



Do high-performance human resource practices help corporate entrepreneurship? The mediating role of organizational citizenship behavior

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ABSTRACT

This study develops a mediation model in which high-performance human resource practices affect corporate entrepreneurship (CE) through organizational citizenship behavior (OCB). In a sample of 139 small-to-medium-sized biotechnology enterprises in the pharmaceutical industry, we find that high-performance human resource practices are positively related to CE, and that this relationship is mediated by the OCB of employees. We discuss theoretical and managerial implications for human resource management research and practice.

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1. Introduction

Presently, intense global competition highlights the importance of innovation, flexibility, responsiveness, and cooperation for long-term organizational success, especially for technology firms. The vitality provided by innovative and discretionary behaviors protects organizations in an ever-changing environment. In order to continue and develop, the technology industry depends on employees with expert knowledge and technological skills or capabilities. In the future, technology firms will become more dependent on employees who are willing to contribute to effective organizational functioning, regardless of their formal role requirements. Thus, employee extra-role behaviors, such as OCB, have become increasingly important and even crucial for the survival of these organizations. An important question for a technology enterprise is how best to implement human resource practices in order to promote corporate entrepreneurship (CE), to upgrade competitive capability, and thus to sustain long-term development.

Compared with other industries, the biotechnology industry must place even greater emphasis on human resource practices. The biotechnology industry has many unique characteristics such as high technology, high investment, long time horizon, highly risky ventures and high potential benefit. Specifically, because the biotechnology industry involves a large amount of knowledge, high technology, and multi-disciplinary involvement, both product development and equipment deployment require a high investment. Furthermore, the process of the development of biological pharmaceutical products involves a great deal of uncertainty. Moreover, biotechnology enterprise's competitiveness hinges directly on the quantity and quality of output of its knowledge/technology employees. Therefore, focusing on the characteristics of knowledge/technology employees, implementing managerial strategy effectively, and making full use of knowledge/technology employees' creativity and potential capability have become the most important problems facing biotechnology enterprises.

Over the past decade, human resource management theory has come under pressure to demonstrate its contribution to organizational performance (Hayton, 2004; Laursen, 2002; Soutaris, 2002; Stewart, 1996; Twomey & Harris, 2000). Morrison and Phelps (1999) have stated that the success of organizations today, especially technology firms, depends on the continuous improvement of the employees' performance. High-performance human resource practices consist of a set of coherent practices that enhance OCB, employee skills, participation in decision making and motivation to put forth discretionary effort (Appelbaum,

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Bailey, Berg, & Kallegert, 2000). Furthermore, Way (2002) has suggested that high-performance human resource practices have a close association with sustainable competitive advantage.

Due to the high rate of change in areas such as technology, globalization, and industry boundaries, a firm must have the competitive capacity to innovate faster than its counterparts in order to be successful. Specifically, this kind of competitive capacity consists of identifying new ways of doing business, developing new technologies and products, and entering new markets in new organizational forms. Covin and Slevin (1991) refer to all of the above behaviors as CE.

Over the past three decades, a growing body of literature has emerged that focuses on the association between human resource management practices and CE. However, only a few studies have examined the influence of human resource practices on a firm's overall CE. Delery and Doty (1996) pointed out that different aspects in human resource practice may reinforce one another so that their sum is a synergistic influence on desired outcomes for the organization.

This research attempts to fill this void in the current theory. Moreover, high-performance human resource practices will encourage employee commitment, cooperation, knowledge sharing and voluntary, and extra-role behaviors. For example, Hayton (2004) provides evidence that human resource practices promote CE, and that this relationship is strongest for firms operating in high technology industries. However, the mechanism underlying this relationship remains unknown.

Therefore, our research question is: Do high-performance human resource practices really matter in the biotechnology industry? If so, how does it occur? We suggest that high-performance human resource practices positively affect CE through increasing OCB. We test the mediation hypothesis in a sample of Chinese small-to-medium-sized biotechnology enterprises in the pharmaceutical industry and discuss implications for human resource theory and practices.

2. Model and hypothesis development

2.1. Definition of high-performance human resource practices

From the perspective of a resource-based approach, Delery and Doty (1996) have described the extent to which human resource practices facilitate the internal development of employees in areas such as training and broad career path. On the other hand, from the perspective of a control-based approach, Snell (1992) has described the extent to which a measure of high-performance human resource practice relates to directing and monitoring employee performance. Both approaches are obviously too narrow and cannot satisfy the needs of modern firms in today's hyper-competitive environment. Therefore, Bamberger and Meshoulam (2000) have combined these two into an integrated framework and put forward the concept of high-performance human resource practices.

High-performance human resource practices consist of three main parts: (1) people flow, including selective staffing, training (such as more extensive, general skills training), employee mobility (for example, broad career paths, promotion within the firm) and guarantee of job security; (2) appraisal and rewards, including performance appraisal (specifically long-term, results-orientated appraisal), compensation and other benefits, such as extensive, open-ended rewards; (3) employment relations, including job design (such as broad job descriptions, flexible job assignments) and encouragement of participation. Specific contents are shown in Fig. 1 as below.

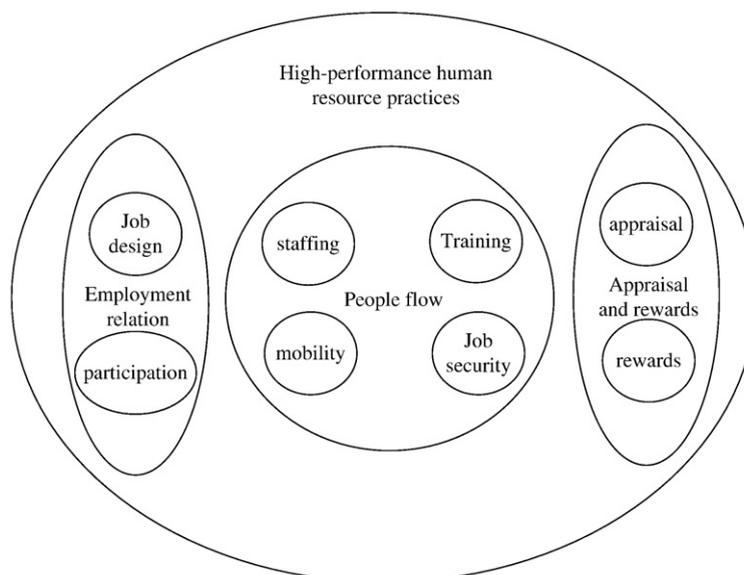


Fig. 1. Configuration of high-performance human resource practices (adapted from Bamberger and Meshoulam, 2000).

2.2. Definition of corporate entrepreneurship

CE depends on an organization's capability of learning through both exploration of new knowledge and exploitation of extant knowledge (Floyd and Wooldridge, 1999; McGrath, 2001; Zahra, Nielsen, & Bogner, 1999). Therefore, CE can have a significant impact on an organization's financial and market performance (Zahra, 1996).

Covin and Miles (1999) have stated that CE is a strategic orientation involving the regeneration of products, processes, services, strategies or even the entire organization. Furthermore, Guth and Ginsberg (1990) have stated that CE is the process through which firms innovate, form new businesses and transform themselves by changing the business domain or process.

According to these definitions, CE is not a one-dimensional construct; rather, it encompasses three major components: innovation, venturing and strategic renewal activities (Guth & Ginsberg, 1990; Zahra, 1996; Zahra & Covin 1995). Specifically, innovation refers to firm behaviors such as the creation and introduction of new products, production processes and organizational systems. Venturing refers to firm behaviors such as entering new businesses through the creation or purchase of new business organizations (Block & MacMillan, 1993; Cheesbrough, 2002). Strategic renewal refers to firm behaviors such as transforming the firm or revitalizing its operations by changing the scope of its business or its competitive approach (Zahra, 1996).

2.3. Features of human resource practices in biotechnology enterprises

Specifically, there are three features of human resource practice always present in biotechnology enterprises. First, most biotechnology employees are knowledge/technology employees, meaning that they have different needs than general employees. This difference makes it necessary for managers to utilize unique incentive measures tailored to this type of employee rather than to traditional ones, including a high degree of autonomy. Second, the work procedure is difficult to monitor, and the work outcomes are difficult to evaluate. Often, this class of workers is more concerned about accomplishing individual goals or being recognized by society rather than receiving some tangible payment or reward. The need on the part of these workers for psychological satisfaction from work itself, and their need for a degree of enjoyability and the possibility for career advancement call for more training opportunities and a long-term career development program. Third, the abnormally high rate of turnover of employees in technology firms has generated increasing attention in society (Pare & Treblay, 2000).

Based on these unique characteristics of the biotechnology industry, and in order to retain valuable human capital, it is necessary for enterprises to implement some kind of discretionary human resource practice, such as high-performance human resource practice, to attract more key knowledge/technology employees to devote themselves to the organization. Specifically, performance-related pay generated by knowledge/technology employees' valuable expertise and skills is more motivating than normal payment. Moreover, traditional human resource practices focus on control and monitoring, but in keeping with Rogers (2001), behavioral controls in the high-tech framework may be useless, or even detrimental to work performance.

Furthermore, for most SMEs in the biotechnology industry, which have little access to external sources of knowledge through alliances, the only way that they can ensure long-term survival development is to rely exclusively on their internal skills and knowledge in remaining innovative. Therefore, a high quality of human resources is vital for these kinds of enterprises. Thus, human resource management is the most important task for SMEs. Human resource challenges include not only how retaining the proper employees but also motivating them to perform extra-role behavior that benefits the organization's innovation and long-term development rather than simply accomplishing their individual task work.

Specifically, key employees to retain are those who possess individual expertise about a particular technology, or those individuals who are part of a highly functioning group that plays a pivotal part in generating the firm's value-creating capabilities. These key employees are critical to the maintenance of absolutely necessary resources in the daily operation of technology firms (Ranft & Lord, 2000). Nelson and Winter (1982) have suggested that, if these employees leave a technology firm, the loss of their tacit and socially complex knowledge will cause organizational capabilities to mutate or wither. More seriously, Fryxell and Judge (1997) have stated that turnover of key employees may cause more systemic disturbances in the social structure of the technology firm, which may negatively alter the firm's capabilities. Thus, valuable human capital is like the main artery of technology enterprises, and human resource practices play a fundamental role in keeping that artery functioning.

2.4. High-performance human resource practices and OCB in the biotechnology industry

Katz (1964) initially pointed out the importance of a class of discretionary and spontaneous behaviors that are beyond explicit role requirements, but that are essential for organizational effectiveness. Later, Organ (1988, p.4) defined OCB as "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization."

High-performance human resource practices for managing the employment relationship are an important element of an organization's inducements. Satisfying employees' needs fosters the employee's perception of a high level of organizational support. From the perspective of social exchange theory, which was initially put forward by Blau (1964), employees who perceive a supportive environment from the organization will be obliged to reciprocate with behaviors that will benefit the organization.

A great deal of evidence has suggested that high-performance human resource practices foster a high quality employee-organization relationship that motivates employees to devote themselves to contributing innovative ideas to the organization (Paul & Anantharaman, 2003; Rogg, Schmidt, Shull, & Schmidt, 2001; Wright, Gardner, & Moynihan, 2003). Shore and Shore (1995) also argue that human resource practices which signal recognition of employee contributions should have a positive relationship

with perceived organizational support. Furthermore, Shore Tetrick, Lynch, and Barksdale (2006) found that perceived organizational support and affective commitment were positively related to a newly developed measure of social perceptions. Rhoades and Eisenberger (2002) used a meta-analysis to posit that there was a positive relationship between several human resource practices and the employee–organizational relationship, such as training and promotion. According to this, an organization's high-performance human resource practices facilitate the process of developing a kind of high-quality exchange relationship between employees and organizations that leads employees to assume the role of good organizational agents (Leana and Van Buren, 1999). Furthermore, Leana and Van Buren (1999) have argued that, if employees believe that their efforts are an integral part of an organization, they are more likely to perceive organizational support. Accordingly, they will engage in extra-role behavior, will work cooperatively, and will spend less time on engaging in tasks that benefit themselves rather than the whole organization.

Especially in the biotechnology industry, high-performance human resource practices suggest that organizations are trying to establish a long-term exchange relationship with employees. Thus, high-performance human resource practices can be viewed as a mutual investment approach to the employee–organization relationship, which was initially put forward by Tsui, Pearce, Porter, and Tripoli (1997). Obviously, high-performance human resource practices will contribute to an employee's OCB, especially in the biotechnology industry. Therefore, we put forward the following hypothesis:

Hypothesis 1. High-performance human resource practices are positively related to OCB.

2.5. The mediating role of OCB in the biotechnology industry

Over the past three decades, a growing body of literature has emerged that focuses on the association between human resource practices and CE. Typical studies and their main points are listed in Table 1. So far, no matter which type of CE or human resource practices these studies consider, they have always found a relationship between them.

The widely documented relationship between high-performance human resource practices and CE has been explained in a variety of ways. One explanation is that enhancement of employee skills and of the motivation to use those skills leads to creativity improvement (Sun, Aryee, & Law, 2007). Employees will not only use their skills to enhance core job performance but

Table 1
Summary of previous studies on HR practices and corporate entrepreneurship

Author	Approach	HRM type	CE type	Main view
Soutaris (2002)	Empirical study	Compensation	Innovation	Both human capital investments and the incentives offered for contribution to innovation were of major importance with respect to firm innovativeness.
Laursen (2002)	Empirical study	Teamwork, delegation, performance related pay	Innovation	Team based practices are positively associated with innovation in medium knowledge intensity industries; while performance related pay is significant in high knowledge intensity industries.
Laursen and Foss (2003)	Empirical study	Teamwork, delegation, performance related pay	Innovation	Functional integration and internal training predict innovation. However, there is little advantage to using a combination of three HRM practices over just one such practice.
Hill and Hlavacek (1972)	Empirical study	Use of autonomous, multidisciplinary, team with little or no time pressure, no job descriptions, and the high committed and involved team members given a share in risks and profits	Venturing	Several structural characteristics are associated with HRM practices and such features of successful venture teams emphasize the role HRM plays in creating a climate for learning involving informal, discretionary and largely anonymous activities.
Von Hippel (1977)	Empirical study	Risk-reward	Venturing	Neither the level of investments in new ventures, nor venture success is related to whether the venture sponsor role is formal or informal.
Souder (1981)	Empirical study	6 success factors such as ability to identify organizational entrepreneurs and so on	Venturing	Organizations can stimulate commitment through the provision of support, and social capital can be successfully used to build a network of support around new innovation.
Twomey and Harris (2000)	Empirical study	Selection, training, performance management, rewards and career development practices	CE	A bundle of HR practices encourage intrapreneurial behaviors and CE.
Kuratko, Montagno, and Hornsby (1990)	Empirical study (US sample)	Five success factors linking HR practices to CE, such as the appropriate use of rewards and so on	CE	Provision of management support for innovation such as these five dimensions of organizational environments promotes CE.
Hornsby, Kuratko, and Montagno (1999)	Empirical study	Five success factors linking HR practices to CE, such as the appropriate use of rewards and so on	CE	Five success factors only predict entrepreneurial behaviors for US managers but not for Canadian managers, which suggest that an organization's internal environment is important.
Hayton (2004)	Empirical study (SEM in US.)	Incentive pay, employee suggestion schemes and formal employee participation programs	CE	Discretionary practices promote CE and this relationship is strongest for firms operating in high technology industries.

will also suggest innovative ideas that will improve CE. In the context of this study, high-performance human resource practices consist of finding ways of investing in employees' knowledge and skills. However, some kinds of tacit knowledge remain intangible, idiosyncratic and difficult to imitate or duplicate, even though they play a vital role in CE. From the perspective of social exchange theory, the employment relationship will obligate employees to reciprocate the organization's inducements with discretionary role behaviors such as OCB to contribute more to the organization (Podsakoff and MacKenzie, 1997). Specifically, on the one hand, if there is a high degree of OCB in the work context, employees will behave proactively, such as actively innovating for the organization. On the other hand, if there is a low degree of OCB in the work context, employees will have no motivation or inclination to contribute more creative ideas for CE. For a technology firm, this lack of employee innovation is fatal.

Especially for biotechnology enterprises, high-performance human resource practices suggest a long-term employment relationship; employees are more inclined to cooperate and assist others, namely engaging in OCB. Furthermore, high-performance human resource practices will foster a supportive work environment, specifically trust and cooperation, which are manifested in OCB and play a pivotal role in biotechnology enterprises. On the individual level of analysis, a high degree of OCB may thus be necessary for employees to be motivated to respond to high-performance human resource practices in a way that will benefit CE. In contrast, a low degree of OCB, which is associated with a transactional psychological contract (Rousseau, 1995) and is involved with economic exchange (Shore et al., 2006), will prevent employees from actively responding to high-performance human resource practices.

Menrad et al. (2002) have stated that biotechnology has emerged as a key technology for the acceleration of economic development in this century due to its potential for the creation of new products and processes, the increase of productivity in existing industries, the stimulated demand for skilled work forces and job creation. Knowledge/technology employees who are inspired by the organization and subsequently perform extra-role behavior and continuously contribute creative ideas are invaluable assets for enterprises, since they cannot only decrease the daily operational cost for the enterprise but also increase its coherence.

Allen, Shore, and Griffeth (2003) have stated that high-performance human resource practices constitute an organizational inducement that will likely affect how employees perceive the quality of the employee–organization relationship. We expect that OCB plays a mediating role between the high-performance human resource practices and CE in biotechnology industry. According to this, we posit that:

Hypothesis 2. The positive relationship between high-performance human resource practices and CE is mediated by OCB.

3. Research methods

We chose small-to-medium-sized biotechnology enterprises (SMEs) in the Chinese pharmaceutical industry for this study, since firms of this size (fewer than 500 employees) presented a more direct litmus test for our hypotheses. However, due to the expectation that formal high-performance human resource practice would be limited for firms with less than 100 employees, these firms were eliminated from the initial sample.

3.1. Sample and procedures

Access to the participating biotechnology enterprises in the pharmaceutical industry was obtained through personal contacts and further networking. This approach is particularly useful in China, where *guanxi* as the traditional Chinese concept of personal relationships and their development significantly facilitates company access (Easterby-Smith & Malina, 1999). A survey team distributed survey packages to each participating enterprise from four large cities in China, namely, Beijing, Shanghai, Xi'an and Guangzhou, from January 2007 to September 2007. Each survey package contained three separate questionnaires administered to the CEO, human resource managers and employees. A cover letter attached to each questionnaire explained the objective of the survey and assured respondents of the confidentiality of their responses and the voluntary nature of participation in the survey. For each biotechnology enterprise, CEO questionnaires requested the CEO to provide data about CE, while the human resource manager questionnaire requested the human resource managers to provide data on high-performance human resource practices. The employee questionnaire was administered to the frontline employees who represented the core departments of each enterprise. Completed questionnaires were sealed and returned in self-addressed envelopes to the human resource manager of each participating biotechnology enterprise.

We collected data from multiple sources in each enterprise. This was done both to match the nature of inquiry with the relevant source of information and to overcome the common method variance in the survey responses. The questionnaires were originally prepared in English, translated into Chinese by a professional translator, and then back-translated into English by another professional translator. The back-translated versions were compared with the originals to ensure accuracy.

Of the 250 survey packages distributed, 146 were returned. Specifically, we received questionnaires from 146 CEOs and human resource managers and 730 employees from 146 biotechnology enterprises, representing response rates of 58.4%. After removing incomplete questionnaires, data were obtained from 139 CEOs and human resource managers and 695 supervisors of frontline employees. Table 2 presents salient characteristics of the biotechnology enterprises that participated in the study.

There were no significant differences between respondents and non-respondents in terms of number of employees, assets and so forth. Therefore, the sample used in the analysis is representative of the population under study.

Table 2
Major characteristics of sampled SMEs^a

Variable	Means	s.d.
1. Firm age	5.63	6.24
2. Average number of employees	224.72	180.23
3. Ownership type ^b		
Public	50	35.97
Not public	89	64.03

^a $n = 139$.

^b Frequency is shown in the “Means” column, and percentage is shown under “s.d.”.

3.2. Measurement

Apart from human resource managers' ratings of high-performance human resource practices (the independent variable), CEOs' ratings of CE (the dependent variable), and OCB (the mediator variable), all other variables are controlled. A seven-point Likert-type scale was used for the responses; answers ranged from 1=100% disagreement, 2=80% disagreement, 3=60% disagreement, 4=neutrality, 5=60% agreement, 6=80% agreement, and 7=100% agreement.

3.2.1. High-performance human resource practices

Following [Bamberger and Meshoulam \(2000\)](#), we developed a 26-item scale to measure integrated high-performance human resource practices. After specifying the domains of human resource practices, we generated items for each domain on the basis of an extensive literature review and in-depth interviews with human resource managers of 10 pharmaceutical enterprises in Beijing and Shanghai. Two measures reported in the literature provided the initial pool of items: [Bae and Lawler's \(2000\)](#) measure, which was originally developed by [Snell and Dean \(1992\)](#), and [Delery and Doty's \(1996\)](#) measure. Interviews with human resource managers in these pharmaceutical enterprises assured the relevance of the items, and these managers suggested a few additional items in some human resource areas. The Appendix gives the text of the items in our high-performance human resource practices scale. The Cronbach's α of this scale was 0.79.

3.2.2. Organizational citizenship behavior

Supervisors of frontline subordinates rated their subordinates' OCB using 20 items originally developed by [Podsakoff, Mackenzie, Moorman, and Fetter \(1990\)](#) and later used by [Lam, Chun, and Law \(1999\)](#). The OCB scale was designed to measure five behaviors: helping, courtesy, sportsmanship, civic virtue and conscientiousness. Example items include “Makes constructive suggestions that can improve the operation of the company” and “Willing to cover work assignments for colleague when needed”. The Cronbach's α of this scale was 0.87.

3.2.3. Corporate entrepreneurship

We used [Zahra's \(1996\)](#) 16-item scale, which broadly measures a firm's entrepreneurial activities on three dimensions: innovation, venturing and strategic renewal. Specifically, innovation is creating and introducing products, production processes, and organizational methods. Venturing is expanding operations in existing or new markets, while strategic renewal is changing the scope of the business and its competitive approaches. The Cronbach's α of this scale was 0.82.

3.2.4. Controls

Firm size was included as a control variable because larger organizations may be more likely to use better developed or more sophisticated human resource practices ([Jackson & Schuler, 1995](#)) and may perform more CE because of these human resource practices ([Hom & Griffeth, 1995](#)). Furthermore, firm size is assumed to have a direct effect the inclination to practice CE because of economies of scale and market power. Firm size was measured as the natural log of the number of full-time employees.

Firm age was set as the years from the founding date of the firm in China. Firm age has been noted to be associated with evolution or adoption of high-performance human resource practices and learning curve advantages in CE.

Firm ownership has been shown to be related to performance and human resource policies and practices. As shown in [Table 2](#), firm ownership had two categories: public enterprises and private enterprises. A dummy variable was used to measure enterprise ownership (1=public, 0=not public).

3.3. Data aggregation

Since data on the high-performance resource practices and CE were both assessed at the organizational level, the organizational citizenship behavior (OCB) data were aggregated to the organizational level ([Klein & Kozlowski, 2000](#)). This aggregation also reflected our conceptualization of the construct as the organizational characteristic. We calculated within-group agreement statistics (r_{wg} s) for the OCB measure. The organization's r_{wg} values ranged from 0.80 to 0.97, with a mean of 0.92. These values all exceeded 0.70, the lowest appropriate value for the aggregation of individual-level measures to the organizational level, suggesting that within-group agreement was sufficient ([James, Demaree, & Wolf, 1993](#); [Klein & Kozlowski, 2000](#)). To further justify aggregation to the organizational level, we calculated the values of the interclass correlation coefficients, ICC(1) and ICC(2). ICC(1)

Table 3

Means, standard deviations, correlations, and reliabilities

Key variables	Mean	s.d.	1	2	3	4	5
1. Firm age	5.63	6.24					
2. Firm size	224.72	180.23	0.07				
3. Firm ownership	0.53	0.47	0.12	-0.04			
4. High performance HR practice	4.24	0.45	0.08	0.10	-0.07		
5. OCB	4.95	0.72	0.17	0.09	0.01	0.38***	
6. CE	4.70	0.81	0.08	0.22	0.16	0.18*	0.22**

Instruction: *, ** and *** are significant degrees of 0.10, 0.05 and 0.01, respectively.

provides an estimate of the extent to which individual-level variability on a given measure is explained by higher-level units. The ICC(1) values were based on a one-way analysis of variance (ANOVA) (Bliese, 2000). In this study, the group effect, or the F -value, for the ANOVA was 0.10 ($p < 0.001$). The ICC(2) provides an estimate of the reliability of group means. Using the Spearman–Brown formula, we derived an ICC(2) of 0.83, which exceeded the lowest acceptable value of 0.70. Taken together, the r_{wg} , ICC(1), and ICC(2) values justified the aggregation of the OCB data to the organizational level.

4. Analysis and results

4.1. Preliminary analyses

4.1.1. Descriptive statistics

Table 3 presents the zero-order correlations among study variables. As shown in Table 3, high-performance human resource practices were related to both OCB and CE. OCB was related to CE in SMEs.

To test Hypotheses 1 and 2, we conducted mediated regression analyses following Baron and Kenny (1986). In step 1, we established the relationship between high-performance human resource practices and the mediator, namely, organizational citizenship behavior (OCB). In step 2, we established the relationship between high-performance human resource practices, OCB and CE. In step 3, we treated CE as a dependent variable by adding the mediator to the equation with high-performance human resource practices. In other words, the new equation includes not only high-performance human resource practices but also the mediator. In step 3, according to the hypotheses, the mediator should be significant, while the previously significant effect of high-performance human resource practices should be reduced or become non-significant.

The regression results for step 1 are presented in Table 4. Models 1 and 2 provide results for OCB as the dependent variable. The control variables are contained in Model 1, and high-performance human resource practices are contained in Model 2. The regression coefficients for high-performance human resource practices were all significant: ($\beta = 0.33$, $p < 0.05$). To summarize, the overall results suggest that an increase in high-performance human resource practices has a positive impact on OCB.

CE was treated as a dependent variable. The results for steps 2 and 3 are presented in Table 5. In Model 1, we entered the control variables. In Model 2, we added high-performance human resource practices to the regression equation. Results from Model 2 suggest that high-performance human resource practices are positively related to CE ($\beta = 0.38$, $p < 0.10$). In Model 3, we added OCB as the mediator to the Model 2 equation. The results indicate that OCB had a significant effect on CE ($\beta = 0.32$, $p < 0.05$), while high-performance human resource practices became non-significant ($\beta = 0.13$, n.s). Combining the evidence from steps 1–3, we conclude that OCB mediates the impact of high-performance human resource practices on CE. Hypotheses 1 and 2 are therefore supported.

In order to guarantee the robustness of the regression analysis results, we conducted a robustness test of the above regression models using three methods. First, we used a Ramsey RESET method to test whether there was an omitted variable problem. If the p value was more than 0.1, then there was no omitted variable problem. Secondly, we used the Breuch–Pagan/Cook–Weisburg

Table 4

Multiple Regression Analysis for OCB

	OCB	
	Model 1	Model 2
Firm age	0.11 (0.79)	-0.09 (-0.66)
Firm size	0.08 (0.56)	0.12 (0.98)
Firm ownership	-0.13 (-0.91)	-0.08 (-0.77)
High-performance human resource practices		0.33 (2.68)**
Constant	0.22 (1.02)	0.13 (0.95)
Omitted variable	0.21	0.13
Heteroskedasticity	0.01*modify	0.08*modify
Adjust- R^2	0.13	0.42
Multicollinearity	1.37	2.57

Instruction: Numbers above the bracket are the regression coefficients; the number in the bracket is t test value in the OLS model. * and ** are significant degrees of 0.10 and 0.05 respectively.

Table 5
Multiple regression analyses for corporate entrepreneurship

	CE		
	Model 1	Model 2	Model 3
Firm age	0.14 (1.03)	0.08 (0.97)	0.12 (1.31)
Firm size	−0.11 (−0.91)	0.10 (0.98)	−0.08 (−0.10)
Firm ownership	0.09 (0.77)	0.15 (1.22)	0.07 (0.69)
High-performance human resource practices		0.38 (1.97)*	0.13 (1.34)
OCB			0.32 (2.31)**
Constant	−0.08 (−0.69)	0.14 (1.19)	0.16 (1.28)
Omitted variable	0.13	0.32	0.27
Heteroskedasticity	0.03*modify	0.03*modify	0.22
Adjust- R^2	0.12	0.31	0.44
Multicollinearity	2.33	2.06	2.78

Instruction: Numbers above the bracket are the regression coefficients; the number in the bracket is t test value in the OLS model. * and ** are significant degrees of 0.10 and 0.05 respectively.

method to test whether there was a heteroskedasticity problem. If the p value was more than 0.1, then there was no heteroskedasticity problem. Because the direct regression results showed that there were heteroskedasticity problems in some models, we modified these models using an item of robust or hc3, which is supplied in STATA 8.0, and found that this has no effect on the original results. Third, we calculated the mean VIFs (variance inflation factors) to test whether there was a multi-collinearity problem in each model. The results showed that there were no significant multi-collinearity problems.

5. Discussion

We found that high-performance human resource practices are positively related to OCB and CE. Furthermore, it appears that OCB plays a pivotal role in establishing the underlying conditions for high-performance human resource practices. Thus, our results have extended the high-performance human resource practice literature by demonstrating the importance of employment relationship factors for high-performance human resource practices.

5.1. Theoretical implications

First, we extend the literature on high-performance human resource practices by investigating organizational behavior's relationship to OCB and CE. The results provide a greater understanding of the outcomes of high-performance human resource practices.

Because previous research did not explain how high-performance human resource practices directly influence CE, this study investigated how OCB mediates the relationship between high-performance human resource practices and CE. This addition to previous efforts is important because OCB focuses on the employee–organization relationship (EOR), which is essential in corporate entrepreneurship contexts.

Second, only a few past studies have examined the influence of sets of human resource practices on a firm's overall corporate entrepreneurship. [Delery and Doty \(1996\)](#) pointed out those different aspects of a set of human resource practices may interact synergistically. This research attempts to fill this general absence of theory.

5.2. Managerial implications

One practical implication of this study is that, in general, high-performance human resource practices may not necessarily be associated with high levels of corporate entrepreneurship. Our findings show that such practices are only positively related to social exchanges between the organization and employees when a high level of OCB exists. In these cases, employees understand that the organization prefers extra-role efforts not limited to prescribed tasks.

Moreover, it is critically important that managers in biotechnology enterprises have the capability to motivate the knowledge/technology employees to engage in more extra-role behaviors. It is known that leadership, personal charm and individual characteristics are likely to influence the leader's judgment and affect the employees. If a manager in a biotechnology enterprise mistakenly used high-performance human resource practices in an organization with a low level of OCB, the knowledge/technology employees would be less likely to be encouraged by this kind of discretionary organizational practice, let alone to promote CE. High-performance human resource practices should encourage knowledge/technology employees to be open to employees' innovative behaviors in general, but these practices should also develop both the managers' and employees' communication to facilitate their mutual understanding.

CE can be regarded as necessary for the survival of technology enterprises, and it will be the driving force for the technology industry both in improving the economy and in the creation of wealth and jobs. Moreover, CE is not a static state, but a dynamic process; therefore, managers in technology enterprises can inspire employees' enthusiasm efficiently through more effective incentive measures.

5.3. Limitations and future research

Like any study, this research is not without limitations. First, prior studies have suggested that discretionary practices, such as incentive pay, employee suggestion schemes and formal employee participation programs, will encourage commitment, cooperation, knowledge sharing and extra-role behaviors (Kuvaas, 2008; Sun et al., 2007). This research has pointed out that OCB can be taken as one kind of underlying mechanism between high-performance human resource practices and CE in biotechnology enterprises. In addition, other kinds of informal behaviors (such as perceived organizational support, affective commitment, procedural justice and so on) may also be effectively encouraged through the creation of a climate in which entrepreneurship contributions are the result of a social exchange between employees and the organization; this awaits future investigation.

Second, when we examine details of high-performance human resource practices, there are also some important contingencies such as technology, strategy, or firm life-cycle that are rarely considered. In the future, we can attempt to consider some more contingencies to investigate which conditions lead high-performance human resource practices to function better.

Third, although we have investigated the influence of sets of human resource practices on a firm's overall CE, all the metrics were borrowed from Western countries, modified slightly, and applied to pharmaceutical biotechnology enterprises in China. In the future, more effort should be spent developing indigenous metrics which will be more valuable for research in China.

Another limitation is that the model was tested on a medium-sized sample drawn solely from the small-to-medium-sized biotechnology enterprises (SMEs) in the pharmaceutical industry in China. Although we expect that these findings will also hold when applied to more diverse industries in other countries, the sole industry and a moderate sample size remain problems. Future research should therefore use larger sample sizes and other types of industries in order to cross-validate the model in different settings.

In spite of the limitations of our research, our findings provide new insights into the relationships between human resource practices and CE.

Appendix A. Selective staffing

1. Great effort is taken to select the right person.
2. Longterm employee potential is emphasized.
3. Considerable importance is placed on the staffing process.
4. Very extensive efforts are made in selection.

Extensive training

5. Extensive training programs are provided for employees.
6. Employees will normally go through training programs every few years.
7. There are formal training programs to each new hires the skills they need to perform their job.
8. Formal training programs are offered to employees in order to increase their promotability in this organization.

Internal mobility

9. Employees have clear career paths in this organization.
10. Employees who desire promotion have more than one potential position they could be promoted to.
11. Employee's career aspirations within the company are known by their immediate supervisors.

Employment security

12. Employees in this job can be expected to stay with this organization for as long as they wish.
13. Job security is almost guaranteed to employees in this organization.
14. It is very difficult to dismiss an employee.
15. If the company was facing economic problems, employees would be the last to get downsized.

Clear job description

16. The duties in this job are clearly defined.
17. This job has an up-to-date description.
18. The job description for a position accurately described all of the duties performed by individual employees.

Results-oriented appraisal

19. Every employee has performance objectives.
20. Performance appraisals are based on objective quantifiable results.
21. Employee appraisals emphasize long term and group-based achievement.

Incentive reward

22. Individuals in this job receive bonuses based on the profit of the organization.
23. Close tie or matching of pay to individual/group performance.
24. Individuals receive ownership shares as incentive pay.

Participation

25. Employees in this job are often asked by their supervisor to participate in decisions.
26. Individuals in this job are allowed to make decisions.
27. Employees are provided the opportunity to suggest improvements in the way things are done.
28. Supervisions keep open communications with employees in this job.

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