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IMPROVING LABOR PRODUCTIVITY: HUMAN RESOURCE MANAGEMENT POLICIES DO MATTER

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Despite the consistency with which the theoretical and normative connections between human resource management practices and firm-level performance outcomes are made, empirical studies that link the two are sparse. This paper presents results from a study of 319 business units that addresses this gap. Hypotheses are derived from a resource-based perspective on strategy. Positive and significant effects on labor productivity are found for organizations that utilize more sophisticated human resource planning, recruitment, and selection strategies. These effects are particularly pronounced in the case of capital-intensive organizations.

INTRODUCTION

The way in which a firm manages its human resources is increasingly recognized as centrally important to execution of its strategy (Hambrick *et al.*, 1989). Despite the consistency with which the theoretical and normative connection is made between human resource management and firm-level performance outcomes, empirical studies that link the two are sparse. Recent empirical studies tend to pursue what Snell (1992) terms a 'behavioral' perspective. In this perspective, firms elect to follow strategies that require employees to behave in certain ways. The central questions are thus which practices will elicit behavior consonant with the firm's chosen strategy, on the one hand, and how certain types of rewards come to be used, on the other. The emphasis in this body of work is upon compensation, incentive, reward and control systems (see, for example, Finkelstein and Hambrick, 1989; Fisher and Govindarajan, 1992; Galbraith and Merrill, 1991; Gomez-Mejia, 1992).

While few would dispute that rewards are powerful mechanisms to elicit desired behavior, they represent only a part of a firm's total human resource management strategy. Indeed, extant theory suggests at least three other 'generic' human resource functions that deserve attention. These are appraisal, selection and development (Tichy, Fombrun, and Devanna, 1982; Devanna and Tichy, 1992). In this paper, we take a closer look at aspects of these functions, arguing that mechanisms routinely used for discerning the number and types of employees needed, their hiring, and development fundamentally influence their productivity. Our discussion is grounded in the resource-based perspective on competition, which argues that a highly productive workforce is likely to have attributes that make it a particularly valuable strategic asset. Superior workforce productivity can be difficult to imitate; can-

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not be replicated quickly; may draw upon idiosyncratic routines and know-how; may be uniquely valuable in a given firm setting, and may add unique value to new strategic input factors (see Barney, 1991; Dierickx and Cool, 1989; Petaraf, 1993). For these reasons, we suggest that a central objective of the human resource management function of a firm is to enhance the firm's competitive position by creating superior 'human capital' resources, in parallel with the product/market strategy the firm pursues at any given time. Our argument thus focuses on human capital strategy, rather than on incentives and compensation.

We begin by drawing a connection between the resource-based perspective on strategy and human resource management. In our view, the resource-based view offers a useful basis for understanding why human resource management makes a potential contribution to performance at the level of the firm. This is followed by a conceptual framework in which it is suggested that investments in certain human resource activities, specifically with respect to human resource planning, hiring and employee development, have a positive effect upon performance, in the form of labor productivity. We then present the methods that we used to test these ideas on a sample of 319 business units. Our results indicate significant positive relationships for human resource policy variables in the framework, even when the powerful effects of industry, capital intensity, unionization and technology are controlled for. We conclude with a discussion of our findings.

WHEN DO INVESTMENTS IN HUMAN RESOURCES PAY OFF?

The resource-based view of competitive advantage: An overview

The strategic management literature has begun to place increased emphasis on idiosyncratic firm resources as predictors of performance. Three kinds of resources, in particular, are often distinguished: physical resources, such as assets and technologies; organizational resources, such as reporting structures and cultures; and human resources, representing the know-how and skills of individuals working in the organization (Hitt and Ireland, 1986; Barney, 1991). Our focus here is upon the last of the three. Of particular interest are firms' processes for creating and sustaining this 'strategic asset' through human resource policies (Amit and Schoemaker, 1993).

Strategies drawing upon such processes, theory suggests, result from two interacting dynamics. The first is fundamental heterogeneity in the productive potential of organizations. As was initially pointed out by Penrose (1959), firms are heterogeneous with respect to the outputs they create, even when the inputs they utilize are substantially similar. In other words, firms will differ in the ways they utilize and combine factor inputs, thus yielding outputs whose 'services' cannot be predicted *ex ante*, even with a comprehensive understanding of the input resources utilized in their production (see also Barney, 1986). This idiosyncrasy yields superior performance for those firms that are able to create more efficient or attractive outputs as a result of the way in which they use their resources. Hence, firms with superior human resource utilization are likely to experience superior performance.

Given this conclusion, why would competitors not simply imitate those combinations that created advantage once their superiority has been demonstrated? To explain why rapid imitation is often inhibited, resource-based theory draws upon a second dynamic, or set of concepts: routines and path dependence (Nelson and Winter, 1982; Teece, Pisano, and Shuen, 1991).

Routines are usually understood to represent repetitive patterns of behavior within an organization. Processes such as combining and allocating resources in a firm to create some set of outputs rapidly become routinized. Routines become 'the most important form of storage of the organization's specific operational knowledge' (Nelson and Winter, 1982: 99). Certain qualities of routines, such as tacitness and complexity, lead to causal ambiguity, that makes imitation by competitors difficult (Reed and DeFillippi, 1990). Difficulty of imitation is exacerbated to the extent that even those carrying out routines may not consciously be aware of them. Substantial evidence suggests that people carry out repetitive tasks by relying on procedural, rather than on conscious, memory, meaning that they are not aware of nor could they articulate the nature of routines, even if they are intensely involved in carrying them out (Cohen and Bacdayan, 1991). These characteristics of routines create immobility

of knowledge and immobility of procedures in resource combination. These routines then 'stick' to the organization in which they were developed.

Routines, moreover, build upon one another in a path-dependent way. Many valuable assets possessed by firms (human capital among them) exist only as a result of sustained investments over time, as is pointed out by Dierickx and Cool (1989). They use the example of a forestry business to illustrate: no matter how large the 'war-chest', a competitor simply cannot accelerate the growth of a forest. Similar arguments can be made for the systems and communications linkages that are the core of many modern businesses. Strategic choices thus often have the effect of directing 'flows' of assets and routines, which accumulate.

By extension, an important objective of human resource management strategy could be articulated as establishing policies which, by directing how human resources are acquired and developed, result in the creation of firm-specific, inimitable assets in the form of knowledge, skills and abilities embedded in the human capital of the organization and useful only to that firm. Specific human resource management practices, such as the approach to employee development adopted by the firm, are indicators that a firm pursues a strategy that is likely to result in particularly valuable human capital assets. Here, we assess the utilization of these practices and the results they obtain, as indicators that the firm has successfully created valuable assets in its people. A key strategic question is, thus, whether certain policies are associated with the creation and maintenance of human capital as a strategic resource. We turn now specifically to this question.

Human resource management sophistication: a conceptual framework

Figure 1 presents the conceptual framework for the constructs of concern in this study. The central theme of our framework is that certain human resource strategies—namely, the accurate projection of human capital needs, the identification of individuals best suited to meet organizational objectives, and the development of employees—are expected to be positively associated with superior workforce performance. We turn now to a discussion of each construct in the framework.

Performance: Labor productivity

Labor productivity has been defined by Samuelson and Nordhaus as 'total output divided by labor inputs' (1989: 980). As such, achieving a high degree of labor productivity is an outcome that most would agree is desirable. Labor productivity taps the extent to which the human capital is delivering value to the firm. If a firm's strategy is effective, it should be able to find good people and put them to good use. A firm that excels in the creation of human capital resources should have people who are highly productive relative to the competition. How might this manifest itself? A broadly accepted perspective is articulated by Porter (1985: 42). He argues that human resource management policies can represent a significant source of competitive advantage because they allow a firm to locate and develop employees who are more effective than those of competitors. Superior emplóyees create superiority both in primary value chain activities (such as managing inbound logistics) and in support activities (such as development of a high-quality infrastructure). Porter thus posits strong interactions between the quality of a firm's human resource management practices and its sources of advantage in competitive markets.

Such a workforce fits the spirit of resource-based competitive advantage exactly. Highly productive people are a relatively rare, difficult-to-imitate, resource (in the spirit of Barney, 1991) or a 'superior productive factor which is in limited supply' (Petaraf, 1993: 180). Indeed, the notion that firms are unique in the way that they combine and utilize human resource inputs, resulting in distinctive outputs, draws directly from the theory of firm growth originated by Penrose (1959). Such a resource should drive superior performance. The construct that we seek to explain in our analysis is thus labor productivity.

Investments in human resource planning

Human resource planning is defined as analyzing an organization's human resource needs under changing conditions and developing the activities necessary to satisfy these needs (Walker, 1980). Firms that practice human resource planning are more likely to know what specific characteristics they are looking for in applicants, and can there-

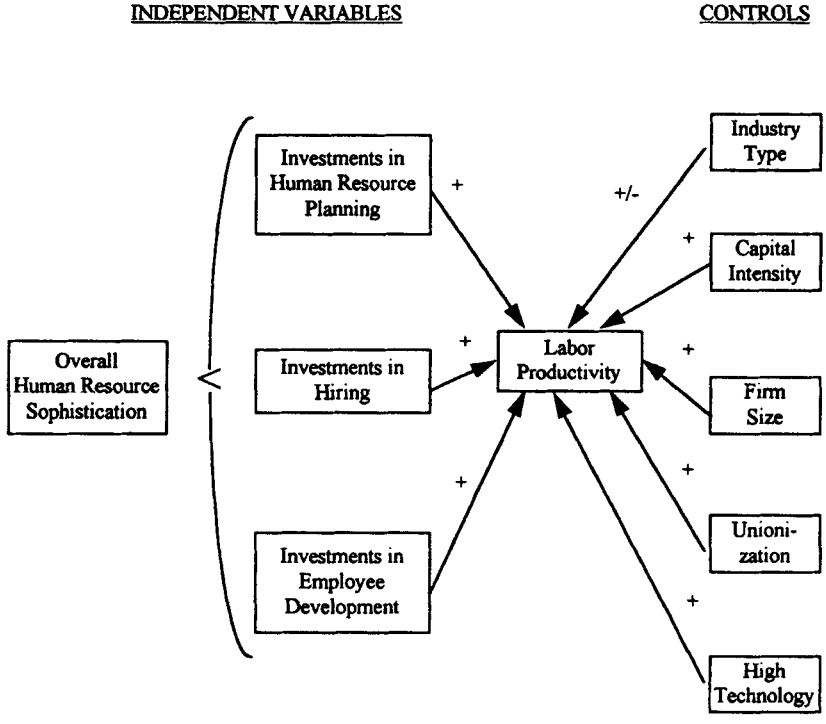

Figure 1. Effects of human resource management sophistication on labor productivity. Note: It is hypothesized that capital intensity and each of the three human resource indices will have interactive and positive effects on labor productivity that are not portrayed in the model.

fore improve the quality of hiring decisions (Craft, 1980). To the extent that a firm can consciously and proactively determine the composition of the workforce that it will need to achieve its strategic objectives, it ought to be able to accomplish those objectives with more precision than a firm that is not able to do so (Walker, 1980).

According to Noe and his co-authors (1994: 318), human resource planning, when implemented properly, 'creates the kind of lead time necessary to ward off potential problems that might otherwise threaten the company's competitive position.' These authors see human resource planning as 'perhaps the most critical aspect' when looking to human resource policies as a means of gaining a competitive advantage. In addition, consider a decade of research that examined the workforce attributes and management policies of Japanese firms. In this body of research, success is often attributed to greater efficiency in deploying and coordinating people (see, for example, Nonaka, 1990; Kagono *et al.*, 1985). This also suggests that to the extent that firms plan for their future hiring requirements, they are likely to succeed in securing the right amounts and types of the right human resources.

Linked with, but not identical to, human resource planning is the manner in which hiring practices are evaluated. Evaluating recruitment and selection practices provides the opportunity for the firm to learn which policies and programs have been demonstrated to be beneficial to the firm and which have not (Heneman *et al.*, 1989). Firms that formally and regularly evaluate their hiring policies are likely to make better-informed adjustments to these policies than firms that do not. As writers suggest that human resource management assumes a position at the locus of key organizational decisions, they also recommend the adoption of benchmarks, metrics and policies that allow the effectiveness of the function to be evaluated (Ulrich, Brockbank, and Yeung, 1990). Further, formal, regular evaluation of recruitment and selection practices allows for the discontinuation of those practices that have not yielded good results in the past (Milkovich and Boudreau, 1988). Hence:

Hypothesis 1: Human resource planning sophistication will be positively associated with labor productivity.

Investments in hiring

The better a firm's human resource planning function, the more likely it is to have insight about the kind of workforce that is required. A subsequent challenge is actually acquiring such a workforce. The acquisition of human resources shares many characteristics with the acquisition of other kinds of strategic factors. In particular, managers faced with the problem of selecting the right inputs confront inevitable uncertainty (Amit and Schoemaker, 1993). In the case of human resource acquisition strategy, this uncertainty manifests itself in the difficulty of knowing, in advance, how well a given individual will perform once hired. Information about a person's real ability to contribute to the competitive position of a firm is not available until after the hiring decision has been made and he or she has joined the firm (Stigler, 1961). Thus, employers are forced to rely upon recruitment and selection practices to increase the quality of information concerning future performance potential of job applicants (Rees, 1966).

We shall argue that, in general, the more effort an employer is willing to make to reduce uncertainty about the future value of new people, the greater labor productivity it will enjoy. Thus, the better the employer 'knows' the labor market, in terms of worker supply and skills distribution, for example, the better informed its hiring choices will be (Malm, 1954; Stigler, 1961).

There are two primary ways for an organization to reduce *ex ante* uncertainty about the future potential of recruits. These are analogous to how a buyer gathers information regarding the best price for an item in the market (Rees, 1966). As Rees put it, '[a] buyer can search at the extensive margin by getting a quotation from more than one seller. He can search at the intensive margin by getting additional information concerning an offer already received' (1966: 560).

In the case of hiring, search at the *extensive margin* involves seeking out a greater number of potential applicants. Thus, employers can increase effort with respect to search extensiveness by using more recruiting sources to reach different pools of potential applicants (Schwab, 1982). Additionally, they might increase the number of candidates screened per hire (Brogden, 1949; Hunter and Schmidt, 1982). Both of these activities have been hypothesized to improve performance (Rees, 1966; Brogden, 1949; Hunter and Schmidt, 1982; Schwab, 1982) by giving employers fuller information about the labor market and its associated applicant pool.

The second mechanism for reducing uncertainty concerning the abilities of job applicants involves increasing the amount of information that can be used to compare individuals within the labor market and is referred to as *intensive search* (Rees, 1966). The search for information about potential employees at the intensive margin involves increasing the amount of information gathered about each applicant in the pool before making a hiring decision. Here, mechanisms such as selection and screening tests are frequently used to predict performance on the job (Hunter and Schmidt, 1982). Selection tests seek to identify candidates with both desirable properties (such as aptitude) and undesirable properties (such as substance abuse). The goal is to hire those with desirable characteristics, and to avoid those with undesirable characteristics. In either case, performance should be enhanced by using selection tests, since their use results in both a workforce of individuals who are better matched to their jobs than would be possible sans screening, and a workforce that does not include those who have undesirable qualities (Bishop, Barron, and Hollenbeck, 1983).

Assuming a sufficiently well-populated labor market from which to choose, firms that take more care in their search, by increasing information at both the extensive and the intensive margins, are more likely to be able to access high-quality new employees. To the extent that these processes allow them to induct better people, we might expect that these 'better people' will positively influence the labor productivity of a firm.

Of course, it is not expected that the acquisition of information pertaining to applicants' productivity is costless; nor it is the case that false or misleading information about job applicants will enhance employee productivity. Thus, two caveats pertaining to the benefits of intensive and extensive search as a means to improve labor productivity are offered: first, that the returns to investments in hiring are marginally diminishing

in nature; and second, that the information gathered accurately reflects and relates to potential productivity.

Hypothesis 2: Investments that increase productivity-related information about applicants in the hiring process will be positively related to labor productivity.

Investments in employee development

We have now touched upon strategies a firm might use to develop insight into the employees that it needs, and to reduce uncertainty, *ex ante*, about how well they will perform. A further human resource management policy decision involves the mechanism through which the firm actually realizes the potential of its people; namely its strategy for developing employees. In particular, we consider the provision of training by the employer and the utilization of promotion-from-within to fill vacancies. According to resource-based theory, there are a number of reasons why investing in training and utilizing promotion-from-within as part of a firm's development strategy should pay off. We shall focus on three: namely, the extent to which internal development creates human capital assets that are specific to the firm; the extent to which these firm-specific skills afford protection from rapid, competitive appropriation of strategic assets; and the extent to which employee development saves the firm the expense of hiring people with demonstrated skills in external labor markets. That is, a firm that develops people internally may be able to enjoy productivity returns that do not require making investments in human 'strategic factors' in open competitive markets (Barney, 1986).

Company-sponsored training often increases the firm specificity of employee skills, decreasing the likelihood that other firms would be able to deploy these trained workers in an equally productive manner. Employees with firm-specific skills are then retained by the firm that utilizes promotion-from-within as a primary mechanism for filling vacancies. A firm that pays for training and that subsequently fails to promote from within is arguably failing to capitalize on its investment.

These notions echo ideas pioneered by Becker (1964: 166), who proposed that it makes economic sense for firms to invest in training that 'has no effect on the productivity of trainees that would be useful in other firms'. A distinction between Becker's argument and that of resource-based theory is that Becker suggests that some kinds of training are equally useful to a firm and to its competitors, in which case the firm offering the training pays a cost that can actually subsidize competitors in the event that employees are hired away. Resource-based theory, on the other hand, suggests that fundamental heterogeneity and firm-specific routines virtually never allow an employee trained in one firm to be of equal use at the same price in another (although the extent to which this is the case will vary from situation to situation, and firms may be willing to pay wage premiums for employees with special training or skills). A corollary to this idea is that any training that upgrades workforce skills should have a positive productivity effect. This will tend to be exacerbated by the extent to which specificity of skills provides an extra increment to labor productivity in a given firm. Thus, theory suggests a strong connection between investments in development and subsequent, comparative productivity of a firm's human capital.

If training creates a highly productive workforce, why would such practices not rapidly diffuse to all competing organizations? The answer, we suggest, lies in path dependence, in which the benefits of training and internal promotion accumulate over time, creating 'bundles' of routines that are difficult to understand or imitate. Resource-based researchers argue that building such bundles of routines is an important driver of performance. The idea of an organization's core competencies, for example, is strongly linked to cumulative learning and investments to capitalize on that learning made by the organization over time (Prahalad and Hamel, 1990). A 'core' competence, as usually defined, means that a firm is able to create unusually attractive products or services, and further, that competitors must find it difficult to duplicate the source of this attractiveness. This echoes Dierickx and Cool's (1989) argument that 'time-compression diseconomies' may offer advantages to those with a head start in building up valuable resources. Hence, accumulated benefits of training and internal promotion act to preserve heterogeneity and prevent competitive erosion, thus allowing some firms to follow practices that give them unusual pro-

ductivity without this instantly diffusing to all competing firms.

Now a firm does not necessarily have to grow its own talent. It can also acquire people with important skills in the external labor market. The difficulty is that the firm should expect to pay more to hire those it needs when their market value can be easily established. This follows the argument offered by Barney (1986), who suggests that the market for strategic input factors (such as employees) will automatically adjust the price of those factors to reflect what is known about their value. Hence, people whose valuable skills are not only well-known but that can also be measured and credentialed (such as medical doctors or actuaries) are able to command a premium price for their services (see also Cappelli and Cascio, 1991).

Firms that do not make investments in developing employees can thus anticipate having the expected value of skills factored into the price they must pay for workers hired from the external market. The issue is then that unless the organization has a unique way of leveraging proven skills, it should not be able to enjoy unusual productivity from them, since any competitor could theoretically acquire the same skills on the open market. Further, the better known the skills are, the more the firm can expect that competitors will imitate, appropriate, or 'raid' the skills away. This is exactly the situation in which investment banks and brokerage houses find themselves: employees with well-known skills are hired away, taking with them large portions of the organization's competitive endowment. In the case of the firm that endows employees with the skills it deems important through training and internal promotion, the opposite condition should apply. In such circumstances, the firm may seek to develop skills that are most productive within its own idiosyncratic context. Such skills are unlikely to command a wage premium on the open market, simultaneously preserving them for the firm and preventing competitors from being able to acquire or exploit them with ease (Becker, 1964).

Together, the above arguments suggest that investments in development are likely to pay off in terms of employee productivity. Hence:

Hypothesis 3: Investments in employee development will be positively related to labor productivity.

Capital intensity

Superior productivity becomes crucial in industries in which firms are required to make heavy investments in plant, equipment, or other assets (Hayes and Wheelwright, 1984). Consider firms in such capital-intensive industries as chemical or aluminum production, shipbuilding, or air transport, in which overcapacity leads to vicious price competition; closing down a facility is often inordinately difficult and expensive; and heavy fixed costs engender margin-based pricing (sometimes associated with 'dumping' in overseas product markets). In such situations, productivity per employee becomes decisive for profitability, as the firm must recoup its investments in assets and equipment, as well as its costs of operations, if it is to be profitable (Porter, 1985).

Moreover, high levels of capital intensity have the effect of leveraging the risk to the firm of a poorly chosen or trained employee. Consider, for example, the damage done by the grounding of the *Exxon Valdez* oil tanker (related to employee impairment), the dangers represented by airline pilot error, or the potentially tragic consequences of impaired railroad engineers. The leverage represented by significant investments in assets can thus also increase the potential downside of poor employee performance. We demonstrate this point algebraically in Appendix 1.[1]

We suggest, therefore, that the capital intensity of the organization will magnify the productivity effects of human resource management policies. In other words, any positive productivity effects of investments in human resource planning, hiring, and developing employees will be pronounced to the extent to which labor is leveraged by costly capital assets. This implies an interaction effect between investments in human resource management practices and level of capital intensity in the firm.

Hypothesis 4: There will be a positive interaction effect upon labor productivity between investments in human resource planning, hiring and employee development, respectively, and capital intensity.

The above argument, taken in its entirety, rep-

[1] Thanks to Ian MacMillan for his assistance in the development of this proof.

resents an interesting means of empirically testing some key tenets of resource-based theory. Given the centrality of human resources in most resource-based arguments, if investments in human resource management do not enhance the productivity of human capital, the assertion that firms will enjoy performance benefits by making such investments is called into question. On the other hand, if such policies do have a discernible impact on the productivity of the firm, these findings would be a powerful statement in support of the resource-based view of firm competitiveness. Let us now turn to the method by which we test these ideas.

RESEARCH METHOD

Sample

The hypotheses developed above were tested by regression analysis using a data set constructed from several sources. The human resource policy data were collected as part of a larger survey conducted at the Columbia University Graduate School of Business. The survey was sent to the 7765 executives in charge of the business units reported in the Compustat II files, a computerized data base published by Standard & Poors containing financial information. *Business units* are defined as a subunit of a company having 10 percent or more of total sales and assets of the organization. In contrast to companies, using business units as the unit of analysis allows for more exact classification by industry, given the high degree of diversification among U.S. companies. Responses were received from 495 business units (6.5 percent response rate). Of these, 319 questionnaires contained information for all the variables used in this study.

In order to see if the sample was representative of the larger population, respondents were compared to nonrespondents. Similar industrial distributions between respondents and nonrespondents were found, though respondents tended to be somewhat larger and more profitable than nonrespondents (see Delaney, Lewin and Ichniowski, 1989, for a detailed discussion of respondent/nonrespondent comparisons).

Furthermore, in order to show that respondents were representative in terms of their human resource management practices, they were compared with firms taking part in the Bureau of National Affairs' (BNAs) *Personnel Policies Forum Survey* from May 1988. The results indicated an overall similarity in the recruiting sources and selection instruments used by the BNA's survey participants and the respondents used in this study. Moreover, distribution of size of the organizations in both studies was the same: both surveys had 54 percent small (i.e., fewer than 1000 employees) and 46 percent large (i.e., more than 1000 employees) organizations in their samples. Thus, while the overall response rate was low, respondents do not differ significantly from either nonrespondents or respondents to other, similar surveys.

Another way of handling a low response rate is to test formally for sample selection bias.[2] A good exposition of this correction technique is given by Berk (1983) in the *American Sociological Review*. The sample selection bias correction technique is appropriate in those cases where 'potential observations from some population of interest are excluded from a sample on a nonrandom basis' (Berk, 1983: 390). In the case of the present study, in light of the low response rate, it is reasonable to ask whether there is some systematic explanation attached to firms' decisions to respond to the questionnaire or not. If there is, it could be the case that the matter of interest (i.e., the effect of human resource practices on labor productivity) may be confounded by a firm's decision to respond to the survey or not. And what the sample selection bias correction does, in effect, is to correct for this effect.

As noted by Berk (1983), sample selection bias, in principle, exists for any and all data sets (but is minimized, he notes, in randomized experiments). The significant question is, therefore, 'whether the bias is small enough to be safely ignored' (p. 392). Hence, we have tested for the effect of sample selection bias in this study, and we briefly describe the method now (following Berk, 1983).

First, the probability of responding to the survey as a function of certain factors is estimated. Specifically, using data for the entire population to which surveys were sent, a probit model is estimated in which the dependent variable is coded as a dummy variable taking on the value

[2] Thanks to an anonymous reviewer for this suggestion.

of '1' if the firm responded to the questionnaire, and '0' if not. The explanatory variables in this model included: industry (two-digit SIC code), identifiable assets of the firm (in millions of U.S. dollars), operating income of the firm (i.e., profits), and percent unionized in the industry.

The predicted values from the probit estimation are saved, and in the second step are used to construct the hazard rate (also known as the inverse of the 'Mills ratio'). The hazard rate is derived by multiplying the predicted values by -1.0, calculating the density and distribution values, and plugging them into the equation:

$$\text{hazard rate}_i = f(z_i)/1 - F(z_i)$$

where z_i are the predicted values from the probit model.[3]

Finally, this new variable, the transformed predicted value—or hazard rate—is then added to any models to be estimated by ordinary least squares.

Returning to the survey of human resource management practices, questions in it concerning human resource practices were asked of each business unit manager for the following seven worker categories: managers, unionized professional and technical employees, nonunion professional and technical employees, unionized clerical employees, nonunion clerical employees, unionized manufacturing and production workers, and nonunion manufacturing and production workers.

Performance data and other control variables were drawn from both the survey and the 1986 Compustat II Industry Segment data files described above.

Measures: Dependent variable

Labor productivity

The dependent variable, labor productivity, is measured by dividing the business unit's net sales (in millions of dollars) by the number of employees. We thus compare the input of labor to the output of sales.

[3] Note that this process of estimating the probit model, transforming the residuals, and outputting a new variable is done easily using software called LIMDEP, developed by William H. Greene.

Measures: Independent variables

Investments in planning

The responses to two questions from the human resource survey were used to create the human resource (HR) planning index. The first question asked whether or not *the business unit formally plans for the number of workers and skills needed to run the business in the future.* The second question asked whether or not *the human resource department formally evaluated its selection and staffing policies.* The responses to both questions were coded '1' if the answer was yes and '0' if no, and added together to create the HR planning index. Thus, the HR planning index ranges in value from zero (if no human resource planning or formal evaluation of the hiring process are done) to two (if both are regularly carried out). This index was used in the analysis presented here.

Investments in hiring

The following questions concerning recruitment and selection strategies were posed in the survey for each of the seven worker groups: (1) *for each employee hired, how many candidates are interviewed on average?* (2) *which recruiting sources are regularly used to identify and recruit employees?* (employee referrals, graduate and undergraduate institutions, search firms, private and government employment agencies, walk-ins, newspaper advertisements) and (3) *which selection tests are the candidates required to take?* (skills tests, aptitude tests, drug tests, and physical examinations).

The measures pertaining to extensive search of the labor market include the number of interviews conducted per hire and the number of recruiting sources used. The variable representing interviews per hire is measured by a weighted sum of the number of interviews per hire for each of the seven job categories. The weights used equal the proportion of employees in each occupational category. So, for instance, the number of interviews for managers was multiplied by the number of managers in the business unit and added to the number of interviews for unionized professionals times the number of unionized professionals, etc., for all seven occupational categories, and the total was divided by total employees. Similarly, the

variable representing the number of recruiting sources is given by a weighted sum of the number of recruiting sources used for the seven job categories. Measures of intensive search include whether skills tests, aptitude tests and drug tests are required of applicants and are also weighted as described above.

A hiring index was subsequently developed that measures the extent and sophistication of a firm's recruitment and selection practices. It is operationalized by adding the number of interviews per hire, the number of recruiting sources used, and whether or not selection testing is used, each weighted as described above.

Investments in employee development

The amount of formal training given to employees by the firm is measured by a weighted sum of the number of job categories receiving formal training. The use of internal promotions is measured by the weighted percentage of nonentry-level job vacancies that are filled by internal sources.

An employee development strategy index was developed that measures how the business unit develops its employees. It is operationalized by adding the weighted number of formal training programs offered to employee groups and the extent to which promotions from within are used.

Overall human resource sophistication

A composite index, in which the scores on the human resource planning, hiring and employee development indices are added was created to assess overall human resource 'sophistication'.

Measures: Control variables

We sought, to the extent possible, to control for systematic variance that is not due to the variables of interest in our study. Toward that end, we have included measures for other factors affecting labor productivity as controls.

1. *Business-unit size.* Size is cited in many studies as having a potentially important effect upon labor productivity, primarily because larger firms are associated with larger scale of operations. As Istvan points out, 'productivity comes from scale effects as fixed capital costs are substituted for variable labor costs and amortized over sufficient volume to achieve a net economic gain' (1992: 526). Size in this study is measured by the total number of employees. The natural log of size is used in analyses owing to the range of values for this variable (from 2 to 316,900).
2. *Degree of unionization.* While the effects of unions on measures of organizational performance can be both positive (e.g., reduced turnover, reduced competition among workers, and offering employees a 'voice' to air and settle grievances) and negative (e.g., rigid work rules, possibility of strikes or slowdowns, and seniority rules), the net result of numerous empirical studies investigating this question indicates that unionized establishments are more productive on average than nonunionized establishments (Noe *et al.*, 1994; Freeman and Medoff, 1984). Unionization is measured in this study by the percentage of the business unit's workforce that is covered by collective bargaining.
3. *Industry.* We should expect to find differences among industries in the overall level of both labor productivity and utilization of various human resource practices (Ulrich *et al.*, 1990). Dummy variables were used to control for industry effects. The industry groups represented include agriculture, mining and construction; finance, insurance and real estate; manufacturing; transportation and communications; wholesale and retail trade; and services.
4. *Degree of technology newness.* Investments in new technologies should allow firms to utilize their employees more productively, thus leveraging labor productivity. Technology newness was tapped by a variable using the classification system employed by Bartel and Lichtenberg (1987) that is based on firm expenditures on research and development (R&D). The underlying belief is that R&D investments serve as a proxy for newer (or 'high') technologies.
5. *Capital intensity.* Capital intensity was measured by the ratio of assets to total employees. The natural log of this measure was used in analyses in order to smooth the skewness (the range was from 0.001 to 52.79). It is worthwhile noting that asset intensity is also likely to be related to such characteristics of the firm as degree of vertical integration. Capital

Table 1. Summary of constructs and operationalizations

Construct	Operationalization
Labor productivity	Sales per employee
HR planning index	The sum of measures of: Whether or not firm engages in HR planning Whether or not firm formally evaluates its hiring practices on a regular basis
Hiring index	The sum of measures of: Number of interviews per hire Number of recruiting sources per hire Utilization of aptitude testing Utilization of drug testing
Development index	The sum of measures of: Number of formal training programs Extent of use of promotion-from-within
Overall HR sophistication	A composite index consisting of the sum of HR planning, hiring and development indices
Capital intensity	Log of assets per employee
Industry	Dummy variables for industry groups: Agriculture, mining and construction Finance, insurance and real estate Manufacturing Wholesale and retail trade Transportation and communications Service
Size	Log of total employees
Degree of unionization	Percentage of employees covered by collective bargaining
High technology	Equals one if firm is in high-tech industry

intensity is an important factor to control for because capital and assets are often used to replace or leverage labor.

The measures used to test the hypotheses presented above are summarized in Table 1.

RESULTS

Descriptive statistics and first-order correlations among the model variables are given in Table 2. The average business unit in this sample has 6511 employees and an assets-to-employees ratio of 0.86. The manufacturing industries are most highly represented in the sample (46 percent). This, coupled with the fact that manufacturing industries historically are the most highly unionized (Freeman and Medoff, 1984), may explain why the mean percentage unionized (21 percent) for this sample is much greater than the national average (about 11 percent). For the entire sample, the HR planning index ranged from values of 0 to 2; and the hiring index ranged from 1.6 to 54.2. The employee development index went from a low of 0 to a maximum value of 100.

Table 3 shows how the average values for the indices we developed differ by industry. The transportation and communications industrial group had the highest rating for two of the three indices and the second highest rating for the

Table 2. (a) Descriptive statistics and correlations

Variable	Mean	S.D.	*N*
HR planning index	1.29	0.67	409
Hiring index	10.10	4.91	395
Development index	56.60	30.73	405
HR sophistication index	69.33	31.42	320
Size (log)	6.72	2.09	464
Capital (log)	−2.00	1.74	462
Industries:			
Agriculture, mining and construction	0.06	0.25	495
Finance, insurance and real estate	0.12	0.32	495
Manufacturing	0.46	0.50	495
Trade	0.07	0.26	495
Transportation	0.16	0.37	495
Service	0.12	0.32	495
High technology	0.10	0.30	495
Percentage unionized	0.21	0.31	422

(b) First-order correlation coefficients

		2	3	4	5	6	7	8	9	10	11	12	13	14
1	HR planning	0.11	0.15	0.17	0.32	−0.00	−0.10	−0.02	−0.01	−0.01	0.04	0.06	0.02	0.09
2	Hiring		0.03	0.16	0.07	0.04	−0.10	0.02	−0.05	0.05	0.09	−0.00	0.03	−0.10
3	Development			0.97	0.28	0.05	−0.12	−0.06	0.01	−0.01	0.19	−0.08	−0.13	0.26
4	HR sophistication				0.37	0.04	−0.12	−0.10	0.01	−0.03	0.21	−0.06	−0.10	0.35
5	Size (log)					−0.32	−0.18	−0.04	−0.03	0.08	0.17	−0.04	−0.10	0.41
6	Capital (log)						0.07	0.31	−0.25	−0.12	0.17	−0.08	−0.02	−0.06
7	Agriculture, mining, construction							−0.10	−0.24	−0.07	−0.12	−0.09	−0.09	−0.06
8	Finance, insurance, real estate								−0.34	−0.10	−0.16	−0.13	−0.12	−0.22
9	Manufacturing									−0.26	−0.41	−0.37	0.36	−0.06
10	Trade										−0.12	−0.10	−0.09	−0.02
11	Transportation											−0.16	−0.15	0.46
12	Service												−0.12	−0.17
13	High technology													−0.18
14	Percentage unionized													

Note: Values of |0.13| or greater are significant at the $p < 0.01$ level.

third. In contrast, the agriculture, mining and construction industrial group had the lowest average ratings on all three separate indices as well as the composite index.

We tested four models using OLS regression analysis. The results of these tests are presented in Table 4. We then tested the same four models with the sample selection bias correction (Berk, 1983) discussed above. We found that firms with greater labor productivity were more inclined to respond. The regression results with the bias correction are contained in Table 5. The results for the variables of interest differ somewhat in Tables 4 and 5. In short, support for our hypotheses is somewhat reduced when the sample selection bias correction was made; meanwhile, the addition of the hazard rate increased the amount of variance explained by 2 and 4 percent for Models 1 and 3, respectively. We may conclude that the decision to respond to the survey has a significant effect on the matter of interest to this study, albeit not an overwhelming one; hence, we will discuss our results in terms of those reported in Table 5.

Table 3. Means of HR planning, hiring, development and sophistication indices, by industry

Industry	Indices							
	Human resource planning		Hiring		Employee development		Human resource sophistication	
	Index	*N*	Index	*N*	Index	*N*	Index	*N*
Agriculture, mining and construction	1.00 (0.71)	21	8.28 (3.71)	29	43.19 (29.61)	30	53.85 (29.90)	17
Finance, insurance and real estate	1.26 (0.75)	50	10.42 (3.56)	43	51.86 (30.91)	46	60.37 (30.32)	36
Manufacturing	1.29 (0.70)	187	9.86 (3.77)	185	57.08 (30.81)	187	69.70 (31.00)	150
Trade: wholesale and retail	1.26 (0.66)	27	10.92 (8.90)	28	55.60 (33.92)	28	66.14 (34.94)	22
Transportation and communications	1.35 (0.60)	77	11.06 (6.56)	65	69.55 (29.32)	67	83.17 (30.36)	58
Services	1.40 (0.58)	47	10.07 (4.43)	45	50.04 (25.07)	47	63.91 (27.68)	37

Note: Standard deviations in parentheses.

Results for Hypotheses 1, 2 and 3

Results for Model 1 in Table 5 support Hypotheses 1 and 2. These hypotheses posited a positive effect upon labor productivity of investments in human resource planning and evaluation and investments in recruitment and selection. Support for Hypothesis 3, which concerned investments in employee development strategy, was not borne out. In a model that includes all control and main effect variables, two of the three independent variables measuring human resource policies show positive and significant effects on labor productivity.

While two human resource management policy indices had positive and significant effects at the 5 percent level or better, the HR planning index had the greater effect (0.27) on labor productivity. The control variables capturing the capital intensity ($p < 0.001$) and whether or not the business unit is considered part of the high-technology sector ($p < 0.10$) are also positive and significantly related to labor productivity, as expected.

Results for Hypothesis 4

Hypothesis 4 suggested that while investments in human resource management practices would be associated with higher labor productivity in general, this relationship would be compounded in highly capital-intensive settings. Model 2 in Table 5 presents results that test for such an interaction effect. Three new variables were created that multiplied the measures for planning, hiring, and development by the measure for capital intensity of the business unit. In a model including all three interaction terms, as well as the main effect and control variables, results support Hypothesis 4. Beta coefficients for the human resource management policy variables—both main effect and interactive—are positive and significant. The adjusted R^2 increased significantly from Model 1 to Model 2 (0.29 and 0.36, respectively; $p < 0.001$ in a Chow test), and the fit of the data in Model 2 also improves ($F = 12.12$ (Model 2) at the $p < 0.001$ level, as opposed to 10.99 (Model 1) at the $p < 0.001$ level).

It is further worthwhile to note that the effect of capital intensity upon labor productivity that was positive and highly significant in Model 1, becomes negative and significant in Model 2, suggesting that it is the interaction between human resource policies and capital intensity that exerts a dominant influence upon productivity, rather than capital intensity on its own.

Table 4. Results of regression analyses for labor productivity

	Dependent variable: Net sales per employee (log) Models			
Independent variables	1	2	3	4
HR planning index	0.36*	0.61*		
	(0.20)	(0.28)		
Planning · capital		0.28**		
		(0.10)		
Hiring index	0.10***	0.12***		
	(0.02)	(0.03)		
Hiring · capital		0.04***		
		(0.01)		
Development index	0.01*	0.01*		
	(0.00)	(0.01)		
Development · capital		0.00*		
		(0.00)		
HR sophistication index			0.01**	0.03***
			(0.00)	(0.01)
HR sophistication · capital				0.01***
				(0.00)
Size (log)	−0.03	−0.10	0.11†	−0.03
	(0.07)	(0.07)	(0.06)	(0.06)
Capital (log)	0.73***	−0.30†	0.72***	−0.06
	(0.09)	(0.18)	(0.09)	(0.15)
Agriculture, mining, construction	−0.45	−0.83	−0.24	−0.49
	(0.58)	(0.54)	(0.59)	(0.56)
Finance, insurance, real estate	−0.71	−1.18**	−0.48	−1.06*
	(0.46)	(0.44)	(0.47)	(0.45)
Manufacturing				
Trade (wholesale and retail)	0.59	0.68	0.81	0.74
	(0.54)	(0.50)	(0.55)	(0.52)
Transportation	−0.80*	−1.02**	−0.55	−0.95*
	(0.40)	(0.38)	(0.41)	(0.39)
Service	0.67	0.39	0.86*	0.50
	(0.43)	(0.40)	(0.44)	(0.42)
High technology	0.86†	0.34	1.11*	0.55
	(0.44)	(0.42)	(0.45)	(0.43)
Percentage unionized	0.81	0.36	0.35	0.28
	(0.53)	(0.50)	(0.53)	(0.50)
Adjusted R^2	0.27	0.36	0.23	0.32
F	10.92***	13.04***	10.64***	14.52***
N	319	319	319	319

Note: Entries represent standardized regression coefficients. Standard errors are in parentheses. One-tailed tests were used for hypothesized relationships.
†$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Further analysis: The 'Human Resource Sophistication' index

In order to explore the possibility of creating an even more parsimonious measure of investments in human resource management, an overall human resource sophistication index was created by adding the scores on the HR planning, hiring and employee development indices. This overall index of human resource sophistication was subsequently used in Models 3 and 4 in Table 5. Results for Model 3 show a significant, positive

Table 5. Results of regression analyses for labor productivity with sample selectivity bias correction

	Dependent variable: Net sales per employee (log) Models			
Independent variables	1	2	3	4
HR planning index	0.27*	0.62*		
	(0.20)	(0.28)		
Planning · capital		0.29**		
		(0.10)		
Hiring index	0.07**	0.13***		
	(0.03)	(0.31)		
Hiring · capital		0.04***		
		(0.01)		
Development index	0.01	0.01*		
	(0.01)	(0.01)		
Development · capital		0.01*		
		(0.00)		
HR sophistication index			0.01†	0.03***
			(0.01)	(0.01)
HR sophistication · capital				0.01***
				(0.00)
Size (log)	−0.12	−0.09	−0.06	−0.05
	(0.08)	(0.07)	(0.07)	(0.07)
Capital (log)	0.79***	−0.37†	0.80***	0.02
	(0.09)	(0.22)	(0.09)	(0.19)
Agriculture, mining, construction	−1.16†	−0.72	−1.28*	−0.70
	(0.62)	(0.60)	(0.62)	(0.62)
Finance, insurance, real estate	−1.10*	−1.13*	−1.09*	−1.14*
	(0.47)	(0.45)	(0.48)	(0.46)
Manufacturing				
Trade (wholesale and retail)	0.33	0.73	0.37	0.65
	(0.54)	(0.52)	(0.55)	(0.53)
Transportation	−0.80†	−1.04**	−0.62	−0.93*
	(0.40)	(0.38)	(0.40)	(0.39)
Service	0.38	0.45	0.44	0.46
	(0.44)	(0.42)	(0.44)	(0.43)
High technology	0.57	0.37	0.63	0.50
	(0.45)	(0.43)	(0.45)	(0.44)
Percentage unionized	0.85	0.34	0.56	0.34
	(0.52)	(0.50)	(0.52)	(0.50)
Hazard rate	0.77**	−0.14	1.08***	0.24
	(0.27)	(0.31)	(0.26)	(0.31)
Adjusted R^2	0.29	0.36	0.27	0.32
F	10.99***	12.12***	11.81***	13.31***
N	318	318	318	318

Note: Entries represent standardized regression coefficients. Standard errors are in parentheses. One-tailed tests were used for hypothesized relationships.
†$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

beta (0.007, $p < 0.10$) for this measure. The adjusted R^2 did not decline significantly over Model 1, which uses the original indices (0.27 as opposed to 0.29). Capital intensity, as anticipated, has a positive and significant effect (0.802, $p < 0.001$), in addition to the hazard rate.

A similar pattern of results can be seen when an interaction term (created by multiplying the value for the overall human resource sophistication index by the capital intensity measure) is incorporated in Model 4. As before, the adjusted R^2 increases significantly from the base model (0.32 compared to 0.27, $p < 0.001$), and the fit of the data is improved ($F = 13.31$, $p < 0.001$). Neither the capital intensity measure nor the hazard rate in the model including an interaction variable are significantly different from zero.

Further insight into the effects of investments in human resource management policies and capital intensity can be obtained by partially differentiating Model 4 with respect to HR sophistication. Thus, for this sample:

$$\delta \text{ productivity}/\delta \text{ hr sophistication} = 0.029 + 0.011 \text{ (capital intensity)}$$

This expression states that productivity equals zero when capital intensity equals -2.64; and is positive when capital intensity is greater than -2.64. What this implies is that, for this sample, the turning point for labor productivity with respect to human resource sophistication is at a point -2.64 standard deviations below the mean for capital intensity.[4] In other words, increases in labor productivity from investments in human resource management policies will be found even at very low levels of capital intensity. This in turn implies that for nearly the entire distribution of capital intensity, investments in human resource policies aid labor productivity.

DISCUSSION

Investments in human resource management do pay off

The results of our study suggest support for three of our four initial hypotheses after correcting for sample selection bias, and for all four of our hypotheses when the level of capital intensity is interacted with human resource policies. Investments in human resource planning and investments in hiring practices are associated positively with labor productivity. This suggests that high labor productivity is related, at least in part, to a willingness to invest in human resource mangement policies and practices in several specific areas.

Labor productivity, we found, tended to be better in firms that both formally plan how many and what kinds of people they will need, as well as where employers systematically evaluate their recruitment and selection policies. These findings suggest that labor productivity is tied to more 'front-end' human resource functions. In other words, *proactive* firms that *plan* for their future labor needs, as opposed to reacting to changes, as well as those firms making investments in getting the right people for the job *at the outset*, tend to be the ones with better labor productivity.

Secondly, firms in our sample that sought more aggressively for new people, that obtained more information about them and that screened out those with undesirable characteristics, also enjoyed better labor productivity. It may be that firms that scan potential labor markets through the use of more recruiting sources capture for themselves that part of the labor market that will work best for them, leaving the remains for their less careful competitors. This potentially creates the platform for forging a true strategic asset.

This argument has particular import for highly capital-intensive organizations in which a relatively small labor force operates a large number of costly fixed assets, systems and equipment. In such a setting, the potential for a poorly chosen employee to do significant harm can be enormous. It stands to reason that screening for particular characteristics, such as skills, aptitudes and drug risks, is one way in which firms can decrease the likelihood of such serious, negative economic consequences. This decreased risk should in turn be associated with overall productivity, a conclusion that is reflected in our results.

Finally, our third hypothesis found support when the interactive effects of capital intensity with human resource policies are taken into account. Specifically, our research indicates that firms that systematically train and develop their

[4] Note that for this sample the mean for capital intensity equals -2.0 and values range from -6.85 to 3.97.

workers are more likely to enjoy the rewards of a more productive workforce than those that do not. If labor markets were 'frictionless' and information perfect, we should have found no productivity effects from 'developing' employees via the use of internal promotions and formal training. Our results thus support the contention offered by the resource-based view, that investments in the development of an idiosyncratic human capital base are associated with a productivity pay-off. Despite the cost of making such investments, they appear to be related to positive productivity effects, for the case of capital-intensive organizations. Firm-sponsored training may also offer the firm a degree of inimitability, by increasing the skill and knowledge base of employees in a way that competitors cannot easily duplicate.

A major theme emerging from this research is that the effects of a firm's human resource strategy may be leveraged in a capital-intensive environment. As firms continue to turn toward the deployment of physical assets and technology to enhance productivity, it seems that an important strategic question is how they should build up the employees needed to operate its heterogeneous asset base. Further, it appears to be important for corporations to screen out those likely to do them damage. Our results with respect to capital intensity suggest that increasing attention needs to be given to the hiring and developing of employees.

This study makes several contributions. In testing tenets of the resource-based approach to strategy, it provides much-needed data in an area of inquiry in which empirical work, although beginning, is not yet very far advanced. Second, this study integrates concepts from both the strategy and the human resource management literatures, potentially enriching both areas of inquiry. Further, by evaluating data from many business units, we have gone beyond the many studies in the field of human resource management that look within single organizations. Finally, this paper has tested the effects of multiple human resource management activities simultaneously, as opposed to one at a time, as has been common. It is our hope that our work will help the field make progress toward a richer conceptualization of the linkages between the human resource management practices of firms and the performance with which they are associated.

Limitations

Before concluding, the reader should be aware of several limitations of this study. The hypotheses apply only when two critical conditions exist: first, market conditions must be such that there are sufficient numbers of qualified people seeking employment (i.e., there is no significant labor shortage). Second, the organization must be in a position to support the types of human resource planning, hiring, and development programs we describe here. Further, it stands to reason that the greater an organization's ability to invest in these sorts of human resource activities, the better its conduct of these activities should be. However, the question of when an organization's investment in hiring and employee development practices reaches the point of declining returns in terms of workforce quality cannot be investigated without factoring in the cost of a given human resource strategy. Unfortunately, this is beyond the scope of the research presented here because actual cost data partitioned with respect to human resource strategy at a business unit level are simply not available.

Theoretically, wages could be either positively or negatively related to human resource practices. According to Stigler (1961), wages will be negatively correlated with human resource practices (recruitment and selection investments, in particular) when viewed or used as a substitute for the latter. Because of the possibility of substituting higher wages for investments in human resource practices, it could be argued that a measure of compensation offered by the business unit should be included in the estimated models as a control variable. On the other hand, organizations that invest relatively more in human resource practices will likely offer higher wages than those that invest less (for example, it has been empirically demonstrated that large firms both pay higher wages and make greater average investments in human resource programs than smaller organizations (Ehrenberg, 1990; Kossek, 1987)). In this case, wages and human resource management practices will be positively correlated. If one accepts the plausibility of both theoretical premises, then it becomes an empirical question whether or not wages and investments in human resource practices are positively or negatively related. One study (Huselid, 1995), to date,

indicates a positive and weak relationship between wages and human resource practices ($r = 0.24$). The addition of wage data to this study would have provided another test of this relationship; however, the data were not available.

Finally, there are obviously many other factors beyond human resource policies and practices that influence measures of organizational performance, including labor productivity. Likewise, there possibly exists a complex set of interactive relationships between human resource practices and other resources of the firm, such as its technologies, that are beyond the scope of this paper and remain for future research. Our purpose here is not to debate the fundamental importance of these factors and relationships. Rather, we hope to suggest that while there may be relatively little that managers can do about many of these conditions, it is relatively straightforward to consciously manage the organization's human resource management processes. For this reason, understanding the relationship between even small performance effects and human resource management practices becomes interesting.

CONCLUSION

At the core of strategy lies the managerial question, 'what shall we do to improve performance?' Our research suggests that the way in which an organization's human resources are managed has a perceptible and significant relationship to the productivity of its employees. We argue that this set of findings supports the resource-based view of strategy, in which the competitiveness of firms is believed to be related, at least in part, to investments in firm-specific assets. Investments explored here include the planning for, recruitment, selection and development of firm-specific human capital assets.

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APPENDIX 1

In order for Hypothesis 4 to be true, we need to demonstrate that the coefficient on the human resource policy-capital intensity interaction term in the estimated labor productivity model will be positive.

Given the Cobb–Douglas production function:

$$P = KY^{\alpha} X^{1-\alpha} \tag{1}$$

where

P = total revenue from production activity, $(P > 0)$;
Y = capital or cost of assets employed, $(Y > 0)$;
X = total cost of labor employed, $(X > 0)$

Let U = unit cost per employee, hence

$$\text{total employees} = X/U$$

Let L = labor productivity (revenue per employee), and

$$L = P/(X/U) = PU/X \tag{2}$$

Substituting (1) for P in (2), we have

$$L = PU/X = UKY^{\alpha} X^{1-\alpha-1}, \text{ or,}$$

$$L = UKY^{\alpha}/X^{\alpha} \tag{3}$$

Let C = capital intensity, or, assets per employee

$$C = Y/(X/U) = UY/X$$

and since $C > 0$, for all $0 < \alpha < 1$, we have

$$C^{\alpha} = (UY/X)^{\alpha}$$

and therefore

$$(C/U)^{\alpha} = (Y/X)^{\alpha} \tag{4}$$

Substituting (4) into (3), we have

$$L = UKY^{\alpha}/X^{\alpha} = UK(Y/X)^{\alpha} = UK(C/U)^{\alpha}$$
$$= KU^{1-\alpha} C^{\alpha}$$

Then solving for C, we have

$$C = (L/KU^{1-\alpha})^{1/\alpha} = K' L^{1/\alpha}$$

where K' = some positive constant. Note that $0 < \alpha < 1$, implies $L^{1/\alpha} > L$.

Now, for the labor productivity model

$$L = \beta_0 + \beta_n Z_n + \beta_n Z_n \cdot C + \ldots$$

where Z_n = HR policy investments. If

$$\delta L/\delta Z_n \Rightarrow \beta_n > 0$$

then

$$C \cdot \delta L/\delta Z = C \cdot \beta_n \Rightarrow K' L^{1/\alpha} \beta_n > 0$$

Since

$$K' > 0,\ L^{1/\alpha} > 0,\ \beta_n > 0 \text{ and } L = {}^{1/\alpha} > L$$