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Applicability of the resource-based and dynamic-capability views under environmental volatility

Lei-Yu Wu *

National Chengchi University, Taiwan

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ABSTRACT

This study uses a group of informants and applies a step-by-step empirical process to examine the applicability of the resource-based view (RBV) and dynamic-capability view (DCV) to environmental volatility. Through examining 253 Taiwanese firms, this study finds that the explanatory power of DCV exceeds that of RBV in volatile environments. Firms that possess dynamic capabilities can effectively enhance their competitive advantages, despite facing highly volatile environments. Nevertheless, the RBV is effective in some ways and firms with valuable, rare, inimitable, and nonsubstitutable resources still possess competitive advantages. This article closes with theoretical and practical implications.

1. Introduction

The resource-based view of the firm (RBV) influences the field of strategic management (Newbert, 2007; Priem and Butler, 2001). Researchers theorize that firms possessing resources that are valuable, rare, inimitable, and nonsubstitutable (i.e. resources with VRIN attributes) can achieve sustainable competitive advantage by implementing fresh value-creating strategies that are difficult for competitors to duplicate (Barney, 1986; Dierickx and Cool, 1989; Grant, 1991; Newbert, 2007; Ray et al., 2004; Uhlenbruck et al., 2006; Wernerfelt, 1984). Most empirical work on this area is consistent with the RBV (Barney and Arikan, 2001). The RBV has become a crucial logical consideration in firm strategy development. Consequently, accumulating resources to foster competitive advantage or economic rent has become fundamental to strategic thinking for numerous managers and scholars.

Scholars of the dynamic-capability view (DCV) are extending RBV to dynamic markets (Helfat and Peteraf, 2003, 2007). These researchers doubt that the mere existence of appropriate bundles of specific resources is insufficient to sustain competitive advantage in situations involving rapid and unpredictable market change (Eisenhardt and Martin, 2000; Teece et al., 1997). Consequently, these researchers argue that *dynamic capability*, or the ability to integrate, build and reconfigure resources, is essential in learning competitive advantage under environmental volatility (Eisenhardt and Martin, 2000; Newbert, 2005; Rindova and Kotha, 2001; Teece, 2007; Teece et al., 1997; Zollo and Winter, 2002). More specifically, most DCV research focuses solely on conceptual discussions (e.g., Deeds et al., 2000; Eisenhardt and Martin, 2000; Griffith and Harvey, 2001; Helfat and Peteraf, 2007; King and Tucci, 2002; Luo, 2000; Madhok and Osegowitsch, 2000; Majumdar, 2000; Makadok, 2001; Petroni, 1998; Rindova and Kotha, 2001; Teece, 2007; Teece et al., 1997; Zollo and Winter, 2002), and empirical studies are rare (e.g., Wu, 2006, 2007). Numerous concepts need examination and DCV needs further discussion. This empirical study attempts to clarify the applicability of DCV to environmental volatility.

This study applies comprehensive and step-by-step empirical procedures to research. Specifically, this study adopts the following empirical procedures: First, this study verifies the applicability of RBV by examining the relationship between resources and competitive advantages. Second, this study adds environmental volatility as a moderator to verify the applicability of RBV to highly volatile environments. Third, this study examines the relationship between dynamic capabilities and competitive advantages. Fourth, this study clarifies the applicability of DCV to dynamic environments using environmental volatility as a moderator.

Unlike previous works on RBV or DCV, this study simultaneously examines RBV and DCV. Most previous empirical studies on RBV or DCV verify either RBV or DCV only, and generally treat different verification topics separately. Accordingly, questions exist regarding whether informant selection was manipulated to obtain desired verification results. This study uses a single group of subjects, drawn from the Taiwan Hsinchu High Technology Industrial Park Council Science Industry Association Registry and the Taiwan Manufacturers Registry, to simultaneously test both RBV and DCV and prevent biased conclusions. Consequently, the study's content persuasively compensates for the lack of RBV and DCV in both theoretical and empirical senses.

* Department of Business Administration, National Chengchi University, No. 64, Sec. 2, ZhiNan Rd., Taipei City 11605, Taiwan. Tel.: +886 2 29393091x88111; fax: +886 2 29398005.
E-mail address: wuly@nccu.edu.tw.

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The remainder of this paper has the following organization. Section 2 presents theoretical background and develops related hypotheses. Section 3 then outlines the study methodology, and Section 4 discusses the empirical results. Finally, Section 5 presents conclusions and managerial implications.

2. Theory and hypotheses

2.1. Resource-based view

RBV is the dominant framework in the strategy literature (Newbert, 2007) attempting to explain performance differences among different firms in the same industry (Zott, 2003). Penrose (1959) proposes that sustained firm growth depends on internal firm characteristics, such as management capability and economy-of-scale in technological expertise. Wernerfelt (1984) proposes the concept of "resource position barrier" which inspires scholars to consider differentiating firm resources as sources of sustainable competitive advantage. Barney (1986), Dierickx and Cool (1989), Grant (1991), and Rumelt (1984) make RBV a crucial consideration in developing firm strategy. The core-competence perspective of Prahalad and Hamel (1990), and the competence-based competitive strategy of Heene and Sanchez (1997) are based on RBV and are key concepts in business strategy.

Rumelt (1984) demonstrates that intra-industry profit differences exceed inter-industry differences, suggesting that resources and internal firm organization are more important than industry effects. Researchers theorize that when firms possess resources that are VRIN, they can achieve sustainable competitive advantage by implementing new value-creating strategies that are difficult for competing firms to duplicate (Barney, 1986; Dierickx and Cool, 1989; Grant, 1991; Ray et al., 2004; Wernerfelt, 1984).

Most empirical findings are consistent with predictions of RBV, possibly because those studies do not involve subjects in contexts within highly volatile environments. For example, Ray et al. (2004) identifies a positive correlation between intangible, socially complex resources and customer service performance in the insurance industry. However, the insurance industry is less volatile than other industries (e.g., high-tech industries), and thus verification in existing studies using the RBV occurs in the absence of interference from environmental volatility. Therefore, scholars extend the RBV to dynamic or highly volatile markets (Eisenhardt and Martin, 2000; Teece et al., 1997).

Though the resource-based view does not necessarily imply a static research approach, researchers propose that adopting a dynamic view of resources is important (Helfat and Peteraf, 2003). Fluid consumer needs, uncertain technological developments, and competition characterize highly volatile markets (Chiou et al., 2002; Desarbo et al., 2005; Liu et al., 2005), and represent a rapidly shifting competitive landscape for firms (Eisenhardt and Martin, 2000). In such environments, the mere existence of appropriate bundles of specific resources is insufficient to sustain firm competitive advantage (Eisenhardt and Martin, 2000; Teece et al., 1997).

For example, though IBM pursues a resource-based strategy of accumulating technological assets and frequently adopting an aggressive intellectual property stance to protect its interests (Teece et al., 1997), its personal computer division (PCD) has long been inadequate. The Chinese computer manufacturer Lenovo Group, Ltd., completed its $1.8 billion purchase of IBM's PCD in May 2005. Lenovo was established in 1984 in a modest one-story bungalow in Beijing, and is currently the third largest PC firm in the world, trailing to Dell, Inc., and Hewlett-Packard, Inc. One rational explanation is that unlike Lenovo, the PCD of IBM was unable to respond to environmental change despite its abundant resources.

Hypothesis 1a. Firm resources relate positively with firm competitive advantage.

Hypothesis 1b. High environmental volatility weakens the positive relationship between firm resources and competitive advantage.

2.2. Dynamic-capability view

Teece (2007) proposes that firms require dynamic capabilities to adapt to changing environments and shape the ecosystems they occupy. Zollo and Winter (2002) propose that dynamic capability is a learned and stable pattern of collective activity, through which organizations systematically generate and modify their operating routines to enhance their effectiveness. Dynamic capabilities enable firms to renew their competences to meet changing market requirements, and include the ability to integrate, learn, and reconfigure internal and external organizational skills and resources (Teece et al., 1997), or (1) to sense and shape opportunities, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and reconfiguring their intangible and tangible assets (Teece, 2007).

Dynamic capabilities are antecedent organizational and strategic routines that managers use to transform their resource base and develop new value-creating strategies (Grant, 1996; Pisano, 1994). Eisenhardt and Martin (2000) propose that dynamic capabilities can enhance existing resource configurations when pursuing long term competitive advantage. In nonlinear and unpredictable competitive landscapes, manager capabilities to "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997: 516) are sources for sustaining competitive advantage.

Dynamic capability is essential in identifying competitive advantage under environmental volatility (Eisenhardt and Martin, 2000; Newbert, 2005; Rindova and Kotha, 2001; Teece et al., 1997; Wu, 2007; Zollo and Winter, 2002). This proposition is antecedent to the suggestion that, regardless of degree of environmental volatility, dynamic capabilities represent an emerging and potentially integrative approach to understanding new sources of competitive advantage. Therefore, environmental volatility does not moderate the relationship between dynamic capabilities and competitive advantage.

Hypothesis 2a. Firm dynamic capabilities relate positively with firm competitive advantages.

Hypothesis 2b. A highly volatile environment does not weaken the positive relationship between firm dynamic capabilities and competitive advantage.

3. Methods

3.1. Survey development and administration

The survey questions were pre-tested and refined based on the opinions of eight experts, including five CEOs and three professors, to determine the content validity of the survey items. Following preliminary testing, a pilot study was conducted involving 32 firms to determine the efficacy of the questionnaire and administration process. Pilot sample members were given one month to respond, after which 21 completed questionnaires were obtained. Informant responses provided a guide for eliminating ambiguities in wording. Overall, respondents easily understood the questionnaire items and questions. Based on the pilot study data, the measurements were refined by checking item-to-total correlations and Cronbach's α (Hair et al., 2006; Nunnally, 1978).

3.2. Measures

Measurements of research constructs were generated in two ways: (1) for variables employed in existing research, measures with acceptable measurement quality were adopted and slightly modified

to increase their applicability; and, (2) for variables unique to the conceptual framework of this study, operational measures were developed and assessed to determine their content validity based on existing conceptual studies via interviews and discussions with five CEOs and three scholars. Self-administrated questions were employed for all variables, and scales were established to measure latent constructs. Measurements were primarily implemented using a 7-point Likert and semantic-differential scale ranging from 1, indicating "strongly disagree" to 7, indicating "strongly agree."

3.2.1. Resources

Based on the literature review and in-depth interview findings, resources were divided into two groups, VRIN and non-VRIN. The VRIN resources were measured using three variables: specialized know-how (Amit and Schoemaker, 1993; Leonard-Barton, 1992); management capability (Collis, 1991; Lippman and Rumelt, 1982); and alliance experience (Gulati, 1998). No items were removed based on item-to-total correlations and Cronbach's α. Non-VRIN resources were measured using a single-item: financial capital (Brush et al., 1997; Tsai and Ghoshal, 1998). Each respondent rated their firm performance in terms of the four variables using semantic-differential scales (Table 1).

3.2.2. Environmental volatility

According to the environmental dynamism scale of Miller (1987) and in-depth interviews, four items were adopted to measure environmental volatility, and none were removed based on the item-to-total correlation and Cronbach's α.

3.2.3. Dynamic capabilities

Following the method of Eisenhardt and Martin (2000), Teece et al. (1997) and in-depth interviews, three items were used to measure dynamic capabilities, and none of these items were removed based on the item-to-total correlation and Cronbach's α.

3.2.4. Competitive advantages

Four measures were used to estimate competitive advantages. These measures were identified via literature review and interviews. They include speed of response to the market (Hill and Jones, 2007); production efficiency (Hill and Jones, 2007; Pisano and Wheelwright, 1995); product quality (Hill and Jones, 2007; Lee et al., 2001); and innovation speed (Hill and Jones, 2007). None of these measures were removed based on item-to-total correlation and Cronbach's α.

Table 1
Constructs and items.

Resources ($\alpha = 0.85$)
Firm specialized know-how is (below the industry average — above the industry average)
Firm management capability is (below the industry average — above the industry average)
Firm cooperative alliance experience is (below the industry average — above the industry average)
Firm capital is (below the industry average — above the industry average)
Environmental volatility ($\alpha = 0.75$)
Product lifecycle in the principle industry in which our firm operates is very short
Accurately forecasting the rapidly changing demands and tastes of consumers is almost impossible
The activities of major competitors are unpredictable and competition is intense
Technological change in the principal industry in which our firm operates occurs very fast
Dynamic capabilities ($\alpha = 0.96$)
Resource integration capability (insufficient–sufficient)
Learning capability (slow–fast)
Resource reconfiguration capability (insufficient–sufficient)
Competitive advantage ($\alpha = 0.92$)
Speed of response to the market (below the industry average — above the industry average)
Production efficiency (below the industry average — above the industry average)
Product quality (below the industry average — above the industry average)
Speed of innovation (below the industry average — above the industry average)

3.3. Sample and data collection

This study adopts Taiwanese technology firms as the research sample. Technology firms are suitable research subjects because their products typically have short product life cycles (Chiou et al., 2002), making them appropriate for the purpose of this study. Taiwan is a major international producer of information related products. However, with Mainland China becoming the world factory because of its low production costs, and given the rapid obsolescence of information products, Taiwanese technology firms face increasingly fierce competition. Therefore, research evidence from Taiwanese technology firms provides rich information and implications for managers (Wu and Wang, 2007).

This study obtains its research sample from the Taiwan Hsinchu High Technology Industrial Park Council Science Industry Association Registry and the Taiwan Manufacturers Registry, published by the China Credit Information Service. Since this study required information from upper management, firm CEOs were the primary informants. Phone calls confirm that the targeted respondents were indeed the CEOs, after which the respondents were contacted and their cooperation requested. Following the questionnaire mailing, respondents were re-contacted to ascertain whether confirm they had received the questionnaires and urged to return promptly (cf. Sivadas and Dwyer, 2000).

The sample comprises 2000 randomly selected firms. Seventeen questionnaires were returned owing to incorrect addresses. Two-hundred and sixty-one firms responded among the 1983 that received questionnaires. Eight of the returned questionnaires are invalid. The final number of valid questionnaires is 253, representing a valid return rate of 12.65%.

Breaking down the respondent firms according to industry, 29.6% are from the computers and peripheral industry, 19.6% are from the communications industry, 16.4% are from the integrated circuit (IC) industry, 11.2% are from the software industry, 7.5% are from the precision machinery industry, 6.4% are from the optoelectronics industry, 5.8% are from the biotechnology industry, and 3.5% are from other industries. The distribution of industries among the respondent firms thus resembles that of the sampling frame. Consequently the responding firms appear representative of the study population.

3.4. Non-response bias

This study employs Analysis of variance (ANOVA) to check for differences in annual sales and number of employees between early and late respondents to measure non-response bias and ensure that the sample firms were representative of the population (Armstrong and Overton, 1977). Responses return within four weeks of the first mailing were classified as early ($n = 182$), while those received after four weeks were classified as late ($n = 71$) (cf. Mishra et al., 1998). The ANOVA indicates no significance difference between these two groups in annual turnover ($p = 0.91$) and number of employees ($p = 0.89$).

4. Analytical results

To identify possible abnormalities this study follows Kline (2005) and checks for missing data points, normality of the data distribution and outliers. Mean substitution is used to deal with missing data (cf. Edelman et al., 2005). To increase the data robustness, Mahalanobis distance is used to check for outliers. The Mahalanobis distance is 0–1 for all observations, indicating that outliers are not a problem in the dataset (Kleinbaum et al., 1988). Thus, the data conforms to normality assumptions.

The highest correlation coefficient (0.71) among constructs is between resources and dynamic capabilities (Table 2), suggesting that all study constructs are conceptually and empirically distinct (cf.

Table 2
Descriptive statistics: means, standard deviations and correlations.

	Mean	Standard deviation	1.	2.	3.	4.
1. Resources	5.1	1.15				
2. Environmental volatility	4.9	0.91	0.20			
3. Dynamic capabilities	5.3	1.14	0.71	0.32		
4. Competitive advantage	5.3	1.06	0.69	0.28	0.62	

Wang et al., 2004). The Cronbach's α value for all four constructs exceeds 0.75, indicating acceptable reliability (Hair et al., 2006; Nunnally, 1978).

According to Eisenhardt and Martin (2000), markets are either moderately dynamic or highly volatile. To evaluate environmental volatility, this work averages the four measurement items, with a value below 6 indicating low or medium environmental volatility and a value of 6 or greater indicating high environmental volatility.

4.1. Resource and competitive advantages

Ignoring market environment, resources and competitive advantages are significantly correlated (0.69; $p<0.01$). Multiple regressions between resources and competitiveness were then applied under different environmental volatilities to examine H1a.

All four resources (using firm size as a control variable) significantly affect competitive advantages in low of medium volatility environments. Following the separation of competitive advantage into specific items, then twelve of the sixteen sets of regression coefficients (four resource items and four competitive advantage items) are significantly positive. In high volatility environments only two of four resources significantly influence competitive advantages. If competitive advantage is separated into specific items, then six of the sixteen sets of regression coefficients are significantly positive (Table 3). High volatility thus weakens the positive relationship between resources and competitive advantages; hence, H1b holds.

Among the four resource indexes, specialized know-how, management capability, and alliance experience are intangible resources, while financial capital is a tangible resource. This investigation finds that in a highly volatile environment, six of twelve coefficients for the relationship between intangible resources and competitive advantages are significant, but no regression coefficient is significant for the relationship between tangible resources and competitive advantages. Consequently, although environmental volatility moderates the relationship between resources and competitive advantages, the RBV still has explanatory power.

Table 3
Firm resources and competitive advantage: high vs. low or medium environmental volatility.

	Speed responding to market	Production efficiency	Product quality	Speed of innovation	Competitive advantage
	(1)	(2)	(3)	(4)	(1+2+3+4)
High environmental volatility					
Firm size	0.07	0.10	−0.02	0.11	0.07
Specialized know-how	0.08	0.33†	0.47*	0.33†	0.33*
Management capability	0.70*	0.51*	0.28	0.39*	0.53*
Past alliance experience	−0.17	−0.23	−0.25	−0.09	−0.20
Financial capital	0.07	0.04	0.11	0.05	0.07
Low or medium environmental volatility					
Firm size	−0.10	−0.07	−0.05	−0.09	−0.06
Specialized know-how	0.49*	0.36*	0.31*	0.32†	0.39*
Management capability	0.23*	0.16	0.36*	0.41*	0.33*
Past alliance experience	0.21*	0.19†	0.10	0.16	0.19*
Financial capital	0.21†	0.12	0.19†	0.26*	0.18†

Note:
1. † significant at $p<0.1$; * significant at $p<0.05$.
2. Firm size is a control variable.

Table 4
Dynamic capabilities and competitive advantage: high vs. low or medium environmental volatility.

	Speed responding to market	Production efficiency	Product quality	Speed of innovation	Competitive advantage
	(1)	(2)	(3)	(4)	(1+2+3+4)
High environmental volatility					
Firm size	−0.14	−0.09	−0.18	−0.07	−0.13
Integration capability	0.22†	0.20†	0.20†	0.29†	0.22†
Learning capability	0.19†	0.22†	−0.06	0.27†	−0.04
Reconfiguration capability	0.38*	0.31*	0.31*	0.49*	0.42*
Low or medium environmental volatility					
Firm size	0.06	0.03	0.05	−0.05	0.03
Integration capability	0.23†	0.18†	0.28*	0.20†	0.23†
Learning capability	0.10	0.01	−0.11	0.05	0.01
Reconfiguration capability	0.33*	0.36*	0.40*	0.43*	0.42*

Note:
1. † significant at $p<0.1$; * significant at $p<0.05$.
2. Firms size is a control variable.

4.2. Dynamic capability and competitive advantages

When not considering environmental volatility, there exists a significant relationship between dynamic capabilities and competitive advantages (correlation coefficient, 0.62; $p<0.01$). In both environmental conditions, two of three dynamic capabilities significantly influence competitive advantage. In low or medium volatility environments, eight of twelve sets of coefficients (three dynamic capability indices and four competitive advantage indices) are significant and positive. In high volatility environments, eleven of twelve coefficients are positive and significant. Thus, in high volatility situations, dynamic capabilities effectively enhance firm competitive advantages, and thus H2a and H2b receive support (Table 4).

5. Conclusions

5.1. Findings and managerial implications

Most previous empirical studies of RBV or DCV verify only one topic per article, and treat different subjects of verification separately. This study uses a single group of subjects and applies a step-by-step empirical process to examine the applicability of the RBV and DCV to environmental volatility. Through examining 253 Taiwanese firms, this study finds that RBV is applicable when environmental volatility is ignored (cf. Barney, 1986; Dierickx and Cool, 1989; Grant, 1991; Newbert, 2007; Ray et al., 2004; Uhlenbruck et al., 2006; Wernerfelt, 1984). However, considering environmental volatility reduces the effectiveness and competitive advantage of resource firms (e.g., Eisenhardt and Martin, 2000; Newbert, 2005; Teece et al., 1997; Rindova and Kotha, 2001; Zollo and Winter, 2002). Nevertheless, the RBV is still somewhat effective, and firms with VRIN resources still have competitive advantages; however, this study finds that the DCV has better explanatory ability than the RBV.

The findings of this study indicate that accumulation of VRIN resources increases firm competitive advantage. However, the strength of this effect depends on the volatility of the specific industrial environment. That is, firms facing low or medium volatility industrial environments can gain competitive advantages through resources, particularly when they emphasize VRIN resource accumulation. However, in highly volatile environments, the effects of resource accumulation on gaining competitive advantages are considerably reduced. Namely, in high volatility environments firms cannot rely on previously accumulated business resources to gain competitive advantages.

The findings of this study also indicate that dynamic capabilities are the main source of competitive advantages for firms. Firms that can rapidly integrate, learn, and reconfigure their internal and external resources can adapt to rapid environmental changes and thus enhance or maintain their competitive advantages. However, a key question is how firms can nurture their dynamic capabilities.

5.2. Limitations and future research directions

This study is limited in that the analysis is based on perceptual data (Nakayama and Sutcliffe, 2005). This perceptual approach creates difficulties for managers of specific businesses in applying the research results to practical problems involving specific businesses. Additionally, future works should survey two or more key informants at each company to increase the accuracy of the survey information. The second research limitation is that this study mainly uses the definitions that Teece et al. (1997) and Eisenhardt and Martin (2000) propose to develop the measures of dynamic capability. However, the existing empirical research is very limited, and excellent potential exists to improve the measures as more research is performed. Therefore, future studies can reference other scholars of dynamic capabilities and apply a more thorough procedure, such as that developed by Churchill (1979), to establish a more robust measurement of dynamic capabilities. Finally, the likely differences in dynamic capabilities among industries deserve further investigation.

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