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Beyond the High-Performance Paradigm: Exploring the Curvilinear Relationship between High-Performance Work Systems and Organizational Performance in Taiwanese Manufacturing Firms

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Abstract

*In this study, we explore the potential downside of the 'high-performance' paradigm by examining the curvilinear relationship between high-performance work systems (HPWS) and organizational performance and the moderating effects of the industry type. Using data from Taiwanese manufacturing firms, we find an inverted-U pattern between HPWS and organizational performance in high-technology firms (*N = 74*), and a linear relationship in traditional manufacturing firms (*N = 86*). These findings are consistent with the viewpoint of diminishing returns of HPWS and the contingency perspective. Theoretical and practical implications of our findings are also discussed.*

1. Introduction

How to attract, develop and retain talented human resources (HR) has become the focus of considerable interest in both academic and popular press (Becker and Huselid 2006; Pfeffer 1998; Wright and Boswell 2002). Based on this trend, HR scholars have strongly advocated the necessity to implement *high-performance work systems* (HPWS) to attain this goal (Datta *et al.* 2005; Guthrie 2001; Huselid 1995). HPWS is an integrated system of HR practices that enables high performance by enhancing employee skills, abilities and motivation (Huselid 1995; Wright and Boswell 2002). Although the majority of empirical findings concerning HPWS support the argument that these

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systems lead to higher levels of organizational performance (e.g. Delaney and Huselid 1996; Huselid 1995; Way 2002), there remain several issues that have not been fully explored in the existing research.

The first unanswered issue pertains to *the potential downsides of HPWS* as pointed out by several scholars (e.g. Appelbaum *et al.* 2000; Godard 2004; Harley 2002). From the economic cost perspective (e.g. Bryson *et al.* 2005; Godard 2001; Jones and Wright 1992), higher costs related to sophisticated selection tools and to continuous investment in training programmes, and competitive wages may offset the benefits of HPWS because of the cost–benefit trade-offs (Forth and Millward 2004). Moreover, given an inherent limit in the amount of performance that can be increased, *diminishing returns* of HPWS can occur when HPWS adoption exceeds its optimal level (Godard 2004; Jones and Wright 1992). As such, the present study attempts to empirically investigate the possible curvilinear relationship between HPWS and organizational performance.

The second issue concerns *the moderating effects of industrial environment*. Based on the contingency theory perspective, the effects of HPWS on organizational performance vary under different industrial environments (Godard 2004; Guest *et al.* 2003; Jackson and Schuler 1995; Wright *et al.* 1994). However, our understanding of the moderating effects of industry types on the HPWS–performance association remains underdeveloped. On the one hand, Kintana *et al.* (2006) have found that HPWS execution is often advantageous for high-technology firms because of fierce competition and industrial dynamism. On the other hand, Chen *et al.* (2005) have suggested that the benefits of HPWS may be less apparent for traditional manufacturing firms owing to their relatively static external environments. Following the call to explore the boundary conditions of the HPWS–performance linkage (Becker and Huselid 2006; Guest *et al.* 2003), we also investigate whether the curvilinear relationship between HPWS and organizational performance is moderated by industry type (i.e. high-technology and traditional manufacturing industries).

The final issue is *whether the positive results obtained from HPWS can be generalized into Eastern cultures*. Published studies that investigate the HPWS–performance linkages have mainly been conducted in Western countries, and especially within the US context (Bae and Lawler 2000; Guest *et al.* 2003; Guthrie 2001). To fully test the generalizability of HPWS–performance linkages, scholars have demanded that more studies be conducted in Eastern countries (Bae *et al.* 2003; Heery 2005; Shih *et al.* 2006; Wright *et al.* 2005b). We respond to this call by testing the aforementioned relationship in Taiwan, a good HPWS research setting for four reasons. First, although Taiwan has become an important production source for a variety of high-technology products in the global market, keen competition from other developed and developing countries continually forces Taiwanese firms to use their HR more effectively (Chang and Chi 2007; Chi *et al.* 2008; Han *et al.* 2006). As a result, HPWS adoption has become a common approach for Taiwanese companies (Bae *et al.* 2003; Tsai 2006). Second, many US-based multinational corporations have established subsidiaries in Taiwan over the last several decades. As these subsidiaries often introduce HPWS, the spill-over of HPWS to local companies has also become clearer (see Chen *et al.* 2003, 2005). Third, while traditional manufacturers contributed to the past economic development of Taiwan, it is the achievement of high-technology firms that has boosted Taiwan's economy in recent years (Han and Shen 2007; Han *et al.* 2006). The coexistence of both types of companies provides a good setting for investigating the HPWS–performance linkage under different industry backgrounds. Finally, given that the theoretical background of the HPWS–organizational performance association is derived from Western theories, the Taiwanese sample provides us with an appropriate setting to illustrate whether such an association can be generalized into an Eastern setting.

In the following sections, we begin with a review of the 'high-performance' paradigm. We then propose the theoretical and empirical rationales that underline the curvilinear relationship between HPWS and organizational performance, and how this relationship varies within high-technology and traditional manufacturing industries. Next, we compile a set of relevant variables to test our hypotheses on a sample of 74 high-technology firms and 86 traditional manufacturing firms. Finally, the theoretical and practical implications of our findings are also discussed, and some conclusions offered.

2. Theory and hypotheses

High-Performance Work System

According to the resource-based view, a firm can develop competitive advantage not only by acquiring but also by developing, combining or more effectively deploying its resources to add unique value (Barney 1991). Following this line of reasoning, it is believed that executing HPWS can increase firms' human (employees' knowledge, skills and abilities) and organizational resources (systems for planning, monitoring and controlling activities), and thereby lead to competitive advantage (Becker and Huselid 1998; Jackson and Schuler 1995; Wright and McMahan 1992). Appelbaum and Berg (2001) and Wright and Boswell (2002) concluded that HPWS includes three categories of HR practices: *employee skills*, *employee motivation* and *employee empowerment*. The employee skills category includes HR practices designed to attract applicants with superior skills and to develop employees' skills. HR practices such as *selective staffing, extensive training, competitive compensation* and *internal promotions* can be included in this category because these practices can increase the firm's ability to attract, select, develop, and retain employees with superior knowledge, skills, and abilities (KSAs) (Becker and Huselid 1998; Snell and Dean 1992). Human capital theory suggests that employee KSAs can create organizational economic values when employees collectively use their KSAs to enable the organization to be more productive (Jackson and Schuler 1995; Lepak and Snell 2002). As a result, these HR practices can be seen as deliberate investments in human capital that are intended to result in better organizational performance (McMahan *et al.* 1999).

Secondly, the employee motivation category comprises HR practices that are created to elicit higher levels of work motivation. Agency theory suggests that efficient contracts and work designs should align the goals of principals (i.e. the organization) and agents (i.e. employees) to better enhance agent motivation and to minimize agency problems (Jackson and Schuler 1995). HR practices such as *performance contingent pay* and *results-oriented appraisal* help to effectively enhance employees' motivation in their jobs and reduce their self-interest-based behaviours; using variable-pay compensation schemes and results-oriented performance appraisals are beneficial in that they align employee goals and interests with the goals of the firm (Huselid 1995; Wright and McMahan 1992). Finally, the employee empowerment category contains HR practices that are implemented to enhance employee participation and sense of voice in the company. HR practices such as *employee participation and formal complaint resolution systems* and *teamwork design* enable employees to express their opinions and viewpoints, as well as make decisions. In these ways, employees are empowered to apply their KSAs and ideas to work-related activities, which lead to higher employee flexibility and productivity (Legge 2005; MacDuffie 1995; Way 2002).

By carrying out the aforementioned HR practices, it is believed that employees gain a broad range of superior KSAs, higher levels of work motivation and greater empowerment, which can collectively boost organizational performance (Evans and Davis 2005; Guthrie 2001; Huselid 1995; Lado and Wilson 1994; Way 2002; Wright and Snell 1998; Zacharatos *et al.* 2005). Taken together, we conclude that HPWS is composed of the following nine HR practices: selective staffing, extensive training, competitive compensation, internal promotion, performance-contingent pay, results-oriented appraisals, employee participation, formal complaint resolution systems and teamwork design. The nine HR practices included in this study are very similar to those employed by previous scholars (see Bamberger and Meshoulam 2000; Datta *et al.* 2005; Legge 2005; Sun *et al.* 2007; Takeuchi *et al.* 2007). The hypothesis development and the HPWS measure are both based on these nine practices in the following sections.

The Curvilinear Relationship between HPWS and Organizational Performance: The Moderating Role of Industry Type

In accordance with the 'high-performance' paradigm, early studies revealed a positive relationship between HPWS and organizational performance. For example, Huselid (1995) found that companies using HPWS could increase organizational productivity and reduce employee turnover; Arthur (1994) and MacDuffie (1995) pointed out that the implementation of HPWS is strongly related to organizational performance. More recent work has also provided empirical evidence to support the positive association between

HPWS and organizational performance (Datta *et al.* 2005; Delaney and Huselid 1996; Guest 2001; Guthrie 2001; Richard and Johnson 2001; Way 2002). The paradigm that 'HPWS leads to higher levels of organizational performance' seems to be well accepted (Gerhart 2005).

However, as Bryson *et al.* (2005) indicate, the benefits associated with HPWS cannot be obtained without cost. HPWS adoption may raise unit labour costs owing to higher wage payments (Forth and Millward 2004). Jones and Wright (1992) proposed a theoretical framework to evaluate the economic costs and benefits of HR practices on organizational performance. According to their viewpoint, the adoption of HPWS also increases the bureaucratic costs associated with negotiating, monitoring, evaluating and motivating employees (Wright and McMahan 1992). Also, firms may invest a large amount of resources in complicated selection/recruitment practices, which raise administrative costs. If firms want to establish results-oriented appraisals and performance-contingent pay systems, monitoring the performance outcomes becomes costly when task uncertainty and complexity are high. Thus, firms often find that they make a trade-off between the benefits and higher bureaucratic costs of implementing HPWS.

Based on the idea of *diminishing returns*, even when HPWS investment yields significant benefits, these benefits may be offset by the additional costs related to the over-implementation of HPWS (Cappelli and Neumark 2001; Handel and Gittleman 2004). High levels of HPWS implementation yield little or no overall marginal utility relative to implementation at an optimal level (Godard 2001). Given the inherent limit in the degree to which performance can be increased, the diminishing returns of HPWS occur when HPWS investment exceeds the optimal level (Jones and Wright 1992). Owing to the cost–benefit trade-offs, execution of HPWS at a moderate level should outperform that at a high level (Godard 2004). These arguments suggest that the linkage between HPWS and organizational performance is less straightforward and more complicated than the 'high-performance' paradigm originally proposed (Godard 2004; Legge 2005).

Furthermore, the resource-based view also embodies a contingency perspective in explaining the 'high-performance' paradigm (Wright *et al.* 1994). That is, organizational resources can be a source of sustainable competitive advantage to the extent that they create value and allow a firm to excel in its particular industrial environment (Datta *et al.* 2005). The effects of HR practices on organizational performance depend on organizational industry characteristics such as dynamic versus stable product markets (Jackson and Schuler 1995; Wright *et al.* 1994).

In terms of the high-technology industry, typical firms are characterized by large research and development (R&D) investments, innovation at a remarkable pace, and frequent technological changes (Baruch 1997; Chen and Wu 2007; Judge and Miller 1991; Kintana *et al.* 2006). As such, high-technology firms often emphasize innovation and employ creative workforces to cope with their highly dynamic, uncertain and short-life-cycle markets (Baruch 1997; Milkovich 1987; Smith *et al.* 2005). All these features require highly skilled employees, greater empowerment in the decision-making process and team-based work designs to facilitate innovation (Kintana *et al.* 2006). In order to attract and retain talented workers, high-technology firms have to make significant efforts to provide high incentives and significant investments in training (Gardner 2005; Lee and Maurer 1997). The aforementioned characteristics highlight the importance and potential benefits of HPWS implementation in high-technology firms. Supporting this argument, Kintana *et al.* (2006) found that the positive effect of HPWS on operational performance was stronger within firms with high production technology than firms with low production technology. Therefore, it seems that adopting HPWS is especially useful for high-technology firms in terms of enhancing their performance (Datta *et al.* 2005; Wright *et al.* 1994).

However, as we mentioned earlier, diminishing returns occurs when the costs of HPWS adoption offset its benefits, and this is particularly apparent for high-technology firms. As the competition for talents in the high-technology industry remains fierce (Gardner 2005; Han and Shen 2007), high-technology firms are more likely to adopt a high level of HPWS to attract the most talented employees. As such, the related bureaucratic costs associated with hiring high-performance employees from rival firms will also multiply (e.g. recruiting, headhunting, and higher levels of pay and benefits). In addition, quick and frequent technological changes force high-technology firms to invest great sums in employee training programmes to keep their knowledge up-to-date (Lee and Maurer 1997), which also raises bureaucratic costs. Therefore, although adequate development of HPWS is often beneficial for high-technology firms, it is possible that high-technology firms suffer from the costs of over-investment in HPWS as well. HPWS can be particularly harmful when adoption exceeds the optimal level in that when firms in the high-technology industry fail to balance the benefits and the costs incurred during HPWS investment, higher levels of expenditures and bureaucratic costs are likely to offset the positive effects of HPWS and make those firms less profitable. Thus, we expect the relationship between HPWS and organizational performance in the high-technology industry to be curvilinear and reflect an inverted-U pattern.

> *Hypothesis 1: The relationship between HPWS and organizational performance is curvilinear and should depict an inverted-U pattern for high-technology firms.*

On the other hand, the traditional manufacturing industry is characterized by less frequent technological progress and therefore is considered a more predictable and stable industrial environment (Bell *et al.* 2004; Judge and Miller 1991). With cost and efficiency considerations, traditional manufacturing firms place greater emphasis on investment in physical factories and equipment (Chu 2004; Datta *et al.* 2005). In Taiwan, traditional manufacturing firms also face a relatively static and long life-cycle market as compared with high-technology firms (Chen and Wu 2007; Tsai and Wang 2004). HPWS can help traditional manufacturers elicit fast and high-quality transformations of raw materials by providing the necessary training for production line employees (Combs *et al.* 2006; Snell and Dean 1992), encouraging line employees to continuously improve quality control (Arthur 1994; MacDuffie 1995), and by enhancing occupational safety, especially for manufacturing jobs that involve potentially dangerous equipment (Zacharatos *et al.* 2005). Thus, HPWS can lead to higher organizational performance for traditional manufacturers. Supporting our argument, Combs *et al.* (2006) also found a positive association between HPWS and organizational performance in traditional manufacturing firms.

In addition, we expect that the diminishing returns of HPWS are less likely to occur within traditional manufacturing firms for two reasons. First, owing to the relatively stable environment, traditional manufacturing firms do not require as much innovation, flexibility or creativity as high-technology firms. As such, the knowledge and skill requirements for employees are less complex and varied as compared with high-technology firms (Kintana *et al.* 2006). In this vein, the personnel and bureaucratic costs associated with attracting, keeping, and training talented employees will be less for traditional manufacturers than high-technology ones (Datta *et al.* 2005). Second, environmental stability fosters the adoption of standardized job designs with limited autonomy and quantitative performance criteria in traditional manufacturing firms (Kintana *et al.* 2006). As such, employees' performance goals and outcomes remain relatively concrete and easier to evaluate than high-technology ones. In this line of reasoning, the bureaucratic costs of monitoring employee performance goals and outcomes will be lessened upon the implementation of performance-contingent pay systems in traditional manufacturing firms (Jones and Wright 1992). Taken together, we expect that the benefits of executing HPWS in traditional manufacturing firms are less likely to be offset by excessive bureaucratic and personnel costs as compared with high-technology firms. Therefore, the following hypothesis is proposed:

Hypothesis 2: The relationship between HPWS and organizational performance is positive for traditional manufacturing firms.

3. Methods

Sample

In order to collect data from manufacturing firms that were more likely to implement HPWS, the top 1,000 manufacturers (including both high-technology and traditional manufacturing firms) ranked by Taiwan Commonwealth Magazine (2004) were chosen as the population for the current study.[1] As the Commonwealth Magazine survey centre has provided reliable annual company rankings with objective financial data (e.g. ratio of return on equity (ROE), ratio of return on assets (ROA), sales growth ratio, net profit margin and sales per employee) over the last decade, it allowed us to collect objective performance data.

The procedure for data collection is described in the following steps. Firstly, we randomly chose 500 firms out of the 1,000 top manufacturers as our sample. We then contacted the top HR executive[2] at each sample firm by telephone to ascertain the name and address of the HR executives for mailing survey packages in December 2004. During the telephone notification, we briefly introduced the research purposes and invited each HR executive to participate in our study. Secondly, a week later, a cover letter and a questionnaire were mailed to the 500 identified HR executives (only the top HR executive was surveyed within each firm). Finally, three weeks later, a follow-up telephone call and a reminder letter were sent to solicit responses from the HR executives who had not yet returned the questionnaire. A total of 160 valid questionnaires were returned, providing a valid response rate of 32 per cent.

Although we acknowledge Gerhart *et al.*'s (2000a,b) suggestion that HR research should obtain multiple respondents from each sample firm, we employed a single-respondent design for the following reason: considering the relatively small firm size (about 57 per cent of the sample firms employed less than 500 employees) and HR department scale (about 90 per cent of the sample firms had less than 20 HR practitioners), HR executives are often responsible for formulating HR policies, implementing HR practices and reporting HR outcomes to the CEO directly. Hence, the HR executive should have been the most suitable respondent to answer questions pertaining to HR practices (Becker and Huselid 2006; Huselid and Becker 2000).

In addition, because HPWS was measured using single-respondent self-reports, it is plausible that either social desirability or common method variance problems may have influenced the results of our study (Podsakoff and Organ 1986). To overcome these problems, we referred to suggestions proposed by Spector and Fox (2003) in terms of designing item scales that asked more fact-based, focused and specific questions to minimize subjective bias. Moreover, objective financial indicators of organizational performance (i.e. return on equity (ROE), return on investment (ROI) and net profit margin) were obtained from the other sources (i.e. the Commonwealth Magazine survey centre database); thus, common method variance should not be a serious problem for this study (Wright *et al.* 2003).

The sample companies were composed of 86 traditional manufacturing firms (53.8 per cent; containing industries such as *iron and steel*, *petrochemical*, *textile*, *automobile*, *metalworking* and *food*) and 74 high-technology firms (46.2 per cent; including industries such as *computer systems*, *electronic communications*, *optoelectronics*, *semiconductors*, *IC design*, *Internet*, *software*, *aerospace* and *biotechnology*). Most of the companies (80.6 per cent) had less than 1,000 employees. In terms of firm capital, 41.4 per cent of the sample companies had less than $US3 million, and 40 per cent ranged from $US3 to $US15 million. We also checked for any possible non-response bias, and the results showed that the responding and non-responding firms did not significantly differ in terms of either firm size or capital. Thus, our sample firms should not be biased.

Finally, there was substantial variation within our sample in terms of firm size, firm capital, R&D intensity, marketing intensity, personnel intensity and total sales (please refer to Table 2 for detailed information). This suggests that our sample included firms with superior/inferior resources and high/low performers.

Measures

Following Delery (1998) and Rogers and Wright's (1998) suggestions, we provided necessary validity evidence in order to keep the construct validity in HPWS studies, which were reported as follows.

(a) High-performance work system

According to Appelbaum and Berg's (2001) and Wright and Boswell's (2002) categorizations, we concluded that HPWS includes nine HR practices: selective staffing, extensive training, competitive compensation, internal promotion, performance-contingent pay, results-oriented appraisals, employee participation, formal complaint resolution systems and teamwork design. These HR practices were also included in several recent studies (e.g. Datta *et al.* 2005; Guest *et al.* 2003; Sun *et al.* 2007; Takeuchi *et al.* 2007); hence, we believe that the selected nine HR practices appropriately capture the construct domain of HPWS.

In order to measure these practices, we referred to well-defined items in the previous studies to measure each practice. Eighteen items were adopted from Snell and Dean's (1992), Huselid's (1995), Delery and Doty's (1996), and Guthrie's (2001) studies to measure the nine HR practices (i.e. two items per practice). Respondents were asked to evaluate the extent to which their firms implement each item on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Means, standard deviations and Cronbach's alphas for all items are presented in Table 1.

Based on the approach taken by existing studies (e.g. Becker and Huselid 1998; Datta *et al.* 2005; Wright *et al.* 2005a), the composite HPWS score was computed by averaging the scores of the 18 items to calculate each firm's adoption of this 'system' (Delery 1998). As the purpose of this study was to explore the effects of HPWS on organizational performance, a single score was deemed appropriate (Delery 1998; Guthrie 2001; Wright and Boswell 2002). Further, as the correlation analysis showed significantly positive associations between the18 items ($r = 0.47$ to 0.71; all ps < 0.01), we followed Takeuchi *et al.*'s (2007) approach by conducting a principal axis factor analysis with an oblique rotation to determine whether these practices could be combined into a single index. The results showed that only one factor emerged: the total variance explained by this factor amounted to 65 per cent, and the Cronbach's alpha for this scale was 0.94. These results provided evidence supporting the suitability of the use of the composite HPWS score.

In order to examine the criterion-related validity of a new measurement, Hinkin (1998) and Schwab (2005) suggested that the score of the new

TABLE 1
The Means, Standard Deviations and Reliabilities of HPWS Items

HPWS items	*High-tech firms*	*Traditional manufacturing firms*	*The whole sample*
Selective staffing (Cronbach's alpha = 0.71)			
1. It is very important to select the best person for a given job.	3.70/0.81	3.53/0.89	3.60/0.86
2. The employee selection processes for a given job in this company is very extensive (e.g. use of tests, interviews, etc.)	3.67/0.69	3.33/0.93	3.48/0.84
Extensive training (Cronbach's alpha = 0.83)			
1. Extensive training programmes are provided for individuals according to their job.	3.38/0.92	3.35/0.86	3.36/0.89
2. There are formal training programmes to teach new hires the skills they need to perform their jobs.	3.49/0.84	3.35/0.88	3.40/0.87
Results-oriented appraisal (Cronbach's alpha = 0.92)			
1. Employees' performance is more often measured with objective quantifiable results.	3.30/0.76	3.10/0.84	3.17/0.83
2. Performance appraisals are based on objective and quantifiable results.	3.18/0.86	3.03/0.85	3.08/0.87
Competitive compensation (Cronbach's alpha = 0.89)			
1. The compensation of this firm is very competitive in this industry.	3.19/0.78	3.08/0.98	3.15/0.89
2. The pay level in this company is higher than other companies.	3.27/0.94	3.18/0.79	3.24/0.87
Performance-contingent pay (Cronbach's alpha = 0.88)			
1. The pay is tied to individual performance closely in this company.	3.11/0.73	3.11/0.72	3.10/0.73
2. There are significant pay differences across employees in this company that represent their differences in performance.	3.23/0.68	3.05/0.78	3.14/0.74
Employee participation (Cronbach's alpha = 0.70)			
1. Employees in their jobs are allowed to make many job-related decisions in their jobs.	3.32/0.81	3.31/0.72	3.31/0.78
2. Employees are provided the opportunity to suggest improvements in the way things are done.	3.21/0.73	3.10/0.78	3.16/0.77
Teamwork (Cronbach's alpha = 0.73)			
1. Employees participate in autonomous work teams regularly.	3.23/0.70	3.15/0.80	3.19/0.75
2. The company increased the usage of work in teams.	3.07/0.67	3.00/0.89	3.01/0.82
Internal promotion (Cronbach's alpha = 0.91)			
1. Individuals in this job know their career paths within this firm.	3.21/0.69	3.00/0.85	3.09/0.78
2. Employees in their job who desire promotion have potential positions they could be promoted to.	3.10/0.67	3.01/0.82	3.05/0.74
Formal complaint resolution (Cronbach's alpha = 0.76)			
1. Employees in this company have access to a formal grievance procedure.	3.32/0.98	3.15/0.89	3.23/0.94
2. Employees in this company have access to a complaint resolution system.	3.53/0.77	3.49/0.83	3.52/0.80

measurement should be correlated to theoretically relevant variables in the nomological network. Therefore, we also examined the associations between HPWS scores and two relevant criteria (i.e. personnel costs for each firm and subjective organizational performance[3]) to establish the criterion-related validity. Firstly, because HPWS adoption increases bureaucratic costs (Bryson *et al.* 2005; Godard 2004; Jones and Wright 1992), it is reasonable to assume that the level of HPWS execution is positively related to personnel costs. Secondly, Delaney and Huselid (1996) and Guest *et al.* (2003) suggested that HPWS should be positively related to subjective organizational performance. Hence, we also correlated the HPWS score with subjective organizational performance. The results show that the HPWS score was positively related to personnel costs ($r = 0.23$, $p < 0.05$) and subjective organizational performance ($r = 0.34$, $p < 0.01$), providing evidence of good criterion-related validity for HPWS scales.

(b) Industry type

Following Guest *et al.* (2003), industry type was measured with a single dichotomous variable (whether the company belonged to the high-technology industry or the traditional manufacturing industry). According to the definition proposed by the Industrial Development Bureau Ministry of Economic Affairs in Taiwan, we added an instruction that briefly introduced the sub-industries that should be categorized into the high-technology industry (e.g. computer system, electronic communications, optoelectronics, semiconductor, IC design, Internet, software, aerospace, and biotechnology) and the traditional manufacturing industry (e.g. iron and steel, petrochemical, textile, automobile, metalworking, and food). Then we asked respondents to choose an appropriate industry on the basis of that instruction.

We also examined the criterion-related validity of the industry type to establish the validity evidence of the dichotomous variable. As the high-technology industry and the traditional manufacturing industry differ in terms of the extent of *investment in R&D*, *investment in HR* and *competitive intensity*[4] (Baruch 1997; Kintana *et al.* 2006), we conducted a multivariate analysis of variance (MANOVA) to test whether firms that belong to either the high-technology or the traditional manufacturing industry had significant differences in terms of these three aspects. The results of the MANOVA show that the high-technology firms differed from traditional manufacturing firms in terms of the R&D intensity (mean = 4.05 vs 1.11 per cent), personnel intensity (mean = 3.70 vs 3.05 per cent), and HR executive-rated competitive intensity (mean = 4.02 vs 3.72). Taken together, these results not only provided validity evidence for the dichotomous measure of industry type but also supported our argument that high-technology firms invest more in innovation and HR, and face higher competitive intensity than traditional manufacturing firms.

(c) Organizational performance

Following previous studies (e.g. Bhattacharya *et al.* 2005; Delery and Doty 1996; Hitt *et al.* 2001; Lee and Miller 1999), three objective financial indicators were collected from the database of the Commonwealth Magazine (2005) survey centre to compute organizational performance: (1) ratio of ROE; (2) ratio of ROA; and (3) net profit margin (net income after taxes/revenue). ROE and ROA have been widely used in strategy and strategic human resource management (SHRM) research because they are good indicators of profitability in terms of measuring how effectively organizations use their funds and assets to grow the size of the business (e.g. Delery and Doty 1996; Lee and Miller 1999; Lepak and Snell 2002; Richard and Johnson 2001). In addition, net profit margin is also an indicator of profitability that reflects how effectively organizations convert revenue into actual profit (Murphy *et al.* 1996).

Following the approach used in past studies (e.g. Collins and Clark 2003; Guest *et al.* 2003; Huselid 1995), we collected financial data from the year 2005 to create a one-year time lag for three reasons. First, we wished to address the potential problem of reverse causality by ensuring that the performance measures were collected after the HPWS measure (Guest *et al.* 2003; Wright *et al.* 2005). Second, as HPWS adoption may take several months or years to show a significant impact on organizational performance (Wright and Haggerty 2005), we believe that a one-year time lag was appropriate to capture the effects of the HPWS investment. Finally, we wanted to hold seasonal effects on business activities constant. The use of a three-month or six-month time lag would not have allowed us to rule out changes in performance that might have been due to seasonal fluctuations in business activities.

As the inter-item correlations between the three performance indicators were high ($r = 0.76$–0.88; all ps < 0.01), we employed a factor analysis to examine if these financial indicators could be combined into one organizational performance index (see Bhattacharya *et al.* 2005; Guest 2001). Following a principal axis factor analysis with an oblique rotation, the three indicators loaded on a single factor and the total variance explained by this factor amounted to 87.5 per cent (Cronbach's alpha for the three indicators = 0.90). Thus, we averaged the three financial indicators to create an organizational performance index.

(d) Control variables

According to the resource-based view, firms with superior resources are more likely to pursue unique strategies that competitors cannot easily imitate (Barney 1991). As large firms have greater resource advantages that allow them to execute more 'sophisticated' HR practices and achieve higher performance (Collins and Clark 2003; Datta *et al.* 2005; Huselid 1995), we included *firm size* (i.e. the number of employees) as a control variable. These data were collected from the Commonwealth Magazine survey database in 2004 and were transformed into the natural logarithm of the values. In addition, we also collected six firm-level variables from the *Taiwan Economic Journal Database of 2004* to control other factors that may have influenced HPWS and organizational performance, such as *total assets*, *the age of the company*, *the R&D intensity* (R&D expenditures-to-sales ratio), *the marketing* *intensity* (advertising expenditures-to-sales ratio), *the personnel intensity* (personnel expenditures-to-sales ratio) and *types of ownership*.[5] The descriptive information of these variables is presented in Table 2.

In order to capture more factors that can influence firms' investment in HPWS and operations, we also collected two subjective measures from the top HR executives. First, as competitive intensity can affect top management's willingness to introduce HPWS and organizational performance (Delaney and Huselid 1996; Fields *et al.* 2000), we added *competitive intensity* as a control variable. A single item from Fields *et al.* (2000) was adopted to measure the competitive intensity: respondents were asked to evaluate the extent of external competition that firms faced on a 5-point Likert scale (1 = none to 5 = a great deal). Finally, as organizational performance is partially determined by the degree of market share possessed by a firm (Delaney and Huselid 1996), we controlled for market share with a variable called *subjective market share*. A single item from Delaney and Huselid (1996) was used to measure this variable (i.e. Compared with other organizations that do the same kind of work, how would you compare your organizational market share over the last one year?). Respondents were asked to evaluate the extent of their market share compared with other competitors on a 5-point Likert scale (1 = much worse to 5 = much better).

Analyses

In order to test whether the effects of HPWS on organizational performance varied across different industries, we followed Guest *et al.*'s (2003) approach to separate the sample into two groups (i.e. high-technology firms and traditional manufacturing firms) and then conducted the hierarchical regression analysis separately (Cohen *et al.* 2003). To reduce the potential for multicollinearity arising from HPWS and HPWS squared, we adopted the procedure suggested by Aiken and West (1991): the HPWS score was centred by subtracting the mean, and then we calculated the variance inflation factor scores for all variables to ensure that they were below 10.0 (see Hair *et al.* 1995).

4. Results

Table 2 presents the means, standard deviations and correlations of all the study variables in the whole sample, whereas Table 3 shows the descriptive statistics for all the study variables in the two samples (i.e. correlations below (above) the diagonal are the correlations between study variables in high-technology firms (traditional manufacturing firms)). According to Table 3, subjective market share, R&D intensity and HPWS were all positively related to organizational performance in high-technology firms ($r = 0.26–0.36$, all $ps < 0.05$). In traditional manufacturing firms, HPWS was unrelated to organizational performance. In addition, subjective market share was positively

TABLE 2
Means, Standard Deviations (SD), Reliabilities and Correlations[a] among Variables in the Whole Sample

	Mean	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1 Total assets[b]	4.36	14.75	—										
2 Subjective market share	3.56	0.88	0.09	—									
3 Research and development intensity[c]	2.67	3.16	–0.05	0.17*	—								
4 Marketing intensity[c]	5.74	6.78	–0.11	0.08	0.09	—							
5 Personnel intensity[c]	3.37	1.91	–0.18*	0.12	0.36**	0.35**	—						
6 Firm age	26.78	16.04	–0.02	–0.05	–0.02	0.25**	0.05	—					
7 Subjective competitive intensity	3.85	0.64	0.02	0.01	0.10	0.10	0.02	–0.23**	—				
8 Firm size[d]	6.14	1.12	0.28**	0.14†	–0.05	–0.08	–0.06	0.21**	0.11	—			
9 Ownership	0.17	0.37	–0.11	–0.09	0.12	0.04	0.14	–0.06	0.02	–0.13†	—		
10 High-performance work systems	3.21	0.60	0.17*	0.20*	0.18*	–0.09	–0.01	–0.12	0.11	0.05	0.13	**(0.94)**	
11 Organizational performance[c]	8.27	9.05	0.01	0.33**	0.24*	–0.18†	–0.20*	–0.10	–0.06	–0.11	0.07	0.24**	**(0.90)**

[a] Cronbach's alpha coefficients are presented in boldface on the diagonal; † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (two-tailed).
[b] Natural logarithm of the total assets (in ten thousands).
[c] In percentage.
[d] Natural logarithm of the number of employees (in thousands).

TABLE 3
Means, Standard Deviations (SD), Reliabilities, and Correlations[a] among Variables in Two Samples

	Mean[b]	*SD*[b]	*Max*[b]	*Min*[b]	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1 Total assets[c]	3.68 (3.81)	1.33 (1.19)	8.48 (8.01)	1.88 (1.93)	—	0.01	–0.07	–0.12	0.29*	0.06	–0.01	0.31**	–0.09	0.13	0.07
2 Subjective market share	3.60 (3.51)	0.89 (0.88)	5 (5)	1 (2)	0.23*	—	0.19*	–0.02	0.23*	–0.01	0.04	0.23*	–0.15†	0.14†	0.34**
3 R&D intensity[d]	1.11 (4.05)	1.51 (3.56)	5.45 (15.96)	0.01 (0.18)	0.01	0.17	—	0.01	0.19*	0.15†	0.18*	0.12	–0.03	–0.05	0.06
4 Marketing intensity[d]	5.90 (5.60)	6.51 (7.05)	35.28 (45.7)	0.91 (0.42)	–0.12	0.17	0.16	—	–0.04	0.36**	0.11	0.10	–0.02	–0.14†	–0.31*
5 Personnel intensity[d]	3.05 (3.70)	1.82 (1.97)	8.49 (11.33)	0.47 (0.65)	–0.06	0.23*	0.37**	0.38**	—	0.07	0.07	0.59**	–0.02	–0.06	0.06
6 Firm age	29.23 (22.10)	14.13 (17.67)	78 (66)	3 (3)	–0.16	–0.11	0.03	0.12	0.05	—	–0.22*	0.28*	–0.12	–0.14†	–0.21*
7 Subjective competitive intensity	3.72 (4.02)	0.66 (0.68)	5 (5)	2 (2)	0.08	–0.01	0.01	0.07	0.02	–0.20†	—	0.07	–0.10	0.07	–0.02
8 Firm size[e]	6.02 (6.27)	1.04 (1.20)	9.01 (10.46)	4.20 (4.17)	0.23*	0 0.07	–0.20†	–0.23†	–0.11	0.18	0.11	—	–0.15†	0.01	–0.01
9 Ownership	0.15 (0.19)	0.36 (0.39)	3 (3)	1 (1)	–0.14	–0.02	0.14	0.10	0.14	0.01	0.14	–0.14	—	0.10	0.06
10 HPWS	3.18 (3.26)	0.66 (0.53)	4.53 (4.47)	1.20 (1.73)	0.20†	0.29*	0.25*	0.01	0.05	–0.08	0.16	0.08	0.15	**(0.94)**	0.11
11 Organizational performance[d]	7.69 (8.89)	6.84 (10.98)	20.94 (52.72)	–9.36 (–31.71)	–0.07	0.30*	0.26*	–0.05	–0.01	0.01	–0.12	–0.20†	0.08	0.36**	**(0.90)**

[a] Correlations below the diagonal are the correlations between study variables in high-technology firms ($N = 74$); while correlations above the diagonal are the correlations between study variables in traditional manufacturing firms ($N = 86$).
[b] Values in the parentheses are the means, SDs, maximum and minimum values of study variables in high-technology firms, while values above the parentheses are the means, SDs, maximum and minimum values of study variables in traditional manufacturing firms.
[c] Natural logarithm of the total assets (in ten thousands).
[d] In percentage.
[e] Natural logarithm of the number of employees (in thousands).
[f] Cronbach's alpha coefficients are presented in boldface on the diagonal; † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (two-tailed).

TABLE 4
Results of Hierarchical Regression Analyses in Two Groups

Variables	*Organizational performance*			
	High-tech firms[a]		*Traditional manufacturing firms*[b]	
	Model 1	*Model 2*	*Model 3*	*Model 4*
Total assets	–0.11	–0.1	0.07	0.08
Subjective market share	0.37*	0.31*	0.36**	0.37**
Research and development intensity	0.24*	0.25*	0.03	0.03
Marketing intensity	–0.15	–0.2	–0.25*	–0.26*
Personnel intensity	–0.16	–0.16	–0.03	–0.03
Firm age	0.07	0.07	–0.11	–0.11
Competitive intensity	–0.07	–0.05	0.01	0.02
Firm size	–0.21	–0.15	0.02	0.03
Ownership[c]	0.05	0.15	0.1	0.1
HPWS		0.26*		0.01
HPWS squared		–0.51**		—
ΔR^2, each step	—	0.30**	—	0.01
Total R^2	0.24**	0.54**	0.23**	0.24**

Note: Standardized regression coefficients (β) are shown in each equation.
[a] $N = 74$.
[b] $N = 86$.
[c] A dummy variable (i.e. 0 = Taiwanese-owned firms, 1 = Japanese/US-owned firms).
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$.
HPWS, high-performance work systems.

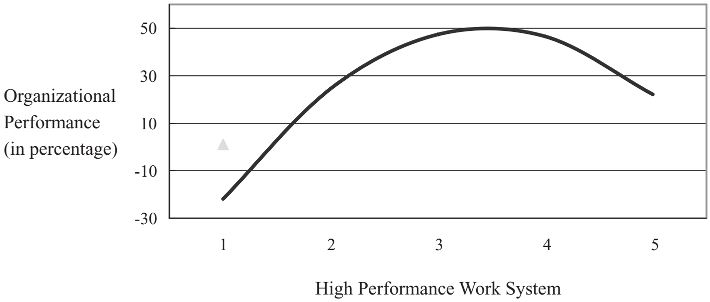
related to organizational performance ($r = 0.34$, $p < 0.01$), while marketing intensity and firm age were negatively related to organizational performance in traditional manufacturing firms ($r = –0.31$ and –0.21, all ps < 0.05).

Hypothesis Testing

Hypothesis 1 proposed that the relationship between HPWS and organizational performance is a curvilinear and inverted-U pattern in high-technology firms. Using organizational performance as the dependent variable, we firstly entered control variables (i.e. total assets, subjective market share, R&D intensity, marketing intensity, personnel intensity, firm age, competitive intensity, firm size and ownership) in step 1 and then added HPWS and HPWS squared as predictors in step 2 (see model 1 and model 2 in Table 4).

Table 4 presents the results of the hierarchical regression analyses. In the high-technology sample, subjective market share and R&D intensity were positively related to organizational performance ($\beta = 0.37$ and 0.24, all ps < 0.05; see model 1). Moreover, HPWS was positively related to organizational performance ($\beta = 0.26$, $p < 0.05$; see model 2), whereas HPWS squared was negatively related to organizational performance ($\beta = –0.51$, $p < 0.01$), which together indicate that a curvilinear relationship between HPWS and organizational performance exists in high-technology firms.

FIGURE 1
The Curvilinear Relationship between High-performance Work Systems and Organizational Performance in High-technology Firms.



Adopting Aiken and West's (1991) procedure, we plotted a graph to clarify the pattern of such a curvilinear relationship (see Figure 1). We firstly obtained the unstandardized regression coefficients from the regression equation from model 2 in Table 4. We then substituted the values of HPWS (from 1 to 5) to get the corresponding values of organizational performance. As such, we could plot the curvilinear relationship between HPWS and organizational performance. As expected, the association between HPWS and organizational performance formed an inverted-U pattern in high-technology firms. Thus, Hypothesis 1 was supported.[6]

For Hypothesis 2, we proposed that HPWS is positively correlated to organizational performance for traditional manufacturing firms. Using organizational performance as the criterion variable, we firstly entered the same set of control variables in step 1 and then added HPWS as the predictor in step 2 (see models 3 and 4 in Table 4). The results showed that subjective market share was positively related to organizational performance ($\beta = 0.37$, $p < 0.01$; see model 3), whereas market intensity was negatively related to organizational performance ($\beta = -0.26$, $p < 0.01$) in traditional manufacturing firms. However, HPWS was not significantly related to organizational performance for traditional manufacturing firms ($\beta = 0.01$, $p > 0.10$). Thus, Hypothesis 2 was not supported.

Additional Analyses

In order to facilitate comparisons with the previous literature and to know how sensitive the results were to the use of alternative performance measures, we performed a series of additional analyses with the sub-group regression analyses (i.e. separating into high-technology and traditional manufacturing firms) using comparative estimates of ROE, ROA, net profit margin, and productivity as the dependent variables.[7] In addition, because we argued that 'HPWS brings higher personnel costs when it exceeds an optimal level', we also included personnel costs as a dependent variable in the additional analyses. These results are shown in Tables 5 and 6.

TABLE 5
Results of Hierarchical Regression Analyses on Five Alternative Performance Indicators in High-Technology Firms

Variables	*Return on equity* Model 5	*Return on assets* Model 6	*Net profit Margin* Model 7	*Productivity*[a] Model 8	*Personnel costs*[b] Model 9
Step 1					
Total assets	–0.14	–0.20†	–0.15	0.13	0.35*
Subjective market share	0.25*	0.41**	0.31**	0.01	0.24†
Research and development intensity	0.29**	0.37**	0.39**	0.09	–0.18
Marketing intensity	–0.18	–0.18†	–0.05	–0.06	–0.09
Personnel intensity	–0.02	–0.15	–0.15	–0.26†	—
Firm age	–0.01	0.02	0.03	0.1	0.06
Competitive intensity	–0.15	–0.09	–0.13	0.01	0.17
Firm size	–0.03	–0.09	0.04	—	–0.1
Ownership[c]	0.1	–0.01	–0.1	0.30*	–0.05
Step 2					
HPWS	0.32**	0.21†	0.27**	0.02	0.18
HPWS squared	–0.56**	–0.46**	–0.56**	–0.34*	0.21†
ΔR^2, each step	0.37**	0.23**	0.36**	0.1	0.05
Total R^2	0.61**	0.59**	0.73**	0.20*	0.32*

Note: Standardized regression coefficients (β) are shown in each equation.
[a] We measured productivity as the logarithm of the ratio of firm sales to number of employees.
As firm size has been used to calculate the value of productivity, we removed firm size from model 8.
[b] As personnel intensity is highly correlated to personnel costs, we also removed personnel intensity from model 9.
[c] A dummy variable (i.e. 0 = Taiwanese-owned firms, 1 = Japanese/US-owned firms).
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; $N = 74$.
One extreme observation was deleted from the dataset ($N = 74$).
HPWS, high-performance work systems.

TABLE 6
Results of Hierarchical Regression Analyses on Five Alternative Performance Indicators in Traditional Manufacturing Firms

Variables	*Return on equity*	*Return on assets*	*Net profit Margin*	*Productivity*[c]	*Personnel costs*[b]
	Model 10	*Model 11*	*Model 12*	*Model 13*	*Model 14*
Step 1					
Total assets	–0.02	–0.03	–0.01	0.21†	0.18†
Subjective market share	0.46**	0.39*	0.27†	0.07	0.17†
Research and development intensity	0.08	0.15	0.17	–0.29*	0.08
Marketing intensity	–0.35*	–0.29*	–0.28†	–0.22†	–0.08
Personnel intensity	–0.16	–0.16	–0.04	0	—
Firm age	0.09	–0.04	0.15	–0.24†	–0.09
Competitive intensity	0.07	0.06	0.07	0.01	0.03
Firm size	0.1	0.17	0.16	—	0.64**
Ownership[c]	0.17	0.21	0.1	–0.03	0.13
Step 2					
High performance work systems	–0.05	–0.01	–0.05	–0.07	–0.14
ΔR^2, each step	0.01	0	0.01	0.01	0.04†
Total R^2	0.32**	0.32**	0.23*	0.30*	0.57**

Note: Standardized regression coefficients (β) are shown in each equation.
[a] We measured productivity as the logarithm of the ratio of firm sales to number of employees.
As firm size has been used to calculate the value of productivity, we removed firm size from model 13.
[b] As personnel intensity is highly correlated to personnel costs, we also removed personnel intensity from model 14.
[c] A dummy variable (i.e. 0 = Taiwanese-owned firms, 1 = Japanese/US-owned firms).
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; $N = 86$.

As can be seen in Table 5, after controlling for the effects of the control variables, HPWS still had a positive impact on ROE, ROA and net profit margin ($\beta = 0.21$–0.32, all *p*s < 0.10), while HPWS squared had a negative one ($\beta = -0.46$–-0.58, all *p*s < 0.01). These findings indicate that the curvilinear relationship between HPWS and organizational performance still holds even when we employed the three separate performance indicators. As for productivity, only HPWS squared had a negative effect on it ($\beta = -0.34$, $p < 0.05$). Finally, although only HPWS squared had a marginally significant association with personnel costs ($\beta = 0.21$, $p < 0.10$), HPWS still revealed the positive values we expected ($\beta = 0.18$, $p = 0.12$).

For traditional manufacturing firms, HPWS remained uncorrelated to ROE, ROA, net profit margin, productivity, and personnel costs after removing the influence of the control variables. This suggests that the benefits of HPWS on organizational performance are less evident in traditional manufacturing firms.

5. Discussion

Theoretical Implications

Building on the viewpoint of cost–benefit trade-offs and diminishing returns of HPWS (e.g. Bryson *et al.* 2005; Godard 2004; Jones and Wright 1992) as well as the contingency perspective (Guest *et al.* 2003; Jackson and Schuler 1995; Wright *et al.* 1994), the present study examines the relationship between HPWS and organizational performance in two different industries. Consistent with our expectations, the results show that the relationship between HPWS and organizational performance is an inverted-U pattern for high-technology firms. This finding confirms Godard's (2004) proposition that a moderate level of HPWS adoption outperforms a high level of HPWS implementation owing to cost–benefit trade-offs. Moreover, we also found that HPWS is positively related to personnel costs ($r = 0.23$, $p < 0.05$), providing preliminary evidence for the cost-benefit trade-offs argument (i.e. higher HPWS implementation leads to higher personnel costs). Past studies have predominantly focused on a linear relationship between HPWS and performance, but the curvilinear association obtained in the current findings may be due to the fact that previous studies omitted the existence of organizations with extremely high levels of HPWS, thereby limiting their ability to detect this curvilinear relationship. However, it should be noted that the variation in terms of HPWS implementation is not so large and only 10 per cent of high-technology firms (i.e. 7 firms) implemented extremely high levels of HPWS. In addition, about 31 per cent of high-technology firms (i.e. 23 firms) in our sample clustered around the 'optimal level' of HPWS. We encourage future researchers to collect a larger-scaled sample and to re-examine the current findings.

As for traditional manufacturing firms, we found that the relationship between HPWS and organizational performance was not statistically significant, which failed to meet our expectation. Therefore, we propose several possible explanations for this unexpected finding. One possibility could be the result of very strong positive and negative effects that offset each other (i.e. the nonlinear relationship). As such, we performed another additional analysis to explore this possibility. The results showed that neither HPWS nor HPWS squared significantly predicted organizational performance, which ruled out this possibility. Second, it is plausible that past researchers (e.g. Arthur 1994; Combs *et al.* 2006; Guest *et al.* 2003; Guthrie 2001) did not separate the manufacturers into high-technology and traditional manufacturing firms when testing the effects of HPWS on organizational performance. Therefore, those studies would not have directly tested whether the effects of HPWS on organizational performance differed across different industries. It is possible that the effect of HPWS on organizational performance is weaker for traditional manufacturing firms, but this was not directly examined in previous studies. Still, some studies have provided related empirical findings to support this explanation. For example, Kintana *et al.* (2006) found that HPWS had no significant effects on organizational performance in low-technology industries. Datta *et al.* (2005) also found that the relationship between HPWS and organizational performance was weaker under conditions of low industry differentiation. We encourage future research to verify our findings with a large-scaled sample that separates the manufacturers into high-technology and traditional firms.

Taken together, our study contributes to the literature by highlighting that the effects of HPWS on organizational performance were not equivalent across the high-technology and traditional manufacturing industries. As Guest (2002) mentioned, the basic assumption regarding HPWS is 'what is good for business is also good for employees', while the dark side of HPWS has been neglected (Appelbaum *et al.* 2000). Our study is one of the first to attempt to explore the possible negative effects of HPWS (e.g. Bryson *et al.* 2005; Godard 2001, 2004; Jones and Wright 1992). Moreover, the results of sub-group analyses showed that different patterns of HPWS–performance linkages exist across different industry types. These findings echo contingency scholar arguments that 'the effects of HPWS are not equal in different industrial environments' (Guest *et al.* 2003; Jackson and Schuler 1995; Wright *et al.* 1994). To further explore the boundary conditions of the HPWS–performance linkage, it would be beneficial for future researchers to examine this relationship carefully in sub-industries with distinct features.

Practical Implications

Our results highlight the necessity for HR executives to strike a balance between HPWS adoption and organizational performance. Thus, in order to identify a precise optimal level of HPWS implementation, it is useful to quantify the costs and benefits associated with HPWS investment (e.g. Datta *et al.* 2005). Huselid *et al.* (2001) suggested that HR executives use an *HR Scorecard* to align HPWS with HR metrics and firm strategies so that the costs and benefits of all HR practices on different performance indicators can be explicitly monitored. High-technology firm HR executives should pay more attention to the negative impacts of over-investment in HPWS.

Limitations and Future Research

A few limitations of our study should be noted. First, we chose the top 1,000 manufacturers in Taiwan as our population. This choice may raise the concern that 'good firms' might simultaneously generate good performance and implement high levels of HPWS, which in turn may have influenced the causal inference derived from our findings (Becker and Huselid 2006). If this concern is true, then our sample would have only included those firms with superior performance and the HPWS implementation should have consistently and positively related to organizational performance. However, as we mentioned in the method section, there were significant variations within our sample in terms of firm size, firm capital, and total sales, which indicate that our sample was likely to comprise firms with high or low performance. In addition, the execution of HPWS only significantly influenced organizational performance in high-technology firms, but not traditional manufacturing firms within our sample. These findings should have helped to reduce the possibility of 'good firm effects'. In order to further mitigate this concern, it would be fruitful for future researchers to select from the population sample firms with high levels of performance variation.

Second, although we have tried to partial out the effects of potential confounding variables on our findings, we did not include other types of management practices as control variables. For example, Snell and Dean (1992) found that adoption management practices such as advanced manufacturing technology, just-in-time inventory control and total quality management influence the implementation of HPWS. In addition, Powell and Dent-Micallef (1997) suggested that the adoption of information technology enhanced the positive impacts of HR on organizational performance. Therefore, it would be fruitful for future research to control for more management practices and re-examine our findings.

Finally, because the data and the scope of the analyses were based on Taiwanese firms, the generalizability of our findings could be limited. However, as Bae *et al.* (2003) indicated, the impacts of HPWS on organizational performance in Taiwanese firms were relatively similar to the findings from firms in other Asian countries (e.g. Korea, Thailand and Singapore). As such, we believe that our findings could be generalized to other Asian manufacturing firms. Future research could further implement the cross-cultural comparisons (e.g. using samples collected from manufacturing firms from Eastern and Western countries) to examine the generalizability of our findings.

To further extend the nomological network of the HPWS model, we propose some directions for future research. Whetten (1989) highlighted the importance of examining qualitative changes within the boundaries of a theory. Thus, we encourage future researchers to further explore the boundary conditions of the curvilinear relationship between HPWS–performance linkages. Accordingly, it would be useful to constructively replicate this curvilinear relationship in different settings (e.g. the service industry). Based on propositions recommended by Jackson and Schuler (1995), another direction for future research is to test whether the cultural environment, sociopolitical environment or economic environment moderate the relationship between HPWS and organizational performance. As external environments may determine the optimal level of HPWS investment (Bae *et al.* 2003; Jackson and Schuler 1995), we expect that patterns of the curvilinear association between HPWS and organizational performance may vary under different cultural, socio-political or economic environments.

In conclusion, this study tests the relationship between HPWS and organizational performance for high-technology firms and traditional manufacturing firms and finds a curvilinear relationship for the former and a nonsignificant relationship for the latter. We believe that these results can open a window for HR executives and researchers to further explore alternative relationships between the HPWS and organizational performance under different cultural, social, political, economical or industrial environments.

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Notes

1. According to a survey by the Small and Medium Enterprise Administration of the Ministry of Economic Affairs in Taiwan, there were 134,172 established manufacturing firms in Taiwan in 2005.
2. If the sample firms did not include 'HR executive' in their job title, we invited the personnel or administrative executives who were responsible for the HR affairs of these firms to participate in our study.
3. The personnel costs of sample firms were collected from another public available database: the *Taiwan Economic Journal Database*. The data pertaining to subjective organizational performance were also collected from HR executives using Delaney and Huselid's (1996) scale.
4. We collected the R&D intensity and the personnel intensity data from the *Taiwan Economic Journal Database* to capture the sample firms' investment in R&D and HR. The competitive intensity data were collected from HR executives using Fields *et al.*'s (2000) 5-point Likert scale.

5. The ownership data of each company were also collected from *the Commonwealth Magazine survey centre database in 2004*. According to the available data, 135 of the 160 firms in our sample were Taiwanese owned, 10 firms were Japanese owned and 15 firms were US owned. We created a dummy variable for ownership (e.g. 0 = Taiwanese-owned firms, 1 = Japanese/US-owned firms) and added it as an additional control variable for subsequent analyses.
6. We randomly separated the high-technology firms into two groups according to the firm id numbers (i.e. the odd numbers vs the even numbers) and re-ran the analyses again. The results showed that the findings were similar for two groups: HPWS was positively related to organizational performance, whereas HPWS squared was negatively related to organizational performance. As such, the finding of a curvilinear relationship should be robust for our sample.
7. We thank Alex Bryson for his insightful suggestions on these points.

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