

A STUDY OF RESOURCE COMPETITIVENESS IN HIGH TECHNOLOGY FIRMS

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ABSTRACT

The link between resource competitiveness and performance in hi-tech firms is examined from the perspective of resource-based theory and strategic management. Departing from previous research, it is argued that the linkage between firm-specific advantages and performance varies according to the underlying control variables of corporate culture, organizational formalization and business targeting. Data obtained from 339 hi-tech firms in China indicate that achieving resource competitiveness requires rapidly adopting technology changes and speedy marketing adaptation. A firm's performance can to a significant extent be attributed to its configuration of technology and market-based resources and capabilities.

INTRODUCTION

Dramatic political, economic, and technological changes in emerging business environments such as China's are giving rise to new explanations for the development of a firm's business in relation to its resource advantages, forms of organizational control, and different performance outcomes. Evidence is needed as to whether a firm's resource competitiveness is most closely associated with its research and development (R&D), production or marketing. Both researchers and practitioners need to test the effect of resource-based specifics on a firm's performance (Liebeskind 1997, Andersen and Kheam 1998, Spencer 2003). Barney (2002) states that identifying

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a firm's resource competitiveness that involves identifying the distinguishing features have been employed to generate its superior performance. There is widespread agreement on the importance of assessing resource competitiveness, not only to examine explicitly the direct effects of a firm's resource bundles that impact on performance (Prahalad and Hamel 1990, Barney 2002, Uhlenbruck, Meyer and Hitt 2003), but also to evaluate the traditional feedback system as a tool that can enhance the firm's manipulation of its resources (Johnson and Jill 1993, Liebeskind 1997).

Organizational control theories and the resource-based view of the firm have provided an alternative perspective from which to assess the relationship between a firm's resources, its control and its performance. The former perspective holds that enforcing a firm's organizational control as a means of strengthening its specific assets shortens product development cycles, improves organizational arrangements, and strengthens relationships with long-established suppliers (Eisenhardt and Martin 2000, Durand 2003). In this view, the control mechanism is a deep-rooted attribute of the firm with fundamental implications for its allocation of resources. Positive control effects arise when a firm achieves competitive advantage through holding assets that are heterogeneous and difficult to imitate (Lebas and Weigenstein 1986). It has been recognized that a firm's internal resources and its appropriate control mechanisms are fundamentally intertwined (Eisenhardt 1985, Simons 1999). Thus, understanding the impact of organizational control on a firm's resources is imperative, as organizational feedback has been thought to mediate the relationship between a firm's resources and its performance.

The alternative, mainstream research strategy favors a resource-based view of the firm. It states that a firm's core resources and capabilities are related to its long-term competitiveness, which is provided by its distinctive asset mix that competitors find difficult to obtain, replicate or imitate. Scholars positing the resource-based view as a basis for research state that a firm with the proper resources and competitive capabilities will prove more successful in terms of implementing a rapid market response to corporate directives (Grant 1991, Collis 1991, Birkinshaw, Hood and Jonsson 1998). Nowadays, increasing market globalization, the reduction of trade barriers and heightened market competition all suggest that certain industries are currently undergoing significant changes and rapid upheavals. As Makhija (2003: 434) has pointed out, "the resource-based view may be a more appropriate analytical lens with which to view firm value and market performance." He identifies three types of knowledge underlying a firm's resource spillovers: its efficiency, its entrepreneurial ability, and its institutional network. The firm's efficiency is its ability to put organizational resources to their most productive use; its entrepreneurial ability involves its ability to be innovative; and its institutional network includes its relationships with other institutional actors. According to Makhija's categorization of knowledge, these three types of capability serve as the engine for creating sustained competitive advantages for a firm.

A firm's specific resources, control, and performance pose various challenges to

the development of its existing or potential resource. Some studies imply that a firm with unusual capital resources or possessing pre-emptive patents or knowledge will enjoy certain monopolistic advantages which can increase its influence and power (Eisenhardt and Martin 2000, King and Zeithaml 2001, Uhlenbruck, Meyer and Hitt 2003). Recently, researchers have been increasingly recognizing that upsurges in a firm-specific resource advantage can improve the firm's "business situation" or "strategic condition" for achieving superior performance (Eisenhardt and Martin 2000). A firm's control system is critically important to its use of resources and/or specific capabilities. Johnson and Jill (1993) suggest that a high level of control involvement is necessary to update the unique resources that will be used by the firm for later market involvement in selling its own products. This suggests that identifying the types of control employed, together with a grasp of a firm's ability to gain ready access to vital knowledge, may be the key to evaluating a firm's resource competitiveness. However, previous studies have paid relatively little theoretical or empirical attention to the nature of a firm's specific resources and capabilities and their interaction with its underlying control mechanisms (Fingham 1992, Durand and Vargas 2003). In particular, studies have yet to investigate systematically whether the increasing role of control in the productive process has actually contributed to resource competitiveness (Andersson, Forsgren and Holm 2002). The primary purpose of the present study is to explore the extent to which corporate culture, organizational formalization and business targeting as a system of overall organizational control have initiated changes or influence on the relationship between a firm-specific advantage and performance.

This report is in four sections. The first classifies firm-specific advantages as marketing and technology-based resources, knowledge, and capabilities. We develop several hypotheses about the impact of firm-specific resources and forms of control on performance. The second explains how the data were collected and analyzed. The third describes the main findings, managerial implications and suggestions for future research. The final section draws conclusions.

THEORETICAL DEVELOPMENT AND HYPOTHESES

Managers adopt efficient control systems in order to maintain the requisite organizational capabilities of the firm (Birkinshaw, Hood and Jonsson 1998). Effective control strengthens a firm's capabilities and is believed to enhance its competitive potential. This competitive potential influences its strategic direction and is a predictor of its efficient use of resources. A considerable theoretical and empirical literature on the resource-based view of the firm has built a strong case for the importance of a firm's resource advantages: resources which are valuable and difficult to obtain and replicate. Hence, strategy researchers believe that a firm with such resource advantages has the potential to generate superior performance (Barney and Zajac 1994, Barney 1998). This important theoretical viewpoint suggests that

managers need to understand and anticipate the significant interactions between a firm's resources and its performance.

The direct effects of firm-specific advantages

The resource-based view provides insights into a firm's resources and capabilities, and its development and deployment of these resources to take advantage of market opportunities (Uhlenbruck, Meyer and Hitt 2003: 261). A firm's resource base can be analyzed in terms of two important resource types: technology-based resources and capabilities, and marketing-based resources and capabilities (Hill, Hwang and Kim 1990). Technology-based resources and capabilities are commonly thought of as the technological system, including product designs, materials, operating systems, labor inputs and maintenance procedures. Shrader (2001: 48) has emphasized the importance of technology-based resources and capabilities. He suggests that continuous investment in R&D is required to maintain a firm's competitive advantages, as its technological advantages may become obsolescent over time. The advantages of employing proprietary technologies often allow firms to provide technologies with the leverage for gaining rights on its product usages. When firms have appropriately provisioned their proprietary technologies registered from the local government, it is believed to safeguard effectively the bulk of the products of the firm from the abuse of its copyrights. For instance, partners in an international joint venture (IJV) may gain rights to use technology from their partnership. To achieve better economic performance, IJV partners can also exploit their technologies by sharing their patented knowledge and their production processes. Cohen and Levinthal (1990) suggest that emphasizing a firm's technological resources and capabilities improves its learning curve.

A firm's new product developments tend to be significantly associated with the technologies it possesses, which are usually related to its core business. The resource-based view considers that a firm's differential endowments of technology-based resources and capabilities are important determinants of its economic performance. These differential endowments not only produce innovative solutions to problems, but also facilitate new product improvements (Bell 1999). Neelankavil and Alaganar (2003) have examined the idea that making a firm technologically efficient often involves proactive resource management. They also believed that a firm's specific technological advances are very important to its ability to create new products and to learn new skills. Hence, the effects of a firm's technology-based resources and capabilities are perceived as an integral part of its long-term success in achieving resource competitiveness.

Hypothesis 1: A firm's performance is positively associated with superior technology-based resources and capabilities.

Marketing-based resources and capabilities encompass a firm's trading linkages,

its contractual agreements, and its transaction bonds, all of which are deeply involved in service quality, brand name, business reputation and goodwill. A firm with sufficiently well developed marketing techniques enriches its organizational capacities by establishing its products as industry standards (Oviatt and McDougall 1995). Capron and Hulland (1999: 42) state that marketing-based resources include the “market offering” that has great value for some market segments. A firm’s marketing-based resources and capabilities consist of two different components that account for the ability of a firm to deliver value-added services and products to satisfied customers. First, marketing-based resources and capabilities can be measured by whether a firm has effectively facilitated, either horizontally or hierarchically, collaboration with its suppliers and distributors (Noble, Sinha and Kumar 2002). Effective marketing-based resources and capabilities need to focus actively on a firm’s external linkages in order to increase its resource competitiveness. Secondly, cultivating the firm’s image through promotional activities is necessary to extend successfully the life cycle of old products (Neelankavil and Alaganar 2003: 493). Creating brand loyalty requires a high level of knowledge about the demands and tastes of local customers (Shrader 2001). Researchers speculate that improving a firm’s marketing-based resources and capabilities will be manifested in enhanced firm performance. (Capron and Hulland 1999)

Hypothesis 2: A firm’s performance is positively associated with superior marketing-based resources and capabilities.

The resource-based view focuses on differences in performance that are based on a complex bundle of a firm’s resources, knowledge and capabilities. Rouse and Daellenbach (2002: 963) indicate that performance should feature as a “selection” variable. They posit that the resource-based view is an inside-out perspective on organizations that is used to identify the characteristics of firms. Their notion of a “generation trail” includes the social-technical processes, resources, knowledge and capabilities that constitute the sources of firm-specific advantages. Kogut and Zander (1993) have suggested that the efficiency of a firm’s technology and its marketing-based capabilities mainly depend on its complex bundle of knowledge. Eisenhardt and Martin (2000: 1107) also use the term “combinative capabilities” to describe the organizational processes by which firms synthesize and acquire knowledge and resources as well as generate new applications from those resources. Henderson and Cockburn (1994) similarly describe the “architectural competence” required for combining technology and marketing-based resources and capabilities, which are the critical drivers for increasing resource competitiveness.

It can be reasoned that those firms which are able to establish the necessary resources and competence are more effective in achieving their performance goals. Bell (1999) suggests that a firm’s resource-based advantages must encompass a complex bundle of resources, knowledge and capabilities, many of which are

embodied in a wide range of different artifacts, people, product specifications, component properties, operating procedures and organizational arrangements. In theory, an improvement in a firm's resources and capabilities is believed to generate competitive advantages when product know-how and marketing are highly integrated (Peteraf 1993, Grant 1996b, Mosakowski and McKelvey 1997, Spencer 2003). Thus, it is theorized that firms which are willing and able to develop their marketing and technology-based resources and capabilities should perform better than others that are not.

Hypothesis 3: A firm's performance is positively associated with a superior configuration of its technology and marketing-based resources and capabilities

The mediating effects of firm-specific advantages

Organizational control theory complements the resource-based view. Organizational control aims to apply effectively a firm's resources, knowledge and capabilities. Factors in organizational control such as corporate culture, organizational formalization and business targeting, are perceived as potential mediators in the relationship between a firm's resources and performance (Prahalad and Doz 1981, Moorman and Miner 1998, Otley 1999). An appropriate corporate culture is likely to increase the effectiveness of a firm's resources, knowledge and capabilities. Some studies include corporate culture as an aspect of the customs, practices, business norms, values and codifications of organizational principles. Deshpande and Webster (1989: 4) propose that business norms and principles can help to share, assimilate and reinforce formally a firm's knowledge and capabilities. In this view, corporate culture centers on embedded values, beliefs and priorities that interact with the behavior that ultimately influences performance. Similarly, Noble, Sinha and Kumar (2002) suggest that a firm needs to exercise successfully its own corporate culture in order to improve its organizational coordination. Dension (1984) suggests that a dominant organizational culture provides cohesiveness and principles which can be applied in tactical activities. This should improve effectiveness and lead to superior organizational performance.

Hypothesis 4: Corporate culture as a form of organizational control in a firm mediates the positive relationship between firm-specific advantages and performance.

Organizational formalization includes the way it builds up its standards for the organization, its reporting strategies, its decision-making structure and its business practices (Moorman and Miner 1998). Some studies confirm that the most important advantages of formalization relate to officially established rules and procedures which help a firm search systematically for information that has emerged within the organization (Coad 1995, Becker and Huselid 1998). Their argument is that, when a firm applies organizational formalization to its operating system, the rules, regulations

and procedures established become very important, as the organization can then use its reporting structure to facilitate information flow and to exploit its rent-seeking opportunities. Given the differences among firms' resources and reporting structures, formalization also promotes organizational coherence in the face of increasing product complexity.

Hypothesis 5: Formalization as a form of organizational control in a firm mediates the positive relationship between firm-specific advantages and performance.

Business targeting is typically concerned with generating strategic targets or a set of organizational goals for directing effectively the application of a firm's resources, including both its explicit and its tacit resources. Targeting maximizes the value a firm can extract from its resources and capabilities. In other words, targeting attempts to guide a firm's technological resources into the markets in which the firm's managers can most effectively apply them. The effectiveness of its targeting can thus help explain the firm's performance in terms of attaining its organizational goals. Eisenhardt (1985) explains that firms benefit substantially through using business targets to facilitate the development of resources and capabilities. Using a similar line of argument, Fingham (1992) suggests that effective targeting requires managers to identify the different stages in which a firm's scarce assets will need to be employed over a period of time. Likewise, other scholars have argued that an essential aspect of establishing a firm's business targets is to ensure that the necessary resources and capabilities are available and are consistent with the business targets established by the management. Simons (1999) has explained that a firm's resource application is based on business targets that are typically related to performance standards. The role of a firm's management is to keep organizational actors focused on the importance of the targets.

Hypothesis 6: Business targeting as a form of organizational control in a firm mediates the positive relationship between firm-specific advantages and performance.

It is fundamental to successful organizational control that resource efficiencies be effectively increased thereby, and business risks and uncertainties reduced (Liebeskind 1997). According to Durand (2003), a high investment in dynamic resources like R&D can positively affect a firm's ability to control its product innovation. Three basic assumptions about overall control have been found to relate directly to the manipulation of resources within an organization. One assumption is that a firm's resources and capabilities tend to be more effectively managed when the corporate culture facilitates sharing both explicit and tacit knowledge and resources (Bell 1999). A second assumption is that good formalization can serve to direct a firm's resources and capabilities more effectively. Formalization has helped organizations introduce a wider product line, upgrade products at a faster pace, and

improve the efficiency of their marketing and its relevant organizational capabilities (Moorman and Miner 1998). The third assumption is that improvements in a firm's targeting are significantly related to attaining its overall organizational goals. The most effective way to expand a firm's business is to allow highly qualified managers to decide on the business targets based on the existing and potential market as well as firm capacities (Becker and Huselid 1998).

Hypothesis 7: The configuration of corporate culture, organizational formalization and business targeting as a system of overall organizational control is expected to mediate between firm-specific advantages and performance.

RESEARCH METHOD

Data source and sample

The data for this study was collected through a mail survey of hi-tech firms in the city of Xian and in Guangdong Province in the People's Republic of China. These were manufacturing firms producing electrical goods, pharmaceutical products, microelectronics, telecommunications equipment and computer products. The sample was drawn from among hi-tech firms for three major reasons. First, the hi-tech industries have drawn on both technology-based and marketing-based capabilities for their success (Grant 1996a). Both technology and marketing-based resources and capabilities are viewed as a priority by most firms in the hi-tech sectors. At the time of the study, hi-tech industries served as a research setting for numerous studies examining resource competitiveness and performance (Luo, Shenkar and Nyaw 2001, Li and Atuahene-Gima 2002). Second, there were sufficient numbers of firms in hi-tech industries to ensure the constructs that rest on the applicability of any firm-specific advantages identified in this study. The hi-tech sector chosen for this study has one of the highest industrial output values among industries in China (National Statistical Bureau 2002). Third, hi-tech industries offer an appropriate context in which to explore the role of organizational control in enforcing firm-specific resource competitiveness. Although choosing cross-sectional data sources can lead to problems with the measurement of variables (Scherer and Ross 1990), the choice of sectors for this study has ensured that the results are broad-based, objective and not biased.

A covering letter to selected firms outlined the nature of the study and emphasized strict guarantees of the confidentiality of the responses. The questionnaire was sent to the most senior managers of each firm. For this kind of survey, the senior manager was considered to be the person with the most comprehensive knowledge about the firm's resources, control and performance. Three questionnaire mailings, with follow-up faxes, e-mails and telephone calls resulted in a sample of 339 high technology firms. The completed responses received from managers represented an 11.3 percent response rate among the 3000 questionnaires distributed.

The survey design was guided by research field work. Three pilot studies

provided the project team with very useful qualitative information concerning resources, control and performance. All the selected firms had been in business for at least three years and employed a minimum of 150 personnel. Based on the relevant literature, empirical research and the hypotheses to be tested, a questionnaire was structured to collect data from the managers of each firm. Most strategic management writers recognize that a firm's resources are characterized by a greater focus on the types of knowledge it uses for organizing activities such as R&D, production and marketing. The creation of a firm's built-in control mechanisms, such as its corporate culture, its organizational formalization and its business targeting, is expected to exert positive influence on its performance.

Construct measures

The relevant literature was thoroughly reviewed to ensure that the measures of the questionnaire captured appropriate constructs. The instrument was then discussed with the managers in a few of the sample firms to confirm the clarity of the instructions and scale items. The validity of each question in the checklist was assessed according to suggestions from the managers who were interviewed, together with comments from the members of the project team involved.

Independent variables

Four items were used to measure technology-based resources, knowledge and capabilities: (1) access to in-house research; (2) in-house development; (3) in-house production, and (4) technology patents. These four items were selected from among items used in prior studies that had investigated the development pattern of firm-specific competences and advantages. They were considered relevant to a firm's knowledge and its degree of innovation in products and processes. Hi-tech firms in China face great challenges in increasing their technological activities in terms of developing the skills of their employees, deciding on their R&D expenditure and increasing their patented proprietary technology. Updating new product technology, in-house research and possessing technological patents lay a solid foundation upon which most hi-tech firms in China can maintain their resource advantages. For each of these four items, the respondents were asked to provide ratings on a 7-point scale ranging from "not important at all" to "extremely important." Sub-scales of technology-based resources and capabilities were constructed by aggregating the scores for the four items into a group with listed alphas of 0.840.

A firm's marketing-based resources, knowledge and capabilities to be invested are closely associated with the service quality, brand development and business reputation. An increase in marketing-based resources may improve the positive image of a firm and reputation. Most hi-tech firms tend to place emphasis on improving their product knowledge, features and specifications. Five items were used to measure the perceived importance of marketing-based resources: the increase in service quality; the adaptation of technology; the increase of marketing knowledge; brand

development, reputation and goodwill, and the improvement of management competence. For each of these five items, the respondents replied on a 7-point scale ranging from “not important at all” to “extremely important.” Sub-scales of marketing-based resources and capabilities were constructed by aggregating scores for the five items into a group with listed alphas of 0.753.

Dependent variables

Respondents recorded their responses to the performance items on a similar 7-point Likert scale with coding ranging from 1 (not satisfied) to 7 (extremely satisfied). The organizational control variables such as corporate culture, organizational formalization and business targeting were measured from ratings on 7-point scale ranging from “not important at all” to “extremely important.” The equity ownership variable was measured on an interval scale. A company’s size was measured in terms of its number of full-time employees. The locations of the firms used dummy variables: 0=Xian and 1=Guangdong province. Business duration was measured by the number of years that the firm had been in operation, estimated by subtracting the year of formation from the year of the survey. The respondents were also asked to indicate the years of experience that their firms had in the management of operations in China (Luo and Ho 2001).

RESULTS

Table 1 provides the results of a principal components factor analysis pertaining to firm-specific advantages. To evaluate the adequacy of the multi-item measures, an exploratory factor analysis was applied to review the theoretical constructs underlying the resource-based variables identified in the study. A rotated (varimax) principal components analysis of each firm’s technology and marketing-based variables was performed. The differences between the two sets of scores were highly significant ($p < 0.001$), accounting for 59 percent of the variance. Factors for both technology and marketing-based variables were extracted with an eigenvalue greater than 1. The principal components factor analysis produced uncorrelated factor scores for each firm’s resource-based advantages. Evidence from both the confirmatory factor analysis [CFA] and the correlation analysis suggested that their respective resource-based measures could be combined into composite technology and marketing-based variables. Five items that focused on marketing-based variables were consolidated ($\alpha = 0.753$). The factored variables explained 28.59 percent of the variance in the marketing-based variables. Four items that covered the technology-based variables yielded one significant factor ($\alpha = 0.840$). The factored variables explained 31.30 percent of the variance in the technology-based variables. Each marketing and technology-based variable captured a distinct underlying construct for firm-specific advantages.

Table 1: Factor Analysis of Firm-specific Advantages (N = 339 hi-tech firms)

Variables	Cronbach's Alpha	Factor loading
Marketing-based resources and capabilities (% of variance explained = 25.6)	0.75	
the improvement of management competence		0.680
the development of a business brand, reputation and goodwill		0.522
the increase of quality of service		0.726
the increase of marketing knowledge		0.714
the adaptation of exclusive technology to the local market		0.738
Technology-based resources and capabilities (% of variance explained = 31.3)	0.840	
in-house house research		0.627
in-house development		0.905
in-house production		0.910
the possession of technological patents;		0.706
Cumulative % of variance explained = 59.0		

Table 2: Descriptive Statistics and Correlations

Variables	Mean	Std. Dev.	1.	2.	3.	4.	5.	6.	7.	8.
1. Re-investment	3.36	.92								
2. Technology-based resources and capabilities	3.52	.75	.408**							
3. Marketing-based resources and capabilities	3.63	.59	.372**	.430**						
4. Corporate Culture	3.47	1.19	.226**	.274**	.427**					
5. Organizational formalization	4.13	.90	.102*	.128*	.226**	.267**				
6. Business Targeting	3.67	1.06	.227**	.253**	.374**	.435**	.412*			
7. Business Duration	9.17	12.24	.035	-.021	.034	-.073	-.011	-.100*		
8. Location	.41	.49	.090	-.035	.123*	-.016	.001	.020	.340**	
9. Ownership Type	.17	.38	.073	-.020	-.009	.044	-.032	.007	-.038	.122**

Notes: N= 339 hi-tech firms. One-tail probabilities: *p<0.05; **p<0.01; ***p<0.001

Table 2 presents descriptive statistics, standard deviations and zero-order correlations for all the variables in the study. Both technology and marketing-based resources and capabilities that would be expected to be associated with organizational control, such as corporate culture, were generally significant. Importantly, the effects of both technology and marketing resources and capabilities on performance were both positive and statistically significant. In summary, the results also show statistically significant correlations between a firm's technology-based resources with its corporate culture ($r=0.26$; $p<0.01$) and performance ($r=0.43$; $p<0.01$). On the whole, no correlation of Table 2 was greater than .46, and more than 10 correlations were significant ($p<0.05$). Hence, multicollinearity among these independent variables did not present a problem in statistical analyses. The signs of the coefficients are reasonable.

Table 3 presents the results of the structural equation modeling analysis, checking to what extent a firm's resources and control appropriations accounted for performance. Analysis of moment structures [AMOS] was used in this analysis to estimate a structural equation model reflecting the structural relationships among the estimates of the theoretical constructs. Our results yielded a general linear model, a common factor analysis for the coefficients and paths identifying standardized total effects and indirect effects on performance. The model employed nine items to measure the two exogenous and seven endogenous constructs. Two captured exogenous constructs: the resource-based advantages for marketing and technology-based resources and capabilities. The endogenous constructs were represented by three variables for corporate culture, organizational formalization and business targeting related to organizational control as well as to control variables.

For each performance variable, the seven models in Table 3 were tested. Hypothesis 1 suggests that a firm that is actively involved in the development of technology-based resources and capabilities will achieve higher levels of performance. The first model shows that technology-based resources did significantly relate to performance, showing that model 1 received strong backing. The AMOS statistics show that the regression weight between technology-based resources and performance was statistically significant ($r=0.66$, $p<0.05$).

The second model suggests that a hi-tech firm which is actively involved in the development of marketing-based resources and capabilities achieves higher levels of performance. The results of Hypothesis 2 show that marketing-based resources and capabilities are used to encourage more entrepreneurial activities, and that building a good relationship with local suppliers and distributors generated better performance ($r=0.769$, $*p<0.05$). Hence, Hypothesis 2 is supported.

Both technology and marketing-based resources and capabilities were added to the third model so that their main combinative effects could be examined. The combinative effects on performance found in this analysis were positive, and this effect was statistically significant. This supports Hypothesis 3. Adding the combinative effect on performance yielded significant increases in explanatory power and a

statistically significant result ($r=0.341$, $p<0.01$). This result supports Hypothesis 3.

The fourth equation tested whether the interaction of the corporate culture and a firm-specific resource influenced performance. The results show that corporate culture serves a positive role in effectively using the firm's technology-based resources and capabilities ($r=0.045$, $p<0.05$) and impacts performance ($r=0.089$, $p<0.01$). Hypothesis 4 is thus partially supported.

The fifth model predicts that the positive effects of formalization allow a hi-tech firm to focus on its resources, knowledge and capabilities. Support was also found for Hypothesis 5 in the correlation between formalization and performance ($r=0.205$, $p<0.01$).

The sixth model states that interaction between business targeting and a firm's resource advantages influences performance. The result testing Hypothesis 6 was not strongly correlated, but a significant relationship was found between technology-based resources and performance ($r=0.046$, $p<0.05$). However, the relationship between business targeting and performance was negatively correlated and statistically significant. ($r=-0.046$, $p<0.05$).

The seventh model includes firm-specific resources and overall control manipulation. The model sheds important light on the relationship involving firm-specific advantages, organizational control and performance (X^2 , d.f. = 23, p-Value = 90.57, $p<0.001$). As expected, technology-based resources had a positive and direct relationship with performance ($r=0.236$, $p<0.01$). Overall control was found to be significantly related with firm-specific advantages ($r=0.241$, $p<0.05$) and performance ($r=0.065$, $p<0.05$). These results indicate that almost all variables had a statistically significant relationship with performance, and in the predicted directions.

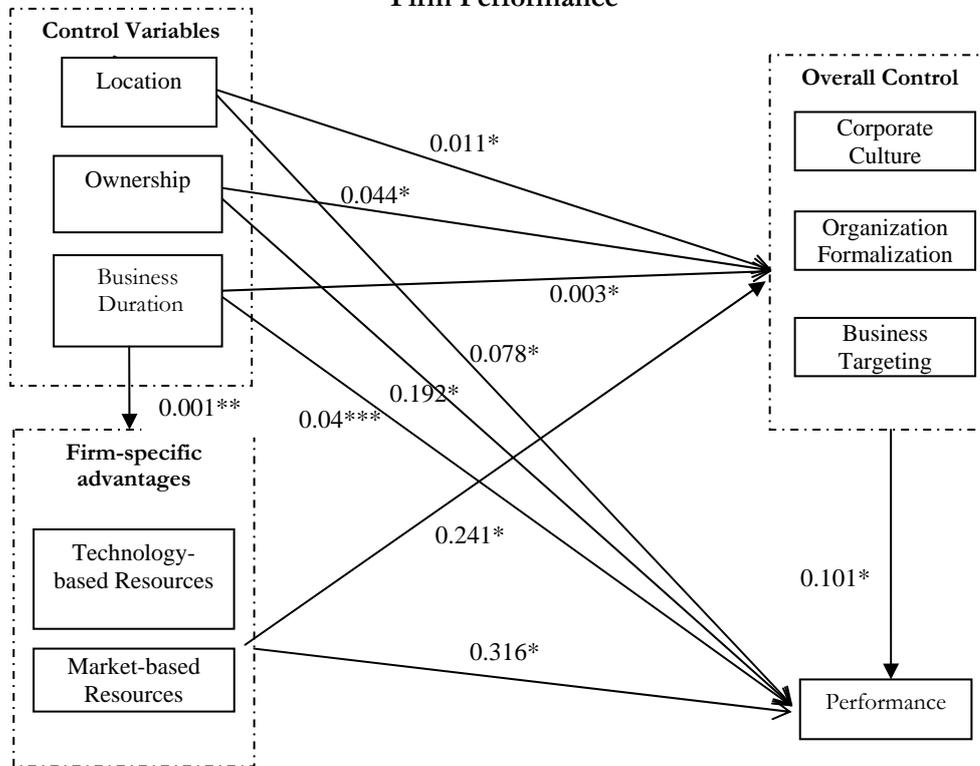
Table 3. Results from Structural Equation Models (N=339 hi-tech firms)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
NPAR	19	22	12	42	42	42	18
RMR	0.362	0.341	0.524	0.239	0.241	0.234	0.429
GFI	0.952	0.959	0.955	0.937	0.942	0.931	0.962
AGFI	0.899	0.920	0.776	0.896	0.903	0.995	0.737
PGFI	0.450	0.490	0.191	0.562	0.565	0.559	0.137
X^2 (d.f., p-value)	94.38 (17, $p<0.000$)	90.57 (23, $p<0.000$)					

Notes: ¹ N=339 hi-tech firms. ² Only statistically significant regressional constructs are shown. NPAR stands for the number of parameters retained; RMR stands for the root mean square

residual; GFI signifies a goodness-of-fit index; AGFI represents an adjusted goodness-of-fit index; PGFI is the parsimony goodness-of-fit index. One-tail probabilities: *p<0.05, **p<0.01, ***p<0.001

Figure 1. Results of Firm-specific Advantages, Organizational Control and Firm Performance



Notes: NPAR: Number of parameters; RMR: Root mean square residual; GFI: Goodness of fit index; PGFI : Parsimonious comparative fit index; N=339 hi-tech firms; One-tail probabilities: *p<0.05, **p<0.01, ***p<0.001

Model Summary	
NPAR	18
RMR	0.429
GFI	0.962
AGFI	0.837
PGFI	0.137
X ² (d.f., p-value)	70.57 (23, p<0.000)

The results that are derived from overall model 7 in Table 3 testing the relationship among a firm's resources, control and performance are presented in Figure 1. This study has involved building a structural equation model of the mediating roles of organizational control. Baron and Kenny (1986) propose testing for mediation using estimates from three sets of regressions: (1) the regression of the mediator variable on the independent variables, (2) the regression of the dependent variables on the independent variables, and (3) the regression of the dependent variables on the independent variables and the mediating variable. Noble, Sinha and Kumar (2002) further illustrate the need for establishing mediation, as the independent variables must affect the mediator in the first regression and the dependent variable in the second regression. The mediating variable must affect the dependent variable in the third and fourth regressions that refer to the dependent variable and the mediating variable only. The overall fit of the model to the data was examined using AMOS techniques. The *a priori* specification of the CFA assessed the divergent validity of the measure. Figure 1 shows that a much higher score was achieved on all measures of the adequacy of the sample data. This model has an adequate fit to the data, as is indicated by the overall chi-square goodness-of-fit test (GFI=0.931). The adjusted goodness-of-fit (AGFI=0.995) and the parsimony goodness-of-fit statistics (PGFI=0.559) confirm this. The model shows that all the items were significantly associated with the corresponding latent variables at the 0.000 level. The comparative fit index for the structural equations indicates a good fit for a firm's resources, control and performance, with the root mean square residual (RMR) =0.234.

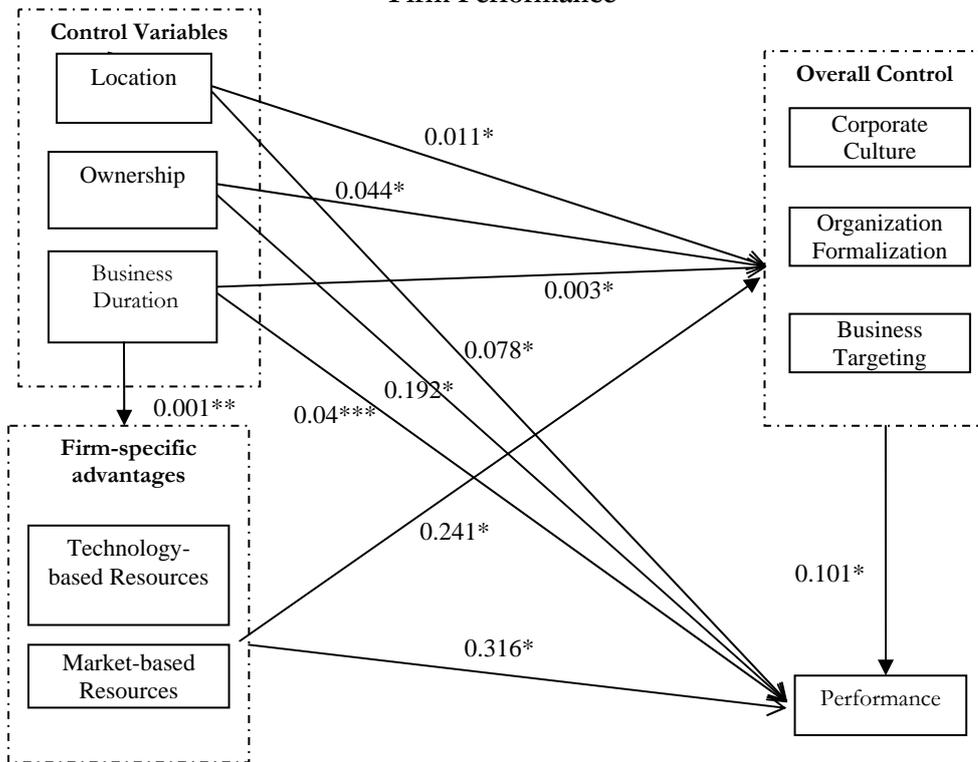
DISCUSSION OF RESULTS AND THEIR IMPLICATIONS

These results suggest some noteworthy patterns in the impact of firm-specific advantages and resource utilization on performance. The results have highlighted the direct combined effect of a firm's technology and marketing on performance. The combined application of a firm's expertise has been shown to exercise a great positive influence on performance. Indeed, the results indicate that both technology and marketing-based resources and capabilities have proved exceptionally useful, particularly as most hi-tech firms are running a business in an emerging market which is characterized by a high degree of technological uncertainty. When hi-tech firms emphasize "combinative resources" such as well-developed marketing to create value for the customer and focus on customer-oriented product design, these firms tend to achieve higher performance.

The findings show that the technology and marketing-based capabilities of most hi-tech firms have undergone significant changes. Their "combinative resource" emphasis has enabled these firms to learn new product demand patterns efficiently. In the meantime, the complementarities of marketing and technology-based resources have not only strengthened their existing R&D capacity, but also strongly supported

their marketing ability. Hence, it can be reasoned that by updating their existing and new technologies and marketing-based resources, firms increase their resource coherence and adaptation. It is conceivable that hi-tech firms in China that have focused on the development of their own combinative capabilities have generated good local marketing practices and product portfolios. In support of this relationship between resources and capability development, our results also confirm that a close match between a firm's R&D operations and appropriate marketing has achieved positive effects. In sum, resource synergies between technology and marketing practices have contributed significantly to the size of these firms markets in terms of the quality of their service, company brand, reputation and goodwill.

Figure 1. Results of Firm-specific Advantages, Organizational Control and Firm Performance



Notes: NPAR: Number of parameters; RMR: Root mean square residual; GFI: Goodness of fit index; PGFI : Parsimonious comparative fit index; N=339 hi-tech firms; One-tail probabilities: *p<0.05, **p<0.01, ***p<0.001

Model Summary

NPAR	18
RMR	0.429
GFI	0.962
AGFI	0.837
PGFI	0.137
X ² (d.f., p-value)	70.57 (23, p<0.000)

The results of this study usefully extend our normative understanding of the relationship between resources, control and performance. Consistent with previous research, our studies have supported recent arguments that a firm's knowledge level, competences and absorptive capacities can be used to identify the levels of its leading-edge capabilities for its value-added activities (Cohen and Levinthal 1990, Durand and Vargas 2003). An examination of an empirical test of technology and marketing-based resources and capabilities underscores these insights and corroborates these arguments. This study has provided strong evidence about how firms' specific assets such as technology work in conjunction with marketing to influence firm performance.

With reference to the resource-based theory of the firm, the results of this study of technology-based resources were robust with respect to other studies in three areas: operational capacities, technical training, and technological supplies (Grant 1996a, Eisenhardt and Martin 2000, Gupta and Govindarajan 2000). Operational facilities appear to furnish an important basis for a firm to exercise its production technology and knowledge. The results suggest that hi-tech firms adopting radical technological improvements to improve their technology-based resources and capabilities in China must first consider their existing operational capabilities (Eisenhardt and Martin 2000). Very importantly, the evidence from the raw data of this study suggests that most firms in China face considerable resource challenges that are characterized by heightened market competition, the adoption of new technology and the increasing costs. Not all hi-tech firms expected to be able to rise to such challenges, particularly if their current operational capabilities were burdened with mediocre technological assets.

The results of this study confirm that a firm's business reputation, customer loyalty and product image add significantly to the quality of its operations. Searching out new markets, adapting products, contacting buyers and developing new products are some of the considerable challenges that face hi-tech firms in China. It is reasonable to suppose the acquisition of raw materials and distribution channels greatly influence productivity (Noble, Sinha and Kumar 2002). Our results suggest that involvement in marketing-based activities can generate performance differences in terms of the effective use of local market conditions in the face of unfavorable governmental policies and the scarcity of technological resources (Machin 1979, Johnson and Jil 1993, Deshpande, Farley and Webster 1993, Marginson 2002). The findings show that a firm can exploit an appropriate control method to adapt and

improve its resources and capabilities in order to put its best foot forward. This study has developed alternative research measures of the mediating role of a firm's organizational control. It has also differentiated three types of control for purposes of assessing the degree of influence on the relationship between firm-specific advantages and performance.

Corporate culture is a good predictor of adaptation to local and marketing knowledge, the improvement of the quality of service and the development of a business brand, reputation and goodwill. This empirical study has examined the notion that building a corporate culture has generated organizational flexibility that allows hi-tech firms to achieve superior cooperation and improve their company image as well. The importance of building a good relationship with distributors is believed to be critical in good networking. Certainly, an appropriate corporate culture is the highest form of organizational adaptation in an emerging business environment such as in China, and it is expected to mesh with common practices and business norms in the local milieu. The corporate culture contributes to new managerial principles that enable a firm to recognize the value of its knowledge (Deshpande, Farley and Webster 1993).

In addition, formalization is perceived to promote distinct organization competencies that facilitate a range of decisional choices (Dermer and Lucas 1986). Managers found that formalization had played a major role in enforcing resource competitiveness, allowing their firms' resources to be applied effectively to optimize returns. Contrary to prior expectations, little evidence was found for any mediating effect of resources on performance. Although maintaining good services and quality standards enables most hi-tech firms to engage continuously in organizational formalization and establish effective targets, only a weak relationship was found between formalization and targeting in structuring hi-tech firms' business activities.

Finally, this research model has also displayed the influence of control variables on location and business duration. The results strongly support the hypothesized relationships, while a firm's organizational control positively mediates the relationship between firm-specific advantages and performance. Hence, this study has supported the usefulness of the resource-based view in explaining the types and extent of overall control. The results suggest that a hi-tech firm in China achieves superior performance not only through its critical resources, but also by utilizing them effectively in an appropriate location. The study confirmed that hi-tech firms in China believed that factors such as financial matters, production, personnel, procurement and supplier quality are also critically relevant to their business location.

FUTURE RESEARCH

The present work may indicate several important areas for future research, including a study of which theory may better explain existing relationships linking resources, control and performance. Here, both the resource-based view and organizational

control theory have been used to characterize the explicitly distinctive resource features and the forms of control that enhance a firm's resource competitiveness (Conant, Mokwa and Varadarajan 1990, Conner and Prahalad 1996, Priem and Butler 2000). Such enquiries will benefit from an examination of the literature over a wide range of disciplines. With regard to conceptualizing the relationship introduced above, it is useful here to highlight several theoretical perspectives. Researchers conducting future studies should clarify the notion of what exactly constitutes a firm's resource advantages, and how the nature and sources of its capabilities may be influenced by the choice of control employed (Flamholtz, Das and Tsui 1985, Eisenhardt and Martin 2000). Some organizational scholars also propose that a firm's control mechanism accentuates its organizational strengths by employing more appropriate strategic, economic, and organizational modes (Eisenhardt 1985, Robins and Wiersema 1995).

It appears that the linkages between resource advantages and appropriate control modes within an organization have yet to be fully explored (Grant 2000). Issues of perception and differences in methodology make it difficult to reach a conclusive verdict on this matter. The results of this study show that influences on the performance of a firm with specific assets can be effectively explored by using appropriate indicators. The resource advantages of such a firm can be further disclosed by tracking its specific resource endowments through its historical development (Wernerfelt 1984, Gupta and Govindarajan 2000). Further empirical investigation will show whether firms may be differentially assisted in their attempts to change from one form of control to a more effective one to generate superior performance (Rouse and Daellenbach 2002: 963).

CONCLUSIONS

The challenge in the resource-based view of the firm is identifying the firm's most critical resources, and measuring how appropriate control takes place. Data from 339 hi-tech firms largely supported the hypotheses of the study. Although this study has theoretically challenged the relationship among resources, control and performance that is consistently demonstrated in the literature, examining the framework of firm-specific advantages has shed light on the direct effects on performance of specific types of technologies and explicit marketing knowledge. The resource-based view and the organizational control view are interrelated, because the former provides recognition that the firm needs a basis for recognizing and developing needed resources and capabilities. The latter perspective enhances an understanding of a firm's intangible resources that in turn increase its possible performance efficiencies (Hitt et al. 2000). This research has sought to cross-fertilize insights from these two complementary theoretical approaches. In a related vein, prioritizing the firm-specific advantages of a hi-tech firm while examining their mediating effect on corporate culture, formalization and targeting control have confirmed the prevalent assumption

that a broadened perspective is needed for considering the relationship among resources, control and performance. Organizational control focuses on the process through which a firm's management acquires new knowledge and routines that lead to resource competitiveness. The major findings focus on identifying the nature of technologies or marketing needed for given control modes. Organizational control analysis has helped to transfer the mechanisms of a firm's control mode to a more transparent level. The seven postulated hypotheses that received data support concerned the impact of organizational control derived from organizational commitment to performance. The results indicate that greater organizational control of corporate culture and organizational formalization appears to focus attention on what a hi-tech firm is capable of achieving with its resources.

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APPENDIX: questionnaire used to measure constructs

PART I: The achievement for Form-specific advantages

The respondents were asked to indicate the importance of the following items, using a 1-7 scale (1= not important and 7 = extremely important).

Marketing-based resources and capabilities
the improvement of management competence
the development of a business brand, reputation and goodwill
the increase of quality of service
the increase of marketing knowledge
the adaptation of exclusive technology to the local market

Technology-based resources and capabilities
in-house house research
in-house development
in-house production
the possession of technological patents;

PART II: Organizational control

The respondents were asked to indicate the importance of the following questions, using a 1-7 scale (1= not important and 7 = extremely important).

Corporate culture
Organizational formalization
Business Targeting

Part III: Market performance

Profitability
growth of sales
market share
re-investment

Would you please tell me the type of products, services or trading made or carried out in China (A brief answer is required)

Turnover
register capital
number of employee
date of the establishment
Location
Ownership