, we code this variable as 0 if performance is below aspirations and as the length of the outperforming periods. For example, we code this variable as 1 if the firm has been outperforming for 1 year, 2 if it has been outperforming for 2 consecutive years, and so on.

Firm, year and industry fixed effects. We include dummy variables for all firms and years to control for heterogeneity. Because 65 firms have changed industries in our sample, we also control for industry fixed effects.

Analytical Approach

We use Stata15 to analyze the panel data and explore the relationship between performance shortfall and R&D investment. Our full model is as follows:

$$RD_{i,t+1} = \beta_1 Gap\_int_{i,t} + \beta_2 Gap\_int^2_{i,t} + \beta_3 Gap\_dur_{i,t} + \beta_4 Gap\_dur_{i,t} \times Gap\_int_{i,t} + \beta_5 Gap\_dur_{i,t} \times Gap\_int^2_{i,t} + \beta_k Controls_{i,t} + \mu_t + \omega_j + d_i + \varepsilon_{i,t} \quad (1)$$

where i represents the firm, and t indicates the year. μ_t represents time fixed effects, ω_j is industry fixed effects, d_i is firm fixed effects, and $\varepsilon_{i,t}$ is the random error term.

Results

Table 1 provides the descriptive statistics, and Table 2 presents the correlation matrix. We perform a cross-sectional dependence test, Breusch and Pagan Lagrange multiplier (LM) test for random effects, and Hausman specification test to determine the model. Based on the results of these tests, we finally use a panel data fixed effects model for the estimations.

Table 3 shows the results of the fixed effects panel regressions for H1 and H2. Model 1 is the basic model that contains only control variables. Model 2 adds underperformance intensity, the square of intensity and duration to Model 1 to test H1. The square term of underperformance intensity is negative and significant ($\beta = -0.075$, $p = 0.00$). We next explore the nature of this inverted U-shaped relationship (Haans, Pieters, & He, 2016). First, the confidence interval of the extreme point must fall inside the bounds of the independent variable. We find the extreme point to be −0.187 and the 95% confidence interval to be [−0.289; −0.084], which are within the range of the independent variable (−1.054, 0). Second, opposite signs should exist between the slopes at the lower and upper ends of this distribution. When underperformance intensity is at the lowest value of −1.054, the slope is significant at 0.131 ($p = 0.00$). When such intensity is at the highest value of 0, the slope is significant at −0.028 ($p = 0.02$). These results support H1, which predicts that R&D investment first increases and then decreases with underperformance intensity. Figure 1 shows this inverted U-shaped relationship.

Model 3 examines the moderating effect of underperformance duration between underperformance intensity and R&D investment. We add the interactions between underperformance duration and underperformance intensity and between underperformance duration and the square of

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

Table 1. Descriptive statistics

Variables	Mean	SD	Min	Max
Dependent variable				
R&D investment$_{t+1}$	0.044	0.041	0.000	0.832
Independent variable				
Underperformance intensity$_t$	−0.017	0.045	−1.054	0
Moderator				
Underperformance duration$_t$	1.387	1.846	0	9
Control variables				
Industry R&D intensity$_t$	0.034	0.022	0.001	0.207
Industry sales growth$_t$	0.128	0.109	−0.256	0.718
Environmental dynamism$_t$	1.291	1.164	0.020	17.338
Firm size$_t$	22.283	1.138	18.984	27.386
Firm age$_t$	2.848	0.295	1.792	3.951
SOE$_t$	0.364	0.481	0	1
Board independence$_t$	0.373	0.055	0.182	0.800
Institutional shareholdings$_t$	0.434	0.233	0.000	1.011
Slack$_t$	1.601	1.721	0.172	28.450
Outperformance intensity$_t$	0.016	0.029	0.000	0.329
Outperformance duration$_t$	1.154	1.702	0	9

Note: Number of observations = 7002.

underperformance intensity based on Model 2. We test for a flattening effect by determining whether the coefficient of the interaction between underperformance duration and the square of underperformance intensity is significant (Haans et al., 2016). Model 3 in Table 3 shows that the interaction between underperformance duration and the square of underperformance intensity is positive and significant ($\beta = 0.101$, $p = 0.00$), which is the opposite of the negative coefficient of the square of underperformance intensity ($\beta = -0.361$, $p = 0.00$). These findings illustrate that underperformance duration may flatten the inverted U-shaped relationship between underperformance intensity and R&D investment. Figure 2 depicts the R&D investment value when underperformance duration is plotted at short (1 year), moderate (2 years), long (4 years), and very long (6 years) durations. The magnitude of the curvilinearity between underperformance intensity and R&D investment is −0.260 (short duration = 1), −0.160 (moderate duration = 2), 0.042 (long duration = 4), and 0.243 (very long duration = 6). Interestingly, the inverted U-shaped relationship flips to a U-shape when underperformance duration is more than 4 years. Following Haans et al. (2016), we further calculate the value of underperformance duration at which the shape flip occurs. When duration $= -\beta_2/\beta_5 = 3.584$, where β_2 is the coefficient of the square of underperformance intensity and β_5 is the coefficient of the interaction between underperformance duration and the square of intensity shown in Model 3 in Table 3, the underperformance intensity–R&D investment relationship is linear, and no turning point exists. Notably, when the underperformance duration is more than 3.584 years, the inverted U-shaped relationship is reversed such that R&D investment first decreases and then increases with underperformance intensity. When performance is just below aspirations with a long underperformance duration, firms may reduce R&D expenses to temporarily prop up their performance. They lose the incentive to conduct problemistic search by increasing R&D. When performance is significantly below aspirations with a long underperformance duration, it means that the firm's early strategic decisions have been completely ineffective. Even if the firm reduces R&D investment, its performance improvement is negligible for rectifying the

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

Table 2. Correlation matrix

	1	2	3	4	5	6	7
1 R&D investment $_{t+1}$	1.000						
2 Underperformance intensity$_t$	−0.034***	1.000					
3 Underperformance duration$_t$	−0.046***	−0.289***	1.000				
4 Industry R&D intensity$_t$	0.314***	0.000	0.004	1.000			
5 Industry sales growth$_t$	0.028**	−0.001	0.011	−0.020*	1.000		
6 Environmental dynamism$_t$	0.003	−0.082***	−0.007	0.010	−0.005	1.000	
7 Firm size$_t$	−0.157***	0.070***	0.079***	−0.071***	−0.011	0.019*	1.000
8 Firm age$_t$	−0.096***	−0.036***	0.133***	−0.003	0.026**	−0.038***	0.164***
9 SOE$_t$	−0.128***	0.008	0.171***	−0.081***	−0.026**	−0.054***	0.270***
10 Board independence$_t$	0.068***	−0.044***	0.052***	0.054***	0.006	0.009	−0.004
11 Institutional shareholdings$_t$	−0.160***	0.081***	−0.021*	−0.106***	0.000	0.043***	0.406***
12 Slack$_t$	0.241***	0.062***	−0.153***	0.100***	0.029**	−0.009	−0.327***
13 Outperformance intensity$_t$	0.012	0.214***	−0.422***	−0.009	0.031***	−0.012	0.035***
14 Outperformance duration$_t$	0.034***	0.259***	−0.510***	0.043***	−0.002	−0.113***	0.113***
	8	**9**	**10**	**11**	**12**	**13**	**14**
8 Firm age$_t$	1.000						
9 SOE$_t$	0.167***	1.000					
10 Board independence$_t$	−0.016	−0.044***	1.000				
11 Institutional shareholdings$_t$	0.112***	0.407***	−0.059***	1.000			
12 Slack$_t$	−0.093***	−0.153***	−0.012	−0.146***	1.000		
13 Outperformance intensity$_t$	0.008	−0.077***	−0.016	0.113***	0.178***	1.000	
14 Outperformance duration$_t$	0.077***	−0.058***	−0.046***	0.096***	0.124***	0.540***	1.000

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

Table 3. Results of fixed-effect regression analysis

Variables	Model 1				Model 2				Model 3			
	Coeff	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*
Underperformance intensity$_t$					−0.028	0.014	−2.06	0.04	−0.084	0.024	−3.53	0.00
Underperformance intensity$_t^2$					**−0.075**	**0.023**	**−3.24**	**0.00**	**−0.361**	**0.049**	**−7.43**	**0.00**
Underperformance duration$_t$					−0.000	0.000	−0.33	0.74	−0.000	0.000	−0.15	0.88
Underperformance duration$_t$ * Underperformance intensity$_t$									0.021	0.007	2.85	0.00
Underperformance duration$_t$ * Underperformance intensity$_t^2$									**0.101**	**0.015**	**6.54**	**0.00**
Industry R&D intensity$_t$	0.026	0.020	1.29	0.20	0.026	0.020	1.29	0.20	0.026	0.020	1.28	0.20
Industry sales growth$_t$	−0.006	0.003	−1.69	0.09	−0.006	0.003	−1.69	0.09	−0.005	0.003	−1.55	0.12
Environmental dynamism$_t$	−0.001	0.000	−3.29	0.00	−0.001	0.000	−3.20	0.00	−0.001	0.000	−3.05	0.00
Firm size$_t$	0.005	0.001	4.74	0.00	0.005	0.001	4.38	0.00	0.004	0.001	3.96	0.00
Firm age$_t$	−0.009	0.008	−1.09	0.28	−0.008	0.008	−0.94	0.35	−0.009	0.008	−1.15	0.25
SOE$_t$	0.003	0.003	1.01	0.32	0.003	0.003	0.94	0.35	0.003	0.003	0.91	0.36
Board independence$_t$	−0.014	0.009	−1.55	0.12	−0.015	0.009	−1.62	0.10	−0.016	0.009	−1.82	0.07
Institutional shareholdings$_t$	0.007	0.004	1.75	0.08	0.007	0.004	1.87	0.06	0.008	0.004	2.01	0.05
Slack$_t$	0.002	0.000	5.10	0.00	0.002	0.000	5.07	0.00	0.002	0.000	5.31	0.00
Outperformance intensity$_t$	−0.000	0.015	−0.00	1.00	0.002	0.015	0.01	0.92	0.002	0.015	0.15	0.88
Outperformance duration$_t$	−0.000	0.000	−0.43	0.67	−0.000	0.000	−0.25	0.80	−0.000	0.000	−0.09	0.92
Year fixed-effects	Yes				Yes				Yes			
Industry fixed-effects	Yes				Yes				Yes			
Firm fixed-effects	Yes				Yes				Yes			

(*Continued*)

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

Table 3. (*Continued.*)

Variables	Model 1				Model 2				Model 3			
	Coeff	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*
Constant	−0.056	0.037	−1.53	0.13	−0.051	0.037	−1.39	0.16	−0.041	0.037	−1.12	0.26
N	7002				7002				7002			
within R^2	0.050				0.052				0.064			
Curvilinear test												
Extreme point and its 95% confidence interval	–				−0.187 [−0.289; −0.084]				–			
Slope at lower bound	–				Slope = 0.131 t = 3.42 p = 0.00				–			
Slope at upper bound	–				Slope = −0.028 t = −2.06 p = 0.02				–			

Notes: Industry fixed-effects are included because a small number of firms changed their industries during the sample period. Bold text indicates the empirical results of hypotheses.

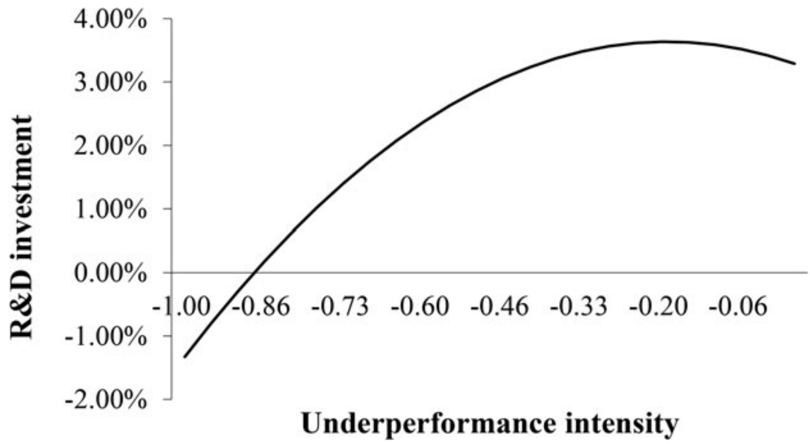

Figure 1. Estimated relationship between underperformance intensity and R&D investment

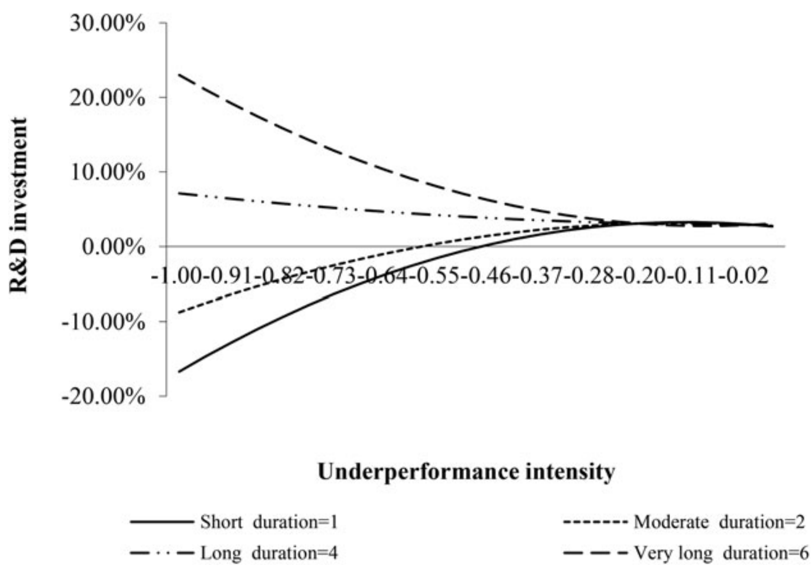

Figure 2. Moderating effect diagram of underperformance duration

large performance shortfall with long-term duration. Managers may be more prone to take risks as a 'last-ditch attempt' at survival and respond to a changed market by increasing investment in R&D and upgrading products and services. This finding complements our identification of the moderating effect of duration in theory development.

The results of several control variables also have some implications. The coefficients of outperformance intensity and outperformance duration are very small and not significant in all models, indicating that a performance that rises above aspirations does not affect a firm's R&D decision. This finding is consistent with the behavioral theory of the firm, which proposes that organizations may be satisfied with the present and thus do not change when performance is above aspirations (Cyert & March, 1963). The coefficients of slack are positive and significant in all models, showing that firms may increase R&D investment with slack. This result verifies the slack search proposed by the behavioral theory of the firm (Cyert & March, 1963). Organizational slack provides not only the resources needed for R&D but also an opportunity for trial and error (Greve, 2003).

Robustness Tests

We conduct several robustness tests. First, we separate SA and HA (Table 4). We respectively calculate the intensity and duration of underperformance based on SA and HA to test the hypotheses. Second, we redetermine the weights of the HA and composite aspirations (A) (Table 5). Considering that different weights affect the results of underperformance intensity and duration, we perform a test by analyzing different values, which range from 0.1 to 0.9 in increments of 0.1, for the weights of the HA and A to exclude the effect of the weights on the results. We find no significant differences in all tests with different weights. Third, we redefine HA and SA such that we measure HA using the ROA of the previous year (Chen, 2008; Ye et al., 2021) and SA using the average value of a company's segmented industry in manufacturing without excluding the focal firm (Audia & Greve, 2006) (Table 5). Fourth, we conduct a robustness check with only firms without gaps to eliminate sample selection bias (Table 6). Fifth, we winsorize the dependent variable and continuous control variables (except for outperformance intensity) at the 1st and 99th percentiles to minimize the effect of outliers (Yu et al., 2019) (Table 6). We avoid outliers for independent variables as much as possible during the sample processing by eliminating from the data each year specially treated firms and industries with fewer than five firms.

In the results of all robustness tests, we find that the coefficients of underperformance intensity squared are significantly negative, indicating an inverted U-shaped relationship between underperformance intensity and R&D investment. The interactions between underperformance duration and the square term of underperformance intensity relate significantly and positively to R&D investment, which means that underperformance duration flattens the inverted U-shape. Thus, all results are consistent with our findings and further support H1 and H2.

Discussion

This study explores how performance shortfalls shape Chinese listed manufacturing firms' decisions regarding R&D investment. According to the shifting focus of attention model that combines the behavioral theory of the firm and the threat-rigidity thesis, we examine the curvilinear relationship between underperformance intensity and R&D investment and explore the moderating effect of underperformance duration. These results carry significant implications for theory and practice.

Theoretical Implications

First, we extend the performance feedback literature by exploring the interaction between underperformance intensity and duration. A few but growing number of studies have examined how underperformance duration directly affects firms' strategic decisions (Yu et al., 2019; Zhong et al., 2023); however, they have ignored how underperformance duration affects firms' perceptions of underperformance intensity and their interactions. Firms' responses to performance feedback are simultaneously influenced by the intensity and length of time of their underperformance (Haleblian & Rajagopalan, 2005). Different from previous studies that have considered only the single influence of intensity or duration (e.g., Chen & Miller, 2007; Greve, 2003; Yu et al., 2019), we consider intensity and duration of underperformance together, which not only conceptualizes performance feedback more completely by exploring the interaction of intensity and duration but also reconciles the contradictory findings regarding performance feedback in the literature from a new perspective (Haleblian & Rajagopalan, 2005). We argue that firms adjust their responses to underperformance intensity based on the duration of performance shortfall. Our study improves the boundary conditions of the performance feedback model and provides a new perspective on the influence of underperformance duration, all of which enhance and improve performance feedback theory.

Second, we add new insights into innovation research by integrating the shifting focus of attention model and underperformance duration. Although recent studies have considered the curvilinear relationship between performance shortfall and innovation (Jirásek, 2019; Yu et al., 2019), they have not

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

Table 4. Results of robustness test 1 by separating historical and social aspirations

Variables	Robustness test 1: Historical aspirations								Robustness test 1: Social aspirations							
	Model 2				Model 3				Model 2				Model 3			
	Coeff	*se*	*t*	*P*	*Coeff*	*Se*	*T*	*p*	*Coeff*	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*
Underperformance intensity$_t$	−0.029	0.013	−2.16	0.03	−0.106	0.024	−4.34	0.00	−0.025	0.013	−1.86	0.06	−0.054	0.023	−2.34	0.02
Underperformance intensity$_t^2$	**−0.067**	**0.024**	**−2.81**	**0.01**	**−0.367**	**0.059**	**−6.25**	**0.00**	**−0.074**	**0.023**	**−3.24**	**0.00**	**−0.297**	**0.047**	**−6.30**	**0.00**
Underperformance duration$_t$	0.000	0.000	−0.03	0.98	0.000	0.000	0.16	0.87	0.000	0.000	0.78	0.44	0.000	0.000	0.81	0.42
Underperformance duration$_t$ * Underperformance intensity$_t$					0.028	0.009	2.94	0.00					0.012	0.007	1.63	0.01
Underperformance duration$_t$ * Underperformance intensity$_t^2$					**0.121**	**0.022**	**5.45**	**0.00**					**0.078**	**0.015**	**5.26**	**0.00**
Controls	Yes				Yes				Yes				Yes			
Year fixed-effects	Yes				Yes				Yes				Yes			
Industry fixed-effects	Yes				Yes				Yes				Yes			
Firm fixed-effects	Yes				Yes				Yes				Yes			
Constant	−0.049	0.037	−1.34	0.18	−0.037	0.037	−1.01	0.31	−0.053	0.037	−1.43	0.15	−0.044	0.037	−1.19	0.23
N	7002				7002				7002				7002			
Within R^2	0.055				0.061				0.053				0.062			
Curvilinear test																
Extreme point and its 95% confidence interval	−0.216 [−0.325; −0.107]				–				−0.169 [−0.278; −0.061]				–			
Slope at lower bound	Slope = 0.113 t = 2.82 p = 0.00				–				Slope = 0.131 t = 3.49 p = 0.00				–			
Slope at upper bound	Slope = −0.029 t = −2.16 p = 0.02				–				Slope = −0.025 t = −1.86 p = 0.03				–			

Note: Industry fixed-effects are included because a small number of firms changed their industries during the sample period. Bold text indicates the results of robustness tests for hypotheses.

Table 5. Results of robustness tests 2 and 3

Variables	Robustness test 2: Using different weights of HA and A								Robustness test 3: Redefining HA and SA							
	Model 2				Model 3				Model 2				Model 3			
	Coeff	*se*	*t*	*P*	*Coeff*	*se*	*T*	*p*	*Coeff*	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*
Underperformance intensity_t	−0.038	0.014	−2.77	0.01	−0.121	0.026	−4.69	0.00	−0.034	0.014	−2.45	0.01	−0.093	0.024	−3.86	0.00
Underperformance intensity_t^2	**−0.091**	**0.024**	**−3.82**	**0.00**	**−0.364**	**0.055**	**−6.62**	**0.00**	**−0.087**	**0.024**	**−3.69**	**0.00**	**−0.361**	**0.048**	**−7.55**	**0.00**
Underperformance duration_t	0.000	0.000	0.40	0.69	0.000	0.000	0.71	0.48	0.000	0.000	1.06	0.29	0.000	0.000	1.35	0.18
Underperformance duration_t * Underperformance intensity_t					0.033	0.009	3.80	0.00					0.023	0.008	3.02	0.00
Underperformance duration_t * Underperformance intensity_t^2					**0.109**	**0.020**	**5.50**	**0.00**					**0.100**	**0.016**	**6.43**	**0.00**
Controls	Yes				Yes				Yes				Yes			
Year fixed-effects	Yes				Yes				Yes				Yes			
Industry fixed-effects	Yes				Yes				Yes				Yes			
Firm fixed-effects	Yes				Yes				Yes				Yes			
Constant	−0.054	0.037	−1.47	0.14	−0.043	0.037	−1.17	0.24	−0.053	0.037	−1.42	0.16	−0.043	0.037	−1.17	0.24
N	7,002				7,002				7,002				7,002			
R^2	0.054				0.059				0.053				0.063			
Curvilinear test																
Extreme point and its 95% confidence interval	−0.213 [−0.296; −0.130]				–				−0.194 [−0.283; −0.106]							
Slope at lower bound	Slope = 0.152 t = 3.91 p = 0.00				–				Slope = 0.147 t = 3.85 p = 0.00							
Slope at upper bound	Slope = −0.039 t = −2.77 p = 0.00				–				Slope = −0.034 t = −2.45 p = 0.01							

Note: Bold text indicates the results of robustness tests for hypotheses. In Robustness Test 2, we perform a test by analyzing different weights of HA and A and report only the results at $\alpha = 0.5$ and $\beta = 0.4$.

Table 6. Results of robustness tests 4 and 5

Variables	Robustness test 4: Using firms without a gap								Robustness test 5: Winsorizing variables							
	Model 2				Model 3				Model 2				Model 3			
	Coeff	*se*	*t*	*P*	*Coeff*	*se*	*T*	*p*	*Coeff*	*se*	*t*	*p*	*Coeff*	*se*	*t*	*p*
Underperformance intensity$_t$	−0.029	0.014	−2.00	0.05	−0.084	0.025	−3.33	0.00	−0.019	0.009	−2.19	0.03	−0.049	0.015	−3.18	0.00
Underperformance intensity$_t^2$	**−0.079**	**0.024**	**−3.27**	**0.00**	**−0.367**	**0.050**	**−7.30**	**0.00**	**−0.038**	**0.015**	**−2.53**	**0.01**	**−0.145**	**0.031**	**−4.64**	**0.00**
Underperformance duration$_t$	−0.000	0.000	−0.37	0.71	−0.000	0.000	−0.20	0.84	−0.000	0.000	−0.76	0.45	−0.000	0.000	−0.54	0.59
Underperformance duration$_t$ * Underperformance intensity$_t$					0.021	0.008	2.67	0.01					0.011	0.005	2.35	0.02
Underperformance duration$_t$ * Underperformance intensity$_t^2$					**0.102**	**0.016**	**6.38**	**0.00**					**0.038**	**0.010**	**3.86**	**0.00**
Controls	Yes				Yes				Yes				Yes			
Year fixed-effects	Yes				Yes				Yes				Yes			
Industry fixed-effects	Yes				Yes				Yes				Yes			
Firm fixed-effects	Yes				Yes				Yes				Yes			
Constant	−0.025	0.032	−0.78	0.44	−0.008	0.032	−0.26	0.79	−0.054	0.024	−2.23	0.03	−0.051	0.024	−2.13	0.03
N	6,396				6,396				7,002				7,002			
R^2	0.050				0.063				0.114				0.117			
Curvilinear test																
Extreme point and its 95% confidence interval	−0.184 [−0.289; −0.078]				–				−0.254 [−0.378; −0.130]				–			
Slope at lower bound	Slope = 0.137 *t* = 3.48 *p* = 0.00				–				Slope = 0.060 *t* = 2.46 *p* = 0.01				–			
Slope at upper bound	Slope = −0.029 *t* = −2.00 *p* = 0.02				–				Slope = −0.019 *t* = −2.19 *p* = 0.01				–			

Note: Bold text indicates the results of robustness tests for hypotheses.

studied the change in the relationship taking into account the temporal effect. We theorize and empirically examine an overlooked boundary condition for the curvilinear relationship between performance feedback and innovation. We reveal that the curvilinear relationship depends on the duration of performance shortfall. When performance falls below aspirations for a short period, underperformance intensity and R&D investment show an inverted U-shaped relationship, which is consistent with the results of recent studies (e.g., Chen & Miller, 2007; Jirásek, 2019). Interestingly, the inverted U-shaped relationship between underperformance intensity and R&D investment flips to a U-shaped relationship when the duration of underperformance is too long. This finding calls for future research to explore the dynamics of the relationship between performance feedback and R&D investment taking into account the temporal effect.

Figure 3 graphically summarizes the main conclusions of our article. This figure shows that when underperformance is low in intensity and short in duration, firms act positively by conducting problemistic search and taking risks to repair performance shortfalls, such as increasing R&D investment (e.g., Chen, 2008; Cyert & March, 1963), which is in line with the behavioral theory of the firm. According to the threat-rigidity thesis, when underperformance is high in intensity and short in duration, firms may reduce costs to conserve resources and become risk averse in response to threats to survival (Liu et al., 2013; Staw et al., 1981), thereby decreasing R&D investment (Chen & Miller, 2007). When underperformance is low in intensity but long in duration, firms lose the incentive to conduct problemistic search and may decrease R&D investment to temporarily prop up their performance. When underperformance is high in intensity and long in duration, it is very difficult for these firms to reduce R&D expenses to solve the consistent failure and intensified threat. Instead, they may take the plunge by increasing R&D investment to upgrade their products and services in response to the changing environment. They hope to solve problems by adopting high-risk, high-return strategies as 'last-ditch attempts' at survival. Greve (2010) proposed that high risk-taking offers the opportunity to win back past losses, which is highly valued in loss situations.

Practical Implications

Our study also has some practical implications for the development of manufacturing firms in an innovation-driven economy. The transformation and upgrading of manufacturing firms must adhere to innovation-driven development to react to the complex and changing environment. Performance feedback is one of the most important factors that can be used by managers to evaluate the effectiveness of their current strategy and decide on the need for future strategic changes (He et al., 2021), such as increasing R&D investment in innovation. Therefore, firms must objectively assess their performance in terms of both underperformance intensity and duration. When a performance shortfall persists, firms should adjust their strategies according to their previous noneffective responses to performance shortfalls. When underperformance intensity is high with a long duration, taking the appropriate risk may solve the persistent and severe problem of performance shortfall. However, firms should be aware of the gambler's fallacy. The result of taking risks related to high underperformance intensity with long duration can be a sequence of 'double-or-nothing' risk escalations to win back losses (Greve, 2010). Firms should rationally evaluate opportunities and available resources to decide whether to take the risk of increasing R&D expenses to solve performance problems. In addition, boards of directors should strengthen their management of performance feedback and enhance the supervision of managers to prevent decision makers from making unreasonable decisions, such as blindly increasing R&D expenses in a manner related to the gambler's fallacy.

Limitations and Future Research Implications

Our work has limitations due to deficiencies in the research sample and dimensions of underperformance. First, we restrict our sample to A-share listed manufacturing firms and do not consider other industries and nonlisted companies that may have different preferences for using R&D investments to

https://doi.org/10.1017/mor.2024.3 Published online by Cambridge University Press

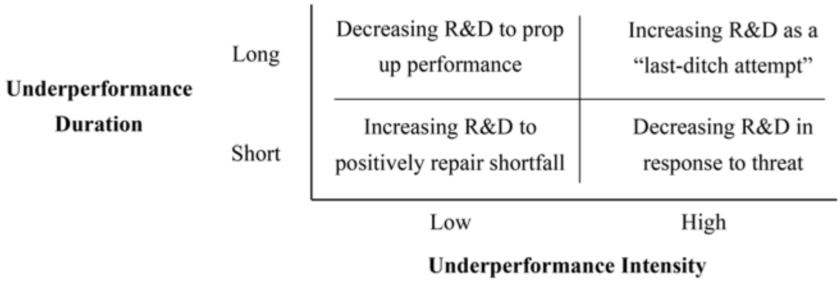

Figure 3. Diagram of conclusion

solve performance shortfalls. Future studies could expand the study sample and explore the impact of performance feedback in different industries to improve the generalizability of the conclusions and to enrich the findings related to performance feedback. Second, the dimension of underperformance is still limited in our study. We do not study how the scope of underperformance based on multiple indicators and the consistency between them affect firms' strategies. In addition, the existing research has focused mostly on measuring firms' performance using financial indicators while ignoring nonfinancial indicators, such as consumer satisfaction and brand; however, these indicators are becoming increasingly important factors for performance and may thus have a direct impact on R&D investments. Future research may assess firms' performance by using nonfinancial indicators and exploring the influence of the scope and consistency of underperformance on firms' decision making.

Conclusion

Our study reveals that the interaction between the intensity and duration of underperformance shapes organizational search patterns. Specifically, underperformance duration weakens the relationship between underperformance intensity and R&D investment. Notably, we identify a shape flip when the underperformance duration is very long. We hope that our study inspires additional behavioral research that goes beyond the intensity of performance shortfalls, expands the study of other dimensions, and explores the interactions among these dimensions.

Data Availability Statement. The data supporting the findings of this study are openly available in the Open Science Framework (OSF) at osf.io/bvf56/?view_only=a6d2d953e2694ef388f17bb50935d571

Acknowledgments. We are grateful for the insightful comments from Senior Editor Zilin He, and three anonymous reviewers. We also greatly appreciate Dr. Kathleen Reid (Shepherd University) and Professor Xinming He (Durham University) for their comments and suggestions on this article. This work was supported by the Major Projects of National Social Science Fund of China (Grant No. 22ZDA047) 'Research on the strategic support of Scientific and technological self-reliance as national development'.

Note

[1] We conduct a robustness test excluding firms with gaps and the results do not affect our conclusions.

References

Audia, P. G., & Greve, H. R. 2006. Less likely to fail: Low performance, firm size, and factory expansion in the shipbuilding industry. *Management Science*, **52**(1): 83–94.

Bourgeois, L. J. 1981. On the measurement of organizational slack. *Academy of Management Review*, **6**(1): 29–39.

Bourgeois, L. J., & Singh, J. V. 1983. Organizational slack and political behavior among top management teams. *Academy of Management Proceedings*, **1**: 43–47.

Bromiley, P., & Harris, J. D. 2014. A comparison of alternative measures of organizational aspirations. *Strategic Management Journal*, **35**(3): 338–357.

Bromiley, P., & Washburn, M. 2011. Cost reduction vs. innovative search in R&D. *Journal of Strategy and Management*, **4**(3): 196–214.

Chen, W. R. 2008. Determinants of firms' backward- and forward-looking R&D search behavior. *Organization Science*, **19**(4): 609–622.

Chen, W. R., & Miller, K. D. 2007. Situational and institutional determinants of firms' R&D search intensity. *Strategic Management Journal*, **28**(4): 369–381.

Cyert, R. M., & March, J. G. 1963. *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

Desai, V. M. 2008. Constrained growth: How experience, legitimacy, and age influence risk taking in organizations. *Organization Science*, **19**(4): 594–608.

Gavetti, G., Greve, H. R., Levinthal, D. A., & Ocasio, W. 2012. The behavioral theory of the firm: Assessment and prospects. *Academy of Management Annals*, **6**(1): 1–40.

Ghosh, D., & Olsen, L. 2009. Environmental uncertainty and managers' use of discretionary accruals. *Accounting, Organizations and Society*, **34**(2): 188–205.

Greve, H. R. 2003. A behavioral theory of R&D expenditures and innovations: Evidence from shipbuilding. *Academy of Management Journal*, **46**(6): 685–702.

Greve, H. R. 2010. Designing performance feedback systems to guide learning and manage risk. *Organizational Dynamics*, **39**(2): 104–114.

Haans, R. F. J., Pieters, C., & He, Z. 2016. Thinking about U: Theorizing and testing U- and inverted U-shaped relationships in strategy research. *Strategic Management Journal*, **37**(7): 1177–1195.

Haleblian, J., & Rajagopalan, N. 2005. Top managerial cognitions, past performance, and strategic change: A theoretical framework. *Advances in Strategic Management*, **22**: 63–91.

He, L., Huang, L., & Yang, G. 2021. Invest in innovation or not? How managerial cognition and attention allocation shape corporate responses to performance shortfalls. *Management and Organization Review*, **17**(4): 815–850.

Hu, S., Blettner, D., & Bettis, R. 2011. Adaptive aspirations: Performance consequences of risk preferences at extremes and alternative reference groups. *Strategic Management Journal*, **32**(13): 1426–1436.

Iyer, D. N., & Miller, K. D. 2008. Performance feedback, slack, and the timing of acquisitions. *Academy of Management Journal*, **51**(4): 808–822.

Iyer, D. N., Baù, M., Chirico, F., Patel, P. C., & Brush, T. H. 2019. The triggers of local and distant search: Relative magnitude and persistence in explaining acquisition relatedness. *Long Range Planning*, **52**(5): 101825.

Jirásek, M. 2019. Curvilinearity in the performance feedback and R&D relationship. *Journal of Strategy and Management*, **13**(1): 1–14.

Kotiloglu, S., Chen, Y., & Lechler, T. 2021. Organizational responses to performance feedback: A meta-analytic review. *Strategic Organization*, **19**(2): 285–311.

Kuusela, P., Keil, T., & Maula, M. 2017. Driven by aspirations, but in what direction? Performance shortfalls, slack resources, and resource-consuming vs. resource-freeing organizational change. *Strategic Management Journal*, **38**(5): 1101–1120.

Lant, T. K., Milliken, F. J., & Batra, B. 1992. The role of managerial learning and interpretation in strategic persistence and reorientation: An empirical exploration. *Strategic Management Journal*, **13**(8): 585–608.

Lehman, D. W., & Hahn, J. 2013. Momentum and organizational risk taking: evidence from the national football league. *Management Science*, **59**(4): 852–868.

Liu, J., Chen, L., & Kittilaksanawong, W. 2013. External knowledge search strategies in China's technology ventures: The role of managerial interpretations and ties. *Management and Organization Review*, **9**(3): 437–463.

March, J. G., & Shapira, Z. 1992. Variable risk preferences and the focus of attention. *Psychological Review*, **99**(1): 172–183.

Miller, K. D., & Chen, W. R. 2004. Variable organizational risk preferences: Tests of the March-Shapira model. *Academy of Management Journal*, **47**(1): 105–115.

Neef, N. A., Shades, D., & Miller, M. S. 1994. Assessing influential dimensions of reinforcers on choice in students with serious emotional disturbances. *Journal of Applied Behavioral Analysis*, **27**(4): 575–583.

Posen, H. E., Keil, T., Kim, S., & Meissner, F. D. 2018. Renewing research on problemistic search—A review and research agenda. *Academy of Management Annals*, **12**(1): 208–251.

Ref, O., & Shapira, Z. 2017. Entering new markets: The effect of performance feedback near aspiration and well below and above it. *Strategic Management Journal*, **38**(7): 1416–1434.

Shen, H. H., Yu, P., & Wu, L. S. 2012. State ownership, environment uncertainty, and investment efficiency. *Economic Research Journal*, **47**(7): 113–126. (Chinese).

Shimizu, K. 2007. Prospect theory, behavioral theory, and the threat-rigidity thesis: Combinative effects on organizational decisions to divest formerly acquired units. *Academy of Management Journal*, **50**(6): 1495–1514.

Sitkin, S. B., & Pablo, A. L. 1992. Reconceptualizing the determinants of risk behavior. *Academy of Management Review*, **17**(1): 9–38.

Staw, B. M., Scandelands, L. E., & Dutton, J. E. 1981. Threat rigidity effects on organizational behavior: A multilevel analysis. *Administrative Science Quarterly*, **26**(4): 501–524.

Ye, Y., Yu, W., & Nason, R. 2021. Performance feedback persistence: Comparative effects of historical versus peer performance feedback on innovative search. *Journal of Management*, **47**(4): 1053–1081.

Yu, W., Minniti, M., & Nason, R. 2019. Underperformance duration and innovative search: Evidence from the high-tech manufacturing industry. *Strategic Management Journal*, **40**(5): 836–861.

Zhong, X., Ren, L., & Song, T. 2023. To cheat when continuously missing aspirations: Does CEO experience matter? *Asia Pacific Journal of Management*, **40**(2): 815–845.

Xuefeng Liu (liuxuefeng@xmu.edu.cn) is Full Professor in the School of Management, Xiamen University, China, and a member of the Academy of Management. He received his PhD degree in Management from Zhejiang University, China. His recent research interests focus on global manufacturing, strategic management, and innovation management. He has published several research papers about innovation in emerging economies in international journals in English and has participated in several research programs supported by National Natural Science Foundation of China.

Lanlan Song (lanlan_song@outlook.com) is a PhD candidate of business administration at School of Management of Xiamen University in China. Her research interests include business strategy and innovation management.

Guowei Lai (gwlai@xmu.edu.cn) is an Assistant Professor in the School of Management of Xiamen University, China, and his main research field is business model innovation and technological innovation.

Yuying Xie (xyuying@gmail.com) is a Full Professor in the Department of Economics and Finance at Shepherd University, West Virginia. He received his Bachelor's degree in economics from Southwestern University of Finance and Economics, China, and PhD degree in Economics from Southern Illinois University Carbondale. His main research interests are technology spillover, product differentiation, and industrial organization. He has published multiple journal articles with regards to product quality, technology spillover, and technological development in various international journals.

Cite this article: Liu X, Song L, Lai G, Xie Y (2024). Influence of Underperformance Duration on Firms' Responses to Performance Feedback: Evidence from the Chinese Manufacturing Industry. *Management and Organization Review* **20**, 296–315. https://doi.org/10.1017/mor.2024.3