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COMPETITIVE INTENSITY AS A QUASI-MODERATOR OF THE RELATIONSHIP BETWEEN INNOVATIVE EFFORTS AND PERFORMANCE*

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This study empirically investigates the moderating effect of competitive intensity on the relationship between innovative efforts and performance. The study proposes that a firm's competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance.

The results support the predictions of the study. The results indicate that competitive intensity moderates the relationship between innovative efforts and performance such that when competitive intensity is high, the relationship between innovative efforts and performance is positive, and vice versa, when the competitive intensity is low, the relationship between innovative efforts and performance is negative. Furthermore, the results reveal that competitive intensity has a positive relationship to the level of innovative efforts but has a negative relationship to performance.

Keywords: competitive intensity; innovative efforts; performance; quasi-moderator

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Introduction

The relationship between innovative efforts and performance has attracted much attention in the management and business literature. Despite all these efforts, empirical studies investigating the influence of innovative efforts on performance often report weak and inconclusive findings. Some scholars (e.g., Burton et al. 2002; Foster 1986) have argued that the relationship between innovative efforts and firms' performance may be contingent upon the competitive environment in which the firms operate.

The purpose of this study is to investigate the moderating effect of competitive intensity on the relationship between innovative efforts and performance. This study predicts that competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance. As a quasi-moderator, competitive intensity will interact with innovative efforts to affect performance. In addition, competitive intensity will affect both the level of innovative efforts and performance. Hence, this study inquires of the following research question: Does competitive intensity moderate the relationship between innovative efforts and performance?

The results support the predictions of this study. The results indicate that competitive intensity modifies the relationship between innovative efforts and performance. When the competitive intensity is high, innovative efforts positively affect performance. On the contrary, when competitive intensity is low, innovative efforts negatively affect performance. Furthermore, the results reveal that competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance. As such, competitive intensity has a positive relationship with innovative efforts but has a negative relationship with performance.

These findings are consistent with the argument that when competitive intensity is high, firms should invest heavily in innovative efforts to increase their ability to produce unique products/services and to gain competitive advantage (Porter 1985). By contrast, when competitive intensity is low, firms should focus their efforts on achieving efficiency through the construction of efficient scale facilities, vigorous pursuit of cost reduction from experience, and cost minimization in areas such as research and development (Miller 1988; Porter 1985). The results suggest that managers need to understand the nature of their firms' competitive intensity before investing in innovative efforts. This study indicates that achieving a good match between innovative efforts and types of competitive intensity is likely to affect performance positively.

The remainder of this paper is organized as follows. Section two reviews the related literature as the basis to develop the hypotheses. Section three describes the research methods employed to examine the hypotheses. Section four presents the results of

statistical analyses. Section five discusses the main findings of this study, limitations, and directions for future research in this area.

Related Literature and Hypothesis

Despite the widely-held premise that innovation is crucial for long-term survival of a company, empirical findings with respect to the effect of innovative efforts on performance have been inconclusive. Based on a survey of 400 senior executives of U.S. technological firms, Calantone et al. (2002), for example, find a positive association between innovative efforts and performance. Similarly, using a sample of 531 firms from Northern Ireland and the Republic of Ireland, Jin et al. (2004) report that firms with high level of investment in innovative efforts perform better than do firms with low level of investment in innovative efforts.

Other studies, however, have reported a negative relationship between innovative efforts and performance. O'Brien (2003) investigates the relationship between innovative efforts, as measured by research and development expenditures, and the performance of firms. Using the Compustat industrial and business segments database, he finds that innovative efforts are negatively associated with performance. In a similar vein, based on a survey of 31 Indonesian publicly-held firms listed on the Jakarta Stock Exchange, Jermias and Armitage (2000) report a negative relationship between innovative efforts and performance.

Miller (1988) suggests that researchers need to investigate the moderating effects of the environment on the relationship between innovative efforts and performance since the relationship between these two variables might be different across different environmental conditions. In a similar vein, Foster (1986) emphasizes the need to consider the environment in which a firm operates when investigating the effect of innovative efforts on performance. He argues that a generic prescription of the relationship between innovative efforts and performance can be as harmful as they are helpful because innovative efforts can only be effective under high competitive intensity.

This study adopts a contingency approach and argues that competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance. Sharma et al. (1981) propose that as a quasi-moderator, the moderator variable should interact with the predictor variable to modify the form of the relationship between the predictor and the criterion variables. In addition, they stipulate that the moderator variable should also have a significant relationship with both the predictor and the criterion variable. Related to this study, the quasi-moderating relationship between innovative efforts and performance suggests that the impact of innovative efforts on performance varies depending upon the level of competitive in-

tensity. In addition, competitive intensity affects both the level of innovative efforts and the performance of the firms.

Milliken (1987) suggests that when competitive intensity is low, firms are able to assess both the present and future state of the environment reasonably well, enabling them to determine the potential impact of decision making on current and future business activities. In such an environment, firms will gain competitive advantage by planning their activities reasonably well and realize efficiency (see also Burton et al. 2002). Porter (1985) suggests that to increase efficiency, firms should produce standard products and employ standardized operating procedures. Miller (1987) contends that although these practices reduce flexibility in responding to changes in technology, customer demand, and competitors, they increase efficiency by narrowing the range of tasks and by making activities more routine. Increased efficiency will, in turn, lower the cost of products or services and will lead to superior performance (Porter 1985).

In contrast, when competitive intensity is high, firms should invest heavily in research and development activities to help them create firm-specific assets (D'Aveni 1994). Likewise, Miller (1987) asserts that investment in research and development activities increases firms' ability to produce new and better products and help them keep up with the innovations of competitors and the changing environment.

Chandler (1962) proposes that innovation is most likely to be found in industries characterized by high competitive intensity in which the rates of new product introduction and technological change are high. If competitive environment is a critical factor in determining the level of innovative efforts and firms need to properly adjust the level of innovative efforts to adapt to the environment in which the firms operate, then a proper match between innovative efforts and competitive environment should enhance the firms' performance.

Previous discussion suggests that the impact of innovative efforts on performance varies, depending upon the level of competitive intensity. When the competitive intensity is high, innovative efforts will have a positive impact on performance due to an increased ability to produce new and better products to keep up with competitors' innovations and the changing environment. When competitive intensity is low, however, innovative efforts will have a negative impact on performance due to the need to increase efficiency by minimizing costs, including research and development activities. Therefore, the following hypothesis is examined:

H_1: The relationship between innovative efforts and performance is moderated by competitive intensity such that when competitive intensity is high, the relationship

between innovative efforts and performance will be positive, but when competitive environment is low, the relationship between innovative efforts and performance will be negative.

Furthermore, this study proposes that competitive intensity acts as a quasi-moderator for the relationship between innovative efforts and performance. As a quasi-moderator variable, competitive intensity will affect the level of innovative efforts (Miller 1987; Tushman and Anderson 1986; Bourgeois 1985) and performance (Calantone et al. 2002; Baker and Sinkula 1999; Prescott 1986; Dess and Beard 1984). Miller (1987) argues that when the competitive intensity is high, innovation is crucial to determining firms' competitive advantage and market success. Innovative products enable the firms to adapt to their rapidly changing environment (Miles and Snow 1978) and to take advantage of emerging trends (Miller 1987). Innovation-based competition thus necessitates the creation and development of products that are superior to others in the market (Mia and Clarke 1999). Consequently, firms operating in high competitive intensity are often characterized by their heavy investments in research and development activities (Porter 1985). By contrast, when the competitive intensity is low, firms tend to be focused on efficiency by producing standardized products, using routine operating procedures, and limiting their spending on areas such as research and development (Miller 1987). These practices enhance the firms' ability to gain competitive advantage by becoming the lowest producers in the industry.

If competitive intensity influences the level of innovative efforts, there will be a good reason to predict that firms operating in high competitive intensity will spend more on innovative efforts than will those operating in low competitive intensity. Specifically, the following hypothesis is examined:

H_2: *There is a positive relationship between competitive intensity and innovative efforts.*

Competitive intensity has been hypothesized and empirically demonstrated to have significant effects on performance (Keats and Hitt 1988; Dess and Beard 1984; Porter 1985). High competitive intensity may influence a firm's performance negatively due to an increased risk and uncertainty surrounding the firm's products and services (Keats and Hitt 1988). Empirical studies have consistently reported that competitive intensity negatively affects performance. For example, based on data from 110 large manufacturing firms listed on Fortune 500 database, Keats and Hitt (1988) report that competitive intensity has a negative relationship with operating performance. Similar results are also reported by Prescot (1986) and Dess and Beard (1984). Therefore, the following hypothesis is tested:

H_3: *There is a negative relationship between competitive intensity and performance.*

This study uses the following moderated regression model to test the hypotheses:

$$PERFORM_i = \gamma_0 + \gamma 1\ INOV_i + \gamma 2\ ENV_i + \gamma 3\ INOVi*ENV_i + \gamma 4\ SIZEi + \gamma 5\ LEV_i + \varepsilon$$

where:

PERFORM$_i$: Financial performance of firm *i* in terms of ROA or ROS

INOV$_i$: The level of innovative efforts as measured by research and development expenses divided by net sales revenues.

ENV$_i$: An indicator equal to 1 for firms competing in low competitive intensity and 0 for firms competing in high competitive intensity.

SIZE$_i$: The size of firm *i* as measured by the logarithmic function of total assets.

LEV$_i$: Leverage of firm *i* as measured by the ratio of debt to equity.

Hypothesis H_1 predicts that the coefficient of INOV*ENV will be negative and significant. In addition, hypothesis H_1 also implies that the coefficient of INOV will be positive but the sum of the coefficients of INOV and INOV*ENV will be negative. To test hypotheses H_2 and H_3, this study employs the three-step moderated regression analysis procedures suggested by Sharma et al. (1981). Assuming that the coefficient of INOV*ENV will be significant (Hypothesis H_1), Hypothesis H_2 will be examined by regressing the performance variables on ENV without the interaction term. It is expected that the coefficient of ENV will be significant. To test hypothesis H_3, the moderator variable (ENV) will be regressed on the predictor variable (INOV) and it is expected that the relationship will be significant. The additional variables in the model control for firm size (SIZE) and monitoring mechanisms by creditor (LEV).

Research Methods

Sample selection

Data were collected from the North American Compustat S&P 500 database. The sample used in this study consists of firms in the manufacturing industry (SIC 2000 and SIC 3000). The manufacturing industry was selected as the research sample because firms in this industry tend to employ different levels of innovative efforts to compete effectively.

Information on industry concentration ratios was obtained from the 1997 U.S. economic census from the U.S. Department of Commerce. To be included in the sample, a firm must report research and development expenses, sales revenues, total assets, total liabilities, and total equities for five consecutive years (1997-2001). In addition, the industry concentration

Table 1. **Sample Selection for Compustat S&P 500 Firms in Manufacturing Industry**

Total number of firms listed on Compustat S&P 500		500
Less:		
Non-manufacturing firms:		
- Mineral industry (SIC 1000-1499)	20	
- Construction industry (SIC 1500-1799)	4	
- Transportation, communications and utilities (SIC 4000-4999)	64	
- Wholesale trade (SIC 5000-5199)	11	
- Retail trade (SIC 5200-5999)	39	
- Financial, insurance, and real estate industry (SIC 6000-6799)	81	
- Service industry (SIC 7000-8999)	49	
- Other industry (SIC 9000-9999)	3	(271)
Sample before data restrictions		229
Incomplete data for five consecutive years (1997-2001)	39	
Unable to obtain data from proxy statements	74	(113)
Total		**116**

ratio for the industry in which the firm belongs to (based on three-digit SIC codes) must be available in the report from the 1997 U.S. economic census. The number of firms that meet these data requirements is 116. Table 1 summarizes the sample selection.

Variables Measurement

Performance. This study utilizes two accounting-based performance measures as the dependent variables since it is interested in investigating the outcome of managerial discretionary efforts engaging in innovative efforts. Some studies have shown that managers prefer accounting-based performance measures that tend to be more controllable than market-based measures (Verrecchia 1986; Elitzur and Yaari 1995). Therefore, this study uses return on assets (ROA) and return on sales (ROS) to measure firms' performance. Some researchers argue that ROA and ROS are the two most commonly used indicators of profitability (Vining and Broadman 1992; Parker and Hartley 1991). Hutchinson and Gul (2004) contend that accounting-based performance measures such as

ROA and ROS tend to be more controllable by managers and, therefore, are considered by many as appropriate proxies for management performance. ROA is measured by the ratio of income before extraordinary items to total assets. Subsequently, ROS is measured by the ratio of income before extraordinary items to total sales revenue. To mitigate the influence of some temporary unusual circumstances occurring in a particular year, this study uses five-year averaged values for ROA and ROS (1997-2001).

Innovative Efforts. This study uses research and development (R&D) intensity as a proxy for a firm's innovative efforts. Although there is no guarantee that large expenditures on R&D intensity will lead to successful production of innovative products/services, a firm investing in R&D at much higher rate than do its competitors is most likely trying to compete on the basis of innovativeness to respond to its competitive environment. R&D intensity is measured by the ratio of research and development expenses to total sales revenues and is averaged over a five-year period (1997-2001).

Competitive Intensity. This study utilizes the industry concentration ratios, measured by Herfindahl Index, to measure the competitive intensity. The Herfindahl Index is calculated based on the sum of squared of market shares of all firms in an industry using the following formula:

$$H_i = \sum_{i=1}^{n} (\text{marketshare}_i)^2$$

where *i* refers to an individual firm in the industry. The higher the index, the more concentrated is the industry. Therefore, the Herfindahl Index is negatively associated with competitive intensity.

Control Variables. Previous studies suggest that size and leverage may influence the performance of firms (Frank and Goyal 2003; Ramaswamy 2001). This study, therefore, includes size and leverage as control variables. A logarithmic function of total assets is employed to control for the effects of firm size on the performance of the firm. Leverage is measured as the ratio of total liabilities to total equity.

Data Analysis and Results

Descriptive Statistics

Table 2 reports descriptive statistics for all sample and are partitioned by competitive intensity. As suggested by Sharma et al. (1981), this study uses median split approach to classify the sample firms into high and low competitive intensity based on the industry concentration ratios. Although the dichotomization of continuous variables is likely to result in loss of information, it improves the understandability and clarity of interpreting the regression results. To examine whether the results are sensitive to different specification, however, the regression using competitive intensity as a continuous variable is also performed. The results are, in general, consistent with those using the dichotomous variable.

Table 2. **Descriptive statistics**

Variables	ROA	ROS	INOV	SIZE	LEV
Panel A: All sample (n=116)					
Mean	8.762	-0.002	0.099	3.661	1.548
S.D.	6.027	0.557	0.101	0.519	1.306
Min	-116.35	-4.790	0.000	2.560	0.110
Max	42.52	0.390	0.740	5.100	7.640
Panel B: Partitioned by competitive intensity					
a. High Intensity (n=58)					
Mean	11.604	0.079	0.124	3.735	1.735
S.D.	8.125	0.059	0.124	0.525	1.201
Min	-3.580	-0.050	0.010	2.570	0.230
Max	40.150	0.250	0.740	5.100	7.640
b. Low Intensity (n=58)					
Mean	5.691	-0.090	0.074	3.580	1.344
S.D.	21.192	0.797	0.065	0.505	1.393
Min	-116.35	-4.790	0.000	2.560	0.110
Max	42.52	0.390	0.330	4.600	7.500

ROA is return on assets as measured by the ratio of net income to total assets
ROS is return on sales as measured by the ratio of net income to total net sales revenue
INOV is innovative efforts as measured by the ratio of research and development expenses to total net sales revenue
SIZE is measured by the logarithmic function of total assets
LEV is the leverage as measured by the ratio of debt to equity

Panel A of Table 2 shows that the average ROA and ROS for the entire sample is 8.762 and -0.002. Panel B of Table 2 shows that firms in high competitive intensity, on average, perform better (have higher ROA and ROS) than do firms in low competitive intensity (11.604 and 0.079 as compared to 5.691, and -0.090 for ROA and ROS, respectively).

The average spending associated with innovative efforts for the overall firms is 10 percent of the total sales revenues. Consistent with our prediction, firms in high competitive intensity show higher innovative efforts as compared to those in the low competitive intensity (12.4 and 7.4% respectively).

Hypotheses Testing

To investigate the moderating effects of competitive intensity on the relationship between innovative efforts and performance, this study employs the three-step moderated regression analysis procedure proposed by Sharma et al. (1981) and uses Chow's

(1960) approach to testing the equality of regression coefficients between the subgroups. Table 3 reports the regression results for ROA and ROS using both the dichotomous [columns (2) and (3)] and continuous [columns (4), and (5)] specifications of competitive environment (ENV). The *F*-statistics for all regressions are statistically significant (F=4.118, p=0.002, R^2=0.159 for column (2); F=3.538, p=0.005, R^2=0.139 for column (3); F=4.788, p=0.001, R^2=0.180 for column (4); and F=4.512, p=0.001, R^2=0.170 for column (5). Since the results are consistent across both specifications, this study discusses only the results using the dichotomous competitive environment (ENV) measure.

Table 3. **Regression Results of ROA and ROS on Independent and Control Variables using Dichotomous and Continuous Measures of Innovative Efforts**[a]

Variables	Prediction	Dichotomous INOV β (t-statistics)[b]		Continuous INOV β (t-statistics)	
		ROA	ROS	ROA	ROS
	(1)	(2)	(3)	(4)	(5)
Intercept	?	0.000	0.000	0.000	0.000
		1.992 **	1.689 *	1.642 *	1.369
INOV	+	0.096	0.077	0.494	0.498
		0.467	0.383	1.693	1.757
ENV	-	0.086	0.122	-0.114	-0.139
		0.664	0.936	-1.018	1.234
INOV*ENV	-	-0.560	-0.516	-0.918	-0.897
		-2.352 **	-2.221 **	-3.041 ***	-3.066 ***
SIZE	?	-0.078	-0.137	-0.065	-0.127
		-0.839	-1.455	-0.706	-1.375
LEV	?	-0.077	-0.027	-0.063	-0.017
		-0.759	-0.263	-0.631	-0.173
R^2		0.159	0.139	0.180	0.170
F		4.118 ***	3.538 ***	4.788 ***	4.512 ***
Sample size		116	116	116	116

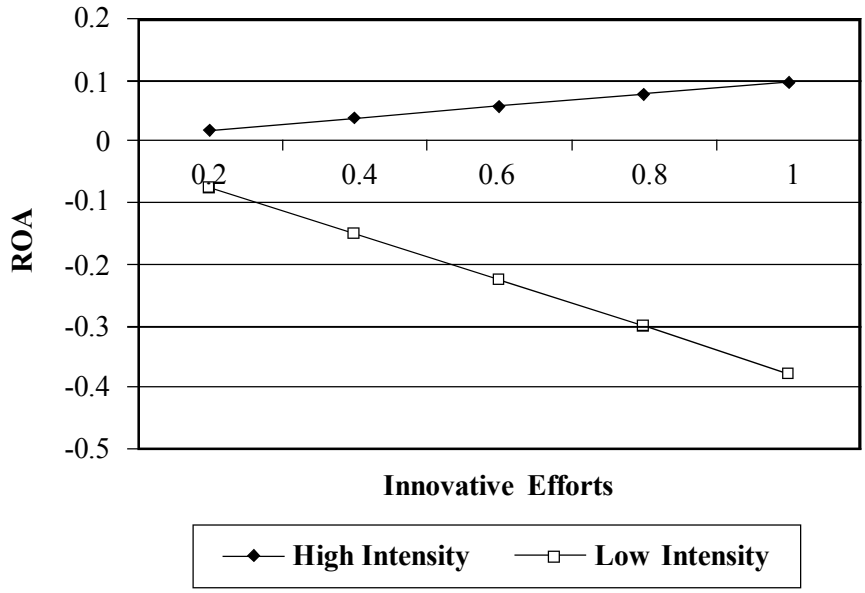
[a] The coefficients are based on the standardized form. INOV is innovative efforts as measured by research and development expenses divided by net sales revenues. ENV is a dummy variable as measured by the industry concentration ratio (1 if high intensity; 0 if low intensity). Size is the logarithmic function of total assets. Lev is leverage as measured by the ratio of debt to equity.
[b] ***, **, and *, denote the significant level at 0.01, 0.05. and 0.1, respectively.

Consistent with Hypothesis H_1, the coefficients of INOV*ENV are negative and significant (β=-0.560, $p<.05$ for ROA, and β=-0.516, $p<.05$ for ROS). Furthermore, the results also show that the coefficients of INOV are positive but not significant, and the sum of the coefficients of INOV and INOV*ENV are negative. These results indicate that competitive intensity moderates the relationship between innovative efforts and performance. In addition, the results reveal that when competitive intensity is high, innovative efforts have a positive relationship with performance (conditioned on the ENV being equal to 0 for high competitive intensity, coefficient of INOV indicates the relationship between INOV and PERFORM in high competitive intensity). When competitive intensity is low, however, innovative efforts have a negative relationship with performance (conditioned on the ENV being equal to 1 for low competitive intensity, the sum of the coefficients of INOV, ENV, and INOV*ENV signifies the relationship between INOV and PEFORM in low competitive intensity).

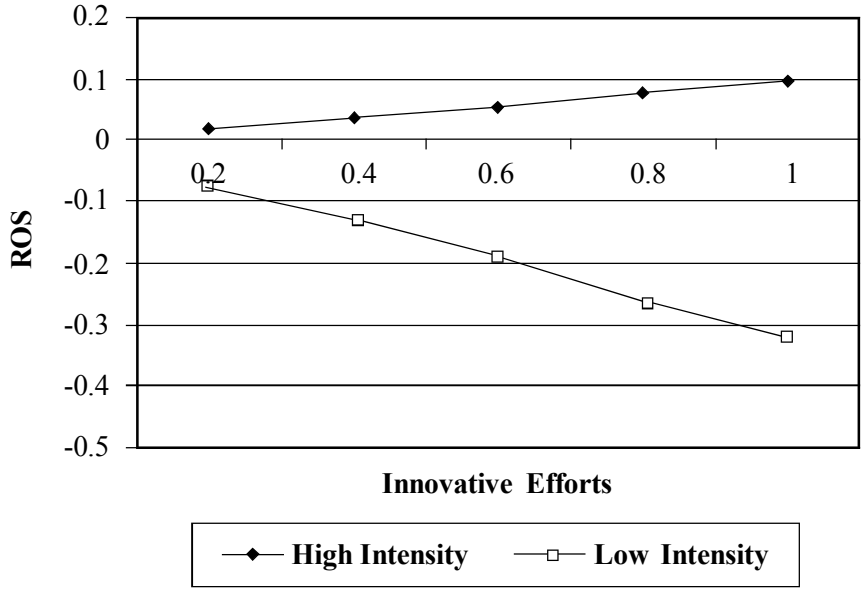
The moderating effects of competitive intensity on the relationship between innovative efforts and performance can be better interpreted in graphical representation. Figure 1 shows the fitted value of PERFORM based on the regression estimates reported in Table 3 using the dichotomous INOV variable found in columns (2) and (3). The relationship

Figure 1. **The Moderating Effect of Competitive Intensity on the Relationship between Innovative Efforts and Firm Performance**

Panel A: ROA



Panel A: ROS



between INOV and PERFORM is positive when competitive intensity is high (coefficients on INOV are 0.096 and 0.077 for ROA and ROS, respectively). However, the relationship between INOV and PERFORM is negative when competitive intensity is low (the sum of the coefficients of INOV, ENV and INOV*ENV are -0.378 (0.096 + 0.086-0.560) for ROA and -0.317 (0.077 + 0.122-0.516) for ROS.

The significant interaction between INOV and performance reported in Table 3 suggests that ENV is either a quasi-moderator or a pure-moderator of the relationship between innovative efforts and performance. To examine whether competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance (test of hypothesis H_2 and hypothesis H_3), this study employs the three-step moderated regression analysis procedures proposed by Sharma et al. (1981). *The first step* is to investigate whether the moderator variable (ENV) is related to the criterion variable (PERFORM). The two criterion variables (ROA and ROS) are regressed on the competitive intensity variables (two dummy variables representing high and low competitive intensity).[1] Table 4 reports the results of this analysis. The results show that competitive

[1] As suggested by Prescott (1986), this study validates the results by regressing ROA and ROS on the continuous measures of competitive intensity (ENV). The results are consistent with those of the dichotomous measures of competitive intensity (Adjusted R^2= 0.018, F= 0.747, p= 0.526 for ROA and Adjusted R^2= 0.027, F=1.168, p=0.325).

Table 4. **Regression Results of ROA and ROS on Competitive Intensity Variable (Dichotomous and Continuous) and Control Variables**

Criterion Variable	SS	DF	MS	F	P	R^2
Dichotomous Variable						
ROA						
Regression	3,377.04	3	1,125.68	4.502	0.036	0.034
Residual	31,752.10	113	280.99			
Total	35,129.14	116				
ROS						
Regression	2.79	3	0.93	3.050	0.083	0.023
Residual	39.03	113	0.34			
Total	41.82	116				
Continuous Variable						
ROA						
Regression	1588.29	3	529.43	3.079	0.072	0.016
Residual	32,348.35	113	286.27			
Total	33,936.64	116				
ROS						
Regression	1.77	3	0.59	3.168	0.058	0.015
Residual	39.37	113	0.35			
Total	41.14	116				

ROA is return on assets as measured by the ratio of net income to total assets
ROS is return on sales as measured by the ratio of net income to total net sales revenues

intensity has a significant effect on performance (R^2 =0.034, F= 4.502, p=0.036 for ROA and R^2=0.023, F=3.050, p=0.083 for ROS).[2] The significant effect of ENV on PERFORM indicates that competitive intensity acta as a quasi-moderator of the relationship between innovative efforts and performance.

[2] This being the case, the competitive intensity acts as a quasi-moderator of the relationship between innovative effort and performance (see Sharma et al. (1981) for excellent discussion on this topic).

Table 5. **The Chow Test for equality of the regression pairs based on the competitive intensity variable (high vs. low) and control variables**

Criterion Variable	SS	DF	MS	F	p
High intensity					
ROA					
Regression	489.31	3	163.10	2.602	0.061
Residual	3,384.56	55	61.54		
Total	3,873.87	58			
ROS					
Regression	0.07	3	0.02	8.417	0.000
Residual	0.14	55	0.003		
Total	0.208	58			
Low intensity					
ROA					
Regression	5,279.64	3	1,759.88	4.599	0.006
Residual	20,281.96	55	368.76		
Total	25,561.59	58			
ROS					
Regression	2.58	3	0.86	3.315	0.027
Residual	13.73	55	0.25		
Total	16.31	58			
Overall Sample					
ROA					
Regression	3,064.06	3	1,021.35	4.129	0.008
Residual	27,459.75	113	243.01		
Total	30,523.81	116			
ROS					
Regression	1.57	3	0.52	3.836	0.012
Residual	15.26	113	0.135		
Total	16.83	116			

ROA is return on assets as measured by the ratio of net income to total assets
ROS is return on sales as measured by the ratio of net income to total net sales revenues

The second step is to test the equality of the regression pairs (high intensity vs. low intensity) using the procedure suggested by Chow (1960).[3] This study uses median split to divide the sample into subgroups on the basis of the competitive intensity variable. The performance variables are then regressed on the innovative efforts variable for each subgroup as well as for the overall sample. Table 5 reports the results of this procedure. The results indicate that the coefficient of regression for high intensity subgroup differs significantly from the coefficient of regression for low intensity sub group [F (3,110)= 5.216, p<.05 for ROA, and F(3,110)=3.65, p<.05 for ROS].[4] These results further substantiate the hypothesized quasi-moderating effect of environment on the relationship between innovative efforts and performance.

The third step is to correlate INOV with ENV. As predicted, competitive intensity is positively related to innovative efforts (r=.247, p=.008), indicating that firms are more willing to spend on innovative efforts as competitive intensity increases.

Discussion, Limitations, and Implications for Future Research

Overall, the results of this study are of consistence with the hypotheses. *First*, this study finds that the relationship between innovative efforts and performance is moderated by competitive intensity. The results indicate that innovative efforts have a positive effect on performance when competitive intensity is high. However, when competitive intensity is low, innovative efforts have a negative impact on performance. These findings are consistent with Porter's (1985) argument that when competitive intensity is high, firms should invest heavily in research and development activities to promote innovativeness. These findings are also of consistence with the argument that firms operate in low competitive intensity should adopt a cost leadership strategy through aggressive construction of efficient scale facilities, vigorous pursuit of cost reduction, tight cost control, and cost minimization in areas such as research and development, services, sales force and advertising

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[3] The Chow Test uses the following formula:

$$\frac{(SSE_R - SSE_U) / K}{SSE_R / (T_1 + T_2 - 2K)}$$

to calculate the F-value with K and (T1 + T2-K) for the numerator and denominator degree of freedom, respectively. SSE R is the sum of squared residual for the overall sample, SSE U is the sum of the two sums of squared residual from the two subgroups, K is the number of independent variables, T1 and T2 are the number of sample in each subgroup.

[4] Since the observed F-value of 5.216 and 3.650 are bigger than the critical value of 2.70 (degree of freedoms of 3 and 110 for the numerator and the denominator, respectively), the coefficients of regressions in the two subgroups differ significantly.

(Porter 1985; Hambrick 1983). These findings suggest that innovative efforts should be evaluated in relation to the types of environment in which the firm operates since good fit between these two variables is likely to affect performance positively.

Second, the results indicate that competitive intensity acts as a quasi-moderator of the relationship between innovative efforts and performance. As such, not only does competitive intensity affect the relationship between innovative efforts and performance, but it also acts as a predictor for the performance variable (Sharma et al. 1981). The negative relationship between competitive intensity and performance is consistent with previous findings investigating the independent, direct effects of environment on performance (Keats and Hitt 1988; Dess and Beard 1984)

Third, firms are inclined to align their innovative efforts with the level of competitive intensity in comprehensive, intuitively meaningful, and often predictable pattern (Zahra and Covin 1993). Firms operating in high competitive intensity spend more on innovative efforts than do those operating in low competitive intensity. These findings suggest that as the competitive intensity increases, firms tend to pursue innovative strategy to gain competitive advantage by intensifying their investments in research and development activities.

The results of this study, however, should be interpreted in light of two limitations. *First*, this study utilizes single industry data to test our hypotheses. Although the most interesting issue regarding the relationship between innovative efforts and performance is to investigate the variability within an industry, the external validity of the results will be enhanced if studies including other industries find similar results. *Second*, this study uses Herfindal index as a proxy for competitive environment. Other measures such as earning volatility, variation in sales or executive perceptions of the environment in which the firms operate may be harnessed to validate the results of this study.

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